

Chas A. Silberrad

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INDEX OF VOL. XX.—1901.

INDEX OF AUTHORS' NAMES.

N.B.—In this Index (P) indicates that the matter referred to is an abstract of a Patent.
The titles of new books are given in quotation marks.

A		PAGE
Abba, F. Water; Need of Uniformity in Bacterial Analysis of —		145
Abegg, R., and Immerwahr, C. "Photo-Chemical Induction"		277
Abney, Sir W. de W. Colour; The Photography of —		1060
Photographic Image; Variation of Gradation of a Developed —		931
Abwärme Kraftmaschinen-ges. Pumps for Fluids of Low Boiling Point (P)		694
Ackroyd, W. Moorland Waters; Researches on —		494
Actiengesellschaft für Anilinfabrikation. Bromo-Compounds; Manufacture of New — (P)		276
Bromo-Compounds; Manufacture of Organic — (P)		833
Colouring Matter, Black; Manufacture of — (P)	38, 241, 241, 241, 467, 467, 467	
Colouring Matters, Brown Azo-; Manufacture of — (P)		467
Colouring Matter, Brown; Manufacture of — (P)		889, 889
Colouring Matters of the Diphenyl- α -naphthylmethane Series; Manufacture of — (P)		1108
Dimethyl Sulphate; Injurious Action of —, on Respiratory Organs		161
Dyeing and Printing with Sulphide Dyestuffs (P)		577
Dyeing with Sulphur Dyestuffs (P)		1208
Dyeing Wool (P)		893
Dyestuff, Sulphurised Reddish-Violet; Manufacture of — (P)		982
Dyestuffs; Amido-ammonium-azo — (P)		708
Dyestuffs, Black Disazo —; Manufacture of — (P)		573
Dyestuffs, Orange-Yellow —, of the Acridine Series (P)		888
Dyestuffs, Orange-Yellow, of the Acridine Series; Manufacture of — (P)		37
Iodo-Compounds; Manufacture of New Organic — (P)		277
Leuco-Compound; Manufacture of a Sulphurised — (P)		573
Photographic Prints; Obtainment of — (P)		608
Photographic Reducer; Manufacture of a — (P)		609
Wool; Mordanting of — (P)		471
Actiengesellschaft für Theer- und Erdöl-Industrie. Fluorene; Manufacture of — (P)		1200
Hydrocarbons; Obtaining Pure —, and Recovering By-Products (P)		796
Phenols; Rendering — Soluble in Water		739
Actiengesellschaft für Zink-Industrie vorm. Grillo und Schroeder. Sulphuric Acid; Apparatus for Making —, by Catalysis (P)		579
Actiengesellschaft "Lauchhammer," The. See Turk, D.		1197
Actien Maschinenbau-Anstalt vorm. Venueth and Ellenberger. Meat and other Extracts; Preparation of — (P)		144
Adams, A. Fuel; Heat Producing Power of —		972, 1084
Adams, S. H. Sewage; Apparatus for Spraying —, upon a Filter Bed (P)		1013
Adams and Westlake Co., The. Acetylene Gas Generators (P)		794
Adcock, S. R. Cupric Oxide; Production of — (P)		718
Aders, R. H. See Graebe, C.		1204
Adler, G. W. Skins; Composition and Process for Tawing — (P)		53
Adolfsson, A. E. Acetylene Gas; Apparatus for Generating — (P)		31
Adolph, G. Alkali; Electrolytic Production of —		715
Adrian. Guaiacol; Approximate Determination of —		1251
Ahrens, C., and Hett, P. Japan Wax; Variations in the Composition of —		909
Aikman, C. M. Foods; Preparation of Concentrated — (P)		1132
Alander, A. Potassium Permanganate; Determination of —		1242
Albert, R. Zymase; Exhibiting the Action of —		269
Albrecht, E. See Engler, C.		1102, 1102
Alderson, W. C. See Cornell, E. B.		1197
Alious, G. Arsenic; Discussion on Occurrence and Detection of —		192, 138
Alexander, A. W. See Deike, A. H.		351
Alexandroff, V. Electrodes for Arc Lamps; Carbon — (P)		816
Allan, F. B. Bismuth; Basic Nitrates of —		603
Allen, A. H. Alcohol in Cider		1011
Arsenic; Discussion on Occurrence and Detection of —		192, 197
Arsenic in Beer; Detection of —		158
Beer and Malt, Arsenical; Discussion on —		342
Beer; Detection of Arsenic in —		231
"Commercial Organic Analysis." Third Edition; Vol. III. Revised and Edited by T. Merritt Matthews.		293
Allen, F. B. Tellurium in Ores of the Hauraki Goldfields		901
Allgemeine Elektrizitäts Gesellschaft. Incandescence Bodies, Electrical; Heating Bodies for Exciting — (P)		237
Allhusen, A. Indigo; Discussion on Artificial Production of —		209
Alliott, J. B., and Paton, J. McC. C. Evaporating Apparatus (P)		1194
Allworth, C. Soap; New and Improved — (P)		728
Alonso-Blasco, A. See Cruz-Pasqual.		38
Aloy, J. Uranium; Preparation of —		480
Aloy, L. Dyeing Compositions; Manufacture of — (P)		893
Alpe, L. Borax; Substitute for — as a Flux (P)		1219
Altmann, P. Nitro Group; Volumetric Method for Determination of —		622
Alvisi, U. Explosives and Detonators; Examination of New —		837
American Wood Fireproofing Co., The. Wood and other Substances; Fireproofing of — (P)		126
Amundsen, J. S., and Rasmussen, E. A. Coating Material for Linoleum, &c. (P)		135
Rasmussen and Hrün. Linoleum; Manufacture of —		148
Amundsen, S. Linseed Oil; Substitute for Boiled — (P)		1005
Ampère Electrochemical Co. Camphor; Manufacture of —		604
Camphor; Piny Oxalate and Piny Formate; Production of — (P)		67
Anderson, W. C. Sugar Refining; Discussion on —		1091
André, G. G. See Curtis, C. H.		1240
Andreas, E. Electrode Plates; Forming Metallic — (P)		1001
Electrodes; Formation of — (P)		816



	PAGE		PAGE
Andrew, T., and Bellis, T. K. Steel; Treatment of Low-Grade — (P).....	369	Avery, S., and Beans, H. T. Paris Green; Determination of Arsenious Oxide in —	936
Andriik, K. Saturation; Chemical Effect of Karlik's Process of Triple —	374	And Beans, H. T. "Paris Green"; Soluble Arsenious Oxide in	495
Saturation Mud; Oxalic Acid in —	140	Aweng, E. Frangula, Sagrada, and Rhubarb; Soluble Active Glucosides of —	66
Sugar Juices; Influence of Alkalinity after Second Saturation on Solution of Magnesia by —	140	Axdorfer, G. See Heidemann, H.	893
Sugar Liquors; Disappearance of Alkalinity of —, during Evaporation and Boiling.....	140	Aymerie, F. See Bourin, A.	119
And Stanek, V. Sugar Products; Nitrites in —	1225		
Urban, K., and Stanek, V. Diffusion Juice and Masse-cuites; Organic Acids Extracted by Ether from — ..	54		
And others. Molasses and Analogous Waste Sugar Products And others. Saturation Mud, Season 1899-1900.....	374 1225		
Angell, A. Arsenic; Discussion on Occurrence and Detection of —	198		
Apel, A. See Peust, A. W.	365		
Appelius, W. See Paessler, J.	1124, 1249		
Appert, L. Glass Industry; New Products in the —	636		
Glass; Method and Apparatus for Rolling — (P)	252		
Arbuckle, W. See Scott, A.	123		
Archangelski, K. Rhododendrol, Rhododendrin, and Andromedotoxin.	1015		
Archbutt, L. Arsenic; Discussion on Occurrence and Detection of —	197		
Arsenic; Discussion on Presence of — in Beer	200		
Heat Producing Power of Fuel; Discussion on —	1084		
Rosin Gresne.....	1193		
And Jackson, P. G. Arsenic in Coke; Determination of Minute Quantities of —	448		
Arends. Balata and Gutta-percha; Purification of — ..	51		
Armani, G. Milliau's Reaction for Sesame Oil; Modification of —	752		
Armitage, H. R. Dyeing and Bleaching Fabrics (P)	471		
Armstrong, E. F. See Fischer, E.	1151		
Armstrong, J. Metals, Volatile; Obtainment of — (P).....	905		
Zinc Ores; Treatment of —, and Apparatus therefor (P) ..	367		
Armstrong (Sir W. G.), Whitworth, and Co., and Orde, E. L. Fuel; Means for Supplying Liquid — to Burners (P).....	109		
Fuel-Oil; Separating — from Water (P)	882		
And Noble. Guns; Preventing Erosion of — (P)	506		
Arnaud, A. Beetroot Juice; Liming and Carbonating — ..	821		
Arnaud, A. L., and others. India-rubber; Manufacture of — (P)	373		
Arnauld. Masse-cuites and Syrups; Rapid Determination of Purity of —	755		
Arndt, M. Furnace Gases; Apparatus for Recording Composition of — (P).....	1025		
Pyrometers (P)	788		
Arnold, J. O. Steel Castings; Properties of —. Part I.	722		
Arthur, M. Leather; Treatment of — (P).....	731		
Arzt, A. H. Gas for Illuminating and Heating (P)	235		
Ashcroft, E. A. See Swinburne, J.	907, 907		
Sulphide Ore Treatment (Phoenix Process).....	1216		
Askham, P. U., and Keevil, W. F. Crushing or Grinding Apparatus (P)	694		
Aspinall, J. A. F. Feed-Water; Purification of —	828		
Aston, B. C. See Easterfield, T. H.	67		
Astruc, A. Alkaloids; Action of Vegetable — on certain Indicators.....	941		
And Murco, H. Aldehydes and Ketones; Acidimetry of — ..	161		
And Murco, H. Cinnamo-Cacodylic Acid	274		
And Murco, H. Guaiaecol Cacodylate	274		
And Tarboureich, J. Arsenic Acid; Acidimetry of — ..	935		
Atkins, G. J. Acetylene or other Hydrocarbons; Manufacture of —, and By-products (P)	31		
Chlorides; Electrolysis of —, and Apparatus therefor (P)	815		
Chlorine; Manufacture of — (P)	808, 897		
Chlorine; Manufacture of —, and Treatment of Ores thereby (P)	808		
Gas, Acetylene; Manufacture of —, and Apparatus therefor (P)	883		
Atkins, W. G. Filtering Apparatus (P)	695		
Atkinson, J. See Crossley, W. J.	1100, 1100, 1197		
Atmospheric Products Co. Nitrogen Compounds from Atmospheric Nitrogen; Manufacture of (P)	726		
Atterberg, A. Arsenic; Rapid Determination of	391		
Aubry, L. Food Extract from Yeast and Brewery Wastes (P) And The Wissenschaftliche Station für Brauerei in München. Extract from Yeast Similar to Meat Extract (P)	924 737		
Auchy, G. Sulphur in Wrought Iron and Steel; Determination of —	620		
Audouin, P. Gas; Apparatus for Condensing or Purifying — (P)	350		
Aue, W. See Wohl, A.	887		
Auerbach, G. Lead Iodide and Lead Chloride; Electrolysis of Fused —	1001		
Auzenat, R. Soap Leys; Dialysis of (Crude Glycerin) — ..	484		
Bach, A. Potassium Persulphate; Action of Anhydrous Sulphuric Acid upon —	716		
Bache, A. Peat Fuel	1195		
Bache-Wiig, B. Eggs and other Articles of Food; Preservation of — (P)	924		
Bachrach, D. C. Nitrocellulose and Similar Compounds; Manufacture of — (P)	741		
Bachtschiew, N. See Kondakow, J.	386		
Badische Anilin und Soda Fabrik. Acetylphenylglycocol-carboxylic Acid; Manufacture of — (P)	893		
1.8-Amido-naphthol-4-sulpho Acid and Intermediate Products; Manufacture of — (P)	889		
Anthracene Series; Halogen Derivatives of the — (P) ..	241		
Aromatic Amines; Manufacture of Derivatives of — (P) ..	981		
Aromatic Compounds, and Colouring Matters therefrom (P)	240		
Colouring Matter, Azo Red, and Lakes therefrom; Manufacture of — (P)	35		
Colouring Matter, Black; Production of — (P).....	35		
Colouring Matter, Blue; Production of — (P).....	357		
Colouring Matter; Red Azo — (P)	240		
Colouring Matters; Azo-Red, Brown, and Blue-Black — (P).....	117		
Colouring Matters; Azo Yellow —, and Materials for Production thereof (P).....	36		
Colouring Matters; Black —, and Products for Manufacture thereof (P)	35		
Colouring Matters; Blue —, and Products for Use in Manufacture of same (P)	889		
Colouring Matters; Blue-Green —, of the Anthraquinone Series, and Intermediate Products (P)	889		
Colouring Matters, Brown, from 1.5-Naphthylene Diamine; Manufacture of — (P)	468		
Colouring Matters; Disazo Red, Brown, Violet, and Blue — (P)	803		
Colouring Matters of the Anthracene Series, and Intermediate Products (P)	707, 708		
Colouring Matters of the Anthracene Series; Manufacture of (P)	1205		
Colouring Matters of the Anthracene Series; Production of — (P)	241		
Colouring Matters; Products for Use in Manufacture of (P)	36		
Colouring Matters; Violet and Blue Azo — (P)	708		
Colouring Matters, Violet Azo —; Production of (P) ...	981		
Discharge Effects on Indigo-dyed Silk and Woollen Goods (P)	121		
Discharging Indigo-dyed Silk Goods (P)	41		
Discharging of Dyed Textiles (P)	247		
Djessuff (Brown) containing Sulphur; Production of — (P)	708		
Hydrosulphites; Manufacture of Solid — (P)	43		
Hydrosulphites; Rendering — Stable upon Keeping (P) ..	888		
Indigo, Indigo Colouring Matters, and Intermediate Products; Production of — (P)	989		
Indigo Leuco Compounds and Indigo Products, and Materials for Use in Production of — (P)	35		
Indigo Leuco Compounds and Indigo Products; Manufacture of — (P)	35		
Indigo Leuco Compounds; Conversion and Application of — (P)	1205		
Indigo; Manufacture of Initial Material for Manufacture of — (P)	1205		
Indigo Paste; Production of — (P)	116		
Indigo Powder; Production of — (P)	981		
Lakes from Azo Colouring Matters (P)	240		
Printing on Raw Silk (P)	360		
Printing Textile Materials with Indigo (P)	1111		
Sulphuric Anhydride; Apparatus for Production of (P) ..	714		
Sulphuric Anhydride; Production of (P)	360		
Badoil, A. Flax; Retting or Steeping —, and Apparatus therefor (P)	38		
Bärwinkel, M. Oil-yielding Seeds; Treatment of — (P) ...	50		
Baeyer, A., and Villiger, V. Monopersulphuric Acid (Caro's Acid)	578		
And Villiger, V. Sulphuryl Chloride; Hydrate of — ..	496		
Bahlsen, E. Copper; Production of — at Ashio, Japan	902		
Gold Industry in Japan	479		
Pyritic Smelting; Present Position of —	814		
Baier. See Nietner	828		
Bailey, W. H. Fire Block or Artificial Fuel (P).....	462		
Baker, H. Electrodes; Connections for Carbon — (P).....	370		
Baker, H. M. See Philipson, E.	563		

	PAGE
Baker, J. L. Arsenic; Discussion on Occurrence and Detec- tion of —	197
Baker, R. C. Steel and other Metals; Compounds for Alloy- ing with — (P)	256
Baker, R. T. Angophora; New Species of —	65
Australian Products; Note on —	169
Eucalyptus Oils; New —	1235
Baker, T. Coals; Solvent Action of Pyridine on Certain —	789
Baker, T. T. Chromium Family; Compounds of the —, Sensitive to Light	931
Balachowsky, D. Cobalt; Electrolytic Separation of — from Nickel	840
Bale, F. Matches and Striking Compositions; Production of — (P)	155
Ball, F. Furnaces for Destruction of Refuse; Apparatus for Consuming Smoke in — (P)	1152
Balland. Bread; Yield of — from Flour	923
Balthazard, V. See Desgrez, A.	1229
Bamberger, G. Detergents and their Manufacture (P)	1122
Bamberger, E. Azoxybenzene; Transformation of —	115
Diazobenzene; Action of — on Phenol	115
o-Hydroxyazobenzene; Synthesis of —	115
Bamberger, M., and Böck, F. Anthragallol; Nitro-Com- pounds of —	1103, 77
And Landsiedl, A. Erythritol in Trentepohlia Jolithus.. And Praetorius, A. Anthragallol; Autoxidation Products of —	1202
And Vischner, E. Exudation Resins	50
And Vischner, E. Exudation Resins—VII.	262
Banyard, W. B. See Hyndman, F. A.	591
Baptistine-Blanc-Baynaud, I. M. Composition for Manufac- ture of Soap for Sea-Water (P)	910
Barba, G. See Kayser, E.	922
Barbe, E. Vinegars; Manufacture of — (P)	737
Barbet, E. Molasses; Fermentation of —	1130
Barbet, E. A. Alcohol and Pressed Yeast; Production of — (P)	270
Barbier, P. See Farbwerke Durand, Huguenin, and Co.	503
Myrcenol and its Constitution.	607
Barendrecht, H. P. Yeast; Agglutination of —	1129
Barker, B. T. P. Yeast; A Conjugating —	918
Barker, T. H. Transport of Chemicals; Discussion on —	424
Barnes, W. Electrolytic Apparatus (P)	49
Barnstein, F. Albumin; Determination of —	160
Barrie, T. S. Hamamelins of Commerce	929
Bartel, C. Milk; Production by Lactic Bacteria of Acetic Acid in —	77
Bartelt, F. L. Washing and Bleaching Compounds (P)	892
Barth, G. Diastase; Examination of Commercial —	490
Barthe, L., and Péry, E. Cacodylic Acid; Toxicological Investigation of —	513
Barton, T., and McGhie, T. B. Lead; De-zincing of Zinc Desilverized — (P)	1219
Bartsch, F. See Stoerner, R.	114
Bary, C. P. Stannic Acid; Manufacture of — (P)	608
Baskerville, C. Thorium; Existence of a New Element Asso- ciated with —	1231
Basle Chemical Works. Aromatic Sulphinic Acids; Manu'ac- ture of — (P)	119
Benzoic Acids; Manufacture of — (P)	1139
Phthalic Acid; Manufacture of — (P)	1139
Silver Parauuclein; A New — (P)	504
Baswitz, C. Textile Fabrics; Rendering — Non-inflammable and Waterproof, and Composition therefor (P)	574
Textile Fabrics; Waterproofing of — (P)	359
Bate, J. A., and Zicart, A. Zinc; Extraction of —, and Apparatus therefor (P)	724
Battandier, J. A. Manna; Production of — by Olive Trees.	375
Batty, R. B. Proceedings of Annual Meeting	676
Bau, A. Melitriose; Hydrolysis of —, by Micro-Organisms.	57
Baud, E. Aluminium Chloride; Ammoniated —	473
Aluminium Chloride; Compounds of Ammonia with —	249
Baud, L. Aluminium Chlorides; Thermochemical Study of Ammoniacal —	363
Baudelot, L. G. Aluminium Alloys (P)	47
Aluminium with other Metals; Composite Articles of Cast — (P)	47
Baum, H. Root Caoutchouc in the Kunene District.	135
Baumann, L. Resists under Parantraniline Red	712
Baur, E., and Marc, R. Luminescence Spectra of the Rare Earths.	1038
Bauschlicher. See Jürgensen.	977
Bawera, J. Vanadium Iron	478
Bayer, (P) Sewage and Trade Effluents; Purification of —	830
Sewage Precipitates; Use of —, and Manufacture of Filtering Media (P)	830
Bayerische Actiengesellschaft. Fungicide; Manufacture of a — (P)	495

	PAGE
Bayrac, P. See Camichel, C.	621
And Camichel, C. Indophenols; Absorption of Light by —	355
Beam, W. See Leffmann, H.	758
Beans, H. T. See Avery, S.	495, 936
Beaver, J. A. See Rogers, W. H.	129
Béchaux, L. Liquid Fermentation Apparatus (P)	270
Behl, G. de, and The General Metal Reduction Co. Zinc Ores; Treatment of Complex — (P)	47
Beck, A. Gun Barrels; Composition for Protecting and Clean- ing — (P)	1240
Beck, C. W. Acetylene Gas Lamps or Generators (P)	794
Beck, M. "Peroxols"; Disinfecting Properties of the —	830
Becker. See Wood, J. T.	263
Becker, H. Anodes in Electrolytic Apparatus; Features for the — (P)	133
Erodin; Use of —, in Tanning.	138
Beckman, E. Honey-Dextrin; Nature of —	1131
Fusel Oil in Alcoholic Liquids; Determination of —	1148
Beckstroem, R. See Thoms, H.	606
Bequerel, H. Metals; Secondary Radio-Activity of —	365
Radium; Chemical Effects Produced by Radiation from —	1251
Radium; Magnetic Analysis of the Radiation from —	845
And Curie, P. Radium; Physiological Action of the Radia- tion from —	845
Beddies, A. See Krause, C.	365
Nitrification and Denitrification	820
Bedford, R. See Saniter, F. L.	903
See Smith, J. L.	724
Bedson, P. P. Indigo; History of the Artificial Production of —	209
Beebe, M. C. See Wurts, A. J.	566
Beggs, D. C., and Fielding, W. Gas, Acetylene; Apparatus for Generating — (P)	976
Béhal and Tiffeneau. Anethoil; Isomeride of —, and its Constitution	384
Behrend, P., and Wolfs, H. Starch in Potatoes; Baumert and Bude's Method of Determining —	623
Behrens, E. A. and J. Acetic Acid; Manufacture of —, from Calcium Acetate (P)	806
Behrens, J. G. Acetic Acid; Manufacture of Chemically Pure — (P)	474
Behrman, T. Mortars; Tests of —	125
Bejorinck, M. W. Indigo Fermentation	112
Beilby, G. Proceedings of Annual Meeting	677
Speech at Annual Dinner	684
Vote of Thanks to Sir W. de W. Abney	1071
Beilby, G. T. See Henderson, G. G.	1212
Metals; Minute Structure of —	992
Bein, W. Gases in Electrolytic Apparatus; Means for Carry- ing off — (P)	49
Beitler. Caffeine; Determination of —	1149
Belin, G. Acetylene; Apparatus for Generating — (P)	1198
Bell, E. D. Food; Use of Waste Products for — (P)	1012
Nuts and Nut-like Substances; Preparation of — (P)	328
Bell, J. Carter. Arsenic; Discussion on Detection of —	206
Belledin, V. E. Elastic Material; Sheets of Flexible — (P)	266
Bellier, J. Dulcine (Phenitol - carbamide) in Foods and Beverages; Detection of —	72
"Sucramine"; A New Sweetening Agent	383
Wine; Detection of Orseille, Cochineal, &c. in —	284
Bellis, T. K. See Andrew, T.	369
Belloc, L. Zinc; Extraction of —	255
Bender. Lime; Valuation of —, for Mortar	477
Benedicks, G. Furnaces; Electric — (P)	370
Bencke, G. Explosives; Factories for the Manufacture of — (P)	279
Bencker, J. C. See Ellms, J. W.	937
Bennett, E. See Wurts, A. J.	566
Bennett, F. M., and Fowler, J. O., jun. Gas; Appliances for Perfect Combustion of — (P)	699
Bennett, J. W. Anti-Bacteria System for Use of Brewers (P)	737
Bunnett, W. H. Oil-Gas; Apparatus for Generating and Burning — (P)	1100
Bennetts, B. H. Gold; Curious Occurrence of —	1117
Bente, A. Soot; Manufacture of —, from Tar, and Appa- ratus therefor (P)	728
Beny, F. A., and Heinrigs, J. Lime; Apparatus for Slaking — (P)	810
Berg, C. Aluminium Alloys containing Tungsten and Copper (P)	1217
Bergé, A. Water; Sterilisation of Drinking —	601
Bergsoe, P. Tin; Obtaining Pure —, from Waste, and Refining Raw Tin (P)	268
Bergsten, C. Beer; Practical Control of Keeping Qualities of —	919
Beringer, E. Zinc Sulphide and Sulphocyanides; Manufac- ture of — (P)	592



	PAGE
Berliner, E., and Herbert, A. Beer; Sterilising —, in Transport Casks (P)	144
Bernadou, J. B. Explosives; Manufacture of Smokeless — (P)	617
Smokeless Gunpowder; A New —	154
"Smokeless Powder, Nitrocellulose, and Theory of the Cellulose Molecule"	1035
Bernard, R. See Glass, P.	155
Bernheim, R. Mordanting and Dyeing Apparatus (P)	47 1
Bernstein, A. See Bühler, E. von	827
Berrigan, J. J. Centrifugal Separating Apparatus (P)	1095
Berry, A. E. Arsenic; Discussion on Occurrence and Detection of —	198
Marsh Test; Effect of Products containing Selenium and Tellurium on —	322
Bersch, W. Extraction Apparatus	389
Berthelot, M. Potassium Chlorate; Explosion of —	388
Berthelot. Alloys containing Copper; Alteration of —, in Contact with Air and Alkali Chlorides	586
Alloys of Gold and Silver from Egyptian Tombs	846
Gas; Analysis of —, by Electricity	1025
Gas; Analysis of —, by Spectroscopy	1025
Mercury; Compounds of Silver and —	365
Phosphoric Acid; Equilibrium between two Bases in Presence of —	806
Phosphoric Acid; Neutralisation of —	806
Silver; Allotropic States of —	365
Silver and Carbon Monoxide	123
Silver and Hydrogen	128
Silver Oxide; Action of Hydrogen Peroxide on —	625, 1253
Silver; Union of —, with Oxygen	128
Titration of Organic Acids and Alkalis by Coloured Indicators	938
Berthold, A. Platinum Residues; Working up —	902
Bertoio, P. Artemisin	1235
Bertrand, G. Coffee from the Comoro Islands; Composition of —	271
And Sazerac, E. Ferments of Vinegar; Biochemical Distinction between —	826
Besemfelder, E. Caustic Alkalis, &c.; Manufacture of — (P)	987
Besemfelder, E. K. Cyanogen Compounds; Manufacture of — (P)	1210
Besson, J. A. Chloral; Production and Rectification of — (P)	1139
Besson, P. Radium; Preparation and Properties of —	845
Bessonoff, S. Still; An Improved — (P)	105
Bathlehem Steel Co. Temperature of Highly Heated Bodies; Determining and Controlling the — (P)	459
Temperature of Highly Heated Receptacles or Objects; Ascertaining the — (P)	460
Tool Steel; Manufacture of — (P)	46
Bethmann, G. Aniline Black; Dyeing Wool and other Animal Fibres with — (P)	577
Bettaney, W. and W. F. Potters' Ovens or Kilns (P)	477
Betts, A. G. Aluminium or its Alloys; Coating of — (P) 130, 1219	831
Bromine; Extraction of —	831
Lead; Refining of — (P)	724
Metals; Apparatus for Refining —, by Electrolysis (P)	1121
Bevan, E. J. See Cross, C. F.	740, 847, 1133
Maize in Wheat Flour; Detection of —	72
Oxygen Dissolved in Water; Discussion on Determination of —	1075
Beveridge, J. "Papermakers' Pocket Book"	847
Retorts for Distilling Shale, &c. (P)	112
Beyer, L. F. G. See Tritton, A. F.	494
Beythien, A. Saffron; Estimation of Red Sanders Wool in —	696
And Bohrisch, F. Brandy "Strengthening" Essences	378
Bez, P. and E. Tanning Hides and Skins (P)	1124
Biddle, H. C. Copper; Precipitation of —, by Ferrous Salts	1217
Bielefeldt, M. Priming for Detonating and Percussion Caps (P)	1240
Bigelow, W. D. Wines, American; Composition of —	57
Bildt, C. W. Iron Goods; Cementation of Finished —	1215
Billing, C. Antiseptic or Detergent (P)	1133
Billing, F. Paper; Manufacture of — (P)	926
Binder, F. and Sunder, C. Gelatin; Substitution of —, for Albumin in Calico Printing	1108
And Zundel, C. Azo Colours; Application of —, on Manganese Brown	712
And Zundel, C. Chromo Mordants; Action of Alkali Phosphates upon —	1108
Bingham, C. Transport of Chemicals; Discussion on —	424
Binz, A. Indigo in an Anhydrous Medium; Reduction of — And Kung, F. Indigo; Physical Condition of Two Preparations of Synthetical —	886
Bird, F. C. J. Arsenic; Discussion on Occurrence and Detection of —	197
Arsenic; Modified Gutzeit Test for —	390
Nux Vomica; Determination of —	75
Birger Carlson. See under Carlson.	
Bisbee, H. See Richards, T. W.	1026

	PAGE
Bischof, G. White Lead; Conversion of — into Oil Paste (P)	372
Biza, E., and Vecsek, F. Milk of Lime; Apparatus for Removing Grit from —	914
Bizzel, J. A. See Fraps, G. S.	74
Bjalobrscheski, M. Strophanthus Seed Oil; Characteristics of —	817
Blacher, C. Charcoal; Half-Carbonised —	111
Blackmore, G. F. Ozotype Photographic Process	154
Blackmore, H. S. Disinfecting, &c.; and Apparatus therefor (P)	739
Metals; Reduction of —, and Production of Alloys (P)	1118
Blair, A. A. Ferrochrome; Determination of Carbon in —	70
Blake, R. F. See Letts, E. A.	1152
Blanc, R. See Seyewetz, A.	888, 1103
Blanc, A. Photographic Reduction; New Process of —	505
Blarcom, E. C. van. Filter for Use in Sewage Treatment, Ore Reducing, &c. (P)	562
Blarez and Tourrou. Sucramin in Foods and Drinks; Detection of —	1030
Blasdale, W. C. Heptane from Coniferous Trees	604
Bleichrode, J. Gas Igniters; Manufacture of — (P)	977
Blériot, L. Acetylene Gas Generators (P)	1102
Blin, E. See Thompson, A.	266, 729
Blix, M. See Stock, A.	1252
Bloch, E. Radium; Action on Selenium of Radiation of —	625
Blomén, J. E. High Explosives and Celluloid Compounds (P)	1140
Blount, B. See Stanger, W. H.	1115
Bloxam, A. G. Basic Superphosphate; Discussion on —	380
Blum, F. Prophylactic, Immunifying or Curative Substances (P)	746
Blum, H. See Noeltling, J.	1106
Blumenberg, H. Electric Battery Compounds (P)	726
Blundstone, E. R. White Lead; Production of — (P)	591
Blyth, M. W. Preservatives in Milk; Detection and Determination of —	844
Boas, F. Building Materials; Manufacture of — (P)	719
Bock, J. Crystallisable Liquors; Transforming — into Large Lumps; and Apparatus therefor (P)	250
Bock, W. E. Glass-Blowing Machines (P)	125
Bode, A. See Willstätter, R.	832
Bodlaender, G. and Breull, P. Sodium Carbonate; Formation of —	715
Bodroux, F. Propylbenzene; Formation and Preparation of —	237
Böck, F. See Bamberger, M.	1103, 1103
Boehm, F. "Merck's Annual Report on the Year 1900"	627
Boehm, W. Electric Illuminating Bodies; Manufacture of — (P)	884
Electric Lighting, Heating, and Resistance Bodies (P)	1199
Boehndel, H. H. Gas for Illuminating and Heating (P)	30
Boehringer, C. F. and Soehne. Amines from Corresponding Nitro Compounds; Production of — (P)	118
Azo- and Nitro-Compounds; Reduction of — (P)	259
Colouring Matters, Triphenylmethane; Manufacture of — (P)	358
Diacytyldiamidouracil; Manufacture of — (P)	931
Xanthine; Manufacture of Homologues of — (P)	833
Bölsing, F. See Verley, A.	1250, 1250
Bömer, Fats; Detection of Vegetable Fats in Animal —	1147
Bömer, A. Honey; Artificially Coloured —	600
Boenke, F. Stone Blocks or Tiles; Fireproof Artificial — (P)	810
Börnstein, E. Aniline; Oxidation of —	701
Paratoluidine; Oxidation of —	701
Boessneck, P. Acetic Acid; Manufacture of — (P)	123
Böttcher, O. Saltpetre; Nitrogen in —; Determination of —	153
Bohrisch, F. See Beythien, A.	378
Boivie, S. E. Stone; Artificial — (P)	1212
Bokorny, T. Milk; Coagulation of —, Spontaneously and by other Bodies	144
Yeast; Action of Reagents upon the Activity of —	824
Yeast Cells and Enzymes; Resistance to Injurious Agents of —	598
Boll, J. H. See Neisse, J. H. G.	1229
Bolland, J. Dyeing Patterns on Fabrics (P)	1110
Bolling, E. Pig-Iron; Irregular Distribution of Sulphur in —	126
Bonal, J., and Fietz, C. Liquids for Lighting and Heating Purposes (P)	110
Bonavita, J. See Thomas, E. G. P.	741, 741
Bond, G. E., Buell, A. C., and Washburn, C. D. Acetylene Gas; Apparatus for Generating — (P)	698
Bone, W. A., and Jerdan, D. S. Carbon and Hydrogen; Direct Union of —	696
And Jerdan, D. S. Hydrocarbons; Decomposition of — at High Temperatures	696



	PAGE		PAGE
Bonnet. Explosives; New Method of Preparing —	932	Breyer, F. Water; Softening of — (P).....	1013
Bonnet, J. Chlorate Explosives less Susceptible to Action of Heat (P).....	1239	Briant, L. Malt, Available Extract of; Determination of —	160
Explosive Substances; Manufacture of — (P).....	1024	Briggs, A. N., and Priestley, W. Wool Smelling of Sulphur Dioxide; Deodorising — (P).....	359
Bonnin, L. Sugar Cane; Coefficient in the Indirect Analysis of —	487	Briggs, J. W. Kilns; Utilising the Waste Heat from Heating — (P).....	126
Booth, R. See Gostling, J. C.	125	Brimmer, C. T. India-Rubber; Recovery of —	818
Borch, O. S. See Toby, F. L.	32	Bristol Company, Waterbury. Air Pyrometers (P).....	28
Borchers, W. See Nerst, W.	1034	British Oil and Cake Mills, and Wass, A. G. Printing Ink; Manufacture of — (P).....	1005
Borland, W. D. Nitro-Explosives; Manufacture of — (P).....	279	British Uralite Co., The. See Friswell, R. J.	1115
Borne, G. v. dem, and Debschütz, W. v. Ceramic Ware; Polychrome, Ornamented, or Glazed — (P).....	252	British Xylonite Co. See Goldsmith, J. N.	741
Bornett, S. Crystallisation Products; Removal of — from Carriers.....	1127	Brochet. Fluorine; Poulenc and Meslan's Apparatus for Electrolytic Manufacture of —	481
Bornträger, H. Cement; Water-Glass as an Addition to —	477	Brochet, A. Potassium Chloride; Electrolytic.....	42
Paste-Glue from Bone-Glue; Preparation of —	139	Broeckmann, L. See Haase, F. W.	78
Peat; Analysis of —	159	Bronnert, E. See Fremery, M.	38
And others. Fodder from Peat; Manufacture of — (P).....	823	And others. Cellulose Solution; Manufacture of — (P).....	1231
Bose, E. See Nerst, W.	791	And others. Cuprammonia Solution; Manufacture of — (P).....	119
Bose, J. A. See Partheil, A.	1244	And others. Thread from Cellulose Solutions; Manufacture of — (P).....	1207
Bose, R. C. L. Nerium Odorum; Chemistry of —	503	Bronson, A. A. Gas; Manufacture of —, and Apparatus therefor (P).....	698
Boudouard, O. Alloys; Aluminium-Magnesium —	814	Brooke, R. G. Fluids; Apparatus for Purifying (P).....	694
Carbon; Reducing Action of — on Metallic Compounds	478	Brothers, W. Textile Fabrics; Filling of — (P).....	358
Furnace Combustion; Phenomena of —	1196	Brough, B. H. Steel; Medal Struck in —	723
Bougault, J. Anethol; Oxidation of — to Anisic Acid.....	502	Brown, A. Enzyme Action.....	1129
Bourdil, F. F. Antiseptic Preparation (P).....	147	Brown, A. J. Fermentation; Heat of —	376
Bourgoin, G. E. See Lavollay, J. H. (P).....	489, 503, 600	Brown, E. W. Paper and Ink for Copying Purposes (P).....	272
Bourin, A., and Aymerie, F. Wools and Textiles; Degreasing and Bleaching, &c. — (P).....	119	Brown, H. See Dunstan, W. R.	66
Bourquelot, E. Sucrose in Plants; Identification of —	1214	Brown, J. C. See Weems, J. B.	1025
And Hérissey, H. Gentianose and Sucrose in Fresh Gentian Root; Simultaneous Presence of —	76	Brown, R. B. Dyeing; Effect of Temperature in —	574
And Hérissey, H. Gentianose; Constitution of —	386	Wool and Silk Union Fabrics; Dyeing of —	228
Bourne, A. O. Rubber Materials or Compositions; Vulcanising — (P).....	912	And McCrae, J. Dyeing; Solution Theory of —	1092
Bourry, H. Favre's New Mordant for Basic Colouring Matters.....	711	Browning, P. E., and Hartwell, J. B. Nickel in Presence of Cobalt; Detection of —	156
Bousquet, F. Brewing Water; Influence of Chemical Composition of —	1226	Bruel, C. and E. Leather Manufacture; Study on the —	138
Bouthillier, V. M. Adhesive Compound (P).....	266	Bruening, G. See Tschirch.....	276
Bower, A. S. Carburetting Apparatus (P).....	698	Brunck, H. Indigo; History of the Manufacture of Synthetic —	239
Bower, G. Gas, Hydrocarbon Vapours and Air; Apparatus for Mixing and Burning — (P).....	697	Brunck, O. Aluminium; Crystallised Metallic Compounds of Silver and Copper; Cyanogen Compounds of — in Gravitimetric Analysis.....	1117
Boyer, E. von. Montan Wax.....	1221	Bruni, G. Solid Solutions of Mixtures of Three Substance....	160
Bradburn, J. A. Soda; Production of — by the Ammonia Process.....	442	Brunn, A. Furnace; Smoke-Consuming Apparatus for — (P).....	462
Bradford, E. M. Tin; Recovery of — from "Hardhead" or Slag (P).....	1217	Bruno, W. Iron Saccharate; Alkali-free —	383
Bradford, E. T. Hot Blast Furnaces for Smelting Pyritic Ores (P).....	1117	Brunschwyler, J., and Pärli, E. Acetylene Gas; Apparatus for Generating — (P).....	111
Bräutigam, W. Carbohydrates; Action of Hypochlorites upon —	1007	Brunton, L., and Tunnicliffe. Spirits; Injurious Constituents of Potable —	736
Brakes, J. Titanic Acid; Colorimetric Determination of —	23	Bruyère, F. Producer; Gobbe's "Quenching" —	1095
Braunsch, F. R. German Yeast; Purifying Molasses and Sugar Juices for Obtaining — (P).....	736	Bruylants, G., and Gody, L. Paper; Detecting Forgeries on —	61
Yeast and Alcohol from Molasses, &c.; Obtaining — (P).....	600	Buchner, E. Zymase, Buchner's; Remarks on Paper by Macfadyen, Morris, and Rowland on —	55
Brand. Fermenting Vats; Varnished —	921	Zymase; Experiments on —	584
Brand, A. Caustic Soda; Manufacture of — (P).....	897	Zymase from Sterilised Yeast.....	55
Brandel, J. W., and Kremers, E. Monarda Oil.....	950	And Rapp, E. Alcoholic Fermentation without Yeast Cells.....	734
And Kremers, E. Thymoquinone in Wild Bergamot Oil.....	744	Buchner, G. Beeswax; Analysis of —	286
Brandenburg, H., and Weyland, A. Tin; Extraction of — (P).....	998	Budzinski, S. L. Lamps; Acetylene — (P).....	576
Tin Ores; Lixiviation of — (P).....	1216	Bueb, J. See Deutsche Continental-Gas-Gesellschaft.....	697
Brandt, J. Diazo Compounds; Action of — on Wool.....	711	Bücheler, M. Yeast Manufacture; Use of Lactic Acid in —	376
Wool Dyeing; Theory of —	242	Yeast; Preparation of — without Lactic Acid Fermentation.....	1123
Brandwood, J. Yarns; Apparatus for Bleaching and Treating (P).....	472	Bücken, J. van de. See Feder, S.	1123
Brangier, P. A. See Magnier, P.	261	Bühler, E. von. Milk; Pasteurising and Sterilising — (P).....	58
Brassard, H. F. A. a. Fibre and Yarn Slivers; Apparatus for Treating with Liquids — (P).....	802	And Bernstein, A. Butter, &c.; Manufacture of — (P).....	827
Brat. Gelatin; Conversion of — into Food Products.....	923	Bühler, F. A. Paper Manufacture; Increased Cost of Wood for —, and Process of Using Cheaper Woods.....	147
Brat, H. Gelatin; Preparation of Food from — (P).....	828	Wood; Distillation of —	885
Braun, A. See Noelting, E.	797	Bühne, F. W. Porous Metal Plates for Accumulators (P).....	907
Braun, F. W. Vapour Burners (P).....	463	Buell, A. C. See Bond, G. R.	698
Breakell, T., and Hopwood, W. Vacuum Filters (P).....	562	Bulow, C., and von Sicherer, W. 1.4-Benzopyranol; Derivatives of —	1106
Brearely, F. T. Furnaces; Glass Annealing — (P).....	581	And Wagner, H. 1.4-Benzopyranol; Derivatives of —	719
Bredig, G. Ampère-Manometer.....	69	And Wagner, H. Dyestuffs; Derivatives of 1.4-Benzopyranol —	704
Diastatic Actions of Colloidal Platinum and Organic Diastases; Analogy between the —	376	Bünning, O. H. G. See Kloth, G. F. W.	815
Platinum; Enzymatic Actions of Colloidal —	376	Bullier, L. M., and La Soc. des Carb. Métalliques. Sulphide Ores and Metallic Sulphides; Metallurgical Treatment of — (P).....	481
And Beinders, W. "Inorganic Ferments"; Gold Catalysis of Hydrogen Peroxide.....	845	Bullheimer, F. Zinc Blendes, Fluorine in; Determination of —	282
Breitmayer, L. Naphthalene; Apparatus for Extraction of — from Gases (P).....	1161	Buncke, G. See Wolfenstein, R.	925
Brenans, P. Phenol; Iodo-Derivatives of —	496		
Bretherton, S. E. Pyritic Smelting and Hot Blast.....	128		
Breull, P. See Bodlaender, G.	715		
Brewer, C. E. See Orndorff, W. R.	979		



	PAGE		PAGE
Bunte, H. Coal-Gas and Water-Gas; Supply of Mixtures of —	28	Carpenter, R. Forbes. Arsenic; Discussion on Occurrence and Detection of —	197
Incandescent Gas Light; Theory of the	791	Sulphuric and Nitric Acid Manufacture; Discussion on —	7
Buntrock, A. Dyeing of Metallic Oxide Mordants	983	Carroll, J. E. Spirits; Distilling and Treating — (P)	270
Burchartz, H. Trass and Trass Mortar	252	Carstairs, J. Fish Guano; Production of — (P)	820
Burford, S. F. Arsenic; Discussion on Presence of — in Beer	409	Cartaud, G. Metals; Cellular Structure of —	811
Arsenic in Coke; Discussion on Determination of —	450	Cartier, T. See Walsler, C.	111
Burgess, C. H., and Chapman, D. L. Phosphorus Suboxides; Non existence of —	1259	Carulla, F. J. R. Arsenic; Discussion on Presence of —, in Beer	208
Burgess, H. Citral, &c.; New Reagent for Identification of —	844	Gas Liquor: The Valuation of —	23
Burgess, H. E. Citron Oil	1237	Heat Producing Power of Fuel; Discussion on —	1083
Lemon Oil: Two New Substances in —	745	Rosin Grease; Discussion on —	1193
And Child, J. F. Lemon Oil Industry; The —	1176	Case, D. R. See Robertson, J. H.	260
Burgess, W. T. Oxygen dissolved in Water; Discussion on Determination of —	1074	Cash, J. T., and Dunstan, W. R. Pseudoaconitine and Japconitine: Pharmacology of —	928
Burmeister, E. Town's Sewage and other Waste; Treatment of — (P)	730	And Dunstan, W. R. Pyraconitine and Methylbenz-aconine: Pharmacology of —	928
Burrows, A. B. Dyeing Machines; Apparatus connected with — (P)	1109	Cassella, L., and Co. Colouring Matters, Brown; Manufacture of — (P)	37
Burrows, H. See Tilden, W. A.	1238	Dyes, Blue Monazo, from Amidonaphtho-sulpho Acids; Production of — (P)	241
Burwell, A. W. Oleaginous Compounds; Production of — (P)	371	Dyestuffs, Blue; Manufacture of — (P)	889
Busch, C. Acetylene Gas; Apparatus for Generating — (P)	1118	Dyestuffs, Brown, from 2,2'-Amidonaphtholdisulpho Acid; Production of — (P)	118
Busch, M. Incandescence Gas-Burners (P)	351	Dyestuffs containing Sulphur; Fast Dyeings with — (P)	247
Bushe, E. Electric Lamps; Increasing the Efficiency of — (P)	700	Dyestuffs; Violet and Blue — (P)	803
Bushman, E. Plaster or Artificial Stone; Composition for Use as — (P)	1212	Dyestuffs, Violet; Manufacture of — (P)	889
Butler, H. W. See Electrical Power Storage Co.	482	Furs; Preparing and Dyeing — (P)	360
Butterworth, J. H. Patent Law; Discussion on —	16	Indazol Derivatives and Brown Dyestuffs Therefrom; Production of — (P)	36
Buyten, H. Polished or Lacquered Surfaces; Removing the Brilliance of — (P)	573	Sulphide Colour and its Leuco Compound; Manufacture of a — (P)	1205
C			
Cables, P. Water; Lead in Potable —	145	Castner Electrolytic Alkali Co. Electrodes; Carbon — (P)	1002
Caird Speech at Annual Dinner	685	Electrolytic Cells; Oscillating — (P)	907
Cald J. See Henderson, N. M.	978	Castro, A. de, and Schloemann, H. W. Batteries; Electric Primary and Secondary — (P)	133
Calderwood, W. See Palmer, H.	910	Cathelincau and Hauser. Oil of Cade	502
Callender, W. M. Paper and Paper-Pulp; Manufacture of — (P)	881	Causso, H. Waters; Reaction of Sodium- <i>p</i> -Benzene Sulpho-nate on Iron Cystinate in Contaminated —	145
Calmette. Glucose; Production of —, by Aid of Mucedinae	140	Cavalier, J. Phosphoric Acid; Acidimetry of —	838
Indigo; Extraction of — from the Indigo Plant (P)	885	Caven, R. M. Arsenic in Coke; Discussion on Determination of —	450
Calmette, A. Mucedinae; Utilisation of — for Manufacture of Glucose	732	Heat Producing Power of Fuel; Discussion on —	1084
Calmette, L. C. A. Glucose; Manufacture of —, and Apparatus therefor (P)	1127	Rosin Grease; Discussion on —	1193
Calvert, H. See Hudnall, M. S.	910	Tanning Extracts; Discussion on —	1087
Calvert, J. Opium; Chinese Extract of —	276	Caye, G. Enamelling Iron; Mechanical Process of —	989
Cameron, D. and others. Sewage; Apparatus for Treatment and Disposal of — (P)	381	Cayvan, L. L. See Woodman, A. G.	506
And others. Sewage Works (P)	1122	Cazeneuve, P. Chromic Acid in Cotton dyed with Chrome Yellow; Detection of —	1029
Cameron, D., Commin, J. F., and Martin, A. J. Sewage; Apparatus for Regulating Delivery of — to Filters or to Land (P)	60	Dyestuffs; Chrome Violet —, derived from Diphenyl-carbazide	980
Camichel, C. See Bayrac, P.	355	And Delourmel, H. Water, Nitrates in —; Detection and Determination of —	838
Triphenylmethane Dyestuffs; Absorption Spectra of Aqueous Solutions of —	114	Cedivoda, F. Glasses; Phosphatic —	580
And Bayrac, P. Indophenols; Detection of —	621	Ceipek, N. Explosive Compounds (P)	1240
Campbell, E. D. Iron; Heat of Formation of Carbides and Silicides of —	721	Centian, S. See Csaky, S.	883
Campbell, J. B. See Robertson, J. H.	260	Cereal Sugar Co. Sugar; Apparatus for Refining — (P)	824
Candenberg, C. A. C. Composition for Paving Roads (P)	126	Chaillly, F. Fuel Briquettes, &c.; Manufacture of — (P)	1197
Caquelin, J. See Masseron, A.	1110	Chain, M. See Marekwald, W.	743
Carey, A. Transport of Chemicals; Discussion on —	422	Chandelon, T. Alkaloids; Precipitation of —, by Picric Acid	63
And others. Sulphur Compounds; Recovery of — from Waste Gases (P)	474	Chandler, C. F. Obituary Remarks on Mr. Waldren Shapleigh	1082
Carey, E. Proceedings of Annual Meeting	677	Chandler, S., jun., and others. Gas; Apparatus for Washing and Scrubbing — (P)	30
Transport of Chemicals; Discussion on —	423	Chanute, O. Timber; Preservation of —	43
Charles, P. Wine; Plastering of —	1130	Chaplet, F. See Masseron, A.	1110
Carlinfanti, E. Quinine Bisulphate; Examination of —	1051	Chapman, A. C. Arsenic; Discussion on Occurrence and Detection of —	198
Carlson, Birger. See Deutsche Gold und Silber-Scheide-Anstalt	370	Coal and Coke; Arsenic in —	1241
Carlson, E. Grosse's Process; Boiling and Crystallising Low Products by —	1126	Lemon Oil Industry; Discussion on the —	1182
Carmien, P. J. See Leroux, J. B.	1101	Chapman, D. L. See Burgess, C. H.	1289
Carmody. Hydrocyanic Acid in Sweet Cassava	502	Charabot, E. Terpene Compounds in the Geranium; Development of —	64
Carnot and Gontal. Steel; State of Combination of Iron with Rare Elements in —	583	Charitschkoff, K. W. Distillation Test versus Flash-point Test	238
Carnot, A. Tellurides of Gold and Silver in the Kalgoorlie Region	813	Kerosine Distillates; Preliminary Neutralisation of —	700
Carpenter, C. Gas Burners; Incandescent — (P)	226	Kerosine; Methods of Testing —	352
		Petroleum Refining with Lime	885
		Chassy, A. Ozene; Formation of —	1220
		Chatelan, A. Extraction Apparatus	938
		Chauveau, A., and Tissot, J. Respiration Apparatus	828
		Chauvin, E. L. H. Acetylene Gas; Apparatus for Generating — (P)	111
		Chavastelon, R. Acetylene; Reactions of —, with Cuprous Chloride	841
		Chemical Works vormals Sardoze. Sulphur Dyes; Manufacture of —, and Materials for Use therein (P)	982
		Chemische Fabrik Brugg and A. G. Brugg. Dyestuffs, Greenish-Black, Sulphurised; Manufacture of — (P)	1205
		Chemische Fabrik E. Schering. Antiseptics; Production of — (P)	382

	PAGE		PAGE
Chemische Fabrik Griesheim-Elektron. Nitronaphthalene Derivatives from 1,4-Chloronitronaphthalene; Manufacture of — (P).....	358	Clyde Chemical Co. Chromium Oxide; Extraction and Treatment of — (P).....	718
Chemische Fabrik Holfenberg. Test Paper Sensitive to Several Substances Simultaneously (P).....	748	Coblentz, V. "The Newer Remedies." 3rd Edition.....	78
Chemische Fabrik Opladen vormals Gebr. Flick. Indigo; Reduction of — (P).....	802	Cochrane, B. Coke; Manufacture of — (P).....	462
Chemische Fabrik Rhenania. Casein; Soluble Compound of —, with Phosphoric Acid (P).....	1229	Codara, G. Copper; Electro-Metallurgy of —.....	816
Chemische Fabrik von Heyden. Peptone; Manufacture of (P).....	827	Code, R. G. See Sharpe, J.	1102
Phenylglycine- <i>o</i> -carboxylic Acid Esters; Preparation of — (P).....	979	Coe, C. T. See Hewitt, J. E.	724
Chemische Fabrik vormals E. Schering. Antiseptic Compounds; Manufacture of — (P).....	608	Coehn. Alloys; Cathode Polarisation and Formation of —.....	1221
Chemische Fabrik vormals Goldenberg, Geromont and Co. Contact Substance; Materials with Platinum Surface for use as — (P).....	250	Coehn, A. Acetylene; Electro-Chemical Behaviour of —.....	905
Cherchewsky, N. Glue; Apparatus for Determining Melting-Point of Solutions of —.....	731	Coghlan, J. M. Gas, Acetylene; Apparatus for Generating — (P).....	883
Chevrotier. See Lumière, A. and L.	273	Cohen, E. Inversion; Studies on —.....	822
Chick, H. Milk; Sterilisation of —, by Hydrogen Peroxide.	1228	Tin; Physico-Chemical Studies of —.....	366
Chicken, B. R., and Smith, A. G. Acetylene Gas; Purification of —, and Apparatus therefor (P).....	110	Cohen, J. B. "Practical Organic Chemistry for Advanced Students".....	293
Child, J. F. See Burgess, H. E.	1176	And Dakin, H. Aluminium-Mercury Couple, Part III.	512
And White, J. Lemon Oil; Preparation of —.....	274	And Dakin, H. Chlorination of Aromatic Hydrocarbons.	512
And White, J. Lemon Oil; Properties of —.....	274	And Dakin, H. Dichlorotoluenes; Constitution of the —.....	512
Chilesotti, A. Nitro Compounds; Electrolytic Reduction of — to Amines.....	1601	And Dakin, H. D. Trinitrobenzene and Trinitrotoluene; Reduction of —.....	1254
Chisholm, S. Proceedings of Annual Meeting.....	660, 678	Cohn, H. A., and Geisenberger, E. Chlorine and Caustic Soda; Manufacture of —, by Electrolysis.....	123
Speech at Annual Dinner.....	684	Soda, Chlorine, and Metals; Apparatus for Production of — by Electrolysis (P).....	726
Chorley, J. C. See Comber, G.	472	Cohn, L. Alumino-thermic Welding and Casting.....	996
Christensen, A. Cinchona Alkaloids; Perbromides of —.....	605	Cohn, P. Chloranthranilic Acids; Two New —.....	1204
Christy, S. B. Metals in Cyanide Solution; Electromotive Force of —.....	259	Diphenylmethane Derivatives; New —.....	464
Chrząszcz, T. Chinese Yeast; <i>Mucor Cambodia</i> , a Mould Fungus.....	757	Diphenylamine; New Derivatives of —.....	978
Ciamician, G., and Silber, P. Light; Chemical Action of — And Silber, P. Light; Chemical Action of —, II.	844 843	Cohn, R. Mercury, Copper, and Zinc; Volumetric and Gravimetric Determination of —.....	1243
Cinquabre, A. E. See Jasset, J. E.	369	Coiffier, H., Vieville, E., and Majesté, A. Bricks and other Articles; Manufacture of — (P).....	477
Classen, H. Beetroot Juice; Determination of Purity of — Beetroot Juice; Krause's Method for Determining Purity of —.....	843 53	Colburn, H. J. Glass-Blowing Machines (P).....	125
Sugar in Crystals; Obtainment of —, and Apparatus therefor (P).....	483	Coleman International Ship and Pile Coppering Co. Anti-fouling Coating for Metal Structures (P).....	925, 925
Sugar Juices; Influence of Specific Heat and Viscosity on Working of —.....	820	Coleman, W. H. See Craven, J.	200
Syrups; Regulating Supersaturation in Boiling of —, and Apparatus therefor.....	1126	Colley, A. Glucose; Koenig and Knorr's Paper on Derivatives of —.....	1125
Clafin, J. A. Lactic Acid in the Manufacture of Leather.....	210	Collie, J. N. See Garsed, W.	511, 1031
Clancy, A. C. and Marsland, L. W. Metals; Extraction of — from Sulphide Ores (P).....	904	Carbon Dioxide; Decomposition of —.....	696
And Marsland, L. W. Sulphide Ores; Treatment of — for Elimination of Zinc and Recovery of other Metals (P).....	481	Collin, F. J. Coke Ovens; Horizontal — (P).....	882
Claremont, E. A. Electrical Insulating Materials (P).....	1220	Collin, G. Leather; Marbling of —.....	595
Clark, J. Proceedings of Annual Meeting.....	661	Collins, —. Du Pont's Nitrometer; Discussion on —.....	102
Waste Liquids of Whisky Distilleries; Discussion on Composition and Disposal of —.....	458	Collins, S. H. Sugar in Swedes. Part I.	536
Clark, T. E. Gas, Acetylene; Apparatus for Generating — (P).....	833	Colson, A. Amine Salts; Action of Bases and Acids on —.....	832
Clarkson and Capel Steam Car Syndicate, The. See Clarkson, T.	349	Comber, G., and Chorley, J. C. Textile Fibres; Coloring (P).....	472
Clarkson, T., and The Clarkson and Capel Steam Car Syndicate. Liquid Hydrocarbons and Gas, &c.; Burning of — (P).....	349, 349	Commin, J. F. See Cameron, D.	60, 181, 1182
Classen, A. "Ausgewählte Methoden der Analytischen Chemie".....	293	Compagnie Française de l'Acétylène Dissous. Acetylene Gas; Means for Generating — (P).....	564
Sugar; Converting Cellulose into — (P).....	734	Compagnie Gén. d'Incandescence par le Pétrole et l'Alcool. See Petróane, E.	234
Sugar; Converting Wood and other Cellulose into — (P).....	1008	Coninck, O. de. Anilines; Reactions of Substituted —.....	113
Claude, E. Air; Apparatus for Manufacture of Liquid —.....	1018	Uranium Nitrate.....	249
Clauser, R. Nitroso Group in Organic Compounds; Determination of —.....	622	Conroy, J. T., Heslop, O., and Eshores, J. H. Sulphocyanides; Action of Reducing Gases on —.....	320
Clayton Aniline Co. See Green, A. G.	118, 713, 713	Iron; Rate of Dissolution of —, in Hydrochloric Acid.....	316
See Sansone, A.	893	Cook, E. G. Milk of Cows; Means for Humanising — (P).....	738
Clayton, E. Indigo; Chromic Acid Process and for Discharge of —.....	684	Cook, E. R., and Heusner, G. F. Acetylene Gas Machines and Regulators (P).....	564
Clayton, E. G. Asbestos; Analysis of —.....	1212	Cooke, A. See Taylor, F.	712
Incrustation from Stone Gallery of St. Paul's Cathedral.....	1212	Cooke, A. W. Leeds Gas Liquor; Analysis of the —.....	225
Clemmer, J. G. Condensing Towers for Noxious Gases.....	1208	Cooke, G., and Parr, J. Metals; Electro-deposition of — on Glass, &c. (P).....	817
Clemons, G. B. Tanning Extracts; Discussion on —.....	1087	Cooper, C. F. See Hermite, E.	482
Clerc, E. See Forsbach, O.	481	Copony, H. See Skraup, Z. K.	63
Clerke, F. W. See Posner, A. M.	913, 913	Corbier, P. Gas-Producers; Riché —.....	563
Cloetta, M. Digitalis Glucosides; Preparation and Composition of —.....	743	Cordier, V. Bromine; Action of — on Metallic Silver.....	1150
Clover, A. M. See Freer, P. C.	665	Light; Influence of Action of Chlorine on Metallic Silver.....	67
Cloves, F. Photometer; Gas Reference Table —, and Pentane-Ten-Candle Lamp.....	792	Cornelio, L. See Martinotti, C.	603
Sewage; Treatment of London.....	145	Cornell, E. B., and Alderson, W. C. Gas for Lighting, Heating, &c. (P).....	1197
And Houston, A. C. Sewage; Bacterial Treatment of Crude.....	494	Cothias, A. F. Crucible for Casting Alloys, &c., under Pressure (P).....	997
Clowse, G. A. Leather; Manufacture and Treatment of — (P).....	139	Cotta, F. A. J. See Palas, H. J. U.	906
		Cottard, A. See Raltaire, J.	372
		Cotton Seed Oil Syndicate, The. See Stanley, J. C. W. (P).....	1122
		Coulson, W. A. See Thiersant, H. de	976
		Coupland, H. S. Glucose, Value of Liquid Commercial; Determination of —.....	160
		Cousin, H. Iodol; Action of Nitric Acid on —.....	497
		Coventry, W. Yarn in form of Cops, &c.; Treatment of — (P).....	1169
		Cowell, W. B. See Stewart-Wallace, J. S.	464
		Cowies, A. H. Elements; Obtaining Volatile — from Ores and Compounds (P).....	968
		Smelting; Electric —, and Apparatus therefor (P).....	817



	PAGE		PAGE
Cownley, A. J. <i>See</i> Paul, B. H.	158, 500, 500	Davidson, S. C. Fuel, Smoke, and Fire-Gases; Apparatus for Effecting more Complete Combustion of — (P)....	234
Cowper-Coles, S. <i>See</i> Sterne, L.	1003	Davies, C. T. <i>See</i> Job, B.	156
Cowper-Coles, S. O. Metals; Apparatus for Electro-deposition of — (P)....	1002	Davies, H. B. Chlorides; Decomposition of —, by Ignition with Organic Matter	98
Zinc; Cleaning, Preparing, and Coating Iron or Steel with — (P)	484	Davies, W. <i>See</i> Matthews, J.	590
Cox, H. Boiling Pans and Similar Apparatus (P)	878	Davis, A. J. Opal Glass Facing Tiles or Plates (P).....	477
Cox, J. D. <i>See</i> Morse, E. F.	343	Davis, A. L. <i>See</i> Sims, W. J. R.	402
Crafts, J. M. Catalysis in Concentrated Solutions.....	796	Davis, C. B. Water in Oils, Fats, and Waxes; Determination and Elimination of —	941
Craig, A. G. Formaldehyde; Determination of — (P)	1149	Davis, G. E. Transport of Chemicals; Discussion on —	423
Craig, G., and Paterson, R. M. Alkali Cyanides; Apparatus for Obtaining — (P).....	809	And A. R. Lead and Zinc in Solution as Nitrates or Chlorides; Separation of — (P)	47
And Paterson, R. M. Alkali Cyanides; Obtainment of — (P)	808	And A. R. Sulphide Ores; Treatment of Mixed — (P).....	47, 129
Cramer, E. Clay; Softening Point of Refractory —	900	Davis, J. W. Iron or Steel; Machines for Use in Re-carburising — (P).....	1118
Quartz and Quartzite; Behaviour of — on Heating	900	Davis, S. Tinned Scrap and Spelter Scrap; Stripping of — (P).....	368
Crampton, C. A., and Simons, F. D. Spirits; Detection of Foreign Colouring Matter in —	153	Dawson, H. M., and McCrae, J. Metal-Ammonia Compounds in Aqueous Solution. Part IV.—Influence of Temperature on Dissociation of Cupri-Ammonia Sulphate ..	758
Craven, J., and Coleman, W. H. Tar Distillation; Treatment of Noxious Vapours from —	200	Day, A. <i>See</i> Holborn, L.	365
Crawford, C. H., and <i>see</i> Fulton, C. H.	749	Day, A. A. Coal Powder; Apparatus for Aërating and Feeding —	881
Crawford, J. A. Furnaces; Smoke-consuming — (P)	1099	Deacon, H. Wade. Transport of Chemicals; Discussion on — ..	423
Crawford, W. J., and Turley, T. B. Batteries; Thermo-Electric — (P).....	260	Dean, L. A. <i>See</i> Lester, J. F.	147
Crean, F. C. Iron or Iron Alloys; Manufacture of — (P)	1218	Debell, H. Mash Tuns for Preparation of Beer Wort (P).....	1131
Creeke, R. W. B. Gas; Apparatus for Washing and Cleansing — (P)	1198	Debierne, A. <i>See</i> Curie, P.	396
Crépelle-Fontaine, C. Rectification and Distilling Apparatus (P)	143	De Brito e Cunha, A. J. Alkaline Salt Solutions; Electrolytic Decomposition of —, and Apparatus therefor (P) ..	1121
Cresswell, C. G. Speech at Annual Dinner.....	686	Debschutz, W. v. <i>See</i> Borne, G. v. dem	252
Crichton, J. <i>See</i> Joselin, P. H.	485	Deegen. Naphthalene Obstructions; Removal of —	346
And Joselin, P. H. Oils, Fats, and Waxes; Refining of — (P)	371	De Forcrand. Sodium Peroxide; Properties of —	273
Croasdale, R. Hide; Treatment of Raw — (P)	1224	Défournel, H. Quinine Basic Saccharinate.....	832
Croasdale, S. <i>See</i> Pohlé, E. C.	368	Saccharin in Foods; Determination of —	755
Croizier, A. H., and Thomine, A. E. Ston Artificial; Manufacture of — (P)	810	Saccharinates; Metallic	497
Crompton, W. H., and Horrocks, W. Yarns; Apparatus for Treatment of — (P).....	985	<i>See</i> Cazeneuve, P.	838
Cromwell, J. C. <i>See</i> Garrett, W.	698	Desires, W., and Feeny, V. J. Steriliser; An Improved — (P).....	830
Crosby, A. A. Crucibles for Treatment of Ores (P).....	587	Dehéraïn, P. P., and Demoussy. Germination in Distilled Water	381
Crosfield, J. J. <i>See</i> Markel, K. E.	1004	Deike, A. H., and others. Acetylene Gas; Apparatus for Generating — (P).....	351
Cross, C. F., and Bevan, E. J. Cellulose-Xanthogenic Acid. 740	740	Deissler, F. Matches; Ignition Material for — (P)	506
And Bevan, E. J. "Researches on Cellulose, 1895-1900". 847	847	Deiter. <i>See</i> Hünemann.	828
And others. Cellulose; Mixed Esters of —, and Reactions of Cellulose with Nitrating Acid.....	1133	Dejey, J. A. Cylinders for Printing Textile Fabrics (P).....	360
Crossle, W. J., and Atkinson, J. Gas Producers (P).....	1197	Dejonghe, G. Sucrase or Invertase in Industrial Fermentations	1130
And Atkinson, J. Gas from Producers; Apparatus for Purifying — (P).....	1100	Delafond, E. Sucrase; Part Played by — in Fermentation ..	1226
Crotogino, —. Amalgams; Alkylammonium —	787	Délaïnage Vervicéris et Cie. Fatty Matters; Extraction of — from Wool and other Fibres; and Apparatus (P) ..	591
Crotte, F. Beer Preserving (P)	492	Délaïnage Vervicéris, Peltzer and Co. Wool; Removing Fat from —, and Apparatus therefor (P).....	891
Crouzel, E. Ethereal Oil from "Orchis militaris L"	150	Delattre, J. Greasy Matters; Apparatus for Liberating — (P).....	371
Crowthey, H. M. Cyanide Tailings; Treatment of —	127	Delépine, M. <i>See</i> Matignon, C.	274
Cruz-Pasqual-de-Bonanza, L., and others. Fibre for Weaving and Spinning (P)	58	Delépine, S. Arsenious Oxide Micro-Sublimate.....	231
Csáky, S., and others. Gas, Acetylene; Apparatus for Generating — (P)	883	Delplace, J. Cupreous Pyrites; Extraction of the Copper of —	128
Cullen, W. Explosives; Notes on the "Heat Test" for — ..	8	De Morsier. <i>See</i> De Perrodil.....	563
Culmann, C. L. Rosin Soap; Production of —, and Apparatus therefor (P)	591	Demoussy. <i>See</i> Dehéraïn, P. P.	381
Curie, P. <i>See</i> Becquerel, H.	845	Denaeyer, A. Stone, Artificial; Materials for Manufacture of — (P).....	125
And Debierne, A. Radium Salts; Radio-Activity induced by —	596	Denayrouze, L. Lamps; Incandescence Oil — (P).....	565
Curtis, C. H., and André, G. G. Gunpowder; Manufacture of — (P).....	1240	Spirits; Manufacture of Solidified Carburetted — (P) ..	976
And others. Explosives; Composition of — (P).....	1240	Denigès, G. Antimony in Presence of Arsenic; Detection and Determination of —	1244
Cusson, G. <i>See</i> Renault, A.	460	Poisons; Method for Searching for Mineral —	1142
Cuthbertson, Sir J. Neilson. Proceedings of Annual Meeting	678	Denk, A. <i>See</i> Kehrman, F.	115
Cuthbertson, L. M. G. <i>See</i> Southby, A. G.	314	Denny, G. H. <i>See</i> Kemp, C. M.	1198
Czerny, C., and Schlimp, C. Kilns for Firing Ceramic Ware, &c. (P)	252	Denton, J. <i>See</i> Garduer, W. M.	929

D

Dafert, F. W., and Halla, A. Chili Saltpetre; Occurrence of Free Iodine in —	914	Desmoulières, A. <i>See</i> Portes, L.	1229
Dakin, H. D. <i>See</i> Cohen, J. B.	512, 1254	Desq and Fracou. Calcium Carbide Mass for Acetylene Manufacture; Preparation of —	109
D'Altoff, L. T. Gas; Manufacture of — (P).....	793	Desrumaux, H. A. Filtering Apparatus (P)	233, 233
Danilevsky, A. Fish; Utilisation of — for Human Food (P) ..	738	And Norman, J. T. Filtering and Treating Liquids and Trade Effluents; Apparatus for — (P)	233
Danner, S., and Kubelka, G. Gas; Purification of — (P) ..	884	Dessle, E. Cast-Iron; Coppering of —	254
Dannert, F. Gas; Mixing Oxygen with — (P).....	976	Desurmont, F. Slivers; Apparatus for Dyeing — (P)	965
Dannert, F. Gas; Mixing Oxygen with — (P).....	977	Deutsche Continental Gas Gesellschaft and Bueb, J. Gas and Coke; Manufacture of — (P).....	697
Darby, J. H. Coke; Apparatus for Manufacture of — (P) ..	1197		



	PAGE
Deutsche Gold und Silber Scheide-Anstalt vorm. Rössler. Alkali Cyanides; Manufacture of —	1113
Cyanamide and its Compounds; Manufacture of — (P)	1139
And Birger Carlson. Furnaces; Electrical Arc — (P)	370
Deval. Cements; Reaction of Calcium Sulphate with —	391
Mortars, Cement; Injurious Action of Saline Liquids on —	43
Dewrance, J., and Paul, J. H. Sulphuretted Hydrogen; Means for Desulphurisation of — (P)	110
Deyce, G. Albumin and Meat Extract; Preparation of — (P)	59
Dhommée, R. Benzylamine; Conditions of Formation of —	1200
Benzyl Chloride; Action of Ammonia on —	1200
D'Huny, P. R. de F. Fuel; Manufacture of — (P)	1197
Dickson, A. A. Peat; Drying of — (P)	793
Diefenthal, L. See Schroeder, J.	59
Diehl, E. Malt; Influence of the Moisture in — on the Grist	1227
Dieselhorst, W. See Siemens Bros. and Co.	51
Dieterich, K. Cantharides; Valuation of —	1235
Dieterich, M., and Langer, A. Blood Preparations; Pro- duction of — (P)	145
Dietrich, R. Steel; Production of Highly Carburised — (P)	1118
Dillan, E. Liquids; Treatment of — with Ozone (P)	830
Dillon, T. A. Peat and other Moist Substances; Drying of (P)	1099
Dinesman, M. Paracymene-3-sulphonic Acid; Manufacture of Salts of — (P)	1019
Thymol; Manufacture of — (P)	1019
Ditz, H. Alcohols; Influence of —, on Electrolytic Disso- ciation of Salts in Aqueous Solution	389
Bleaching Powder; Formation and Composition of —	247
Chlorates; Determination of —, in Bleach Liquors and in the Potassium Chlorate Manufacture	1026
Cobalt, Iron and Peroxides; Some Reactions of —	889
Cresol; Determination of —	394
Metacresol in Mixtures of Cresols; Determination of —	73
Divers, E. Arsenic; Discussion on Occurrence and Detection of —	190
Borax and Nitrates; Discussion on Manufacture of —	325
Marsb. Test; Discussion on Effect of Selenium and Tellurium on —	324
And Haga, T. Nitrosulphates; Obtainment of —	757
And Ogawa, M. Ammonium and other Imidosulphites	716
Dobbie, J. J., and others. Alkaloids of Corydalis Cava	66
Corybulbine; Conversion of —, into Corydaline	66
Dobbin, L. Barium Sulphate; Solubility of —, in Solution of Sodium Thiosulphate	218
Potassium Permanganate and Alkali Thiosulphates; Inter- action of —, in Neutral Solutions	212
Dodge, H. P. Lime; Treatment of — (P)	717
Dörr, C. Fuel; Artificial — (P)	30
Dohme. Strophanthin; Determination of —	756
Dolezalek, F., and Gahl, R. Secondary Batteries; Resistance of —	257
Domergue, P. E. Liquids; Apparatus for Regulating the Density of — (P)	695
Donald, J. T. Limestones; Composition of some Canadian —	810
Donaldson, W. J., and others. Fuel; Apparatus for Burning Pulverised — (P)	882
Donath, E. Cobalt; Reactions of —	618
Metallic Sulphides; Precipitation of —, by Thiosul- phates	619
Doremus, C. A. Cryolite; Treatment of — (P)	580
D'Orlowsky, J. See Vulliteh, D. de	1198
Dormoy, A. Enamelling Metal; Means and Apparatus for — (P)	364
Dourgoin. See Lavollay	607, 1236
Dowson, J. E. Gas Plants for Engines; Efficient Work- ing —	974
Dowzard, E. Castor Oil; Physical and Chemical Constants of —	370
Gutzeit's Test for Arsenic; Modification of —	506
Drake, B. M., and Nerst Electric Light, Ltd. Glow Bodies for Electrolytic Lamps (P)	884
Lamps; Incandescence Electric — (P)	565
Dralle, C. Glass; Coloration of —, by Iron and Manganese. Glass Furnaces; Cause and Composition of Chimney Incrustation in —	124
Drawe, P. Copper Oxide for Glass Making; Cuprous Oxide in —	869
Dreher, C. Paper; Manufacture of — (P)	831
Soap Containing Free Rosin; Preparation of — (P)	485
Drenckmann. Beetroot Juice; Krause's Method for Determin- ing Purity of —	1125
Drescher, B. See Yorlander, D.	800
Drossbach, G. P. Cerium; Experiments on —	273
Drouin, F. Mica; Influence of Oil on Insulating Properties of —	482
Duboin, A. Magnesium and Aluminium; Reducing Properties of —	512

	PAGE
Dubois, R. Ferro-Manganese; Cause of Disintegration of —, when Exposed to Open Air	1215
Sulphur in Fuel; Determination of the Total —	1241
Dubourg, E. See Gayon, U.	1010
Dueru, O. Arsenic; Determination of —	69
Arsenic; Determination of —, as Ammonio-Magnesium Arsenates	157
Dunkelberg, W. Stone, Artificial; Manufacture of —, and Apparatus therefor (P)	562
Duff, E. J. Gas-Producers (P)	110, 110, 975
Refuse; Destructive Treatment of — (P)	272
Dufton, A., and Gardner, W. M. Lamps for Colour Matching (P)	237
Dugast, J. Wine Must; Concentration of —	922
Duke, J. F. Gold; Extraction of —, from Sea Water, &c. (P)	1218
Dumont, J. Superphosphate; Absorption of —, by Arable Earth and Humus	374
Duncan, A. W. Arsenic; Discussion on Detection of —	207
Duncan, J. H. H., and others. Incandescence Bodies for Gas Lighting (P)	32
Duniczewski, M. Sugar; Apparatus for Manufacture of Lump — (P)	823
Dunlop, R. Shale-Oil Work at Orepuhi, New Zealand	854
Dunn, J. Blacking for Foundry Purposes; Manufacture of — (P)	1119
Dunstan, W. B. See Cash, J. T.	928, 928
And Brown, H. Hyoscyamus Muticus and Datura Stra- monium; Alkaloids of —	66
And Henry, T. A. Lotus Arabicus Poison; Nature and Origin of —	929
Duquesnoy, J. Silk; Production of Artificial — (P)	469
Duryea, C. B. Starch, Thin Boiling or Modified; Manufacture of — (P)	1127
Dutoit, M., and Wallach, J. Oxyhydroquinonephthalein; Fluorescein Esters of —	1105
Duyk. Kubel-Tiemann Method for Determining Organic Matter in Water; Source of Error in the —	756
Duyk, M. Lard Oil	590
Silk, Artificial; Identification and Determination of —	569
Dvořáček, P. See Holub, B.	351
Dybowski, J., and Landrin, E. Iboga; Properties and Com- position of —, and the Alkaloid it contains	1234
Dyer, B. Arsenic; Discussion on Occurrence and Detection of —	191
Basic Superphosphate; Discussion on —	330, 331
Oatmeal; Composition of —	827
Dyson, S., and Gaskell, J. Saponaceous Products; Manufac- ture of — (P)	262

E

Easterfield, T. H., and Aston, B. C. Tutu; Examination of —	67
Eberhard, O. Lactic Acid; Percentages by Weight and Volume in Sac of —	470
Eberhard, G. Intensifier; Mercuric Sulphocyanide —	387
Eccles, D. C. Antipyrin and its Derivatives	832
Eckardt, A. Beer-Wort; Production of High or Low Fer- menting — (P)	737
Ecob, J. R. Mercersing Apparatus (P)	359
Eder, J. M., and Valenta, E. Sodium Perborate; Preparation of — (P)	1239
Edison, T. A. Batteries; Alkaline Storage — (P)	1002
Batteries; Reversible Galvanic Storage — (P)	258
Batteries; Secondary — (P)	589
Briquetting Pulverised Material (P)	697
Magnetic Separating Apparatus (P)	998, 998
Portland Cement, &c.; Sampling and Storing — (P)	982
Edmonds, W. D. See Roesi, A. J.	588
Edmunds, J. Arsenic; Discussion on Occurrence and Detec- tion of —	193
Edmundson, J. W. Acetylene Gas; Apparatus for Produc- tion of — (P)	31
Edson, E. R. Gelatin and Oil; Apparatus for Extraction of — (P)	261
Gelatin; Manufacture of —, and Apparatus therefor (P)	140
Edwards, A., and Nelson, E. M. Photographic Plates, Films, and Papers; Drying of — (P)	932
Ehrlich, F. Beet Juice; Determining Purity of —, by Krause's Method	563
Krause Method for Determining Purity of Beet Juice	754
Eichengrün, A. Oxy-Alcohols; Production of Aromatic —	1239
Photographic Developer; A New —	1239
Eichhorn, O. Wax; Acid and Saponification Values of —, Modification of Hubl's Method	74
Eiehler, J. See Kehrman, F.	705
Einhorn, A., and Pfeiffer, H. Disalicylide; Preparation and Properties of —	1134



	PAGE		PAGE
Eitner. Leather; "Spueing" of —	594	Ewers, F. Printing Tinplate in Dull Colours (P)	1208
Eitner, P., and Keppeler, G. Acetylene and other Gases; Determination of Phosphorus and Sulphur in —	538	Exbrayat, A. Coal Briquettes, and Agglutinant Material therefor (P)	234
Ekenstein, W. A. van, and Lobry de Bruyn, C. A. Sugars; New Derivatives of —	291	Eydmann, F., jun. Phosphorus; Ignition Temperature of —	617
Ekker, M., and Krajesics, J. Alloy; Manufacture of a Nickel-coloured — (P)	1217	Eyre, J. V. See Meldola, R.	572, 1204
And Krajesics, J. Alloy; Manufacture of a Silver-coloured — (P)	1217		
And Krajesics, J. Alloys, Nickel Coloured and Silver Coloured; Production of — (P)	47		
Elbers, A. D. Blast-Furnace Slag; Treatment of Molten — (P)	1119		
Elbs, K. Ketones; Electro-Chemical Reduction of —	700		
Manganous Salts; Behaviour of —, at the Anode	49		
Sulphuric Acid containing Iron; Electrolysis of Dilute —	48		
And Fischer, F. Lead Persulphate; Electrolytic Production of —	182		
And Silbermann, F. Nitro-Compounds; Electro-Chemical Reduction of —, to corresponding Amines	725		
Electrical Power Storage Co., and others. Plates for Secondary Batteries (P)	482		
Elektricitäts-Aktienges. vorm. Schuckert and Co. Colophony and other Soft Resins; Hardening of — (P)	729		
Elias, L. See Raphael, M.	582		
Ellershausen, F. Ores; Treatment of Complex or Refractory — (P)	47		
Elliott, C. Incrustation from Steam Boilers; Removal of — (P)	878		
Ellis, S. H., and Holt, T. Earthenware; Apparatus for Dipping —, into Glaze or Colour (P)	476		
Ellms, J. W., and Beneker, J. C. Carbonic Acid in Water; Determination of —	937		
Elmqvist, H. Metal; Casting of — (P)	998		
Elschner, C. Sulphur in Asphaltams and Bituminous Chalks of Palestine	885		
Superphosphate; Preparation of, for Market —	267		
Elworthy, H. S. Tanning Materials; Discussion on Leather-forming Value of Different —	436		
Embrey, G. Maize in Wheaten Flour; Detection of —	72		
Emerich, G. S. See Donaldson, W. J.	882		
Emich, F. Alkalis and Acids; Micro-chemical Detection of —	1142		
Gases; Sensitiveness to Explosion of Mixtures of —	278		
Ozone and Water; Detection of Small Quantities of —	1142		
Emmerling, O. Yeast Maltase; Synthetic Action of —	377		
Emmerson, G. W., and Ward, J. Furnace for Manufacturing Calcium Carbide and Melting Metals (P)	344		
Engelhardt, V. Bleaching Apparatus; Electrical —	131		
Engels, E. W. Carbonic Oxide; Production of (P)	350		
Engler, C., and Albrecht, E. Petroleum; Filtering, through Fullers' Earth —	1102		
And Albrecht, E. Inclusions in the Muschelkalk Formation of Roth-Malsch, Baden	1102		
And Frankenstein, W. Active Oxygen.—VII. Auto-oxidation of Unsaturated Hydrocarbons	1151		
Enoch, C. Drinks; Manufacture of Non-Alcoholic Aromatic — (P)	924		
Enzinger, K. Filter-Presses, and Material therefor (P)	694		
Ephraim, J. Patent Laws in Chemical Industry	1251		
Erben, W. Wool, Recovering Solvent from Emulsions from — (P)	359		
Erdmann, E. Jasmine Flowers; Essential Oil of —	930		
Erdmann, H. Indigo; Conversion of Anthranilic Acid Derivatives into —	801		
Erfmann, F. R. K. Water for Steam Generators; Apparatus for Determining the Condition of —	147		
Erfurt, M. Boiler for Rosin Soap (P)	1004		
Liquids; Boiling of Brothing —, and Apparatus therefor (P)	591		
Ericsson, C. Carbon Dioxide in Products of Combustion; Means for Indicating and Recording — (P)	110		
Erlenbach. Naphthalene Obstructions; Prevention of —	347		
Ernst, K. Inflammable Liquids; Safety Vessels for Storing —	450		
Erny, W. Electrodes Containing Zinc; Construction and Use of — (P)	1001		
Esser, C. See Pollak, A.	830		
Essner, J., and Laurans, E. Furnace; An Improved Melting — (P)	430		
Arsenic in Beer; Detection of —	267		
Extraction of —, from Ores	902		
Eulert. Bismuth; —	882		
Eunson, M. Furnaces and Muffle Ovens; Liquid Fuel — (P)	719		
Evans, J. See Schougaard, S.	722		
See Stead, J. E.	482		
Evans, J. S. See Pickard, H. J. H.	825		
Evans, R. E. Malting; Experiments in —	825		
Ewan, T., and Pfleger, J. Alkalino Amide; Preparation of — (P)	853		
Ewell, E. E. Sugar in B. ets; Rapid Determination of —	915		
Fabrik Chemischer Praeparate von Dr. R. Sthamer. Saponin; Production of — (P)	833		
Fabrik Explosionsssicherer Gefasse. Non-Explosive Vessels for Inflammable Liquids	298		
Fages. Chlorates and Bromates; Detection of —	280		
Fairley, T. Beer and Malt, Arsenical; Discussion on —	312		
Dyeing Wool and Silk Union Fabrics; Discussion on —	232		
Leeds Gas Liquor; Discussion on Analysis of —	226		
Lime; Analysis of —, for Tanners, Discussion on —	225		
Lime; Solubility of —, in Water, Discussion on —	224		
Malt-kilns; Arsenic in —	918		
Fajole, E. Gas, Acetylene; Apparatus for Generating — (P)	883		
Falk, R. See Just, A.	1199		
Falkenstein, G. S. and C. F. Leather, Artificial; Manufacture of — (P)	731		
Fallnicht, R. Naphtha; Production of Solidified — (P)	796		
Fallot, B., and Michon, L. Invertase in White Wines	491		
Farbenfabriken vormals F. Bayer and Co. Acetylphenylglycine-o-carboxylic Acid; Neutral Esters of — (P)	277		
Chlorocarbonic Acid Ethers and Compounds therefrom; Manufacture of — (P)	151		
Colouring Matters, Azo, and Intermediate Products; Production of — (P)	342		
Colouring Matters; Azo-Red and Orange — (P)	982		
Colouring Matters; Azo-Yellow, Red, and Violet —, and Intermediate Products (P)	803		
Colouring Matters; Trisazo-Blue — (P)	117		
Colouring Matters, Yellow, of the Acridine Series; Manufacture of — (P)	118		
Dyestuffs containing Sulphur; Manufacture of — (P)	573		
Derivatives of the Stilbene Series; Production of — (P)	1205		
Dyeing with Amido-oxanthraquinone Sulphonic Acids (P)	982		
Dyestuffs, Anthraquinone; Production of New — (P)	471		
Dyestuffs, Azo Blush-Red and Orange, and Intermediate Products; Production of — (P)	36		
Dyestuffs, Azo-Red and Violet, for Cotton (P)	982		
Dyestuffs, Blue, of the Triphenylmethane Series; Production of — (P)	117		
Dyestuffs, Blue Trisazo; Manufacture of — (P)	981		
Dyestuffs of the Anthracene Series; Manufacture of — (P)	358		
Dyestuffs of the Anthraquinone Series; Production of — (P)	1205		
Dyestuffs, Violet-Red and Blue —, of the Anthracene Series (P)	357		
Pharmaceutical Compounds; Production of New — (P)	890		
Printing Cotton with Sulphur Dyestuffs (P)	1139		
Shades, Fast against Washing; Production of —, on the Fibre (P)	1110		
Wool; Blue Shades Fast to Light on — (P)	1207		
Farbwerk Durand, Huguenin and Co., and Barbier, P. Perfume; Preparation of a New: "Janthone" (P)	1210		
Farbwerk Muhlheim vormals A. Leonhardt and Co. Phenylglycine Carboxylic Acid, &c. (P)	503		
Farbwerke vormals Leonhardt and Co. Dyeings from Substantive Colouring Matters; Fixing of — (P)	277		
Farbwerke vormals Meister, Lucius und Brünig. Alizarin Products for Directly Dyeing Fibres	893		
Celluloid, Manufacture of (P)	247		
Coal-Tar Colours; Transformation Products of — (P)	62		
Dyeing with Sulphur Dyestuffs (P)	117		
Dyes, Blue to Blue-Black; Obtainment of —, on Wool Fibre (P)	41		
Dyestuff, Blue Sulphurised; Manufacture of — (P)	472		
Dyestuff, Blue-Violet, Manufacture of — (P)	467		
Dyestuff; Brown and Black —, for Wool (P)	37		
Dyestuff, Brown from 1.8. Dinitro-naphthalene; Manufacture of — (P)	890		
Dyestuff, Brown or Grey, for Wool; Manufacture of — (P)	468		
Dyestuff; Violet-Black Azo —, for Wool (P)	468		
Dyestuffs; Black-Azo — (P)	240		
Dyestuffs, Blue Mordant, of the Anthraquinone Series; Manufacture of — (P)	708		
Dyestuffs, Fast Yellow and Orange; Manufacture of — (P)	37		
Dyestuffs, Orange-Yellow to Red Mordant; Manufacture of — (P)	468		
Dyestuffs, Sulphurised Black, and Derivatives; Production of — (P)	982		
Indigo; Manufacture of — (P)	982		
Indigo-Vat Dyeing (P)	981		
Milk; Rendering Cows' and Goats' — Digestible (P)	472		
Oxybenzylamine, Hydrogenised, and Hydrogenised Benzylamine Bases; Manufacture of — (P)	601		



PAGE	PAGE
Farbwerke vormals Meister, Lucius und Brüning—cont.	
Rhodamine Sulphonic Acids; Manufacture of (P) . . .	709
Salicylate of 4-Dimethylamido-1-Phenyl-2,3-Dimethyl-5-Pyrazolone (P) . . .	504
Sulphur Trioxide; Production of (P) . . .	578
Sulphuric Anhydride; Manufacture of —, by the Contact Process (P) . . .	1209
Wool: Rendering — Incapable of Absorbing Dyestuffs (P) . . .	111
Farmer, H. Trichromatic Photography: Optics of — . . .	337
And Symmons, G. Photography: Practical Tricolour — . . .	1019
Fascetti, G. Casein for Technical Purposes . . .	1014
Faucheux d'Humy, P. R. de, and McKenzie, R. Anthracite Briquettes; Manufacture of (P) . . .	697
Faust, A. Water and Pulp; Recovery of —, from Waste Waters of Paper Mills (P) . . .	496
Favre, C. Mordant for Basic Dyestuffs: A New — . . .	710
Fay, H. and North, E. Lead Amalgams: Nature of — . . .	479
Fazan, J. Acetylene Gas; Apparatus for Generating — (P) . . .	31
Fearnside, W. E. Unions; Dyeing of —, with Diamine Dyestuffs.	39
Feder, S., and Van de Büeken, J. Soap: Apparatus for Making Carpet — (P) . . .	1122
Feeny, V. J. See Defries, W.	830
Fellner and Ziegler. Cement Kilns and the Like (P) . . .	810
Fels, J. Glue; Determination of Viscosity of — . . .	139
Fendler, G. Cascarella Oil	274
Fenton, H. J. H. Sagars from Cellulose	757
Feret, R. Puzzolane; Experiments on Pulverising — . . .	252
Fergus, D. Speech at Annual Dinner	685
Fergusson, A. A. Distilleries; Treating Waste Products from (P) . . .	144
Fernau, A. Drinking Water: Examination of —, by Erdmann's Method	581
Fernbach, A. Beer: Atmospheric Infection of —	921
Tannase; Preparation of —	137
Ferraris, E. Furnaces for Distillation of Zinc, &c. (P)	997
Treatment of Mixed — for Separation of Metals (P)	1117
Ferraro, A. Ammonia; Use of Corrosive Sublimate for Detection of —	280
Ferreira da Silva, A. J. Salicylic Acid in Wine: Detection and Determination of —	396
Salicylic Acid in Wines; Sensitiveness of Different Methods for Detecting —	938
Fessenden, R. A. Lamps; Incandescence Electric — (P) . . .	352
Feuerstein, W. Maltol; Presence of — in Needles of the White Fir	826
Feyerabendt, G. Wood; Preserving and Fireproofing — (P) . . .	1212
Fichtel, P. A., and Heurtey, R. M. J. Gas Generators (P)	1197
Fiedler, M. Explosives; Manufacture of Safety — ("Donar") (P)	837
Fielding, W. See Baggs, D. C.	976
Fietz, C. See Bonal, J.	110
Fiora, P. Phenol; Characteristic Reaction for —	507
Firth, A., and Jackson, R. Vaporisers or Carburetted Apparatus (P)	697
Fischel, I. Waste Liquids from Sugar Manufacture; Treatment of — (P)	734
Fischer, E. Egg Albumin; Formation of α -Pyrrolidincarboxylic Acid and Phenylalanine by Hydrolysis of —	1151
And Armstrong, E. F. Glucose; Isomeric Acetohalogen Derivatives of	1151
And Armstrong, E. F. Glucosides; Synthesis of —	1151
And Skita, A. Silk; The Fibroin of	1108
Fischer, F. See Elbs, K.	132
"Die Brennstoffe Deutschlands und der übrigen Länder der Erde, und die Kohlennoth"	1253
And Kiefer, L. Liquids; Apparatus for Saturating — with Gases (P)	1024
Fischer, G., and others. Carburetted Air Producer (P)	564
Fischer, J. Gas Burners; Incandescence — (P)	884
Fischer, O. Isorosinduline and Isorosindone Reaction.	571
Triphenylcarbinols; Etherification of —, by Alcohol.	33
Fischer, R. Alkaloids of Eschscholtzia Californica	1015
Alkaloids of Glaucium Luteum	1016
Alkaloids of Sanguinaria Canadensis	1016
Fitzgerald, F. A. J. Graphite Produced by the Acheson Process	443
Flanagan, C. A. Sulphuric Acid; Apparatus for Concentrating — (P)	1112
Plath, J. Zinc in Spathic Iron Ores; Estimation of	935
Flather, G. W. Varnish, Amber; Manufacture of — (P)	372
Fleischer, E. Water-Gas; Production of — (P)	110
Flessa, R. Malt; Production of Colouring — (P)	736
Fletcher, T., and others. Burners for Gas and Vapours (P)	31
Fleurent, E. C. A. Flour; Desiccation and Sterilisation of — (P)	690
Wheaten Flour; Densimeter for Valuation of —	941
Flcury, G. Morphine; Characteristic Reaction for —	1146
Flick, Gebrüder. Indigo Paste; Production of Soluble — (P)	472
Nitrites; Manufacture of — (P)	364
Flintoff, R. J. Paranitraniline Red; Printing of —	470
Flower, G. W. Lime; Analysis of —, for Tanners' Purposes	224
Flügge, A. Food from the Seeds of Horse-Chestnut (P)	1012
Flusin, G. Osmosis of Liquids through Membrane of Pig's Bladder	292
Foden, A. Arsenic and Antimony; Discussion on Determination of —	187
Foerster, F. Carbon Anodes; Influence of — on Electrolysis of Alkali Chloride Solutions	999
Foerster, O. Phosphoric Acid in Basic Slag Powder; The Molybdate Method of Estimating —	751
Fog, S. L., and Kirschner, A. G. Matches; Phosphorus-free — (P)	1024
Fonzes-Diacon. Cadmium Selenide	76
Copper Selenides; Formation of —	161
Forbes, Sir C. S. Acetylene Gas Generators (P)	236
Forbes, W. T. Hides and Skins; Treatment of —, and Apparatus therefor (P)	457
Force. See under Société Anon. Force.	
Forcerand. Sodium Hydroxide; Solid Hydrates of —	896
Forell, C. von. Cement, Portland; Manufacture of — (P)	810
Forster, H. C. B. See Patent Agglozment Fuel Syndicate.	350
Forsbach, O., and Clerc, E. Crucible Smelting Furnace (P)	481
Forsselles, A. von. Iron Industry; New Process in the —	366
Petroleum for Metallurgical Purposes.	461
Fortmann, G. See Russig, F.	394
Fossilitch, Leather Co. Leather: Artificial — (P)	373
Foster, J. Evaporating Vessels for Liquids (P)	562
Foster, W. J. Iron; Introducing Carbon and Fluxes in Manufacture of (P)	603
Fouché, M. Acetylene; Dissolved —	1196
Fournier, E. Disinfecting, and Apparatus therefor (P)	147
Fowler, G. C., M. A., and E. J. See Welcome and Co.	
Fowler, G. J. Iron Nitride; Characteristics of —	77
Fowler, J. C., jun. See Bennett, F. M.	699
Fox, C. E. See Orchard, R.	1230
Fox, W., and Kingscote, T. H. Filters and Separators for Gils and other Liquids (P)	544
France, G. H. Fabrics; Treatment of —, with Liquids (P)	1207
Francken, P. E. Battery; Constant Electric — (P)	815
Francou. See Desq.	109
Frank, F. Benzols; Prices, Imports and Exports, Composition, &c., of —	566
Franke, E. Mercury Cell for Electrolytic Soda and Chlorine.	815
Frankel, S. "Die Arzneimittel-Synthese auf Grundlage der Beziehungen zwischen Chemischem Aufbau und Wirkung"	78
And König, A. Hydrocarbons; Rendering Sulphurised — Soluble in Water	277
Frankenstein, W. See Engler, C.	1151
Fraps, G. S. Pentosans; Determination of —	843
Wood Oil; Composition of a —	237
And Blizzell, J. A. Protein Nitrogen in Vegetable Matter; Determination of —	74
Frasch, H. A. Metals; Extraction and Reduction of — by Electrolysis (P)	370
Metals; Recovery of —, from Ores and Concentrates (P)	907
Nickel, &c., Electrolytic Process for Refining —	483
Nickel Salt, and Production thereof (P)	580
Fraser, J. H. See Gestling, J. C.	125
Frede, G. Seed Yeast; Lactic Acidification of the —	825
Freeman, T. K. Milk; Apparatus for Preservation of — (P)	827
Freer, P. C., and Clover, A. M. Jamaica Dogwood; Constituents of —	605
Frémery, M. Bronnert, E., and Urban, J. Cuprammonium Solutions; Preparation of — (P)	38
See Bronnert, E.	119, 1207, 1231
Frémy, E. See Mare, F. de	138
Frerichs, G. Bismuth; Volumetric Determination of —	186
Fresenius, W. Cement; Detection of Powdered Slag in —	1143
Freund, F. See Plagwitz, P.	154
Freund, M. 7-Cyano-stilbene; Isomeric Diamino Bases of — Di-p-aminophenyl-cyano-butadien; Substantive Nature of Azo Dyes from —	1107
Freundler, P., and Banel, L. Bisulphite Compounds of Aldehydes and Ketenes; Decomposing the —	832
Frew, W. Barleys; Valuation of —, for Brewing and Distilling.	221
Technical Research; Endowment of —	219
Waste Liquids of Whisky Distilleries; Discussion on Composition and Disposal of —	458
Freyer, F. Alcohol in Ether; Determination of —	1250
Freysoldt, O. Sewage and Effluents; Purification of —, and Apparatus therefor (P)	61



	PAGE		PAGE
Freyss, G. <i>See</i> Noeltling, E.	354	Gayon, U., and Dubourg, E. Mannitol Ferment; The — ..	1010
Ortho-anisidine; Nitro Derivatives of — ..	356	Gebauer, F. Bleaching Textile Products, &c. (F) ..	892
Fric, V. <i>See</i> Votocek, E.	76	Gebrüder Flick. <i>See under</i> Flick.	
Friedel, C. <i>See</i> Nietzki, R.	514	Geige, K. Peat Fibre in Germany ..	804
Friedländer, I. Testing Precious Stones ..	512	Geigy, Dyestuffs; Constitution of Sulphur — ..	381
Friedländer, P. "Fortschritte der Theerfarbenfabrikation und Verwandter Industriezweige" ..	513	Geigy, J. R., and Co. Dyeing with Azo Colouring Matters; Production of Grounds on Cotton in — (P) ..	41
And Seidel, H. Paper Sizing; Chemistry of — ..	602	Indigo and α -Isatine-anilide; Production of Homologues of — (P) ..	357
Friswell, R. J. Refractory Materials; Manufacture of — (P) ..	992	Indigo; Transforming Crystalline —, into Reducible form in Paste (P) ..	53
And The British Uralite Co. Refractory Materials; Manufacture of — (P) ..	1115	Geisenberger, E. <i>See</i> Cohn, H. A.	123, 726
Fritchie, O. P. Tungsten in Ores; Determination of — ..	840	Gelder, A. P. Van. Nitric Acid and Mixed Acid Analysis; Notes on — ..	330
Uranium and Vanadium Ores; Analysis of — ..	70	Gelsthorpe, C. L. and P. Copperas; Recovery of —, from Waste, and Apparatus therefor (P) ..	453
Frith, W. F. L. <i>See</i> Holzer, W.	1218	General Electric Co., The. Light; Methods and Means for Producing —, Electrically (P) ..	237
Fritz, A. von. Incrustation in Steam Generators; Mixture for Preventing — (P) ..	561	General Electro-Chemical Co. Abrasive Material from Bauxite, &c. (P) ..	78
Froehling, H. Alkaloids and Vegetable Oils; Extraction of —, and Apparatus therefor ..	1019	General Metal Reduction Co. <i>See</i> Bechi, G. de.	47
Frölich, O. Metals; Extraction of —, by Means of Calcium Carbide ..	719	Gentsch, O. Steel, Hardening of — ..	1116
Froitzheim, E., and Schumacher, M. M. Water; Apparatus for Purifying and Softening — (P) ..	602	Genyresse, P. Limonene, New Alcohol Derived from — ..	385
Fromm, O. Gum Arabic; Valuation of — ..	624	Terpineol; Preparation of — (P) ..	503
Frost, C. E. <i>See</i> Notley, W.	464	Georgievics, G. v. Rosaniline Bases ..	34
Froyck, A. Glass; Pressing or Moulding — (P) ..	124	And Springer, L. Azo Dyestuffs from β -Naphthol and α -Naphthylamine Sulphonic Acids; Behaviour of —, to Wool ..	34, 34
Fryklind, K. E. Eggs; Method of Preserving — (P) ..	1229	Indigo; Oxidation of — ..	33
Fuchs, L. Sugar; Apparatus for Refining — (P) ..	1003	Gerdes, H. Gas Generators (P) ..	697
Fuehrer, J. Explosives; Manufacture of — (P) ..	68	Gerhardt, F. Binding Substances for Paints, &c. (P) ..	372
Füllner, E. Pulp Fibres; Apparatus for Separating —, from Waste Waters (P) ..	603	Gerin, F. <i>See</i> Vignon, L.	1244, 1254
Separating Mechanical Admixtures from Liquids, and Apparatus therefor (P) ..	1194	Gerland, —. Vanadium; Discussion on — ..	1188
Fürst, L. Meat Extracts; Food Value of — ..	58	Gerland, B. W. Arsenic; Discussion on Detection of — ..	207
Fuerstenheim, F. Gas Burners; Incandescence — (P) ..	565	Geschwind, L. <i>See</i> Salter, C.	817
Fürth. Bleaching; Electrolytic ..	359	Gesellschaft vorm. Felser and Co. Oil-Presses; Plates for Hydraulic — (P) ..	1004
Finishing Materials and their Application ..	243	Geugnier and Valette. Indigo Plant; Treatment of —, by Diastase (P) ..	836
Fulton, C. H., and Crawford, C. H. Zinciferous Precipitates from the Cyanide Process; Determination of the — ..	719	Gevaert-Naert, L. Leather, Artificial; Manufacture of — (P) ..	597, 1007
Fulton, O., and Gillard, M. Photographic Printing Surfaces (P) ..	388	Gfeller, E. Saccharin; Manufacture of — (P) ..	386
Fulweiler, W. H., and Smith, E. F. Silver; Electrolytic Precipitation and Separation of — ..	1002	Toluene Sulphochlorides; Manufacture of — (P) ..	504
Funk, R. <i>See</i> Mylius, F.	249	Gibb, A. Arsenic and Antimony in Cupreous Materials; Determination of — ..	184
Acids Analogous to Sulphuric Acid; Sodium Salts of Dibasic ..	291	Cement, Portland; Manufacture of — (P) ..	810
Furnival, S. B. Clay or Filter Presses for Manufacture of China, &c. (P) ..	564	Furnaces; Melting or Smelting — (P) ..	723
		Gibbons, W. P. and G. B. A. Furnaces; Construction of —, and Bricks therefor (P) ..	344
		Gibson, H. W. <i>See</i> Vulte, H. T.	370
		Gibson, J. M. Packing Material for Glover and other Towers (P) ..	807
		Giese, L. H. A. von, Paper; Rendering —, Transparent Temporarily (P) ..	603
		Giese, O. Flash Light Apparatus, and Cartridges therefor (P) ..	237
		Giesel, F. Radio-active Substances ..	290
		Gilbert, Sir J. H. "Memoranda of the Origin, Plan, and Results of the Rothamsted Experiments" ..	1035
		Gill, F. N. G. Bagasse; Value of —, as Fuel ..	695
		Sugar Canes; Valuation of — ..	915
		Gillard, P. <i>See</i> Fulton, O.	388
		Gilmour, J. D. Alkaline Chlorides; Electrolytic Decomposition of —, and Apparatus therefor (P) ..	1220
		Girard, A. C. Explosives; Manufacture of — (P) ..	155
		Girard, G. Explosives; Manufacture of —, with Solidified Oil (P) ..	609
		Glæss, P., and Bernard, R. "Duteol," a New Indicator ..	155
		Glaser, L. Lead; Electrolytic Deposition of Metallic — ..	259
		Glaser, Von Dr. F. "Indikatoren der Acidimetrie und Alkalimetrie" ..	514
		Glen, W. J. Refuse Consuming Furnaces or "Destructors" (P) ..	60
		Glover, J. G. Gaslighting Torches (P) ..	698
		Gnehm, R., and Gansser, A. W. E. Gallamide Derivatives ..	354
		And Scheutz, T. Alkylated Aminobenzene Sulphonic Acids and Metaminophenols ..	798
		Gnezda, J. Albumin; Formation of an Isatin-Derivative of — ..	1254
		Gobbe, E. Furnaces for Treatment of Lime, &c. (P) ..	105
		Gody, L. <i>See</i> Bruylants, G.	61
		Göckel, H. Glass Tap with Universal Mercury Seal ..	153
		Goedecke, C. Blast Furnace for Dusty Granular Iron Ore (P) ..	253
		Göhler, M. Gas; Apparatus for Production of — (P) ..	351
		Göttig, C. Silver Plating by Reduction ..	901
		Goldberg, A. Canarin and Pseudosulphocyanogen (Pseudothiocyanogen) ..	238
		Sulphocyanogen, Pseudosulphocyanogen, and the Yellow Dyestuff from Sulphocyanide Salts ..	798, 1103

G

Gabrielli, A. Fireproof Coating for Walls and Floors (P) ..	126
Gadamer, T. Atropine Sulphate; Tests for — ..	923
And others. Alkaloids of <i>Corydalis cava</i> ..	1234
Gaedicke, J. Bromide Prints; Permanence of Toned — ..	154
Gahl, R. <i>See</i> Dolezalek, F.	257
Gallagher, G. S. Furnaces; Consuming Smoke and Gaseous Products in — (P) ..	1039
Gallenkamp, W. Indigo, Natural; Manufacture of — ..	466
Gansser, A. <i>See</i> Parker, J. Gordon.	1085
Gansser, A. W. E. <i>See</i> Gnehm, R.	354
Garassino, J. Plates for Secondary Batteries (P) ..	726
Gardner, W. M. <i>See</i> Dufton, A.	237
<i>See</i> Lawson, C.	1152
And Denton, J. Indigo containing much Indirubin; Analysis of Samples of — ..	939
Garrett, W. Rolling Mill Practice; American and British — ..	722
And Cromwell, J. C. Gas Producers (P) ..	698
Garrigou, F. Wine Vinasses and Spoilt Wine; Utilisation of —, as Manure ..	914
Garrison, J. M. Glass; Separating Molten —, from Impurities (P) ..	1114
Garsed, W. Oil of Akee; Composition and Properties of — ..	134
And Collie, J. N. Cocaine and Di-iodo-cocaine Hydroxide; Determination of — ..	511
And Collie, J. N. Cocaine; Determination of — ..	1031
Garside, J., and Saxon, G. J. and A. Boilers; Composition for Prevention and Removal of Incrustation in — (P) ..	28
Gaskell, J. <i>See</i> Dyson, S.	262
Gathmann, E. Explosives; Manufacture of — (P) ..	68, 69
Gathmann, L. Water; Apparatus for Purifying — (P) ..	1133
Gauntlett, F. W., and Lloyd, J. H. Printing on Glass, &c. (P) ..	718
Gautier, A. Sulphides, Hydrosulphides, &c., co-existing in Solution; Determination of — ..	392
Gayley, J. Air Drying, and Apparatus therefor (P) ..	27



	PAGE		PAGE
Goldberger, P. Hydrosulphurous Acid; Application of Reducing Action of —	112	Griffith, R. W. See Youl, J.	426
Goldie, T. I. Sewage; Structures for the Bacterial Treatment of — (P)	495	Griffiths, W. Metals; Uniting or Welding — (P)	905
Goldovsky, M. Lactic Acid; Application of —, in Dyeing Aniline Black	710	Grimaux, E. Dyestuffs from Di-Alkylated <i>m</i> -Aminophenol Ethers	356
Goldschmid, E. Steel; Production of — (P)	1218	Dyestuffs from <i>m</i> -Aminophenols	355
Goldschmidt, C. Anæsthetic; Ethyl- <i>o</i> -Anisidine Formate as an —	605	Dyestuffs; Triphenylmethane — (Blue)	355
Camphor Derivative; A New —	833	Dyestuffs; Triphenylmethane — (Pink)	355
Phenacylphenacetin; Preparation of — (P)	929	Triphenylmethane Derivatives	355
Goldschmidt, H. High Temperatures; Production of —, by Combustion of Aluminium	253	And Lefèvre, L. Dyestuffs; Triphenylmethane	355
Welding Process; Automatic Tapping Arrangement for the Thermite —	1214	Grimbert, L. Acetylmethylcarbinol; Production of —	491
Goldsmith, J. N., and British Xylonite Co. Celluloid; Manufacture of — (P)	741	Grimm, Perchlorates in Chili Saltpetre; Determination of —	1144
Goldstein. Radiations; Coloration of Salts by —	1240	Grimshaw, H. Patent Law; Discussion on —	16
Goldzweig, A. Fibrous Materials; Purifying from Grease, &c. (P)	119	Proceedings of Annual Meeting	662
Gomberg, M. Triphenylchloromethane; Characteristics of Triphenylchloromethane; Preparation of —	114	Grimsey, G. P. Portland Cement Industry in California	857
	33	Griveau. Gold; Grollet's Method for Recovery of —	127
Gomez-Valdivia, M. See Cruz-Pasqual	38	Gröger, M. Alkali-Copper Carbonates	368
Goppelsroeder, F. "Capillaranalyse"	758	Gronwald, J. F. H. Liquors, Aromatic Alcoholic; Preventing Changes in —, during Sterilisation (P)	827
Gordin, H. M., and Merrell, C. G. Berberine; Gaze's Pure Base —	1235	Grosheintz, H. Indoine Blue; Discharging —	891
Gordon, R. H. Disinfectant or Deodorising Composition (P)	61	Gross, O. Fluorescein, its Derivatives and their Leuco Bases; Sensitiveness of —, to Light	883
Goreham, W. F. Cement; Apparatus for Separating Finer Particles of — (P)	1115	Fluorescein; Sensitiveness of —, to Light, its Substitution Derivatives and Leuco Bases	1104
Gorjaninoff, A. Decanting or Settling Apparatus (P)	344	Grossmann. Vanadium; Discussion on —	1188
Gosswiler, K. Acetylene Gas Generator (P)	1102	Grossmann, J. Address to Manchester Section	1078
Vaporising Apparatus (P)	1100	Arsenic; Discussion on Detection of —	206
Gostling, J. C., Fraser, J. H., and Booth, R. Cement; Manufacture of — (P)	125	Arsenic; Discussion on Need of Standard Test for —	332
Gottstein, L. Paper Materials from Wood, and the Waste Waters from their Manufacture	495	Patent Law; Discussion on —	15, 16
Gould, R. H. Tin; Recovery of —, and Generation of Electric Energy (P)	817	Patents; Novelty in —, according to German Patent Law	1079
Goutal. See Carnot	583	Grünberg, A. Stone; Production of Artificial —, and Apparatus therefor (P)	365
Grabill, C. A. Bismuth; Determination of —	1144	Grüneisen, E. See Holborn, L.	988
Græbe, C. Chlorine; Preparation of —	473	Grüss, J. Yeast; Oxidising Enzyme of —	824
Phosphorus Trichloride; Preparation of —	473	Yeast; Oxydase Reactions of —	919
And Aders, R. H. Euxanthone and Alizarin; Methylation of —	1204	Grunauer, G. Cast Iron; Treating —, for Obtainment of an Alloy (P)	908
Græler, K. P. See Möhlan, R.	1203	Grunmach, L. Mercury; Alteration in Volume on Melting, and Thermal Expansion when Solid	1253
Græve, S. von and Reinecken, A. Fats or Fatty Acids; Manufacture of Oxidising Agents from —	261	Gürber, A. Milk; Production of Condensed — (P)	58
Graham, E. L. Minerals or Ores; Disintegration of — (P)	1221	Guerbet, M. Alcohol, Cænanthylie; Action of —, upon its Sodium Derivative	383
Graham, J. Bacteria Beds; Apparatus for Automatically Emptying — (P)	381	Alcohols; Synthesis of —	292
Graham, W. Pumpkin-Seed Oil	1003	Güssow, G. E. Stone Building Blocks; Manufacture of — (P)	125
Grandage, H. Textile Materials; Apparatus for Testing — (P)	709	Gueugnon, F. See Roussy de Sales	726
Granger, A. Mercury Iodo-antimonide	757	Guggenheim, B. See Kehrman, F.	706
Granja, R. Tinfoil and Bottle Caps Manufacture	1191	Guichard, M. Molybdenum and its Oxides; Action of Water Vapour on —	161
Graunag, A. Gases; Filling Vessels with Liquefied —, and Apparatus therefor (P)	1018	Guigues. Quinine Arsenate	499
Gray, G. Watson. Calcium in High-Grade Ferro-Silicon; Determination of —	538	Guilbert, M. L. A. Soap; Manufacture of Resinous — (P)	818
Calcium in High-Grade Ferro-Silicon; Presence of —	1027	Guillet, L. Alloys; Aluminium-Molybdenum —	814
Ferro-Silicon; Analysis of High-Grade —	1027	Alloys of Aluminium and Copper	1217
Gray, T. Proceedings of Annual Meeting	677	Alloys of Aluminium and Molybdenum	902
Green, A. G. Sulphur Colours; Employment of New —, in Dyeing and Printing	576	Alloys of Aluminium and Tungsten	723
And others. Calico Printing, with Sulphide Colours	713	Electro-Chemical Industry in France	48
And others. Colouring Matters; Intermediate Products for Production of — (P)	118	Guilliermond, A. Yeasts; Sporulation of —	734
And others. Dyeing Black, with Sulphide Colours (P)	713	Guimaraes, J. F. Lighting Apparatus for Instantaneous Photography (P)	237
Green, G. Water; Apparatus for Filtering and Purifying — (P)	272	Guissani, T. Wood; Preservation of — (P)	991
Green, L. M. Cyanide Solutions containing Zinc; Testing	1144	Gulden, P. Extraction; Method of — (P)	38
Greenway, A. G. Iron or Steel in Molten State; Purification of —, and Apparatus therefor (P)	908	Gullet, L. Chemical Industry in France	517
Greenwood, J. Alkaline Salts; Decomposition of —, and Electrolytic Apparatus therefor (P)	1220	Gulli, S. Bergamot Oil; New Adulterant of —, and its Detection	1017
And J., jun. Fuel; Manufacture of — (P)	975	Gumprecht, C. See Häckel, W.	141
Greiner, K. Poisonous Boraginaceæ	65	Gunkel, F. See Michaelis, A.	502
Greiner. Vacuum Pans; Construction of —	1125	Guntrum, J. B. See Selg, O.	1012
Greiner, A. Blast-Furnace Gases; Dust in —	721	Gustafsson, K. G. Acetylene Gas; Apparatus for Generating — (P)	236
Greiner Art Co. Photographic Fabrics, and Production thereof (P)	1020	Gustavson, G. Aluminium Chloride, Bromide, and Iodide; Preparation of —	383
Greshoff, M., and Sack, J. Waxes; Characteristics of —	817	Gutbier, A. Tellurium; Gravimetric Method for Determining —	1145
Greville, H. Leicester. Sulphuretted Hydrogen in Cool-Gas; Determination of —	73	Gutensohn, A. Picric Acid; Production of — (P)	837
Griebel, O. See Vanino, L.	1243	And Price, H. H. Sulphide Ores; Eliminating Sulphur from — (P)	723
Grieder, G. Catechu; Substitutes for —, and their Application	246	Guthrie, A. Lime; Solubility of —, in Water at Different Temperatures	223
Griffin, J. J., and Sons, and Ibbetson, F. H. Photographic Chemicals; Receptacles for Holding — (P)	932	Guttmann, O. Borax and Nitrates; Discussion on Manufacture of —	325
		Condensing Apparatus (P)	987
		"Heat Test" for Explosives; Discussion on the —	11
		Smokeless Powder; Machinery for Manufacture of —	834
		Sulphuric Acid and Nitric Acid; Early Manufacture of —	5
		Guy, B. A. Air and Vapour of Volatile Liquids; Apparatus for Producing Constant Mixture of — (P)	976
		Guyot, A. See Haller, A.	465, 465, 799
		Gwynne, J., and Sargeant, E. W. Slimes; Means for Aerating — (P)	368



	PAGE		PAGE
H			
H., L. Amylomyces; Investigations on Certain	377	Hargreaves, A. F. <i>See</i> Curtis, C. H.	1240
Haagen, A. Colouring Matters; Manufacture of — (P)	729	Hargreaves, J. Iron Oxides and Metallic Chlorides; Manu- facture of —, (P)	364
Haarmann and Reimer. Ionone from Cyclo-Citral; Prepara- tion of — (P)	150	Metallic Chlorides and Oxides; Obtaining and Treating — (P)	808
And Reimer. Ionone; Preparation of — (P)	1018	Harloff. Sugar-Cane Factory; Carbonating in the	487
And Reimer. Iso-Ironone; Isolation of —, from Costus Root Oil (P)	745	Harper, W. A. <i>See</i> Woodcock, W. H.	363
Haas, M. Electrolytic Apparatus (P)	1120	Harrises, C. Carvone; Auto-oxidation of — Formaldehyde; Preparation of —	929
Haase, F. W. and C., and Broeckmann, L. Tobacco; Freeing —, from Nicotine (P)	78	India-Rubber; Behaviour of —, towards Nitrous Acid And Schauwecker, O. Citronellal; Constitution of —	604 1123
Haber, F. Ferrite Solutions; Experiments on —	906	Harris, A. Condensed Steam and Other Waters; Purification of — (P)	1094
Indigo; Electrolytic Reduction of —	1103	Water; Apparatus for Softening or Purifying — (P) ..	925
Habermann, R. Ammonia Ice Machines; Connection between Temperature and Quantity of Ammonia Injected	459	Harrison, R. Combustible Gases from Peat, &c.; Production of —, and Apparatus therefor (P)	697
Hackathorn, C. F. <i>See</i> Worstall, E. A.	263	Hart, E. Albuminoids; Determination of Decomposition Products of —	1149
Hackl, H. <i>See</i> Roesler, F. A.	39	Hartel, A. E. Hydrocarbon Vapour Burners (P)	32
Haddon, A. Hydrocyanic Acid; Action of — on Finely- Divided Silver	981	Hartleb, R. Bacteroids; Producing Cultures of —, and Inocu- lating Seeds and Soils with Micro-Organisms (P)	374
Hadfield, H. Bleaching Textiles; and Apparatus therefor (P) ..	246	Hartley, C. Yarn; Apparatus for Dyeing and Treating — (P)	1103, 1109
Häckel, W., Heinrich, A., and Gumprich, C. Paste; Liquid — (P)	141	Hartley, W. N. and Ramage, H. Basic Bessemer Blow; Spectra of Flames during —	933
Haën, E. de. Hydrochloric Acid; Manufacture of Chemically Pure — (P)	474	And Ramage, H. Dust and Soot; Mineral Constituents of —	513
Hydrochloric Acid; Preparation of Chemically Pure — ..	123	Hartmann, R. Chromium Oxide in Chrome Mordants; Volum- etric Determination of —	954
Haensel, H. Cassia Fistula; Volatile Oil of —	586	Hartwell, B. L. <i>See</i> Wheeler, H. J.	753
Eucalyptus Oil; Terpenecless	1236	Hartwell, J. B. <i>See</i> Browning, P. E.	156
Olive-Leaf Oil	1228	Harvey, T. F. Ethyl Nitrite Solutions; Causes of Instability in —	742
Rhamnus Purshianus; Essential Oil of —	1234	Harz, C. O. and Miller, H. von. Metals; Coating or Over- laying with — (P)	587
Häntzschel. Alloys of Nickel, Copper, and Aluminium	1217	Haslam, C. H. Hexone Bases in Heteroalbumose and Peptone; Determination of —	494
Haerle, F. Paper; Metallised — (P)	741	Hasse, R. <i>See</i> Windisch, W.	1129
Häussermann, C. Amines; Tertiary Aromatic —	356	Hasselmann, F. Fuel from Moor Earth and Moor Moss (P) ..	793
Hafner, B., and Kreissl, W. Creosote; Determination of — ..	1251	Hasslacher, F. Stretching Apparatus for Use in Mercerising (P)	359
Haga, T. <i>See</i> Divers, E.	757	Hatsohek, M. P. Yeast; Manufacture of Bakers' — (P) ..	144
Hahlo, C. <i>See</i> Ruttenau, W.	713	Hatt, W. K. Slag Cement	1212
Hahn, M. Sap of Arum Maculatum; Chemical Changes in the Cell Free	375	Hauberisser, G. Photographic Chrome Pictures; Intensifying —	1239
Hahn, P. Textile Fabrics; Drying Moist — (P)	463	Haucke, H. Paper for Photographic Copying of Line Draw- ings (P)	1140
Hahn, P. D., and Lenz, O. Sewage and Effluents; Deodorising and Clarifying — (P)	1013	Haughton, T. W. <i>See</i> Lishman, W. W. W. L.	892
Hall, C. M. Alumina from Bauxite; Obtainment of Pure — (P)	808	Hauser, O. <i>See</i> Vanino, L.	383
Alumina; Manufacture of — (P)	808	Hauslich, S. H. Air; Apparatus for Carburetting — (P) ..	462
Hall, S. Arsenic; Discussion on Occurrence and Detection of —	190	Hausser. <i>See</i> Cathelineau	502
Proceedings of Annual Meeting	662	Hawley, C. G. <i>See</i> Schutz, J. M.	1012
Hall, W. A. Casein Glue; Composition of — (P)	597	Hay, J. S. Steel; Manufacture of —, and Tools therefrom (P)	129
Halla, A. <i>See</i> Dafert, F. W.	914	Hayes, A. Gas and Vapour Burners (P)	1198
Hallensleben, O. Yarn; Apparatus for Printing and Treating — (P)	892	Haywood, J. K. London Purple; Composition and Analysis of —	157
Haller, A., and Guyot, A. Dimethylaminobenzoylbenzoic Acid; New Derivatives of —	465	Hazlehurst, S. F. Gold Ores; Sampling and Milling of — at Cripple Creek, Colorado	44
Dyestuff derived from Diphenylenphenylmethane	799	Heathcote, H. L. Iron; Passivity of —	1116
Tetramethyldiaminophenyl-Anthranol, and -Oxanthranol; Formation and Properties of —	465	Heberlein, M. <i>See</i> Kahn, A.	1039
And Umbgrove, H. Dialkylaminobenzoylbenzoic Acids; New Derivatives of —	980	Hébert, A. Fatty Acids; Action of Zinc Dust on —	513
And Umbgrove, H. Tetrachlorodialkylamino- <i>m</i> -oxybenz- oylbenzoic Acids; New Derivatives of —	980	Hecking, M. Mixing and Drying Apparatus (P)	344
Halphen, G. Oils; Detection of Drying and Marine Animal —	1244	Hefelmann, R. Gum Arabic; Amount of Pentosans in — ..	822
Halse, E. Electro-silvered versus Plain Copper —	259	Heffter, A. Cactus Alkaloids	1134
Hamet, H. Caoutchouc; Apparatus for Vulcanising Articles of — (P)	486	Hehner, O. Arsenic; Detection of —	280
Hamilton, A. O. Scale from Boilers; Composition for Removing — (P)	878	Arsenic; Discussion on Occurrence and Detection of — 188, 193, 197, 198, 199	188, 193, 197, 198, 199
Hamilton, L. P., and Smith, E. F. Alloys made in the Electric Furnace	589	Basic Superphosphate; Discussion on —	331
Hands, H. Potassium Permanganate as a Photographic Red- ucer.	153	Bunsen's Work; Correction of Remarks on —	193
Hansen, E. C. Saccharomyces; Variations of the —	377	"Heat Test" for Explosives; Discussion on the	12
Hansen, H. J. T. <i>See</i> Sabro, T. T.	1194	Marsh Test; Discussion on Effect of Selenium and Tel- lurium on —	394
Hanson, W. D. Arsenic; Discussion on Presence of — in Beer	208	Oxygen Dissolved in Water; Discussion on Determination of —	1075
Hantko. Beer; Nature of the Carbonic Acid in —	143	Stannous Sulphide; Discussion on Action of Caustic Potash and Soda on —	426
Hanus, J. Fats and Oils; Use of Iodine Monobromide in Analysis of —	1246	Tanning Materials; Discussion on Leather-Forming Value of Different —	434
Haravodine, V. Crystalline Bodies containing Water; Solidi- fication of — (P)	382	Varnish; Discussion on Manufacture of —	1077
Harden, A. Carbohydrates; Chem. Action of Bacillus Coli Communis on —	492	Heidel, G. Batteries; Electric — (P)	907
And Rowland S. Yeast; Autofermentation and Lique- faction of Pressed —	1223	Heidemann, H., and Axdorfer, G. Gas-Burners for Heating Purposes (P)	883
Hardy, W. E. Arsenic; Discussion on Presence of —, in Beer	208	Heidenreich, O. N. Copper in Pyrites; Determination of — ..	283
		Heidenstam, W. A. G. von. Wood and Peat; Charring —, and Apparatus therefor (P)	112
		Heine and Co. Perfume; Preparation of —, by means of "Jasmine"	745
		Sandal-wood Oil; Extraction of Alcoholic Constituents of — (P)	1017
		Santalol; Preparation of — (P)	150

	PAGE
Heine, G. Peat: Treatment of —, and Apparatus therefor (P).....	1099
Heinemann, W. Coke-kiln Gases; Recovering By-Products from — (P).....	564
Heinrich, A. See Häckel, W.	141
Heinrigs, J. See Beny, F. A.	810
Heintz, R. Guttmann's Filling Material for Reaction and Absorption Towers.....	362
Heinz, R. Barium Monoxide and Dioxide; Manufacture of —.....	474
Heinze, M. See Möhlau, R.	570
Heinzelmann, G. Alcohol in Distilleries during 1900; Causes of poor Attenuations and Deficient Yields of —.....	142
Alcohol in Spent Distillery Wash.....	491
Fermentation Vats; Tar Coating for —.....	56
Helbing, E. Wood; Production of Artificial — (P).....	991
Helbing, H. B., and Passmore, F. W. Mineral Oils; Solidification of — (P).....	50, 50
Helbronner, A. Camphor; Compound of —, with β -oxy- α -Naphthoic Aldehyde.....	930
Hellriegel, C. Celluloid, Material Resembling; Production of — (P).....	62
Helm, E. Paten's Law; Discussion on —.....	16
Helmer, L. L. See Noyes, W. A.	1143
Hemingway, H. W. Tin; Stripping —, from Tinned Iron, and Recovering the Respective Metals (P).....	368
Hempel, W. Carbon Oxy-sulphide.....	1038
Gases, Calorific Power of; Determination of the —.....	880
Pulverisation of Materials.....	1025
Temperatures; Measurement of High —, by the Spectroscope.....	343
Henderson, G. G. Sugar Refining; Discussion on —.....	1091
And Beilby, G. T. Metals; Action of Ammonia on —, at High Temperatures.....	1212
Henderson, N. M., and others. Paraffin; Purification of — (P).....	978
Hendler, J. J., and Reeves, E. K. Acetylene Gas; Apparatus for Generating and Burning — (P).....	531
Hendrick, J. Whisky Distilleries; Composition and Disposal of Waste Liquids of —.....	450
Hengstenberg, K. Food Products; Preservation and Sterilisation of — (P).....	738
Henke, A. See Seubert, K.	69
Henle, K. See Soden, H. von.....	930
Henneberg, W. Lactic Acid Bacteria of Distillery Mash, &c.	920
Slime Fungus; Yeast-Enclosing Amoebæ of a —.....	491
Henneberg, W. S. See Pape, E. C. H.	587
Hennig, C. T. Alloy, and Method of Making same (P).....	998
Hennings, C. Acetylene Gas; Apparatus for Production of — (P).....	698
Henriot, H. Nitrates in Waters; Determination of —.....	619
Henry, T. A. Sandarac Resins; Constituents of the —.....	1222
See Dumstan, W. R.	929
Hensgen, C. Copper Sulphate; Dissociation of —, under Influence of Water and Temperature.....	943
Hérâus, W. C. Aluminium; Uniting —, to other Metals or Aluminium (P).....	587
Herberlein and Co. Textile Materials; Manufacture of Lustrous — (P).....	710
Herbert, A. See Berliner, A.	141
Herborn, H. Tar Oils; Treating —, for Production of Preservative Oils (P).....	1103
Hérissey, H. See Bourquelot, E.	76, 386
Saccharification of the Carbohydrates of the Horny Albumin of Leguminous Seeds.....	944
Hermite, E., and Cooper, C. F. Thermo-Electric Couples; Manufacture of — (P).....	452
Herter, E. Zinc, Raw, and other Metals; Method and Means for Casting and Refining —, Simultaneously (P).....	724
Herting, O. Cyanic Acid in Commercial Cyanides; Determination of —.....	838
Tungstic Acid; Determination of; and Separation from Silica.....	392
Hertwig, O., and Liebaug, E. Artificial Marble; Manufacture of — (P).....	1212
Herz, W. Zinc; Quantitative Determination of —.....	392
Herzberg, W. "Mechanical" Wood Pulp and Normal Papers.....	739
Herzfeld, A. Molasses Residues; Acids Soluble in Ether from —.....	1127
Molasses Residues; Ether-Soluble Acids of —.....	1225
Sugar, Alkalinity of; Methods of Determining.....	1124
Sugar Beet; Apparatus for Extracting the Cane Sugar from —.....	753
Sugar Commission; Notes on Recent Work of the German —.....	268
Sugars Raw; Alkalinity of —; Determination of —.....	510
Ultramarine for Blueing Sugar.....	1607
Herzfeld, H. Beer Yeast in Pressed Yeast; Detection of —.....	919
Herzig, J., and Pollak, J. Brasilin and Hæmatoxylin.....	700

	PAGE
Herzog, Sugar; Action of Ozone in Manufacture of —.....	54
Herzog, J. See Manchot, O.	841
Heslop, O. See Carey, A.	474
See Conroy, J. T.	320
Hesse, A. Jasmine Flowers; Essential Oil of — V.	275
Jasmine Flowers; Essential Oil of —.....	1137
And Zeitschel, O. Methyl Anthranilate in Essential Oils; Determination of —.....	289
And Zeitschel, O. Orange Flowers; Essential Oil of —.....	1138
Hesse, O. Acetyltropic Acid.....	1135
Hyosaine and Atroscine.....	1233
Lichens and their Characteristic Constituents.....	161
Mandragora Root; Alkaloids of —.....	1135
Hett, P. See Ahrens, C.	909
Heupel, A. Varnishes; Chemical Processes in the Manufacture of —.....	818
Heurtrey, R. M. J. See Fichet, P. A.	1197
Heusner, G. F. See Cook, E. R.	564
Hewitt, J. E., and Coe, C. T. Alloy, and Production thereof (P).....	724
Heycock, C. T., and Neville, F. H. Copper-Tin Alloys; Results of Chilling —.....	814
Heydebrand und der Lasa, F. C. von. Fuel; Artificial — (P).....	793
Heydweiller, A. Reactions; Change of Weight in Chemical and Physical —.....	76
Heyen, A. Meat Extract; Preparation of — (P).....	924
Heyl, G. Alkaloids and Saponins of the Cactaceæ.....	1016
Heyl-Dia, G. E. Electric Cables, &c.; Covering — with Insulating Material (P).....	593
Heyn, C. Metallic Copper and Oxygen.....	723
Heyn, E. See Wahlberg, A.	901
Copper and Oxygen; Fusibility Curve for —.....	996
Zinc; Theory of the Method for Removing Lead from Crude —.....	128
Heyne, P., and Sanchez-Rosal, E. "Practical Dictionary of Electrical Engineering and Chemistry".....	628
Heys, —. Patent Law, Discussion on —.....	16
Heywood, J. Oil; Extraction of —, from Dirty Waste (P).....	50
Hiby, W. See Kehrmann, F.	701
Higgins, C. Longuet. Proceedings of Annual Meeting.....	679
Higgins, H. Wood; Preserving, Desiccating, and Seasoning — (P).....	365
Highfield, J. S. Refuse Destructors and Electric Power Stations.....	1012
Hilger, A. Malic Acid; Determination of —.....	288
Hill, A. C. Maltose; Isolation of —, when mixed with Glucose.....	491
Taka-dia-stase, and Reversed Ferment Action.....	736
Hill, H. Casks and other Vessels; Apparatus for Purifying — (P).....	1230
Mantles for Incandescence Lighting (P).....	699
Hill, H. W. "Tables of Colour and Solubility of Simple Salts".....	162
Hilliard, J. B. Pumping Air or Gases; Apparatus for — (P).....	843
Hiltner, R. S., and Thatcher, R. W. Sugar in Beets; Rapid Determination of —.....	754
Hinchley, J. W. Heating Powdered Iron Salts, and Apparatus therefor (P).....	1222
Hinze, A. Beetroot Juice; Krause's Method for Determining Purity of —.....	843
Hirth, F. Fibrous Material; Drying of —, and Apparatus therefor (P).....	1095
Hirsch, R. Alcohol for the Toilet Soap Industry; Denaturing — Nitrosalicyclic Acid and Nitrosulphonisalicyclic Acid.....	134
65	135
Hitchcock, R. White Lead; Manufacture of —.....	135
Hlavnicka, O. J. Allocinchonine.....	409
Hobson, H. A. Beer; Production of — (P).....	1131
Wort, Concentrated Hopped; Production of — (P).....	144
Hoch, C. Leather; Drying Apparatus for Production of Enamelled (P).....	487
Hochnel. Vaseline; Tests for and Properties of Natural —.....	909
Hoepfner, C. Alkali Salts and By-Products; Manufacture of — (P).....	987
Hofacker, W. Irisamine in Calico Printing; Application of.....	40
Hoff, J. H. van't. Crystallisation from Complex Salt Solutions.....	715
Hoffmann, B. Flour and other Food Material; Medicinal — (P).....	1229
Hoffmann, F. Gas, Compressed; Production of — (P).....	564
Hoffmann, O. Colours upon Threads; Producing Repetitions of Long Suites of — (P).....	121
Hofmann, K. A., and Strauss, E. Lead; Radio-Active —.....	290,
625, 1150	76
And Strauss, E. Radio-Active Lead and Rare Earths.....	76
Korn, A., and Straus, E. Radio-Active Substances; Action of Cathode Rays on —.....	387
Holborn, L., and Day, A. Gold; Melting Point of —.....	365
And Grüneisen, E. Porcelain and Glass; Expansion of —, at High Temperatures.....	988



	PAGE		PAGE
Holde, D., and Stange, M. Cholesterol in Meats-foot Oil.....	484		
Fats; Mixed Glycerides in Natural —	1003		
Holland, J. T., and Laurie, A. P. Porous Diaphragms for Electrolytic Apparatus (P).....	370		
Holland, A. Antimony: Electrolytic Deposition of —	589		
Copper; Analysis of Commercial —	840		
Silver in Sulphide Ores; Determination of —	331		
Holme, H. Peat; Carbonisation of — (P).....	1197		
Peat; Carbonisation of —, and Apparatus therefor (P) ..	793		
Holmes, E. M. Oil of Akee; Notes on —	134		
Holmes, J. See Thorpe, T. E.	758		
Holt, T. See Ellis, S. H.	476		
Holub, B., and Dvoráček, P. Acetylene Gas; Apparatus for Generating — (P).....	351		
Holzer, W., and Fröh, W. F. L. Iron and Steel; Toughening, Hardening, and Annealing of — (P).....	1218		
Homfray, I. See Ramsay, W.	1071		
Hommel, J. Paint; Heat Insulating — (P).....	728		
Honegger, H. Sliver Cans to Permit the Circulation of Dyeing Liquids or Gases (P).....	41		
Honneus Sulphide Co., The. Refractory Ore; Converting —, into Free Milling Ore (P).....	724		
Hooker, W. Burners for Incandescence Gas and Vapour (P).....	699		
Hooper, E. Grant. Stannous Sulphide; Discussion on Action of Caustic Potash and Soda on —	426		
Tanning Materials; Discussion on Leather-forming Value of Different —	435		
Hope, C. H. Textile Fabrics; Colour-Printing of — (P) ...	577		
Hopwood, W. See Breakell, T.	562		
Horrocks, W. See Crompton, W. H.	985		
Horsin-Déon, P. Saccharimeter; A New —	1141		
Sugar; French Manufacture of —	1007		
Horst, P. K. See Orlow, N. A.	511		
Galangal Oil	833		
Horstmann, O. Insulating Materials; Manufacture of — (P).....	907		
Hoult, R. Fire-Extinguishing Substances (P).....	809		
House, J., and Lancaster, E. W. Fermenting Apparatus; Collecting and Using Gases from — (P).....	600		
And Lancaster, E. W. Hops; Drying, Curing, and Sterilising — (P).....	492		
Houston, A. C. See Clowes, F.	494		
Howard, D. Arsenic; Discussion on Occurrence and Detection of —	189		
Marsh Test; Discussion on Effect of Selenium and Tellurium on —	323		
Howell, H. Incandescent Gas - Lighting; High - Pressure Accumulator for — (P).....	977		
Hoz, A. Colours for Chemical Printing (P).....	985		
Hroinadnik, C. Liquids or Materials therein; Apparatus for Treating — (P).....	233		
Liquids; Vessels for Mixing, Dissolving, &c. — (P).....	233		
Hrun. See Amundsen	148		
Huber, H. von. Alkali; Titration of Free —	283		
Hudnall, M. S., and Calvert, H. Lubricant, and Manufacture thereof (P).....	910		
Hudson, E. J. See Mabery, C. F.	568		
Hünemann and Deiter. Drinking Water; Sterilisation of —	823		
Hughes, J. Basic Superphosphate; Preparation and Use of Superphosphate; Converting Acid —, into Alkaline or Basic (P).....	267		
Huldchinsky, E. See Rosenheim, A.	840		
Hulme, F. A. Soap; Manufacture of Soft — (P).....	1005		
Soft Soap; Manufacture of — (P).....	910		
Humphrey, C. Producer Gas Burners for Boilers (P).....	119		
Washers for Producer or other Gases (P).....	1198		
Humphrey, H. A. Mond Gas, and its Application to Gas Engines.....	107		
Humphrey, J. See White, E.	1152		
Humphrys, Norton H. "The Chemistry of Illuminating Gas".....	1034		
Hunger, F. W. T. Oxydase and Peroxydase Reaction	1030		
Hungerford, O. T. Insulation of Electrical Conductors, &c. (P).....	729		
Hunt, E. W. See Jackson, C. L.	120		
Hurst, G. H. "Dictionary of Chemicals and Raw Products Used in the Preparation of Paints, Colours, Varnishes, &c.".....	397		
Hurter, C. S. Slimes; Agitation Process for Cyaniding —	253		
Huson, T. Chimney Chemical Cleaners (P).....	30		
Hussong, J. Yarn Dyeing Machines (P).....	247		
Hutchinson, R. H. Fibres; Lubricant for — (P).....	242		
Huth, G. Brazing; Flux for — (P).....	369		
Huth, P. Brown Coal Tar; Use of Superheated Steam in Distilling	885		
Oils and Fats; Treatment of —, to Improve their Taste.	371		
Fyatt, W. H. Aluminium or its Alloys; Improvement of — (P).....	724		
Hyndman, F. A., and Banyard, W. B. Pigments; Manufacture of — (P).....	591		
Ibbetson, F. H. See Griffin, J. J., and Sons	932		
Idris, T. H. W. "Notes on Essential Oils".....	1151		
Ihle, G. Bunsen Burners for Incandescence Lighting (P) ...	1189		
Immerwahr, C. See Abegg, R.	277		
Incandescent Gas Light Co. Incandescent Gas-Lighting; Apparatus for — (P).....	463		
Indemaus, W. G. Coconut Oil in Butter and Margarine	493		
Ingalls, W. R. Magnetic Separation; The Wetherill Process of —	478		
International Acheson Graphite Co. Electrodes; Graphitising — (P).....	258		
Graphite; Manufacture of — (P).....	492		
International Chemical Co. Alkaline-Earth Silicides; Manufacture of — (P).....	43		
Silicon and Hydrogen; Combination of — (P).....	43		
International Smokeless Powder and Dynamite Co. Gunpowder; Manufacture of Smokeless, and Apparatus therefor (P).....	383		
Ipatiew, W. Methylheptenone; New Synthesis of —	604		
Organic Compounds; Pyrogenetic Contact Reactions of —	1200		
Irminger. Fir Wood; Dry Distillation of —	111		
Irvine, H. A. Ores and Compounds; Electrolytic Reduction of — (P).....	908		
Irwin, W. Sulphur in Benzol; Test for —, for Use in Gasworks.....	440		
Issaew, W. Invertase; Preparation of Active Solutions of —	269		
Itallie, L. van. See Tschirch, A.	1122, 1136, 1136		
Ives, F. E. Trichromatic Photography; Optics of —	63		
Ivison, F. Wines and Spirits; Rapidly Ageing —, and Apparatus therefor (P).....	923		
J			
Jackson, C. L. Kiers for Treating Textiles, &c. (P).....	712		
And Hunt, E. W. Piece Goods; Scouring, Dyeing, &c. — (P).....	120		
Jackson, P. G. See Archbutt, L.	448		
Jackson, R. See Firth, A.	697		
Jackson, W., and Rich, E. M. Glass; Constitution of —	555		
Pottery Glazes; Solubility of Lead Glasses or Frits used in Preparation of —	43		
Jacobsen, E. "Chemisch-Technisches Repertorium" 162, 514, 946, 1256			
Jacquemin, G. Bottom Yeasts Fermenting at High Temperature; Preparation of —	825		
Yeasts; Preparation of Bottom Brewery —	918		
Jaeger, C. See Thiele, J.	1105		
Jaeger, W. "Die Normalelemente und ihre Anwendung in der Elektrischen Messtechnik".....	1255		
Weston Cadmium Cell; Irregularities of —	939		
Jahoda, R. See Strache, H.	791		
James, A. Gold and Silver; Apparatus for Precipitating — (P).....	129		
Jamieson, G. S. Cæsium Bismuth Nitrate	1014		
Janitzky, E. Gold; Extraction of —, by Sodium Hyposulphite.....	901		
Ores for Cyaniding; Advantages of Roasting —	901		
Jasset, J. E., and Cinqualbre, A. E. Nickel and other Metals; Depositing —, upon Metallic Surfaces (P).....	369		
Jaubert, G. F. Alkaline Earth Dioxides; Manufacture of — (P).....	474		
Aniline; New Synthesis of —	464		
Hydrates of the Peroxides of Lime, Baryta, Magnesia; Manufacture of — (P).....	42		
Oxygen Gas; Preparation of — (P).....	931		
Sodium Peroxide and other Salts; Preparation of Compressed — (P).....	43		
Sodium Peroxide Hydrates; Preparation and Properties of —	273		
Sodium Peroxide; Properties of —	273		
Javal, E. A. Acetylene Gas; Apparatus for Generating — (P).....	51		
Jean, F. Sulphur in Oils; Determination of —	1147		
Sunflower Oil	908		
Tanning Liquors and Extracts; Tannin and Acids in —			
Determination of	159		
Tanning; Micro organisms and Antiseptics in —	265		
Tanning; Use of Sulphite-pulp Waste Liquors in — (P).....	1007		
Jeancard, P., and Satie, C. Essential Oils; Surface Tension and Viscosity of —	607		
Geranium; Essence of Cannes —	607		
Thyme; Essences of —	1237		



	PAGE
Jebson, P. Peat; Treatment of — (P)	1197
Jelinek, J. See Votocek, E.	1106
Jenks, R. L. See Cross, C. F.	1133
See Smith, R. F. Wood	437
Jennings, E. P. Copper Ores; Leaching —, with Sulphurous Acid	479
Jennings, W. E. A. Gas; Governor and Enricher of — (P) ..	699
Jensen, J. Eggs; Preservation of — (P)	738
Jenter, G. C. See Jordan, W. H.	732
Jerdan, D. S. See Bone, W. A.	696, 696
Jerwitz, W. Fat-Extraction Apparatus	618
Jettmar, J. "Fat Liquor"; Preparation and Uses of —	373
Jewell Export Filter Co. Water Purification; Production of Reagents for (P)	61
Jex, R. Cements; Studies in —	364
Job, A. Ampere Manometer and its Applications	257
Job, R., and Davies, C. T. Steel, Carbon; Rapid Determination of —	156
Jochum, P. Lime and Cement Kilns; Quartz Shale versus Firebrick as Material for —	1212
Joé, J. Palladium Toning	154
Jørgensen, E. Fire-kindling Substances (P)	30
Johanssen, A. Cement Substance for Shipbuilding (P)	582
Johnson and Sons. Gold Sodium-Chloride; Assay of —	210
Johnson, A. C. Sulphuric Acid; Production of — (P)	250
Johnson, C. J. Gas; Apparatus for Manufacture of — (P) ..	699
Johnson, C. M. Disease Germs; Means for Destroying — (P) ..	60
Johnson, E. See Petolite Fuel Syndicate	563
Johnson, W. M. Mercury; Electrolytic Purification of — ..	1062
Johnston, J. P. Gas; Apparatus for Manufacture of — (P) ..	693
Johnstone, J. J. Boilers; Composition for Preventing or Removing Scale in — (P)	233
Johnstorff, H. J. von. Iron and Steel from Point of View of the Phase Doctrine	721
Jollyman, W. H. See Pakes, W. C. C.	292
Joly, C. Liquid Air and other Gases; Preservation of — (P) ..	695
Joly, C., and Richardson, E. J. Air and other Aeriform Fluids; Liquefaction of — (P)	1095
Jones, A. L. Transport of Chemicals; Discussion on —	424
Jones, E. W. T. Arsenic in Beer; Detection and Determination of	251
Jones, G. Cecil. Gasworks; A Danger Incidental to Gas-Firing in Small —	535
Jones, H. E. Gas; Modern Practice in Manufacture and Distribution of —	1196
Jongh, F. L. de. Syrups and Masecutes; Purity of —	468
Jordan, W. H., and Jenter, G. C. Soda; Substitution of —, for Potash in Plant Growth	732
Jordis, E. Cuprous Oxide-Alkali-Zinc Batteries; Treatment of —	258
Jorissen, A. Apitol; Detection of —	285
Cinnamic Acid in Presence of Benzoic Acid; Detection of —	285
Joselin, P. H. See Crichton, J.	371
And Crichton, J. Blown Oil; Obtainment of — (P) ..	435
Joseph, L. Waterproof Paper, &c.; Manufacture of — (P) ..	1231
Joshua Bros., Proprietary. Maturing of Spirituous Liquors; Accelerating the — (P)	737
Jouet, C. H. Vanadium in Slags and Cinders; Determination of —	620
Jouniaux. Silver Chloride; Action of Solar Radiation on —, in presence of Hydrogen	834
Silver Chloride; Reduction of —, by Hydrogen	814
Jousser, A. Red Lead; Determination of Foreign Impurities in —	1144
Jouve, A. Iron Silicides	479
Selenium in Sulphuric Acid; Detection of —	619
Jürgensen and Bauschlicher. Wood Charcoal; Manufacture of —, by the von Heidenstam Process	977
Jungfleisch, B., and Léger, E. Cinchonine	1232
Cinchonine; Hydrocinchonine in —	499
Hydrocinchonine	384, 499
Jungfleisch, M. E. Sulphur Industry in Sicily	714
Jungner, E. W. Accumulator Electrode; Negative — (P) ..	482
Junk, H. J. Sensitive Linen and other Fabrics; Preparation of —	154
Jurie, P. Furnaces; Electric Crucible — (P)	697
Just, A. Disinfectant Pocket Handkerchief (P)	739
And Falk, R. Incandescence Bodies for Electric Lamps (P) ..	1199
Just, J. A. Mineral Oil Distillates; Solidification of — (P) ..	484
Rennet Ferment; Preparation of — (P)	69

	PAGE
K	
Kändler, R. Explosive Resembling Dynamite; Manufacture of a Safety — (P)	1240
Primer for Producing Ignition by Electricity (P)	1140
Kahlbaum. Metals; Distilled —	1213
Kahn, A., and Heberlein, M. Fuel; Artificial — (P)	1099
Kajmar. Barley; Treatment of —, with Lime in Steeping Water	141
Kalle and Co. Bismuth-Albuminoid Compounds; Preparation of — (P)	383
Colouring Matters, Brown Substantive; Manufacture of — (P)	467
Discharge Effects on Dyed Goods; Production of — (P) ..	985
Printing of Indigo and other Colouring Matters (P)	577
Kamps, H. Iron; Films of Oxide on Sheet —	478
Steel; Magnetic Properties of Hardened —	254
Kapferer, C. A. See Terranova Industrie	1222
Kapff, S. Lubricating Oils; Friction of —, at High Temperatures	1100
Karfunkelstein, C. Carburettling Apparatus (P)	351
Karsten, W. Incandescence Mantles; Manufacture of — (P) ..	1094
Kasper, M. Gases; Apparatus for Purifying — (P)	1084
Liquids; Apparatus for Cooling or Aerating — (P) ..	497
Kassner, G. Leprarin-Chloroform; Characteristics of — ..	1112
And Keller, H. Manganic Acid and Barium Manganates ..	608
Kastner, E. Metal Developer; Limit of Dilution of —	813
Katzer, F. Gold Deposit in Bosnia; Composition of Alluvial — ..	999
Kaufmann, A. Iron Cathode; Action of —, in Ammonium Nitrate Solution	987
Kaufmann, I. Concentration of Heavy Lyes and other Liquids (P)	250
Crystallisation; Rapid Process of — (P)	123
Salts; Crystallisation of — (P)	463
Kautny, T., and Lotz, E. W. Acetylene Gas; Apparatus for Generating — (P)	922
Kayser, E., and Barba, G. Wines; Acidity of —	983
Kayser, E. C. Dyeing with some New Insoluble Azo-Dye-stuffs.	756
Kebler, L. F. Sandal-Wood, Lavender, and Thyme Oils; Examination of —	727
Walnut Oil from Juglans Nigra, L.	694
Keevil, W. F. See Askham, P. U.	799
Kehrmann, F. Azoxonium Compounds	115
And Denk, A. Isorosindulines and 5-Acetamino- β -Naphthoquinone	705
And Eichler, J. Flavindulines; Nitro- and Amido- — ..	706
And Guggenheim, B. Fluorindines;	701
And Hiby, W. Azonium Dyestuffs; Chloro Derivatives of —, Part I.	703
And Krazler, S. Azonium Dyestuffs; Chloro Derivatives of —, Part III.	706
And Misslin, E. Isorosinduline No. 8 and Derivatives of Trinitro- α -Naphthol OH; NO ₂ , NO ₂ = 1, 2, 4, 1' ..	1201
And Müller, H. Azonium Dyestuffs; Chloro Derivatives of —, Part II.	1201
And Nüesch, P. Rosinduline No. 15	116
And Ott, E. Rosinduline No. 14	116
And Schaposchnikoff, W. Dyestuffs; Thionine —	116
And Silberstein, M. Rosinduline No. 13	1104
And Steiner, G. Diphenylamine; Two New Nitro-amino Derivatives of —	115
And Steiner, G. Isorosinduline No. 9; Constitution of — ..	115
And Steiner, G. Isorosinduline; Twelfth Isomeride of — ..	879
Keller, C. A. Electric Furnace with Two Bed Plates (P)	1112
Keller, H. See Kassner, G.	48
Keller, M. Electric Furnace; Development of the —	367
Kellner, C. Zinc; Extraction of —, from Waste Products (P) ..	61
Kelsey, D. McClellan. Disinfectant Compound (P)	267
Kelsey, L. L. Glue, and Products therefrom; Manufacture of — (P)	916
Kelvin, Lord, and others. Report on Arsenical Poisoning ..	1198
Kemp, C. M., and Denny, G. H. Bunsen Burners (P)	731
Kennedy, J. E. Leather and other Fabrics; Testing — for Porosity (P)	260
Kent, H. A. Electrodes; Electrolytic —, and Electrical Resistances (P)	932
Kent, W. Gunpowders; Smokeless — (P)	938
Keppeler, G. See Eitner, P.	1144
Kern, E. F. Uranium; Quantitative Separation and Determination of —	878
Kershaw, H. B. Heating, Cooking, and Evaporating Apparatus (P)	878



	PAGE		PAGE
Kershaw, J. B. C. Acker Cell and Process for Electrolytic Production of Alkali and Chlorine (P).....	1219	Kochs, J. Tea; Theine in —.....	58
Alkali Process; The Outhenin-Chalandre Electrolytic —.....	473	Köhler, Alkalinity; Indicators for —.....	1147
Aluminium and other Metals; Durability of —, under Atmospheric Exposure.....	133	Sugars; Alterability of Stored Raw —.....	1147
Aluminium as an Electrical Conductor.....	133	König, A. See Fränkel, S.....	277
Calcium Carbide; Manufacture of —.....	103	König, E. Jute Fibres and Fabrics; Softening — (P).....	893
Electro-Chemical and Electro-Metallurgical Industries of the World.....	401	König, J. See Skraup, Z. H.....	740
Kessler, J. L. Plaster and other Porous Substances; Hardening — (P).....	719	Koenigs, W., and Knorr, E. Glucose and Galactose; New Derivatives of —.....	626
Sulphuric Acid; Apparatus for Concentration of — (P).....	807	Koerner, T. Tanning Materials; Determination of Tanning Matter in —.....	286
Keto, E. Copaiba Balsams; Resins of —.....	1238	Körting, J. Water-Gas; Comparison of — with other Combustible Gases.....	879
Kettel, B. A. van. Alkaloids in Cinchona Bark; Determination of —.....	511	Kohl, G. Incandescence Bodies, and Manufacture thereof (P).....	699
Keyes, F. E. Wood-Pulp, Fireproof; Manufacture of — (P).....	62	Kohlschütter, V. Uranium Red.....	262
Kidder, W. P. Vapour-Burners for Steam Generators (P).....	975	Köhner, E. Anthranilic Acid; Action of Formaldehyde and Nascent Hydrocyanic Acid on —.....	801
Kiefer, L. See Fischer, F.....	1094	Kolb, A. Hydrogen Peroxide; Reduction of Mercury Salts by —.....	148
Kieny, A. L. Acetylene Gas; Apparatus for Generating — (P).....	31	Kolitsch, W. Oak-wood; Staining — by Means of Ammonia (P).....	893
Kiliandjef, Z. Bulgarian Brandy; Examination of —.....	1010	Kollerich, L. von. See Szirmay, I.....	1003
Killiani, H. Digitalinum germanicum; Obtaining all the Valuable Constituents of —.....	1234	Kollock, L. G., and Smith, E. F. Molybdenum; Electrolytic Determination of —.....	1145
And Mayer, O. Luteolin and Digitoflavone; Identity of —.....	1202	And Smith, E. F. Uranium; Electrolytic Determination of —.....	1029
Killon, H. B. Sewage; Apparatus for Discharging — on and Withdrawing from Filter Beds (P).....	61	Kolltrepp, A. See Wohl, A.....	376
Kingdon, Z. H. See Siemens Bros. and Co.....	789	Kolwitz, E. Algae; Soluble Colouring Matter of Blue-Green.....	77
Kingscote, T. H. See Fox, W.....	344	Kondakow, J., and Bachtshiew, N. Bucco Leaves; Essential Oil of —.....	398
Kippenberger, C. Alkaloids; Use of Tannin in Purifying Residues containing —.....	74	Koninck, L. L. de. Nitrites; Determination and Separation of —.....	456
Strychnine and Brucine; Action of Bromine on —.....	64	Kopp, O., and Usueli, E. Cotton Yarn; Stretching and Mercerising — (P).....	469
Kipping, F. Stanley. Arsenic in Coke; Discussion on Determination of —.....	450	Koppelman, E. Filtering Media; Cleaning and Treating (P).....	827
Gas Liquor Valuation; Discussion on —.....	23, 25	Koppers, H. Coke-Ovens (P).....	882
Kirkby, W. Arsenic; Apparatus for Applying Gutzeit's Test for —.....	281	Coke-Ovens; Heating of Bye-Product Saving — (P).....	882
Arsenic in Beer; Detection of (P).....	153	Coke-Ovens Workable With or Without Saving Bye-Products (P).....	882
Kirkham, Hulett, and Chandler. See Chandler, S., jun.....	30	Gas Liquors; Treatment of — (P).....	579
Kirkpatrick, J. J. See Lishman, W. W. L.....	892	Korn, A. See Hofmann, K. A.....	387
Kirkpatrick Picard, H. F. Cyanogen; Haloid Compounds of —; Manufacture of (P).....	717	Kornfeld, A., and Zirner, J. H. Moths; Means for Exterminating — (P).....	123
Sulphide Ores; Treatment of Complex — (P).....	130	Kornfeld, F. Alizarin Dyeing Processes (P).....	93
Zinc; Treating Slags and By-Products containing — (P).....	1219	Korsowsky, I. Composition for Protecting Iron (P).....	532
Kirschner, A. G. See Fog, S. L.....	1024	Kosell, A. Proteids or Albuminoids; The Chemistry of — And Kutscher, F. Proteids; Composition of the —.....	1228 270
Kissling, R. Glue; Apparatus for Testing —.....	509	Kostanecki, St. V. Luteolin; Synthesis of —.....	354
Paraffin Wax; Melting Point of Crude and Commercial —; Determination of.....	795	And others. Luteolin; Synthesis of —.....	116
Kistiakowsky, W. Hydrogen Peroxide in Aqueous Solution; Sensitiveness to Light of —, when Prussiates are Added.....	387	And Steuermann, J. 1, 3, 3'-Trioxylflavone.....	355
Kitson, A. Oil-vaporising Apparatus (P).....	1100	Kovács, E. See Székely, S.....	380
Vapour-burning Apparatus (P).....	1198	Kowalski, J. de and Tomarschenko, P. Sugars; Influence of Salts; Rotary Power of —.....	623
Kitt, M. Hübl's Solution; Improving the Stability of —.....	940	Koyl, C. H. Water; Apparatus for Softening and Purifying Water; Purification of — (P).....	925 830
Linseed Oil; Boiled —. Analytical Constants.....	484	Kozai, Y. Saké; Researches on Preparation of —.....	378
Siccative for Oil-Colours in Tubes.....	910	Kraemer, G. and Weissgerber, R. Diphenylene Oxide from Coal Tar and Diphenol therefrom.....	795
Kitto, C. W. and H. H. Pulverising and Separating Apparatus (P).....	1195	Krafft, F. and Wilke, W., Sulphonic Acids; Separation of —, by Distillation in Acid Vacuo.....	113
Klapproth, W. See Ost, H.....	1028	Krajesics, J. See Ekker, M.....	47, 1217, 1217
Klason, P. Molybdenum Blue.....	262	Kramer, H. See Saxl, H.....	374
Klaveness, J. See Tschirch, A.....	743	Krauschwitzer Thonwarenfabrik für Chemische Industrie. Acetic Acid of High Percentage; Production of, and App. therefor (P).....	42
Klein, Iron Ores; Briquetting of Fine-Grained —.....	901	Distilling and Evaporating Apparatus (P).....	460
Klein, O. H., and Peckham S. F. Cement Testing; Notes on —.....	539	Krause, A. Yeast; Increase of Efficiency of Bottom Fermentation —.....	1123
Kleinke, D. F. Hops; Preservation of —.....	1008	Krause, C. and Beddies, A. Wood and Fibrous Substances; Impregnation of — (P).....	365
Klenk, G. Quebracho Extract; Analysis of —.....	841, 1249	Krause, K. Beetroot Juice; Determination of Purity of —.....	813
Klenze, W. von. Butter Fat; Determination of Commercial —.....	396	Krause, M. Peat Fibre; Production of Purified and Bleached — (P).....	602
Kley, P. Indium; Detection of —, Micro-chemically.....	934	Krazier, S. See Kehrman, F.....	703
Kleye, F. F. Coal Industry in Saghalien Island.....	28	Kreissl, W. See Hafner, B.....	1251
Klimont, J. Cacao Butter; Mixed Glycerides in —.....	1121	Krell, G. Sulphuric Acid; Apparatus for Concentrating — (P).....	714
Kling, A. Propyl Glycol; Oxidation of — by Mycoderma Aceti.....	944	Kremann, See Skraup, Z. K.....	513
Klinger, E. Acetylene Gas Generators (P).....	794	Oils containing Carvone; Analysis of —.....	16
Kloth, G. F. W., and others. Batteries; Secondary — (P).....	815	Kremers, E. See Brandel, J. W.....	744, 930
Klumpp, A. Soap; Manufacture of — (P).....	818	Krüber, E. Pentosans; Determination of —.....	396
Knaps, P. Zinc; Determination of — by Iodine Solution.....	935	Krönke, O. Ferruginous Waters; Purification and Rapid Filtration of —.....	59
Knecht, Dr. Arsenic; Discussion on Detection of —.....	207		
Knecht, E. Erica Pink.....	800		
Knez-Milojkovic, D. See Zega, A.....	270		
Kniffen, F. Powder Explosion at Indian Head, Maryland.....	102		
Knöfler, O. Incandescence Bodies for Gas-Lighting (P).....	463		
Knopf, A. B. (né Fuchshuber). Paper-making Materials; Washing of — (P).....	926		
Knorr, E. See Koenigs, W.....	626		
Koch, H. Hydrogen Sulphide Apparatus; Continuous-working —.....	1141		
Kochs, E., and Seyfert, F. Enamels and Silicates; Estimating Fusibility of —.....	189		



	PAGE
Kronstein, A. Chinese Wood Oil and Mixtures; Oxidising — (P)	485
Varnishes and Bodies Resembling Resin and Balsams; Production of — (P)	1123
Waterproofing Materials (P)	460
Krüger, F. Albuminoids; Precipitation of —, by Chloroform	923
Krull, P. Lille Water; Sterilisation of —	331
Water; Abraham and Marmier's Method of Purifying —	271
Kubelka, G. See Danner, S.	884
Kubierschky, K. Mixtures of Inflammable Gases with Air; Explosion of —	345
Kubin, O. F. Acetylene Lamps (P)	791
Kügelgen, F. V. Calcium Carbide; Reducing Power of —	582
Calcium Carbide; Reductions effected by —	126
Kühling, O. Arsenious Acid; Determination of —, by Permanganate	391
Copper Oxide; Reaction of Carbonic Acid and Salts of Alkali Metals on —	1253
Künstner, J. Carbonate of Soda Crystals; Manufacture of — (P)	363
Küster, F. W. Iron and Nickel; Electro-deposition of —, from Solution of the Sulphates	50
Iron and Nickel; Simultaneous Electro-deposition of — (P)	907
Kuettner, B. Secondary Battery Plates; Manufacture of — (P)	1120
Küttner, S. and Ulrich, C. Beer Yeast in Pressed Yeast; Detection of —	919, 1010
Kufferath, A. Indicators; Employments of certain —, with Artificial Light	1142
Kugel, M. Nickel, its Allied Metals and Alloys; Electrolytic Deposition of — (P)	260
Kuhn, R. P. Formaldehyde Generators. (P)	272
Kullak, F. C. Preserving Food; Media for —, (P)	1229
Kunhardt, J. G. L. D. See Kloth, G. F. W.	815
Kuuz Krause, H. Tannoids; Contribution to the Study of the	1223
Kursanoff, N. Menthol; Halogen Derivatives of —, and Hydrocarbin thereof	1236
Kurz, F. K. Gas; Apparatus for Carburetting — (P)	883
Kurz, K. Beer; Starchy and Dextrinous Cloudiness in —	921
Kutscher, F. See Kossel, A.	270
Antipeptone	384
Antipeptone; Reputed Non-existence of —	276
Yeast; Auto-Fermentation of —	490
Kyle, T. D. Bismuth Ores; Assay of —	839
See Warwick, A. W.	620

L

L. H. Amylomyces; Investigations on certain —	377
Laband, L. Zinc; Action of —, On Plants	846
Laborde, J. Wine; Influence of Composition of —, on the "Tourne" Ferment	921
Lachmann, A. Chemistry; Instruction in Technical —	546
Lacomme, J. M. A. and Lauder, W. Water; Apparatus for Purification of — (P)	739
Ladenburg, A. Isoconiine	1232
And Quasig, R. Ozone; Quantitative Determination of —	749
Laer, H. Van. Yeast; Extraction of Protoplasm of — (P)	376
Lagerheim, G. Starch; Iodolactic Acid as a Reagent for —	1245
Lagerqvist, C. A. See Reichmann, F. A.	469
Laird, D. Assay-Furnace. (P)	255
Lamar, W. R. Coca Leaves; Assay of —	1250
Lamb, C. G., and Walker, M. Iron and Steel; Instrument for Measuring Permeability of —	811
Lamb, M. C. Leather Dyeing; Application of Titanium Salts for —	1111
Leather, Dyeing, Staining, and Finishing of —	41
Leather; Dyeing, Staining, and Finishing —	120
Lamont, M. Beer; Filtering of —	921
Lancashire, J. H. See Worsej, J. W.	367
Lancaster, E. W. See House, J.	492, 600
Acetylene Gas; Apparatus for Purifying — (P)	463
Calcium Carbide; Retarding Decomposition of — (P)	463
Casks; Apparatus for Sterilising and Lining — (P)	826
Landau, J. See Liebermann, C.	886
Landauer, J. See Taylor, J.	848
Landrin, E. See Dybowski, J.	1234
Landriset, E. See Rossel, A.	345
Landsiedt, A. See Bamberger, M.	77
Lane, H. Gas; Apparatus for Manufacture of — (P)	1101
Lane, N. J. Fats and Oils; Proportions of Liquid Fatty Acids in some, and the Iodine Values	1083

	PAGE
Lang, G. Chimney Construction; German Practice in — ..	1211
Lang, H. Pyretic Smelting	719
Lang, W. R. Proceedings of Annual Meeting	676, 677
Lange, A. Carbon Dioxide; Examination of Commercial Liquid —	122
Lange, H. Aluminium; Sodering of — (P)	369
Chicory; Spirit from —	1011
Starch in Mixed Pressed Yeasts; Determination of — ..	395
Lange, L. Flesh Preservation; Value of Boric Acid, Borax and Sodium Sulphite fo. —	923
Lange, M. Dyestuffs, Yellow and Orange; Production of — (P)	241
Langer, A. See Dietrich, M.	145
Langer, F. Base from Cinchonine, Analogous to Nicotine ..	499
Tautocinchonine	500
Langfurth, A. Beer Yeast in Pressed Yeast; Bau's Method for Detection of —	843
Beer Yeast in Pressed Yeast; Detection of —	1010
Larin, J. A. Mercury Salicylate; Solubility of —	927
Larter, A. T. Alkyls; Displacement of — from Phenols by Nitration	745
Lasne, H. Dissolved Substance in a Solution; Determination of —	285
Laszczynski, St. V. Batteries; Replacement of Lead by other Metals in Secondary —	998
Lathbury, B. B., and Spackman, H. S. Cement; Apparatus for Calcining — (P)	582
Lauder, A. See Dobbie, J. J.	66
Lauder, W. See Lacomme, J. M. A.	739
Laughlin, A. Gas Producers (P)	462
Laurans, E. See Essner, J.	480
Laurie, A. P. See Holland, J. T.	370
Lavollay, J. H., and Burgoin, G. E. Essential Oils; Improving the Odour of — (P)	503
Perfumes; Improvement of —	607
Perfumes; New Method of Improving —	1236
Saccharine Solutions; Purifying and Decolorising — (P) ..	489
Spirit; Purification of Crude — (P)	600
Law, G. F. Gas-burners for Use with Incandescence Mantles (P)	884
Lawrence, C. S. Wood; Preservation of — (P)	592
Lawton, A. W. Common Salt; Obtainment of — in Pure State (P)	717
Laycock, W. F. See Rawson, C.	1152
Lazareff, P. Gases; Generator for Combustible — (P)	883
Lea, M. Carey. Allotropic Silver	386
Lebbin. Yeast; Substitute for Meat Extract Prepared from —	825
Lebeau, P. Ferrosilicons; Constituents of Industrial — ..	479
Lebeuf, A. G. See Arnaud, A. L.	373
Lebiota, G. F. Wood, Apparatus for Impregnating — with Preservatives (P)	900
Wood; Fire-proofing and Rot-proofing — (P)	126
Le Blanc, M. Chromic Acid; Electrolytic Regeneration of — ..	132
Diaphragms; Electrolytic	815
Diaphragms; Manufacture of Acid-proof —	132
Le Bon, G. Elements; Modification of Chemical Properties of — by Addition of Foreign Substances	230
Lecomte, A. Vapour Burners (P)	32
Lecomte, H. Vanilla; Formation of the Perfume of —	1236
Lederer, L. Acetyl-Cellulose; Manufacture of — (P)	741
Ledoux, L. Phosphoric Acid in Superphosphates, etc.; Determination of —	936
Leduc, E. Puzzuolana; New Uses of —	1114
Lee, T. H. Tecomin; Characteristics of —	116
Leent, F. H. van. Potassium in Mixtures of Salts; Separation and Determination of —	1242
Lees, F. H. See Power, F. B.	1238
Lees, F. H. See Schryver, S. B.	500
Lefebvre, P. Alcohols; Action of Calcium Carbide on Primary —	847
Lefemann, F. W. Acid-proof Vessels and Articles (P)	223
Lefèvre, L. See Grimaux, E.	355
Leffmann, H. and Beam, W., "Select Methods in Food Analysis."	758
Léger, E. See Jungfleisch, E.	384, 499, 1232
Legrand, E. Salts and Sodium dissolved in Liquified Ammonia; Conductivity of —	725
Lehner, F. Filaments, Artificial; Manufacture of — (P)	1208
Horsehair; Manufacture of Artificial — (P)	1109
Leidic and Quenessen. Platinum and Iridium in Platinum Ores; Determination of —	1242
Leidic, E. Platinum; Separation of the Metals Accompanying —	46
Lémeray. Metals; Relation between Expansibilities and Fusing Points of —	253



	PAGE		PAGE
Lemoult, P. Substituted Aminobenzophenones and Aromatic Amines; Reaction between —	571	Ling, A. R. See Newlands, B. E. R.	748
Triphenylmethane; Relation between Chem. Constitution of Dye-stuffs from —, and Absorption Spectra of their Aqueous Solutions.	33	And Newlands, B. E. R. Malting; Examination of Fuels used for, with Special Reference to Arsenic	3008
Lenchs, G. and Lenchs, K. Glasses and Enamels; Production of Clouded (P)	990	And Pope, T. H. Tornøe's Optical Method for Determining Alcohol and Extract in Beer	755
Lengfeld, F. Gold Halides	1216	Lintner, C. J. Distillery Yeast and Low Fermentation Beer Yeast; Distinction between —	1010
Lenz, O. See Hahn, P. D.	1013	Yeast; Differentiation of Grain—and Bottom-fermentation Beer	1128
Lépinos, E. Cod-liver Oil; Production of —	860	Lippert, W. Copals; Fusion of —, under Pressure	1123
Leroux, J. B. and Carmien, P. J. Incandescence Lighting; Apparatus for — (P)	1101	Lippmann. Aluminium-Antimony Alloy; Density of	814
Le Roy, G. A. Coal Briquettes; Examination of —	235	Lishman Process Bleaching Co. See Lishman, W. W. L.	892
Leroy, P. Gas Generators (P)	235	See Taylor, F.	713
Lery, J. B. de. Gas Lighting Incandescent —, and Burners and Elements therefor (P)	834	Lishman, W. W. L., and others. Kiers for Boiling, Bleaching, and Dyeing (P)	892
Lessing, W. and Rheinfeld, D. Cement, Gypsum, &c.; Burning —, and Apparatus therefor (P)	253	Littlefield, R. D. See Rawson, W. S.	993
Lester, J. F. Hides and Fibrous Materials; Apparatus for Treating — (P)	53	Litzelmann and Tailfer. Amalgams; Decomposition of —, and Apparatus therefor (P)	717
And Dean, L. A. Furnaces for Burning Refuse and Garbage (P)	147	Livache, A. Enamelling; Report on Dornoy's Apparatus for Zinc White; Use of —, in place of White Lead	251 728
Le Sueur, E. A. Air; Obtaining Gas or Liquid rich in Oxygen from — (P)	931	Liversedge, A. J. Refuse Destructors (P)	69
Letts, E. A. and Blake, R. F. Sewage; Changes in — during treatment by Bacterial Process	1132	Liversege, J. F. Camphorated Oil; Analysis of —, Formaldehyde in Milk; Approx. Determination of —	289 844
Levesque-Hérent, G. Desiccation of Beetroots; Influence of — on Storage in Silos	1125	Ljöö, A., and Törnell, V. Cleansing Material for Brewery Vessels	1130
Levinstein, H. Indigo; Manufacture of —, from Naphthalene Indigo; Notes on —	802 332	Lloyd, F. J. Arsenic; Discussion on Occurrence and Detection of —	191
Levinstein, I. Patent Law	13	Basic Superphosphate; Discussion on —	329
Patent Law; Report of Sir E. Fry's Committee on —	1079	Cider; Dry and Sweet	1611
Proceedings of Annual Meeting	676	Lloyd, J. H. See Gauntlett, F. W.	718
Speech at Annual Dinner	682	Lobry de Bruyn, C. A. See Ekenstein, W. A. van	291
And others. Colouring Matters; New Black — (P)	1107	Löb, W. Benzidine; Electrolytic Production of —	133, 700
Levinstein, Lim. See Levinstein, I.	1107	Electro-thermal Reactions and Syntheses	1119
Lévy, Lucien. "Microbes et Distillerie."	78	Pyrogenetic Reactions by Aid of the Electric Current	598
Lewes, V. B. Coal Gas; Manufacture of — (P)	350	Löhr, H. Camphor in Camphor Oil; Determination of —	510
Water-Gas; Utilisation of — in Destructive Distillation of Coal	1095	Loew, O. Catalase; a New Enzyme	598
Lewis, E. A. Copper; Effect of Arsenic on —	254	Logan, L. See Vulté, H. T.	599
Lewis, J. A. Fuel; Manufacture of Artificial — (P)	974	Lohöfer, W. See Lunge, G.	1231
Lewkowitzsch, J. Candle Oil	909	Lonay, A. Ammoniacal Salts as Nematocides	267
Glycerin; Determination of —	395	Longridge, C. C. Copper Ores; Dry and Wet Treatment of	1117
Lemon Oil Industry; Discussion on the —	1183	Lopresti, F. Alum in Wine; Detection of —	158
Proceedings of Annual Meeting	676	Lorenz, C. Mortar; Production of —, and Treatment of Stone (P)	992
Rosin Grease; Discussion on —	1183	Lorenz, G. See Wagner, E.	477
"The Laboratory Companion to Fats and Oils Industries."	1255	Lorenz, N. von. Thomas Slag; Detection of Mineral Phosphate in —	69
Varnish; Discussion on Manufacture of —	1077	Lothammer, F. J. Carburetted Air; Apparatus for Cold Production of — (P)	31
Varnish Resins; Examination of —	372	Lotsy, Alkaloids in Cichona Trees; Formation of —	498
Leybold, W. Gas pipes; Destruction of — by Electricity	1697	Lotsy, J. P. Cinchona Alkaloids; Formation of the —	150
Léys, A. Saccharine; New Reaction of —	622	Lotz, R. W. See Kautny, T.	463
Lich, M. L. H. and Werk, A. van de. Cocoa; Manufacture of — (P)	924	Louis, D. A. Basic Superphosphate; Discussion on —	330
Lidow, A. Wool; Action of Nitrous Acid on —	469	Lucas, A. F. Petroleum Well at Beaumont, Texas	885
Liebaug, E. See Hertwig, O.	1212	Lucas, M. Copper, Oxygen in Commercial; Determination of —	157
Liebermann, C. Colour Change; Theory of —	569	Lucchini, V. Iron, Manufacture of — in the Electric Furnace	816
Dihydroxyfluorescein; Characteristics of —	1104	Luckow, C., jun. Electrodes for Secondary Batteries (P)	49
Dyeing of Oxide Mordants	710	Ludwig, A. Diamonds; Artificial Production of — (P)	1934
Eupiton and Pittakall	569	High-Pressure Gases; Vessels for Reception of — (P)	878
And Laudau, J. Carbinone Compounds	586	Luebert, A. G. Formaldehyde in Milk; Modification of the Sulphuric Acid Test for —	1146
And Wiedermann, F. Dye-stuffs of the Esculetin Series	1104	Lütppo-Cramer. Ammonium Persulphate; Photographic Reduction by —	278
And Wiedermann, F. Eupiton Derivatives	569	Developers; Substitution in —	1140
Liebig, M., jun. Lead Peroxide in Red Lead; Volumetric Estimation of —	1027	Gelatin; Indirect Action of Sulphite upon —	1140
Liebschutz, M. Lead; Determination of Arsenic, Antimony, and Bismuth, in Fine —	1023	Photographic Density; Loss of — during Fixing	1019
Liesegang, R. E. Developers; Action of Sodium Sulphite in Sulphite in the Developer	278	Photographic Developers; Misunderstood —	1019
Toning and Fixing Bath	153	Photographic Development; Theory of —	1013
Lifschitz, J. Peppermint Oil; Examination of —	151	Silver Bromide; Action of Developers upon —	1020
Lillie, S. M. Sugar Solutions, &c.; Treatment of — (P)	140	Lumière and Seyewetz. Photographic Reducers	153
Limb, C. M. J. Metallic Carbides and Derivatives; Production of — (P)	433	Lumière, A. and L. Photographic Printing with Iron Sulfate And Chevrolier. Mercury; New Organo-Metallic Compounds of —	273
Linde, F. Rape-Seed Oil; Purification of — (P)	591	And Perrin, F. Glycerophosphorous Acid and Glycerophosphites	1232
Linde, O. Alkaloids; Exhausting Drugs for Determination of — (P)	624	And Perrin, F. Mercuric Oxide; Action of — on Organic Substances	497
Linder, E. Porcelain Sand, and Composition of Porcelain Body	900	Lumière, A., et ses Fils. Photographic Emulsions (P)	278
Lindet, Wheat Embryos; Saccharifying Action of —	377	Lumière Brothers. Photographic Reducers; Ammonium Persulphate and other —	1140
Wheat Germs Saccharifying Action of —	490	And Seyewetz. Silver Prints; Reducing the Intensity of —	534
Lindner, E. Porcelain Sand; and the Composition of Porcelain Pastes	364	Lunge, G. Du Pont's Nitrometer	106
Lindner, P. Beer; Nathan's Process for Brewing —	919	Nitrocellulose; Researches on —	1021
Yeast and Sugars; Fermentation Experiments with —	141	"Zur Geschichte der Entstehung und Entwicklung der Chemischen Industrien in der Schweiz."	945
Lindsay, C. F. Conductivities of some Double Salts	258	And Lohöfer, W. Silica; Removal of — from Alkaline Liquors	1231
ing, A. Arsenic; Discussion on Occurrence and Detection of —	145, 169	Luther, R. Electro-motive Behaviour of Substances capable of Different Stages of Oxidation	1119

	PAGE
Luxton, W. G. <i>See</i> Raschen, J.	809
Luyten, L., and Blumer, E. Anthracene; Manufacture and Purification of —	796
Lynn, A. H. Arsenic; Discussion on Occurrence and Detection of —	193
Lyncker, G. A., and Mohr, M. P. Fire-damp and other Gases; Means for Indicating Presence of — (P)	30
Lyon, A. C. <i>See</i> Noyes, W. A.	943

M

Maben, T. Hydrastine and its Determination	942
Mabery, C. F. Petroleum; Composition of Texas —	795
And Hudson, E. J. Petroleum; Composition of Californian —	568
And Siplein, O. J. Asphalts; Determination of Melting Points of —	394
And Takano, S. Petroleum; Composition of Japanese —	569
McAlley, R. <i>See</i> Storer, T.	737
McAllister, E. J. <i>See</i> Deshler, C.	352
Macalpine, T. Fuel; Manufacture of Improved — (P)	874
Macar, J. de. Explosives; Manufacture of New — (P)	617
McCaffrey, C. F. <i>See</i> Richards, T. W.	1026
McCalla, W. E. <i>See</i> Storey, J. H.	126
McClellan, W. Thermometer Glass at Higher Temperatures.	899
McClurg, W. J. Gas; Apparatus for Generating — (P)	975
Macconel, W. Yarns; Apparatus for Mercerising, Scouring, or Dyeing — (P)	39
McCrae, L. Lime, Solubility of — in Water; Discussion on	224
McCrae, J. <i>See</i> Brown, R. B.	1092
<i>See</i> Dawson, H. M.	758
Macdonald, A. Sugar Refining; Discussion on —	1691
Waste Liquids of Whisky Distilleries; Discussion on Composition and Disposal of —	458
McDonald, D. Acetylene Gas; Apparatus for Generating — (P)	111
McDougall, I. S. and I. Sheep Dipping Preparations (P)	495
MacEwan, P. Varnish; Discussion on Manufacture of — ..	1077
McGhie, T. B. <i>See</i> Barton, T.	1219
McGill, A. Cloves; Approximate Analysis of —	625
Macgregor, P. <i>See</i> Pickering, J.	915
MacL, L. Aluminium Alloy; Manufacture of — (P)	257
McIlhenny, P. C. Linseed Oil and its Adulterants.	909
McIntosh, J. Geddes. "The Chemical Essays of Charles William Scheele"	946
McKenzie, A. <i>See</i> Marckwald, W.	379
McKenzie, R. <i>See</i> Faucheux d'Humy, P. R. de	697
Mackie, W. Calcium Iodate; Preparation of —	149
McLaughlin, A. C. Ammonium Ichthyol-Sulphonate; Preparation of — (P)	1230
McLean, J. R. Coai-Gas, Enrichment of —, and Apparatus therefor (P)	351
McLeod, J. A., and others. Solder for Aluminium, etc. (P) ..	1219
McNamee, F. Peat Fuel (P)	882
MacNaughton, J. <i>See</i> Rossi, A. J.	588
McNeil, J. C. and C. Evaporating Apparatus (P)	460
Saccharine Liquids; Concentration and Crystallisation of —, and Apparatus therefor (P)	55
Mactear, J. Chlorine and Alkali; Electrolytic Apparatus for Production of — (P)	1121
Metals and Minerals; Extraction of — from Alluvial Deposits (P)	1217
Madan, H. G. Piperine; Colloid form of —	607
Maddison, J. W., and Rhodes, W. Iron; Melting of —, and Materials employed therein (P)	1218
Made, P. R. van der. Air; Carburettng —, and Apparatus therefor (P)	976
Madsen, T. Hydrolysis; Influence of Temperature upon — ..	512
Maertens, E. Solvents; Separation of —, from Oily and other Solutions (P)	372
Wool and other Animal Fibres; Apparatus for Treating — (P)	119
Wool and other Animal Fibres; Cleaning — (P)	119
Maey, E. Alloys, Copper-Tin, Copper-Zinc, and Tin-Zinc; Determination of Specific Gravities of —	1117
Magnier, P., and others. Fatty Substances; Saponification of — (P)	261
Oleic Acid; Conversion of — into Solid Fatty Acids (P) ..	261
Mailhe, A. Cupric Hydroxide; Action of — on Solutions of Metallic Salts	943
Mercuric Oxide; Action of — on Aqueous Solutions of Metallic Salts.	846
Metallic Salts; Action of Mercuric Oxide on Solutions of —	806
Main. Arsenic; Discussion on Occurrence and Detection of — ..	198
Maingard, L. A. Fuel; Artificial — (P)	697

	PAGE
Majesté, A. <i>See</i> Coiffier, H.	477
Majewski, K. von. <i>See</i> Rupe, H.	151
Major, J., and Wood, T. J. Yarn; Apparatus for Dyeing, Bleaching, &c. — (P)	121
Maldes. <i>See</i> Massol.	896
Malfitano, G. Aspergillus Niger; the Proteolase of —	56
Mallinson, G. Yarns; Apparatus for Dyeing or Drying (P) ..	577
Mallol, J. Gas-Burners; Incandescence — (P)	1199
Malméjac, F. Metals; Action upon — of Alcohol of 95°	365
Alkaloid; New —, from Elder Bark.	929
Manceau, E. Wines; Secondary Fermentation of Sparkling —	599
Manchot, W., and Herzog, J. Indigo; Determination of Value of —	841
Indigo White; Oxidation of — by Oxygen	841
Manhardt, A. Aluminium Alloy (P)	1219
Manley, J. J. <i>See</i> Velej, V. H.	1208
Manley, T. C. Alcoholometers; Improved — (P)	1228
Mannich, C. <i>See</i> Thoms, H.	606
Maquenne, L., and Roux, E. Glucamine; a new Base derived from Glucose	847, 605
Marc, R. <i>See</i> Baur, E.	1098
Marckwald, E. <i>See</i> Meyer, R. J.	62
Marckwald, W. Fusel Oil; Separation of Amyl Alcohols of —	378
And Chain, M. Morpholine; Preparation of —	743
And McKenzie, A. Fusel Oil; Separation of Amyl Alcohols of —	379
Marcusson, J. Cholesterol and Phytosterol in Mixtures; Separation of —	484
Mare, F. de, and Frémy, E. Steatite; Application of — as an Electrical Insulating Material (P)	133
Marie, C. Acetone; Action of Hypophosphorous Acid on —	944
Markel, K. E., and Crosfield, J. J. Liquids; Apparatus for Separating Solid Matters from — (P)	1094
Markfeldt, O. India-Rubber; the Colouring of —	592
Tanks for Acid or Alkaline Liquids; Construction of — ..	986
Marks, G. C. Yeast; Treatment of — (P)	1131
Marpmann, G. Fats and Waxes; Optical Examination of — ..	509
Marquardt, H. Milk and Cream; Preserving —, and Apparatus therefor (P)	924
Marsh, A. L. Nickel Oxide Cell; the Alkaline —	998
Marsh, W. Magnesium Carbonate; Manufacture of — (P) ..	1113
Marshall, A. Glycerol Phthalate; Discussion on —	1076
Marshall, E. M. Hydrobromic Acid; Preparation of —	926
Santonin; the B. P. Test for —	938
Marshall, G. <i>See</i> Sunderland, R. H. and F.	531
Marshall, L. W. <i>See</i> Clancy, J. C.	481, 904
Marston, R. Nitrogen and Nitrous Oxide from Air; Manufacture and Use of — (P)	1204
Martin, A. H. and others. Paper or Similar Material; Preparation or Treatment of — (P)	1133
Martin, A. J. <i>See</i> Cameron, D.	60, 381, 1132
Martin, C. J., and Masson, O. Conductivities of Solutions of Potassium Chloride, etc.; Influence of Cane Sugar on —	482
Martin, E. Aluminium Plates covered with Silver; Manufacture of — (P)	724
Plates of Steel or Iron Covered with Copper; Manufacture of — (P)	905
Martin, M. Acetylene Gas; Apparatus for Automatically Generating — (P)	564
Martin, W. H. Evaporating Apparatus (P)	694
Martin-Claude. <i>See</i> Truchon	380
Martinand, V. Invertin or Invertase in Grapes; Presence of —	57
Martindale, W. Arsenic; Discussion on Occurrence and Detection of —	192
"The Extra Pharmacopœia" and Westcott, W. Wynn ..	627
Martindale, W. H. Cacodylic Acid and Cacodylates.	149
Martine, C. Benzylidenemethone; New Methods of Preparing —	914
Menthol; Action of Benzaldehyde on Sodium Compound of —	1045
Martinez, R. <i>See</i> Nihoul, E.	994
Martini, A. Gas-Igniters (P)	884
Martinotti, C., and Cornelio, L. Basic Bismuth Salicylate ..	603
Marty, E. Textile Fabrics; Manufacture of — (P)	39
Marx, F. Stone, Artificial; Manufacture of — (P)	810
Maseau. Phenol; Detection of —	841
Mason, F. H. Engine; The Waste-Heat Auxiliary —	1194
Mason, J. W. Hydrocarbon Oils; Purifying — and Rendering Non-explosive (P)	1100
Mason, W. D. <i>See</i> Yeaton, S. N.	793
Massacci, C. <i>See</i> Stock, A.	391
Masse, C., and La Société Française de Ramie. Ramie, etc.; Treatment of — (P)	985
Masseron, A., and others. Warps; Apparatus for Dyeing, etc. —	1110



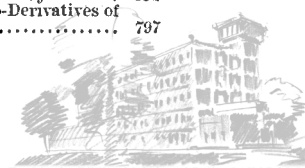
	PAGE		PAGE
Massot and Muddes. Copper Sulphate and Sodium Sulphate; Solubility of Mixtures of —	896	Messer, A. Acetylene Gas Generators (P)	110
Masson, O. See Martin, C. J.	482	Mestern, H. See Fischer, G.	564
Mather, W. Bleaching and Dyeing, and Apparatus therefor (P)	360	Mészáros, A. Preserving Organic Bodies, and Apparatus therefor (P)	601
Mather, W. S. Crucibles for Smelting (P)	723	Metcalf, S. Calcareous Matters; Compositions for Removing — from Metal Surfaces (P)	105
Mathieson-Thom, T., and Oakes, A. C. Stone, Artificial; Manufacture of — (P)	719	Metcalf, D. J. See Curtis, C. H.	1240
Matignon, C. Hydrogen and Nitrogen; Absorption of — by Metals of the Rare Earths.	160	Methner, P. Bone-meal Phosphoric Acid; Citrate Solubility of —	374
Metals of the Rare Earths; Combination of Hydrogen with —	63	Mette, L. Gas-Igniters; Automatic — (P)	1101
Metals of the Rare Earths; Combination of Nitrogen with —	63	Metzger, F. J. See Wells, H. L.	749
And Delépine, M. Thorium; Hydride and Nitride of —	274	Meunier, S. Iron; Mass of Meteoric — from the Soudan	366
Matthews, J., and Davies, W. Electrolytical Apparatus (P)	590	Meurant, J. Metals and Alloys; Precipitation of — (P)	370
Merritt. Indigo, Synthesis of —	551	Meurer, N. Glass; Colouring of —	1021
Matthews, T. Merritt. See Allen, A. H.	293	Glass; Colouring — Yellow, Red, Brown, and Black (P)	477
Matthey, E. Tellurium; Preparation of Large Quantities of —	586	Meyenberg, A. See Green, A. G.	118, 713, 713
Matuschek, J. Potassium Ferricyanide; Action of Hydrofluosilicic Acid upon —	579	Sulphide Dyestuffs; Analysis of —	508
Potassium Ferricyanide; Action of Sunlight on Aqueous Solution of — II.	833	Meyenberg, J. Mother's Milk; Substitute for — (P)	601
Potassium Ferricyanide Solution; Influence of Light on —	757	Meyer, A. Mashing and Fermenting Vessels (P)	1228
Potassium Ferro and Ferri-Cyanides; Action of Carbon Dioxide on Aqueous Solutions of —	1112	Meyer, G. Incandescence Bodies for Lighting Purposes (P)	1106
Potassium Ferro and Ferri Cyanides; Action of Light on Solutions of —	897	Meyer, G. W. Rum; Free Sulphuric Acid in —	821
Potassium Ferrocyanide; Action of Hydrofluosilicic Acid on —	363	Meyer, J. Dithionic Acid; Formation of —	1252
Potassium Ferrocyanide; Action of Sulphurous Acid on —	987	Meyer, R. "Jahrbuch der Chemie"	1152
Prussian Blue, Formation of —	987	Meyer, R. J., and Marckwald, E. Curite Earths of Monazite Sand; Separation of —	62
Red Prussia's of Potash; Action of Sulphur Dioxide on Solution of —	897	Michael, O. Furnace; Crucible — (P)	1118
Maxim, H. Smokeless Powder Charges for Guns (P)	1141	Michaelis. Thiopyrine and Selenopyrine	1234
Maximowitch, α - and β -Naphthol; Comparison of —	77	Michaelis, A., and Gunkel, E. Phenylmethylchloropyrazol Chloromethylate; Action of Aniline and of Ammonia on —	502
Maxwell Lefroy, H. Remedies for Insect Pests in the West Indies.	521	Michalowsky, T. Nickel; Preparation of — (P)	1119
May, J. H. See Electrical Power Storage Co.	482	Michon, L. See Fallot, B.	491
Mayer, H. See Ralli, P. A.	263	Miecko, See Pum.	53
Mayer, L. J. Morphine; Lloyd's Reaction for —	938	Middleton, W. B., and others. Ores; Production of Zinc White from, and Apparatus therefor (P)	911
Mayer, O. See Kiliani, H.	1202	Miklaszewski, B., and St. v. Niementowski. β -Aminophenylbenzimidazoles; Comparison of the Three — VII.	1202
Meade, R. K. Standard Hydrochloric or Nitric Acid; Preparation of —	748	Miklosich, D. Copper Oxide; Determination of Cuprous Oxide in —	384
Sulphuric Acid; Preparation of Standard Solutions of —	392	Milius, F. Fog in Dye- and Bleach-Works; Prevention of —	574
Mears, W. A. See Donaldson, W. J.	882	Miller, A. M. See Wartenberg, H.	131
Medanich, G. See Skraup, Z. K.	63	Miller, A. Stanley. "A Manual of Assaying"	293
Medinger, H. Fermentation Gases; Utilisation — in the United States	56	Miller, E. H., and Page, R. W. Cadmium; Quantitative Determination of —	1029
Meerum Terwogt, P. C. E. See Smits, A.	73	Miller, H. von. See Harz, C. O.	587
Mehner, H. Anthranilic Acid; Derivatives of —	606	Miller, J. C. Sterilising and Cooling Liquids, and Apparatus therefor (P)	924
Diazo-Nitrogen in Diazo-Amino Compounds; Apparatus for Determining —	623	Miller, W. von and Rohde, G. Cinchona Alkaloids	63
Meikle, J. Furnace for Oxidising Iron and Steel Surfaces (P)	904	Milthorp. Arsenic; Discussion on Presence of —, in Beer	209
Meillère, G. Mercury in Antiseptic Solutions; Determination of —	1243	Mindus. Tanning; Rapid — (P)	1006
Saccharose; Presence of —, in Panama Wood	267	Miquel, P. Yeast as a Means of Detecting Communication with Subterranean Waters	844
Meisenheimer, J. Nitro-Anthracene	396	Misslin, E. See Kehrman, F.	706
Meissner, C. Acetylene Gas; Apparatus for Production of — (P)	31	Mitchell, C. A. Maumené Test for Oils.	939
Meissner, R. Glycogen in Yeast; Appearance and Disappearance of —	55	Translation of Oppenheimer's "Ferments and their Actions"	1255
Meithe, A. Absorption Spectra; Plates for Photographing — Green Colour Screen and Red Printing Plate	504	See Sykes, W. J.	1148
Melkola, B., and Eyre, J. V. Dinitroanisidine; Diazotisation of —, and Constitution of the Resulting Product.	572	Mitchell, G. Gutta-Percha; Extraction of — from Leaves and Twigs (P)	912
Dinitro-ortho-anisidine; Chemical Reaction of —	1204	Mitchell, J. See Deike, A. H.	351
Meldrum Bros. and Orton, J. S. Kilns for Treating Minerals — (P)	694	Mitth. Actienges für Anilin Fab. Ferrotypic Positives; Preparation of —	746
Melichar, M. Beetroot Diffusion Juice; Warm Diffusion and Warming —	54	Mizuno, T. Metals; Transparency of —, to Radium Rays	291
Melland and Waldron. Aluminium; Influence of — on the Carbon in Cast Iron	1213	Möhlau, R. and Graclert, K. P. Benzene-azo- β -naphthylauramine	1203
Mellor, J. W. Cyanides and Cyanates; Determination of —	284	And Heinze, M. Amino-Azo Compounds.	570
Mensching, C. See Levinstein, I.	1107	Möller, G. and Pfeiffer P. Cement; Solid Blocks of —, from Cement Slush; Manufacture of (P)	582
Menschutkin, N. Reaction Velocities; Influence of Chemically Indifferent Solvents on —	75	Möller, J. α -Nitro-anthraquinone and 1:5 and α -Dinitro-anthraquinones; Electrolytic Reduction of —	1001
Menzies, W. See Morgan, J. T.	472	α -Nitro-anthraquinone; Electrolytic Reduction of —, to α -Amino-anthraquinone	1061
Mering, Baron von. Food Preparations; Manufacture of — (P)	738	Möller, J. J. Foodstuffs; Preservation of —, and Apparatus therefor (P)	58
Merklen, M. E. Creosote for Therapeutic Purposes; Examination of —	1245	Mohr, G. L. Lacquer or Enamel for Leather (P)	487
Merrell, C. G. See Gordin, H. M.	1235	Mohr, M. F. See Lyncker, G. A.	30
Merry, A. See Noble, J. H.	1121	Moissan, H. Ammonium-Chloride dissolved in Liquid Ammonia; Electrolysis of —	1220
Merry, A., and Noble, J. H. Soap; Manufacture of — (P)	728	Calcium-Ammonium and Lithium-Ammonium; Decomposition of —, by Ammonium Chloride.	1252
Meslans, M. Fluorine; Apparatus for electrolytic Production of — (P)	259	Liquefied Gases; Method of Manipulating —, in Sealed Tubes.	1252
Messel, R. Arsenic; Discussion on Occurrence and Detection of —	190, 192	Sulphammonium; Preparation and Properties of —	362
		Sulphuryl Fluoride; Characteristics of —	396
		Molet, A. Gases; Apparatus for Mixing (P)	882
		Molisch, H. Chromogen, Producing a Carmine-Red Colouring Matter —, in Schenckia Bitumenaviana	888
		Moltke-Hansen, J. Lead; Electrolytic Separation of —, from Manganese	750

	PAGE
Montgomery, B. W. D. <i>See</i> Taylor, F.	712
Moodie, R. Cooling Apparatus (P).....	694
Moody, H. R. <i>See</i> Tucker, S. A.	626, 970, 471, 1245
Moor, C. G. and Priest, M. Pharmacopœia Conditions; Notes on —	385
Morani, F. Electric Furnaces of Great Power (P).....	588
Morel, L. A. Gluten; Manufacture of — (P).....	738
Morelle, C. T. Acetylene Gas; Apparatus for Generating — (P).....	236
Morgan, F. Oils; Hydro-Refiner for — (P).....	371
Morgan, G. T. Ferric Salts; Reduction of — Stannous Sulphide; Discussion on Action of Caustic Potash and Soda on —	1143 426
And Menzies, W. Yarn; Apparatus for Dyeing and Treating Hanks of —	472
Morison, D. B. Evaporating Apparatus (P).....	694
Morris, E. W. Milk; Diabetic Sugar-free — (P).....	380
Morris, H. N. Arsenic; Discussion on Detection of —	208
Morrison, E. Pins; Apparatus for Electro-plating — (P)...	134
Morse, E. F. and others. Temperature of Substances Luminous or (P) Incandescent on Heating; Apparatus for Determining —	343
Moseley, O. G. Iron and Steel Wire, &c.; Forming Protective Coating on — (P).....	46
Mosenthal, H. de. "Heat Test" for Explosives; Discussion on the —	12
Muckerji, P. Phosphorus; Detection of Free —	743
Mühle, P. Amphopectone; Preparation of Pure —	745
Müller, A. Fermented Beverages; Desalcoholising —, and App. therefor (P).....	600
Sulphretted Hydrogen in Coal Gas; Determination of —	73
Müller, R. Cathodic Depolarisation; Disturbance of —, by Potassium Chromate	257 369
Periodates; Electrolytic Preparation of the Alkali —	1110
Mueller, E. J. <i>See</i> Masseron, A.	1110
Müller, F., and Roszbach, G. Rosin; Treatment of —, to Produce Rosin of Low Melting Point.....	1123
Müller, H. <i>See</i> Kehrmann, F.	702
Müller, J. Gloves; Dyeing of — (P).....	713
Müller, K. Cement; Manufacture of — (P).....	392
Müller, O. <i>See</i> Phillips, M.	738
Müller, T. Batteries; Chemically Consolidating the Active Material of Secondary — (P).....	259
Münsterberg, O. Lime Light; Obtaining Intense Heat for — (P).....	351
Muir, J. Iron Hardened by Overstrain; Tempering of —	234
Muller, T. N. Steel; Manufacture of Open Hearth — (P) .	587
Mulliken, S. P. and Scudder, H. Methyl Alcohol in Mixtures; Detection of —	71
Murco, H. <i>See</i> Astruc, A.	161, 274, 274
Murmann, E. Alloy of Aluminium and Magnesium (P)....	905
Murphy, A. J. Beer and Malt; Arsenical —	340
Murphy, E. E. Carbonating Apparatus. (P).....	59
Murumow, J. Oxycellulose and Hydrocellulose.....	739
Muspratt, M. Chemicals; Transport of —	420
Mutual Electric Trust. <i>See</i> Wright, A.	49
Myblin, D. Ammonium Persulphate as a Photographic Reducer	68
Myers, H. C. Sugar-Beet in Alkali Soil.....	445
Mylius, F. and Fenk, E. Chromates of Sodium and their Production.....	249
And von Wrochem, J. Calcium Chromate.....	249

N

Nabl, A. Hydrogen Peroxide; Action of — on Thioculphates	76
Nabouleix, S. G. Sterilising Apparatus (P).....	380
Naef, P. Coke, Gas and By-Products; Production of —, and Apparatus (P).....	340
Crystallising or Freezing; Process and Apparatus for — (P).....	233
Furnaces; and Means for Recovery of By-Products of Fuel (P).....	463
Gas and By-Products; Production of —, and Apparatus therefor (P).....	235
Liquid and Gas; Treating Materials with —, and Apparatus therefor (P).....	1195
Liquids; Treatment of —, with Gases, and Apparatus therefor (P).....	28
Smelting and Calcining Ores, and Limestone, Distilling Bituminous Fuel, and Recovering By-Products, and Apparatus therefor (P).....	366
Sodium Bicarbonate; Precipitation of — (P).....	1112
Solid Materials for Manufacture of Gas, Coke, &c.; Treatment of —, and Apparatus therefor (P).....	57
Solids and Liquors; Heating of —, and Apparatus therefor (P).....	1210
Nahusen, G. A. Explosive Materials; Sheds for Manufacture or Storage of — (P).....	155

	PAGE
Namias, R. Ammonium Persulphate as a Photographic Reducer	505
Nardin, E. W. Gold Ores; Chlorination of — at Mount Morgan, Queensland.....	45
Nasse, O. Millon's Reagent; Applicability of —	383
Nastukoff, A. Oxycelluloses; Researches on —	573
Nathan, Major. "Heat Test" for Explosives; Discussion on the —	10
National Electrolytic Co. Electrolysis, and Apparatus therefor (P).....	432
National Packing Co. Fibrous Compositions; Manufacture of — (P).....	273, 603
Nauck, M. <i>See</i> Zeidler, A.	269
Naumann, K. <i>See</i> Tafel, J.	1233
Naylor, W. A. H. Oleates of the Metals; Preparation of —	498
Neff, P. Oleines; Unsaponifiable Matter in Commercial —	509
Neil, A. <i>See</i> Fletcher, T.	31
Neisse, J. H. G. and Boll, J. H. Margarine; Production of — (P).....	1229
Nelson, D. M. and G. R. Fertiliser; Application of Spent Oxide as a — (P).....	495
Nelson, E. M. <i>See</i> Edwards, A.	932
Nernst Electric Light Co. Limited, The. <i>See</i> Drake, B. M. 565, 884	565, 884
Nernst, W. and Borchers, W. "Jahrbuch der Elektrochemie" And Bose, E. Auer (Welsbach) Light; Theory of the —	1034 791
And Wild, W. Lamps; Behaviour of Electrolytic Incandescence —	234
Neuberg, C., and Wohlgenuth, J. Arabinoses; Behaviour of — in the Animal Organism.....	825
Neufeld, C. A. Extraction Apparatus.....	279
Neuhäuss, R. Lippmann's Colour Process; Sensitising Gelatin Plates for —	154 67
Photographic Plates; Increasing Sensitiveness of —	67
Neumann, B. Calcium Carbide and Silicon Carbide as Reducing Agents	46
Chromium; Electrolytic —	816
And Wittich, E. Cadmium Oxide; Natural —	943
Neureuther, C. F. Furnace; Regenerative Retort Heating — (P).....	462
Neville, F. H. <i>See</i> Heycock, C. T.	814
New Process Lighting Co. Gas Burners; Apparatus for Supplying Air to — (P).....	1101
Newbigging, T. "A Hundred Years of Gas Enterprise".....	397
Newjadomsky, A. M. Methyleneresorcinol as a Mordant for Basic Dye-stuffs.....	1168
Newlands, B. E. R. <i>See</i> Ling, A. R.	1008
Arsenic; Discussion on Occurrence and Detection of —	191, 195
Malt, Hops, Hams, and other Alimentary Matters; Drying, Roasting, or Smoking of — (P).....	736
And Ling, A. R. Arsenic in Sugars, Malt and Beer; Determination of —	748
Newman, G. F. Waterproofing Composition (P).....	892
Newth, G. S. Ethylene; Laboratory Preparation of —	737
Newton, W. Borax and Nitrates; New System for Manufacture of —	324
Nichols, E. L. Acetylene Flame.....	29
Acetylene Flame; Temperature of the —	109
Nicolardot, P. Iron; Separation of —	1242
Niederstadt, B. <i>See</i> Tschirch, A.	729, 729
Nielsen, L. C. Burners for Oil Lamps with Incandescence Mantles (P).....	1199
Nielsen, R. A. Incandescing Media; Manufacture of — (P).....	565
Niemann, C. Lamps; Incandescence Gas and Vapour — (P).....	794
Nietner, Thiesing, and Baier. Town Drainage; Report on Purification of —	828
Nietzki, R., and others. "Chimie des Matières Colorantes Organiques".....	514
Nihoul, E. Leather; Analysis of —	1249
Leathers; Composition of Belgian —	1223
And Martinez, R. Tanning Materials; Influence of Nature of Water used in Extraction of —	1065
Nixon, A. Insulating Composition (P).....	729
Noaillon, E. Sulphur; Influence of Aluminium Salts in Determination of —	934
Nobis, L., and Wenzel, A. Tanks, Boiling Vessels, &c.; Manufacture of — (P).....	562
Noble, J. H. <i>See</i> Merry, A.	728
And Merry, A. Electrolytic Cells (P).....	1121
Noble, Sir A. <i>See</i> Armstrong, Whitworth, and Co.	506
Nodon, A. Electrode Plates of Secondary Batteries (P).....	1120
Noelting, E. Dye-stuffs; Mordant —	1204
<i>See</i> Nietzki, R.	514
And Blum, H. Indandion (Diketohydrindene); Derivatives of —	1106
And Fryess, G. Luteolin; Report on Prize Essay on —	354
And others. Xylidines; Nitro- and Bromo-Derivatives of the —	797



	PAGE		PAGE
Non-Injurious White Paint Syndicate. See Middleton, W. B.	911	Ough, L. Hydrastin (Resinoid); Preparation of —	929
Nordtmeyer, H. Filtering Medium (P)	27	Ouvrard, J. Borates of Magnesium and Alkaline Earth Metals	363
Norman, J. See Raschen, J.	809	Overbeck, O. G. C. L. J. Fermenting Vessels; Contrivance for Use in — (P)	731
Norman, J. T. See Desrumaux, H.	233	Overtoun, Lord. Proceedings of Annual Meeting	678
Norris, G. L. Manganese in Ferro-Manganese; Determination of —	551	Oxylin-Werke ActienGes. Rubber-coated Materials; Preparing and Treating — (P)	804
Nickel in Steel; Determination of —	551		
Explosive; Composition of a New — (P)	1140		
North, E. See Fay, H.	479		
Notkin Syndicate, The. See Purves, W. T.	462		
Notley, W., and Frost, C. E. Lamps for Hydrocarbon Oil or Spirit (P)	464		
Novak, F. Intensification; Chemical Processes in Mercurial	1020		
Mercury Intensification; The Chemical Process in —	1140		
Nové, H. Syrups; Table for Degrees Baumé of —, at Different Temperatures	488		
Novel, J. Aluminium; Soldering of — (P)	47		
Noyes, W. A., and Helmer, L. L. Sulphur in Iron and Steel Determination of —	1148		
And Lyon, A. C. Chlorine and Ammonia; Reaction between —	943		
And Warfel, R. R. Alcohol and Water; Boiling Point Curve for Mixtures of —	928		
Nüesch, P. See Kehrman, F.	1201		
Nussbaum, H. C. Exhaled Air; Non-Poisonous Character of	1013		
O			
Oakes, A. C. See Mathieson-Thom, T.	719	Pärl, E. See Brunschwyler, J.	111
Obermaier, J. O. Dyeing Apparatus (P)	1207	Paessler, J. Hide-powder; Report on Experiments with Freiberger Tanning Materials; Analysis of —	395
Rovings; Apparatus for Treating — with Fluids (P)	984	Quebracho Extracts Soluble in the Cold, and their Analysis And Appellus, W. Chromed Hide-powder; Use of — in Analysis of Tanning Materials	1124
O'Connor, Beer and Malt, Arsenical; Discussion on —	342	Page, R. W. See Miller, E. H.	1029
O'Connor, H. "The Gas Engineer's Pocket-Book"	1034	Pagel, M. Calcium Glycero-arsenate	743
Oddo, G. Ethers; Production of — by Means of Inorganic Salts	1014	Pagnoul, A. Beetroots; Composition of some Varieties of — Butters; Composition of —	732
Oehler, K. Colouring Matters; Disazo Red and Violet — (P)	803, 807	Pain, P. Santonin; The B. P. Test for —	938
Oehmichen. Platinum-Gold-Silver Assay	803	Pakes, W. C. C. and Jollyman, W. H. Formates; Bacterial Oxidation of —, by Nitrates	232
Oelbermann, E. Candles and other Illuminants; Manufacture of — (P)	1200	Formic Acid; Bacterial Decomposition of —	292
Oesterheld, A. Leather and Rubber Substitute, and an Adhesive; Manufacture of — (P)	1222	Palas, H. J. U. and Cotta, F. A. J. Sulphates; Electrolytic Production of Metallic — (P)	906
Oesterreich. Gaslöh. and Electric Gesellschaft. Osmium Filaments of Incandescence Lamps; Means for Supporting — (P)	834	Pallitseau, P. G. See Dobbie, J. J.	66
Oettel, F. Bleaching Apparatus; Electrical —, of Haas and Oettel	130	Pallester, P. See Fischer, G.	564
Ogawa. See Divers, E.	716	Palmais, P. Dephosphoration Scoriae; Notes on Treatment of —	267
Ohlsson, O. Centrifugal Separating Apparatus (P)	344	Palmer, A. N. Tan-Yard Liquors; Determination of Tanning Substance in —	138
Opalite Tile Co. Glass Tiles; Manufacture of — (P)	364	Palmer, H. and Calderwood, W. Candles for Spring Lamps (P)	910
Oppenheimer, C. Ferment Processes; Theory of —	735	Pant-American Light Co. The Hydrocarbon Burners (P)	1199
"Ferments and Their Actions"	1255	Pantgwyn, W. F. R. Gas for Regenerative Furnaces; Production of — (P)	350
Orchard, R., and Fox, C. E. Water; Purification or Sterilisation of — (P)	1230	Panzl, R. and Troetscher, A. Tubes and Vessels; Protective Linings for — (P)	27
Ordé, E. L. See Armstrong, Whitworth and Co.	109	Pape, E. C. H. and Henneberg, W. S. Ores and Metallurgical Products; Crushing and Lixiviating — (P)	587
See Armstrong, Whitworth and Co.	882	Pappenheim, V. See Winter, R.	1120
Orlow, N. A. Boron; Impurities in Commercial Amorphous Sulphur; Reaction for Formation of Green Modification of —	845	Paramore, E. C. Chlorine Gas; Electrical Method and Apparatus for Generating, — (P)	1002
Sulphuric Acid; Seleniferous —	943	Parker, A. Electric Furnaces; Continuous Arc — (P)	977
Wöhler's Sulphur; Formation of Blue or Green —	280	Parker, C. Tanning Materials; Discussion on Leather-Forming Value of Different	434
And Horst, P. K. Alkaloids; New Reagent for —	943	Parker, F. W. Fluids; Cooling or Condensing —, and Apparatus therefor (P)	694
And Horst, P. K. Morphine; Determination of —	511	Parker, G. E. Coated Wire; Manufacture of — (P)	729
Ormandy, W. R. See Pilkington, W. W.	511	Parker, J. Gordon. Tanning Materials; Discussion on Leather-Forming Value of Different	436
Orndorff, W. R., and Brewer, C. E. Gallein and Coerulein; Constitution of —	900	Parker, J. Gordon and Gansser, A. Tanning Extracts containing Bisulphites; Effect of — on Leather	1085
Orton, J. S. See Meldrum Brothers	979	Parkes, L. and Rideal, S. Water-borne Enteric Fever; Prevention of —	1229
Osaka, Y. Dextrose; Birotation of —	694	Parr, J. See Cooke, G.	817
Osann, B. Blast Furnace; Calculation of Composition of Cases from —, and Volume and Loss of Blast in the —	395	Parry, E. J. Citronella Oil	930
Osenbrück, A. Ammonia Process for Working Cooling and Ice Machines (P)	1213	Lemon Oil; Determination of Citral in —	75
Oshima, K., and Tollens, B. "Nori" from Japan	974	Lemon Oil Industry; Discussion on the —	1182
Ost, H., and Klapproth, W. Tin; Precipitation and Separation of —	737	Shellac; Analysis of —	1245
O'Sullivan, C. Gum Tragacanth	1028	Parsons, C. L. Sodium; Use of — in Blow-pipe Analysis	618
Oswald, F. Lactic Acid in Calico Printing; Some Applications of —	733	Partheil, A. Boric Acid and Lactic Acid; Determination of —	1244
Ott, E. See Kehrman, F.	40	And Bose, J. A. Boric Acid; Direct Gravimetric Determination of —	1244
Ott, G. Porcelain and the like; Fusing of — (P)	1201	Parziale, T. Soap; Manufacture of — (P)	591
Otto, C. Iron and Steel; Direct Production of —	581	Passburg, E. Milk; Solidifying and Preserving — (P)	827
Otto, M. Ice Manufacturers; Treatment of Water for — (P)	44	Passmore, F. W. See Helbing, H. B.	50, 50
Petroleum; Product Obtained by Solution of Ozone in — (P)	147	Passon, M. Calcium; Determination of — by the Citrate Method	507
	112	Passow, H. Cement; Production of First Class — (P)	992
		Patent Agglomeration Fuel Syndicate and Others. Fuel, Artificial; Manufacture of — (P)	350
		Paterson, R. M. See Craig, G.	808, 809
		Paton, J. McC. C. See Elliott, J. B.	1194
		Patterson, T. L. Sugar Refining; Improvements in — during last Twenty-five Years	1088
		Paucheur, J. Briquette; Combustible — (P)	30
		Paul, B. H. and Cownley, A. J. Arsenic in Beer and Sugar; Detection of —	158
		Ipecacuanha; Alkaloids of —	500
		Ipecacuanha; Chemistry of —	500
		Paul, J. H. See Dewrance, J.	110
		Paul, L. See St. v. Kostanecki.	1106



	PAGE
Paul, T. Theobromine; Properties of —	635
Pauli, R. Brown-Coal Tar Purification; Chemical Function of Sulphuric Acid in —	32
Paraffin; Extraction of — from Lignite Tar (P)	978
Paulitschky, C. Sponges; Manufacture of Artificial — (P)	1224
And R. and Wüste, F. Rubber Substitutes; Manufacture of — (P)	912
Pawlewski, B. Canarine; New Formation of —	113
Peary, A. C. See Curtis, C. H.	1240
Peckham, S. F. See Klein, O. H.	539
Pélabon, H. Bismuth Sulphide; Action of Hydrogen on —	255
Pellat, H. Cane Sugar; Specific Rotation of —	1224
Pellerin, A. Margarine; Manufacture of —	1229
Pellet, H. Acidity and Alkalinity in Coloured Sugar Solutions; Determination of —	488
Beetroot Juice; Krause and Perroche Methods for Determining Purity of —	488
Cane Sugar; Determination of — in Presence of Levulose, &c.	754
Glucose; Analysis of Commercial —	754
Mannose in Cane Sugar Products; Detection and Determination of —	754
Nitrites; Determination of —	156
Salicylic Acid in Wine; Source of Error in Detection of —	284
Salicylic Acid in Wines; Cause of Error in Detection of —	158
Sugar Solutions; Solubility of Lime in —	821
Syrups and Maseuites; Determination of Real and Apparent Purity of —	489
Third-Jet Sugar and Molasses; Composition of Insoluble Matter of —	53
And Weisberg, J. Sugar Solutions; Solubility of Lime in —	733
Pemberton, W. Water; Apparatus for Softening and Purifying — (P)	601
Pentecost, S. T. Tanning Extracts; Discussion on —	1087
Pepin. See Roubertie.	568
Périn, L. Plaster of Paris; Determination of Underburnt and Overburnt —	156
Perkin, F. Mollwo. "Qualitative Chemical Analysis, Organic and Inorganic"	162
Stannous Sulphide; Action of Caustic Potash and Soda on —	425
Sulphuretted Hydrogen; Obtaining a Saturated Aqueous Solution of —	438
Perman, E. P. Ammonia Solution; Vapour Pressure of Aqueous —	473
Ammonia Solution; Vapour Pressure of Aqueous —; Influence of Sodium Sulphate on —	474
Nitric Acid in Alkali Nitrates; Detection and Determination of —	619
Perrier, A. Gas; Apparatus for Production of — (P)	39
Perrin, F. See Lumière, A. and L.	497, 1232
Perrot, E. Broom; Dangerous Substitution of Spanish — for Common —	944
Pertsch, F. A. Amido-benzoic Acids, Anthranilic Acid, and Colouring Matters therefrom; Manufacture of Substituted — (P)	1204
Péry, R. See Barthe, L.	513
Peska, Z. Formaldehyde; Determination of —	10.1
Peters, C. A. Calcium, Strontium and Barium; Determination of — as Oxalates	1143
Copper as Oxalate; Volumetric Determination of —	137
Petit, P. Malt Worts; Analysis of Saccharified —	142
Petkow, X. Walnut Oil; Bulgarian —	1122
Petolite Fuel Syndicate and Johnson, E. Compound for Manufacture of Briquettes of Artificial Fuel (P)	563
Pétréano, E., and La Comp. d'Incandescence par le Pétrole et l'Alcool. Hydrocarbon Burner without Solder (P)	234
Pettigrew. Arsenic; Discussion on Detection of —	237
Peust, A. W., and Apel, A. Insulating Coatings for Electric Conductors (P)	365
Pfahler, H. Saccharometer Readings	269
Pfahner, N. Nickel Ammonium Sulphate; Electro-Chemical Behaviour of —	906
Pfeiffer, H. See Einhorn, A.	1134
Pfeiffer, P. See Möller, G.	582
Pfister, J. Timber; Dyeing or Preserving — (P)	900
Pfefer, J. See Ewan, T.	838
Pfeiderer. See Werner	789
Philip, M. Cotton Goods; Yellowish Stains on Hot-Calendered Oxycellulose; Detection of —	358, 393
Philips, M., and Muller, O. Food for Animals; Treatment of Cotton Pods for Manufacture of — (P)	788
Philipson, E., and others. Vapour Burning Apparatus and Systems (P)	563
Phillips, F. C. Hydrogen in Gas Mixtures; Estimation of —	752
Philp, H. R. A. Paint; Preservative — for India-Rubber Tyres	911

	PAGE
Phlox-Glühlicht-Gesellschaft. Mantles for Incandescence Gas (P)	794
Piccard, J. Glass; Plasticity and Adhesiveness of Diamond-cut —	1210
Pich, F. Soldering Experiments with "Ferrofix" (P)	1215
Pick, W. Ferrates; Electro-Chemical Production of —	905
Pickard, H. J. H., and Evans, J. S. Accumulator Plates; Composition of Paste for Filling Cells of — (P)	482
Pickering, J., and Macgregor, P. Sugar Juice, &c.; Subsiders for — (P)	915
Pictet, A., and Rotschy, A. Tobacco; New Alkaloids of —	501
Pictet, R. P. Gases; Separation of —, and Apparatus therefor (P)	1194
Pierce, S. F. Heat-producing Devices for Smelting in Electric Furnaces (P)	1221
Pierron, L. See Raynaud, E.	42, 52
Pilkington, W. W., and Ormandy, W. R. Fire-Bricks and Cement; Manufacture of — (P)	900
Pintsch, J. Gas for Power Purposes; Generation and Supply of — (P)	699
Pioneer Investment Trust, The. See Smith, R. F. W.	61
Pitcher, F. H. See Tory, H. M.	946
Pitman, J. R. Powder Explosion at Indian Head; Discussion on —	103
Pitoy, H. F. Fermented Non-Alcoholic Beverage; Preparation of — (P)	826
Pittsburg Reduction Co. Aluminium; Purification of — (P)	727
Pivert, J. See Masseron, A.	1110
Plagwitz, P., and Freund, F. Photographic Plates, &c.; Protecting Paint for — (P)	154
Plaissetty, A. M. Mantles for Incandescence Gas-lighting (P)	699
Nitrocellulose Compounds; Preparation of Non-Inflammable — (P)	709
Planru, E. Textiles; Apparatus for Treating — with Liquids (P)	985
Playfair, D. J. Sugar Refining; Discussion on —	1092
Poech, K. See Turner, T.	583
Poetter, H. Gas Generators (P)	883
Pohl, E. C., and Croasdale, S. Ores; Reduction of Refractory — (P)	368
Polenske, E. Borax; Behaviour of —, on Distillation with Methyl Alcohol.	273
Pollak, A., and Esser, C. Peat Turf; Treatment of — for Paper-making (P)	830
Pollak, J. See Herzog, J.	700
Poltvein, H. Tannase; Preparation of —	137
Pommeranz, C. Ethoxy-Isoeugenol; Preparation of —	1135
Pommerehne, H. Damascenine; Action of Alkali on —	500
Pontini, V. U. See Depangher, M.	728
Poole, H. S. Coals; Effect of Washing Certain Cape Breton —	562
Pope, T. H. See Ling, A. R.	755
Popp and Becker. See Wood, J. T.	263
Poppe, M. Butter, Artificial; Manufacture of — (P)	924
Butter; Manufacture of — (P)	1132
Poppe, O. Leather; Artificial — (P)	373
Poppewell, J. M. Prussian Blue in Spent Oxide; Rapid Determination of —	225
Porter, H. F. J. Nickel Steel as Used in Commercial Work	996
Porter, R. Water-Gas Practice; British —	790
Portes, L. and Desmoulières, A. Salicylic Acid; Occurrence of — in Strawberries	1220
Posener, A. M., and Clerke, F. W. Artificial Leather, Floor-Coverings, &c. Manufacture of — (P)	913, 913
Potměšil, R. See Votoček, E.	1147
Potter, H. N. See Wurts, A. J.	566
Pottevin, H. Gallotannin; Constitution of — (P)	486
Potut, J. Sulphuric Acid; Apparatus for Manufacture of — (P)	363
Sulphuric Acid; Manufacture of — (P)	987
Potvliet, M. Sandalwood Oil; East Indian —	1017
Pouchet, G. Antimony; Localisation and Dissemination of — in the Organism	1253
Poulenc, C. Les Nouveautés Chimiques pour 1901	758
Poupé, F. Beet Juice; Apparatus for Removal of Air from —	267
Powér F. B. Bark of Robinia Pseud-Acacia	1018
Manganese and Iron; Compounds of —	927
Manganese Citrate; A Soluble —	927
And Lees, F. H. Asarum Canadense; Constituents of Essential Oil of —	1238
And Shedden, F. Iodo-tannin Compounds; Chemical Character of —	1015
Powter, N. B. Oil, Grease and Glue; Extraction of — from Wastes, and Apparatus therefor (P)	485
Separating Apparatus (P)	788
Pozzi-Escot, E. Alkaloids; Micro-Chemical Detection of —	1030
Alkaloids; Micro-Chemical Investigation of —	605
Praetorius, A. See Bamberger, M.	1202



	PAGE		PAGE
Prager, B. Aminoazo Compounds; Fatty Acid —	1202	Ramsay, W. Oxide of Hydrogen Higher than the Dioxide	1254
Prampolini, V. Gum; Manufacture of Elastic — (P)	373	Varnish; Discussion on Manufacture of —	1077
Predmerský J. and G. Acetylene Gas; Apparatus for Generating — (P)	111	And Homfray, I. Oxygen Dissolved in Water; Colorimetric Method for Determining —	1071
Pregardien, J. E. Gas; Apparatus for Purifying — (P)	1101	Rankin, D. J. "Prospecting for Gold"	1256
Prentiss, F. F. See Morse, E. F.	343	Ranwez, F. Cocoanut Oil in Butter; Detection of —	1030
Prescher, H. Gas; Apparatus for Self-ignition of — (P)	699	Raphael, M. Asbestos; Rendering — Waterproof and more Fire-Resisting (P)	1212
Prescott, Prof. Proceedings of Annual Meeting	677	And Elias, L. Insulating Material; and Manufacture thereof (P)	582
Prescott, A. B. Methyl Alcohol; Detection of — in Presence of Ethyl Alcohol	1030	Rapoport, J. Enamelled Articles; Manufacture of — (P)	1211
Proceedings of Annual Meeting	661	Rapp, R. See Buchner, E.	734
Prested, H. G. Gases; Apparatus for Indicating Presence of Dangerous — (P)	350	Rasch, E. Electric Arc Light (P)	699
Preston, E. Yarns; Power-Dyeing Machines for — (P)	1110	Raschen, J., and others. Cyanides; Manufacture of —, and Apparatus therefor (P)	809
Preto F. W. Tin; Extraction of —, from Waste (P)	368	Rasmussen, E. A. See Ammundsen, J. S.	135, 148
Preuss, P. Balsam of Peru	606	Rattaire, J., and Cottard, A. Soaps Soluble in Sea-Water; Manufacture of — (P)	372
Peru Balsam in Central America	150	Rauch, J. Tar; Manufacture of — (P)	352
Prevost, H. E. See McLeod, J. A.	1219	Raufer, G. Copper Oxide for Glass-Making	899
Preyer, A. Cacao Fermentation	735	Rawson, C. Indigo Industry in India	165
Price, H. H. See Gutensohn, A.	723	And others. "A Dictionary of Dyes, Mordants, and other Compounds used in Dyeing and Calico Printing"	1152
Priest, M. See Moor, C. G.	385	Rawson, W. S., and Littlefield, R. D. Refractory Bricks, etc.; Manufactory of — (P)	992
Pritzko, A. Beetroot Sugar Factory Effluent; Purification of —	1226	Ray, P. C. Mercurous Nitrite	742
Procter, H. R. Tannin; International Association Method of Determining —	104	Raynaud, E., and Pierron, L. Sulphuric Acid by the Catalytic Process; Manufacture of — (P)	42
Tannin; Report on Methods for Determining —	1246	Sulphurous Acid; Purification of — (P)	42
Tanning Materials; Discussion on Leather-forming Value of Different —	434	Raynes, A. Marking Inks and Vessel for Holding Same (P)	1108
And Searle, A. B. Leather; Mineral Acids in; Determination of —	287	Rebuffat, O. Calorific Power of Fuels; Determination of —	563
Prost, E. Fluorine in Zinc Blende; Determination of —	506	Portland Cement and Sulpho-Aluminate of Calcium; Action of Sea-Water on —	581
Prud'homme, M. Dyeing Wool Black by Iron Nitrosulphide	575	Recoara, A. Basic Salts with Two Metals	806
Prunier, L. Hydrocyanic Acid; Preparation of Official —	273	Metallic Hydroxide; Action of —, on Salts of other Metals	806
Puckner, W. A. Morphine; Extraction of — from Solutions	928	Redwood, B. See Thomson, J. H.	848
Pullar, Sir R. Proceedings of Annual Meeting	676, 677	Reeb. See Schlagdenhauffen	66
Speech at Annual Dinner	685	Reeb, H. Gold Chloride; New Method of Titrating —	620
Puls, K. Toluene; Electrolytic Oxidation of —	464	Reeves, E. K. See Hendlar, J. J.	564
Pum and Micko. Oranges; Artificial Colouring of —	58	Reeves, K. H. Sewage and Effluents; Treatment of — (P)	601
Punnett, H. M. and H. M., Jun. Metals; Electro-deposition of — (P)	50	Règle, L. M. Glass Melting Pots or Crucibles (P)	252
Purgotti, A. and L. Match Composition; free from Phosphorus; Igniting —	747	Reichard, C. Chronic Acid; Detection of — in Presence of Vanadic Acid	1241
Purves, W. T., and The Notkin Syndicate. Air or Gas Apparatus for Carburetting — (P)	462	Cyanides; Isopurpuric Acid Test for —	935
		Morphine; Determination of —	169, 624
		Morphine in Opium; Determination of —	1129
		Potassium; Detection of — by Means of Sodium Picrate	938
		Reicher, L. T. Butter; Low Reichert-Meissl Value of Dutch —	379
		Reichmann, F. A., and Lagerqvist, C. A. Mercerising Yarns and Fabrics (P)	469
		Reid, W. F. "Heat Test" for Explosives; Discussion on the —	12
		Proceedings of Annual Meeting	662
		Sulphuric and Nitric Acid Manufacture; Discussion on —	8
		Tanning Materials; Discussion on Leather-forming Value of Different —	435
		Varnish; Discussion on Manufacture of —	1077
		And The Velvrl Co., Ltd. Coverings for the Drawing Rolls used in Spinning Cotton (P)	148
		Reim, C. Alkali Silicate; Production of a Dry — (P)	808
		Reimer. See Haarmann	150, 745, 1018
		Rein, B. Fuel, Liquid; Apparatus for Burning — (P)	563
		Generators and Burners for Boilers, etc.; Hydrocarbon Vapour — (P)	560
		Reinders, W. See Bredig, G.	845
		Reinicken, A. See Graeve, S. von	261
		Reinke, O. Copper; Electrolytic Estimation of —	283
		Reinsch, H. Waters; Apparatus for Purification of — (P)	495
		Reisz, F. "Ice Colours" on Wool and Silk; Formation of —	243
		Renault, A., and Cusson, G. Flour and other Pulverulent Materials; Machines for Purifying and Separating — (P)	460
		Rensing, C. Sandstones; Hardening Calcareous — (P)	125
		Renz, C. Indium; Characteristics of —	1145
		Rey, J. A., and J. M. B. Hydrocarbons and other Combustible Liquids; Apparatus for Burning — (P)	976
		Reynolds, A. Crucibles and Crucible Furnaces (P)	47
		Metals; Converter Treatment of —, and Apparatus therefor (P)	587
		Reyval, J. Metals; Electrolytic Cleansing of —	50
		Rheinfeld, D. See Lessing, W.	253
		Rhodes, W. See Maddison, J. W.	1113
		Rhodin, J. G. A. Gaseous Matter; Device for Indicating Presence of Explosive — (P)	31
		Potash Salts; Production of Soluble —, from Potassium Felspar —	439
		Rich, E. M. See Jackson, W.	43, 555

Q

Quantin, H. Rum; Non-Existence of Methyl Alcohol in — Tartar; Commercial Determination of —	143 941
Quasig, R. See Ladenburg, A.	749
Quennessen. See Leidié	1242
Quilez-Quilez, D. See Cruz-Pasqual	33
Quinan, K. B. Gun cotton and Smokeless Powder; Estimation of Soluble Nitrocellulose in —	844

R

Raab, A. Fluorescent Bodies; Antiseptic Action of —	61
Rabe, H. Sulphuric Acid; Water or Sulphur Trioxide in Fuming —	619
Radclyffe, D. E. Mantles of Incandescent Lamps, and Covers of Tyres; Fabric for — (P)	111
Ragosine, A. Viscosimeter; the Engler-Ragosine —	933
Rahften, A. Indigo, Monobrom, Dibrom, etc.; Preparation of — (P)	1205
Railsback, L. D. Acetylene Gas; Apparatus for Generating — (P)	111
Raken, H. See Smits, A.	73
Ralli, P. A., and others. Gutta-Percha; Substitute for — (P)	263
Ramage, A. S. Colour Substances from Ferrous Liquors (P)	910
Ferro-Ferric Oxide; Obtainment of — (P)	809
Oils for Manufacture of Paints and Varnishes (P)	1003
Ramage, H. See Hartley, W. N.	513, 99



	PAGE
Richard, M. Alizarin Blue Resist under Paranitraniline Red	712
Prussian Blue Reserve under Paranitraniline Red	884
Richards, G. H. Insecticide; Preparation of — (P)	1133
Richards, J. Residuals from Use of White Metal; Utilisation of	902
Richards, J. W. Blast-Furnace Gases; Use of — in Gas Engines	108
Gold and Silver Buttons in Quantitative Blowpipe Assays; Measurement of —	839
Iron in Magnetite Ores; Determination of —	126
And others. Calcium Oxalate; Oclusion of Magnesium Oxalate by —	1026
And others. Calcium Oxalate; Solubility of —	1026
Richardson. Beer and Malt, Arsenical; Discussion on —	342
Richardson, A. Blowpipe; A Kerosine Oil	747
Richardson, C. Analysis; Uniformity in Technical —	334
Letter to President	689
Proceedings of Annual Meeting	677
Speech at Annual Dinner	685
And Wallace, E. C. Petroleum from the Beaumont, Texas, Field	690
Richardson, C. G. Gas-Lighting; Incandescence — (P)	566
Richardson, E. J. See Joly, C.	1095
Riches, H. L., and the Wool, Hide, and Skin Syndicate. Hides, Skins, and Furs; Treating and Preserving — (P)	913
Hides and Skins; Removing Hair, Wool, and Fur from — (P)	1124
Richter, F. Oil-Burners; Incandescence — (P)	565
Richter, M. See Fischer, G.	564
Rickard, T. A. Telluride Gold Ores of Cripple Creek and Kalgoorlie	45
Rideal, S. Oxygen Dissolved in Water; Discussion on Determination of —	1074
Sewage, Bacterial Treatment of —; Humus and Irreducible Residue in the —	1132
Sewage Effluents; Aeration Test for —	1012
Sulphuric Acid as a Typhoid Disinfectant	1133
Tanning Materials; Discussion on Leather-forming Value of Different —	434
And Stewart, C. G. Nitrites and Organic Matter in Waters	841
And Stewart, C. G. Oxygen in Waters; Determination of —	841
See Parkes, L.	1229
Ridsdale, C. H. Steel; Correct Treatment of —	994
Rieder, J. Electrolytic Manufacture of Polishing Tools	1002
Rieger, E. Formaldehyde and Milk Sugar in Milk; Detection of —	285
Formaldehyde; Gasometric Determination of —	510
Saccharin and Salicylic Acid, or Mixtures; Detection of —	284
Salts; Constitution of Semi-Complex —	1001
Riesefeld, E. H. Electrolytic Phenomena at the Interface between two Solvents	726
Rigamonti, C., and Tagliani, G. Kiers for Bleaching Textile Fabrics (P)	577
Riley, F. G. Filtering Apparatus (P)	344
Ripper, M. Aldehydes; Volumetric Determination of —	288
Rissmuller, L. Whale and Seal Oils; Bleaching of — (P)	1005
Ritter, E. Cholesterol Phytosterol; Quantitative Extraction of —, from Fats	1147
Robb, H. de V. Sugar; Apparatus for Dissolving — (P) ..	489
Roberts, F. G. Adair. Arsenic; Discussion on Occurrence and Detection of —	190
Robertson, F. E. Soap; Effect of Sodium Chloride in Estimating Free Alkali Hydrate and Carbonate in —	936
Robertson, J. H., and others. Fibrous Material; Coating of —, with Metal (P)	260
Robin Hood Powder Co. Explosives; Manufacture of — (P)	1141
Robin-Langlois, J. Sugar-Refining; Method and Apparatus for — (P)	55
Robine, R. Methyl Alcohol in Vinegar; Detection of —	753
Robrecht, G. Stains and Unevenness in Dyed Woolen Tissues; Causes of —	39
Rocca, E. Oils; Method and Apparatus for Refining — (P) ..	485
Rochereau. See Truchelut.	387
Roe, J. P. Iron; Puddling — (P)	129
Roesler, F. A., and Hackl, H. Aniline Black over-dyed with Basic Dyestuffs; Bronzing of —	39
Roesler. Rhodium Alloys; Characteristics of —	128
Rössler, O. Morphine Salts; Impurity of —	1015
Röttger, H. Water; Apparatus for Taking Samples of —	59
Rogenhagen, F. K. Soaps; Chemical Composition and Disinfecting Properties of —	371
Rogers, W. H., and Beaver, J. A. Tin Plate; Manufacture of —, and Apparatus therefor (P)	129
Rogow, M. β Naphthol and Aldehydes; Reaction between	393
Rohde, A. Nitro-Compounds; Electrolytic Reduction of —	132

	PAGE
Rohde, G. See Müller, W. Van	63
Rohrer, M. Antimonic Acid; Iodometric Determination of —	749
Antimony; Volumetric Determination of —	749
Arsenic; Separation of — from Antimony, &c.	282
Rohn, S. Yeast and Grain Distilleries; Examination and Foodstuff Classification of —	58
Rohahn, W. See Soden, H. von. 64, 65, 833, 1136, 1136, 1236	1236
Roller Maschinenfabrik. Drying Apparatus (P)	694
Romann, A. Silk; Detection of Weighing Matters in —	1147
Romburgh, P. van. Basil Oil; A New Terpene in —	744
Ronay, A. Briquettes from Pulverulent Ore; Manufacture of — (P)	723
Rose, F. Carbide and Acetylene Industries in Germany; Report on —	28
Rose, F. B. Report on Chemical Instruction and Industries in Germany	849
Rosenberg, A. Gas-Lights; Self-igniting Incandescence — (P)	1199
Rosenberg, M. Barley "Biting Test"; Infection with Actinomyces	826
Rosenfeld, F. Asparagin; Nutritive Value of —	271
Rosenfeld, M. Acetylene Lamp; New Immersion —	348
Rosenheim, A., and Huldsehinsky, E. Nickel and Cobalt; Quantitative Separation of —	840
Rosenheim, O. Arsenic; Influence of Selenium on Tests for —	751
See Tunnicliffe, F. W.	390
Rosenstiehl, A. Dyestuffs; Reduction of Nitrated Azo —	570
Rosenthal, S. A. Firedamp in Collieries; Detection and Indication of — (P)	350
Rosenthal, T. Brown Coal Tar; Constituents of —	885
Rosier, C. A. Burners; Hydrocarbon —, for Use in Furnaces (P)	110
Ross, J. H. Acetylene Gas; Apparatus for Generating — (P) ..	564
Ross, J. M., and Schneider, J. Mercerising Apparatus (P)	709
Roszbach, G. See Müller, F.	1123
Roszel, A., and Landriset, E. Acetylene; Analysis and Purification of —	345
Rossi, A. J., and others. Titanic Oxide; Concentrates containing — (P)	588
Roth, C. Manures; Artificial — (P)	914
Rothwell, J. E. Gold Extraction at Florence, Colorado	812
Rothwell, O. F. S. See Thornton, J. E.	68
Rothwell, R. P. "The Mineral Industry; its Statistics, Technology, and Trade"	945
Rotschy, A. See Pictet, A.	501
Rotten. Methyl Alcohol; Pure —	604
Roubertie and Pepin. Chlorine; Production of —, by Electrolysis	588
Rouse, T. Concrete Articles; Manufacture of — (P)	810
Roussy de Sales, G. de. Batteries; Secondary — (P)	726
Roux, E. See Maquenne, L. 605, 847	847
Rowland, S. See Harden, A.	1228
Roxburgh, J. J. C., and Scott, C. F. H. Wash or Dip for Animals (P)	1133
Royley, M. See Spence, F. M.	830
Rozycki, A. See Kostanecki, S. v.	116
Rubenstein, J. Lamps; Incandescence Oil and Spirit — (P) ..	565
Rubner and Schmidtman. River-Water Pollution by Waste Lye	738
Rudloff. Alloys of Iron and Nickel	127
Rudolf, J. Fibrous Materials; Impregnation of —, with Substances of Low Melting Point	38
Rudolph, A. Air; Apparatus for Carburetting — (P)	462
Rudolph, B. Wheat-Malt; Manufacture of —	141
Rudolph, C. Colouring Matter; Black —, and Condensation Products; Manufacture of (P)	468
Rüffer, E. Oats; Employment of — in Manufacture of Beer	1008
Ruegenberg, M. J., and Smith, E. F. Tungsten Trioxide; Separation of — from Molybdenum Trioxide	69
Rümmler, T. Scale in Steam Boilers; Composition for Removal of — (P)	105
Rümpler, A. Crystallisation; General Method for Inducing	291
Ruff, O. Ferric Oxide and its Hydrates	1252
Nitrogen Iodide; Characteristics of —	68
And Stein, V. Diazo-Compounds; Sensitiveness of — to Light	834
Ruffle, J. Basic Superphosphate; Discussion on —	323, 331
Ruggeri, R. See Tortelli, M.	261, 753
Rumpf, C. Dyes, Fast Brown, on Wool; Production of —	890
Dyestuffs; Rendering — faster to Water, Soap, and Acids ..	983
Rumpler, Potassium Hydroxide; Absorption of — by Silicates	846
Rumsey, H. W. See Vickers, J. W.	68



	PAGE
Rung, F. See Binz, A.	116
Runyan, E. G. Wines; Indicator for Determining Total Acidity of —	941
Rupe, H., and Majewski, K. von. Diazoimides (Triazo-compounds)	151
And Majewski, K. von. Osomorphous (Scent-forming) Groups	151
And Wasserzug, D. Chromophoric Groups	1200
Rupp, E. Mercury in Mercury Salicylate; Determination of —	604
Ruppert, O. Gas and Coke; Manufacture of —, and Apparatus therefor (P)	1198
Russell, H. L. Anthrax Traceable to Tannery Refuse; Report on —	405
Tannery Refuse; Anthrax Traceable to —	494
Russig, F., and Fortman, G. Cresol: Determination of —	394
Ruthenburg, M. Ores and Concentrates; Agglomerating Comminuted —, and Reducing Metal therefrom (P)	1218
Ruttenau, W., and Hahlo, C. Dyeing; Method and Apparatus for — (P)	713
Rutter, H. F. Sand Filters; Working of —	1230
Ryan, T. D. See Martin, A. H.	1133

S

Saare, D. Finishing Materials containing Starch, &c.	1206
Sabatier, P. Metallic Oxide or Hydroxide; Action of — on Solutions of Salts of other Metals	806
And Senderens, J. B. Aniline and Analogous Bases; Preparation of —	978
Sabel, W. B. See Philipson, E.	563
Sabrée, T. T., and Hansen, H. J. T. Fluids; Apparatus for Equalising the Temperature of — (P)	1194
Sachs, F. Tables for Conversion of Quotients of Purity and Saline Quotients of Sugar Products	1225
Sack, J. See Greshoff, M.	817
Sadtler, S. P. "Handbook of Industrial Organic Chemistry." 3rd Edition	78
Saget, G. Bleaching; Notes on —	359
Saget, M. G. Potassium Permanganate; Application of — in Dyeing	575
Sahlfeld, F. See Bornträger, H.	823
Sahlin, A. Blast-Furnace Bosh; A Water-cooled —	720
Pig Iron for Acid Steel Processes; High Silicon in —	721
St. C. Legge, J. Incandescence Lighting; Mixture for — (P)	564
St. Minovici. Picrotoxin; New Reaction for —	285
Sales. See under Roussy de Sales.	
Salkowski, E. Albuminoids; Precipitation of — by Chloroform	379
Invertase of Yeast	489
Salkowski, H. Sodium Chromate; New Hydrate of —	806
Salt, J. Pottery; Flowing Under-Glaze Colours in —	1211
Salter, C. Translation of L. Geschwind's "The Manufacture of Alum, and the Sulphates and other Salts of Alumina and Iron"	847
Samelson, S. Azo-compounds from <i>m</i> -Toluidine	240
San Martin, P. V. See Trant, L. B.	731
Sanchez-Rosal, E. See Heyne, P.	628
Sand, H. J. S. Copper Sulphate and Sulphuric Acid; Electrolysis of a Mixture of —	725
Sander, W. E. Filaments for Incandescence Electric Lamps (P)	1199
Sanders, J. F. Carbons; Electric Light — (P)	236
Saniter, F. L., and others. Steel Furnaces; Open-Hearth — (P)	903
Sansone, A., and The Clayton Aniline Co. Sulphide Colours; Printing with — (P)	893
Sarg, E. Moulding Material for Use in Casting Steel (P)	46
Sargeant, E. W. See Gwynne, J.	368
Sargent, C. L. Tungsten and Molybdenum Alloys; Production of —	134
Sárkány, J. See Csáky, S.	883
Sarnighausen, W. Yeast; Treating Brewers' for Making Bakers' — (P)	1131
Sasse, F. Gas Purifying Apparatus	564
Satie, C. See Jeancard, P.	607, 607, 1237
Sauer, A. Milk Similar in Composition to Human Milk; Production of Condensed — (P)	380
Sauer, F. Beer and Pressed Yeast; Simultaneous Manufacture of — (P)	920
Saxl, H., and others. Superphosphates; Manufacture of — (P)	374
Saxon, G. J. and A. See Garside, J.	28
Sazerac, R. See Bertrand, G.	826

	PAGE
Schorowitz, S. Marble; Production of Artificial — (P)	992
Schaal, E., and M. Gum Copal and Amber; Substitute for — (P)	263
Schacherl, G. Carbolic Acid; Determination of Crude —	1231
Schacht, W. Cellulose (Wood Pulp); Alkaline Process of Boiling —	1230
Schaer, E. Ferric Salts in Solution; Physical and Chemical Alteration of —	742
Schärtler, C. Stoneware Industry	980
Schaffstädt, H. Cooling and Concentrating Apparatus (P) ..	105
Schaller. Furnace for Ignition of Magnesium Ammonium Phosphate	1025
Schapiro, A. Burners; Incandescence Oil-Lamp — (P) ...	1199
Schaposchnikoff, W. See Kehrman, F.	116
Schauer, J. R. Incandescence Mantles for Gas-Lighting (P) ..	1199
Schauwecker, O. See Harries, C.	1136
Scheibe, A. Lactose in Milk; Determination of —	287
Schenck, R. Sulphur Trioxide	577
Scherdel, H. White Discharge Effect on Blue Ground; Production of —	576
Schertel, A. Lead-refining Furnace; Separation of Mass Rich in Copper in the —	366
Scheuer, C. Hydrochloric Acid Free from Sulphuric Acid; Preparation of — (P)	1112
Scheuffgen, B. Explosion of Fluids by Ignition; Apparatus for Preventing — (P)	974
Scheurer, A. Ammonium Persulphate; Destructive Action of —, on Cotton	391
Chromium Phosphate Green on Chromium Chromate Brown Ground	391
And Schoellkopf, A. Lactic Acid; Application of —, in Dyeing Aniline Black	710
Schütz, T. See Gnehm, R.	798
Schierholz, K. Water; Purification of —	271
Schill, C. H., and Primrose, W. G. Gas; Manufacture of — (P)	975
Schilling, B. Griess-Diaminobenzoic Acid, for Identifying Sugars, &c.	621
Schimmel and Co. Methyl Methylantranilate; Preparation of, — (P)	1015
Schindelmeiser, J. Alkaloids; Solubility of —, in Carbon Tetrachloride	384
Schirmann. Potato Spirit from the Mashing Space; High Yields of —	56
Schirp, P. Textiles; Apparatus for Dyeing, Washing, &c. — (P)	471
Schlagdenhauffen and Reeb. Erysimin, a New Glucoside from Erysimum Seeds	63
Schleuning, W. See Terranova Industrie	473
Schlichtegroll, C. F. von. Spirit; Rectification of — (P) ...	827
Schlump, C. See Czerny, C.	252
Schloesing, T. Phosphoric Acid in Soils; Determination of —	759
Schlomann, H. W. See Castro, A. de	133
Schmatolla, E. Carbon Dioxide Manufacture	121
Schmatolla, O. Camphor in Spirit of Camphor; Determination of Oxalic Acid; Preparation of Chemically Pure —	756
Tin; Flame Reaction of —	493
Tin; Flame Reaction of —	748
Schmidt, E. Citroptene; Characteristics of —	1017
Schmidt, H. Kilns for Cement, &c. (P)	582
Schmidt, J. Nitrous Acid; Action of —, on α - and β -Naphthol	113
Schmidt, O. Effluents; Apparatus for Purifying — (P) ...	381
Hydrogen from Electrolysis of Water; Lighting with Waste Waters; Purification of —, and Recovery of Pulp Water; Electrolysis of —, on the Large Scale	109
Hydrogen from Electrolysis of Water; Lighting with Waste Waters; Purification of —, and Recovery of Pulp Water; Electrolysis of —, on the Large Scale	382
Hydrogen from Electrolysis of Water; Lighting with Waste Waters; Purification of —, and Recovery of Pulp Water; Electrolysis of —, on the Large Scale	130
Schmidtmann. See Rubner.	738
Schmiedeberg, O. Purine Derivatives; Pharmacological Action of —	1125
Schmitt, F. Acetylene Gas; Apparatus for Generating and Storing — (P)	1102
Schmitt, J. Dyeing Cotton, Stubbings and Rovings, and Apparatus therefor (P)	713
Schmitz. Steel and Iron; Carbon Determination in —	934
Schmolka, H. Paper Pulp; Apparatus for Purification of — (P)	496
Schneegans, A. Raisin Wines; Composition of —	599
Raisin Wine; Constituents of Sweet —	1227
Schneider. India-rubber; Exhibit of —	1222
Schneider, C. Chromium Oxide Salts; Electrolytic Oxidation of Solutions of — (P)	1221
Schneider, H. Photolithography; New Process of —	503
Schneider, J. See Ross, J. M.	709
Schneiwind, F. W. C. Coke Ovens; Regenerative — (P) ...	462
Gas; Apparatus for Manufacture of — (P)	1197
Gas; Enrichment of — (P)	31
Gas; Illuminating —, from Coke Ovens	1093



	PAGE
Schoellkopf, A. <i>See</i> Scheuer, A.	710
Schön, L. Stoppers for Receptacles for Inflammable Liquids (P)	695
Schöne, A. Micro-organisms in Manufacture of Beetroot Sugar	733
And Tollens, B. Beet-Molasses; Presence of Lactic Acid in	54
And Tollens, B. Cane Sugar; Action of Strontia on Solutions of	55
And Tollens, B. Pentosans of Brewers' Grains, Jute, and Loofah	1226
And Tollens, B. Pentosans of Seeds; Behaviour of —, during Germination	268
And Tollens, B. Pentoses; Fermentation of the	735
And Tollens, B. Sugar Solutions; Action of Strontia on	821
Schöpfeld, F. Ammonium Fluoride as a Disinfectant for Hose Pipes	830
Yeast for Top Fermentation; Supply of Pure	490
Schönfeld, R. Breweries; Risk of Microbial Infection in Top Fermentation	920
Scholvien, K. Gas-valve which Prevents Passage of Liquids	748
Scholz, Welsbach's Osmium Incandescence Lamp	348
Schoop, P. Electrolytic Apparatus (P)	906
Schoop, U. Hydrogen and Oxygen; Commercial Electrolytic Manufacture of	258
Schott, G. A. J. Slip and Glazes for Pottery; Pumping Apparatus for (P)	364
Schouggaard, S., and Evans, J. Stone, Artificial; Manufacture of (P)	719
Schrader, J. C. Explosive Compounds; Machines for Mixing (P)	389
Schrader, R. Molasses, Fodder; Apparatus for Making (P)	601
Molasses, Fodder; Process and Apparatus for Making (P)	489
Schramm, O. Iron; Hardening of (P)	903
Schreib, H. Ammonia-Soda Process; Progress of the	896
Schreiber, L. Dyeing Textile Fabrics (P)	713
Schreiner, O. Phellandrene Nitrite; Properties of	927
Schroeder, J., and Diefenthal, L. Food from Brewers' Spent Grains; Manufacture of (P)	59
Shroeder, P. von. Tanning Materials; Japanese	265
Schryver, S. B., and Lees, F. H. Morphine: Researches on	500
Schubart, P. <i>See</i> Vörländer, D.	800
Schüder. Water Purification; Schumburg's Process of	828
Schüle, R. F. Yarn; Boiling and Dyeing —, and Apparatus therefor (P)	892
Schüpphaus, R. C. Powder Explosion at Indian Head; Discussion on	104
Schürholz, H. Stones; Production of Artificial (P)	253
Schule, R. F. Yarns; Dyeing —, and Apparatus therefor (P)	577
Schulten, A. de. Ulexite (Boronatrocalleite); Synthesis of	832
Schulthess, W. Calcium Hydrate; Production of — and Apparatus therefor (P)	717
Schultz, H. Liquids and Gases; Maintaining the Temperature, Pressure and Humidity of (P)	788
Schultze, K. Incandescence Bodies for Gas-Lighting (P)	566
Schumacher, M. M. <i>See</i> Froitzheim, E.	602
Schumann, K. Caoutchouc; Togo	135
Schumann, V. Photographic Plates; Making Ultra-Violet Sensitive	1020
Schutz, J. M., and Hawley, C. G. Coffee Compound, and Production of same (P)	1012
Schwartz. <i>See</i> Valentiner	1007
Schwartz, W. Limestone; Manufacture of (P)	810
Schweissinger. Jalap; Determination of	756
Schwerin, G. R. Liquids; Extraction of —, from Mineral, Vegetable and Animal Substances (P)	726
Scott Leather Machine Co. Hides and Skins; Apparatus for Treating and Colouring (P)	913
Scott, A., and Arbuckle, W. Iodic Acid; Preparation of	123
Scott, C. F. H. <i>See</i> Roxburgh, J. J. C.	1183
Scott, E. G. Ammonia Liquors; Treatment of (P)	352
Evaporators; Vacuum (P)	105
Scott, R. W. Explosive Charges for Guns (P)	617
Scudder, F. Arsenic; Discussion on Detection of	207
Scudder, H. <i>See</i> Mulliken, S. P.	71
Seagrave, G. Acetylene Gas; Apparatus for Generating (P)	564
Searle, A. B. <i>See</i> Procter, H. R.	287
Tanning Extracts; Absorptive Influence of Materials used in Determination of Soluble Matter in	264
Sebelien, J. Electrical Heating Apparatus for the Laboratory	837
Seel, E. Alcin; Oxidation of	66
Seeman, R. Copper Ores; Treatment of —, and Apparatus therefor (P)	1218
Seidel, P. <i>See</i> Friedlaender, P.	602

	PAGE
Seidenschnur, F. Wood; Economical Saturation of —, with Tar Oils	581
Wood; Saturation of —, with Tar Oil	718
Seidner, M. Molasses; Properties of —, after Substituting the Potassium	375
Seifarth, H. Stone; Preparation of Artificial (P)	365
Seifert, C. M. Gas-burners for Heating Purposes (P)	975
Seifert, W. Wine; Organisms of Alcoholic Fermentation in Manufacture of	1010
Seiler, F. Carbolic Acid; Determination of Crude	1251
Seitter, E. <i>See</i> Vanino, L.	1251
Selg, O., and Guntrum, J. B. and C. F. Beer and Ale; Means for Converting Wort into — (P)	1012
Seligsohn, M. Ores; Improved Method of Treating (P)	587
Sellar, W. C. Silico-Fluorides; Treatment of Calcium Fluoride for Production of (P)	718
Selva-Javaloyes, J. <i>See</i> Cruz-Pasqual	38
Semmler, F. W. Camphene; Transformation from Pinene to Terpene Series; Loss of Water, Ammonia, &c., in	150
Terpene Series; Reduction in the —, Myrcene and other Olefinic Compounds	503
1135	
Sendereus, J. B. <i>See</i> Sabatier, P.	978
Sénéchal de la Grange, E. Impermeable Threads and Fabrics (P)	39
Sesti, G. Tannin; Determination of	1031
Setlik, B. Aluminium; Galvanic Deposits on	260
Seubert, K. Chromic Acid; Iodometric Estimation of	69
And Henke, A. Potassium Bichromate; Action of — on Potassium Iodide in Presence of Sulphuric Acid	63
Sezewetz, A. Colouring Matters; Qualitative and Quantitative Determinations of	394
<i>See</i> Lumière	153
<i>See</i> Lumière Brothers	504
And Blanc. Diazo-Sulphonates and Phenols or Amines; Action of Light on Compounds of	1103
And Blanc. Sodium Tetraxotolylsulphite; Compound of — with Ethyl β -naphthylamine	888
Seyfert, F. <i>See</i> Kochs, E.	989
Seymour-Jones, A. Tanning Materials; Discussion on Leather Forming Value of Different	435
Sharpe, J., and Code, R. G. Acetylene Gas Apparatus (P)	1102
Sharpies, C. Filtering Media (P)	601
Shearer, A. Alkali Chromates and Bichromates; Manufacture of — (P)	718
Arsenic; Discussion on Detection of	206
Chromic Acid Compounds; Manufacture of (P)	988
<i>See</i> Spence, F. M. and D. D.	475
Shedden, F. <i>See</i> Power, F. B.	1015
Shenstone, W. A. Vitrified Quartz	250
Shenton, J. Porter. <i>See</i> Thomson, W.	204
Shpherd, H. Acetylene Gas; Apparatus for Generating (P)	351
Sherman, H. C. and Snell, J. F. Oils; Heat of Combustion of; Determination of	590
Shores, J. H. <i>See</i> Conroy, J. T.	320
Shukoff, A. A. Oleine; Unsaponifiable Matter in Commercial Soap; Structure of	509
1004	
Shuman, F. Extinguishing Fires in Vessels containing Inflammable Liquids (P)	626
Mercerising Apparatus for Yarn (P)	574
Sicherer, W. von. <i>See</i> Bülow, C.	1106
Sidersky, D. Pipette; New Form of	389
Sieglfeld, M. <i>See</i> Vieth, P.	1131
Siegfried, M. Antiptone and Amphopeptone	276
Siemens Bros. and Co. and Dieselhorn, W. Gutta-Percha; Manufacture of (P)	51
Siemens Bros. and C. and others. Pumps for Liquids (P)	759
Siepen, W. Lime-kilns; Construction of (P)	1115
Sieplein, O. J. <i>See</i> Mabery, C. F.	394
Siefert, P. T. Glass; Machines for Blowing (P)	124
Glass; Manufacture of Sheet (P)	124
Silber, P. <i>See</i> Ciamician, G.	844, 943
Silbermann, F. <i>See</i> Elbs, K.	725
Silberstein, M. <i>See</i> Kehrman, F.	116
Silva, A. A. da. Explosives; Production of (P)	1240
Simmonds, C. <i>See</i> Thorpe, T. E.	476
Simon, A. Copper Ores; Treatment of (P)	368
Iron; Electrolytic Manufacture of (P)	1221
Manganese, Ferro-Manganese, and Manganese Alloys; Apparatus for Production of (P)	256
Simonds, W. E. Alloys, and Production thereof (P)	725
Simonini, A. Gas Igniters; Automatic (P)	1198
Lighting Devices for Gases and Vapours (P)	236
Simons, F. Cotton; Mercerising or Silk-finishing (P)	242
Simons, F. D. <i>See</i> Crampton, C. A.	158
Simpson, F., and Woods, A. E. T. Evaporating Apparatus (P)	233



	PAGE		PAGE
Sims, W. J. R., and Davis, A. L. Peat; Treating and Drying — (P)	462	Société Général des Aciers fins. Steel; Manufacture of — (P)	724
Sinclair, D. Tiles, Porcelain or Metal Ware; Colouring or Decorating — (P)	727	Société H. Crozier et Cie. Stone Blocks and Bricks; Manufacture of Artificial — (P)	810
Sinnhold, H. Extraction Apparatus	743	Société Lumière Boule. Gas-Burners; Incandescence or Bunsen — (P)	794
Sisley, P. Dyesuffs; Sulphonated Oxazo — and their Salts Hydrogen Peroxide; Determination of Value of Commercial —	1203	Gas-Lighting Plant; Incandescence High-pressure — (P)	794
Sjöo, A., and Törnell, V. Fermentation Industries; Cleansing in — (P)	1131	Société Mangano Electrique. Beverages and Liquids; Purification of — (P)	404
Sjollema, B. Mustard Oil from Seeds of Brassica Napus	633	Society Forderia Milanese d'Acciaio. Steel; Manufacture of — (P)	724
Skirrow, F. W. Boric Acid; Volatility of —, with Steam	805	Society of Chemical Industry, Basle. Indophenolthiosulphonates; Manufacture of — (P)	803
Skita, A. See Fischer, E.	1108	Sodeau, W. H. Chlorates; Decomposition of —. Part III. Chlorates; Decomposition of —. Part IV.	42
Skoglund, J. V. Explosives; Manufacture of — (P)	617	Soden, H. von, and Henle, K. Oil of Rue; Algerian —	930
Skraup, Z. H. Cinchonine; Transformation of Haloid Acid Addition Compounds of — into Bases free from Halogen	743	And Rojahn, W. Bergamot Oil; New Crystalline Constituent of —	1236
Cinchonine; Transformations by Means of Sulphuric Acid	499	And Rojahn, W. Calamus Oil; Chemistry of —	833
And König, J. Cellose; a Biase obtained from Cellulose	470	And Rojahn, W. Lemon Oil; New Aldehydes of —	1136
And Kreinann. Acetochloroglucose, Acetochlorogalactose, and Acetochlorolactose	513	And Rojahn, W. Rose Oils; Occurrence of Phenylethyl Alcohol in —	65
And Zwenger, R. Isocinchonine, α - and β -; Characteristics of —	63	And Rojahn, W. Sandal Wood (Annyrol); West Indian	64
Copony, H., and Medanich, G. Isocinchonine, α - and β	63	Sörensen, C. P. Aluminium; Preparation of —, for Soldering (P)	1119
Slaski, J. Waste Waters of Sugar Factories in Russia; Purification of —	146	Sohege, P. Composition for Manufacture of Tiles, Linings, &c. (P)	582
Slatter. Beer and Malt. Arsenical; Discussion on —	343	Soldani, G. See Trant, L. B.	731
Dyeing Wool and Silk Union Fabrics; Discussion on —	232	Sollman, T. Sugar Reaction; A New —	753
Smith, A. G. See Chicken, B. R.	110	Soln, M. F. Glazed Bricks; Manufacture of — (P)	126
Smith, A. J. Varnish; Manufacture of — by the Pressure Process	1076	Soltsien, P. Halphen's Reaction for Cotton-Seed Oil. Lards; Behaviour of some American —	393
Smith, C. L. W. See Curtis, C. H.	1240	Sesame Oil in Arachis Oil; Detection of —	1121
Smith, E. A. Gold Ores; Assaying of Complex —	830	Sommer, R. Vanillin; Preparation of —, from Protocatechuic Aldehyde (P)	1135
Smith, E. F. See Fulweiler, W. H.	1002	Sommer, W. Filter-Press (P)	106
See Hamilton, L. P.	889	Sorel, A. Molasses Distilleries; Continuous Fermentation in —	143
See Kollock, L. G.	1029, 1145	South Durham Steel and Iron Co. See Saniter, F. L.	903
See Ruegenbreg, M. J.	69	See Smith, J. L.	724
See Spare, C. R.	1027	Southby, A. G., and others. Filter-Press; High-Pressure — (P)	344
Smith, E. Shrapnell. Transport of Chemicals; Discussion on	425	Souvero, M., and Co. Muffle Kilns; Continuous Gas — (P)	581
Smith, F. A. Upsher. Bismuth; Subnitrate; Commercial —	149	Spackman, H. S. See Lathbury, B. B.	582
Smith, F. W. Explosives; Analysis of —	1032	Spare, C. R., and Smith, E. F. Mercury; Electrolytic Separation of —, from Copper	1027
Smith, G. G. Acetylene and other Gases; Purification of —	1102	Spatz, E. Aluminium in Steel; Determination of —	507
Smith, G. R. Textile Materials; Drying of —	709	Spence, F. M., D. D., and H. Aluminous Compounds; Manufacture of — (P)	364
Yarn and Cloth Testing Machines	38	Soda Alum; Manufacture of — (P)	250
Smith, H. Brass Lacquers; Action of Light on Coloured —	1183	And Royley, M. Sewage Sludge; Treatment of — (P)	830
See McLeod, J. A.	1219	Spence, F. M. and D. D., and Shearer, A. Sodium and Potassium Chromates and Bichromates; Manufacture of — (P)	475
Smith, H. G. Eucalyptus Oil containing 60 per cent. of Eucalyptus Oils; New Aromatic Aldehyde occurring in —	275	Spencer, W. Kilns for Limestone, &c. (P)	344
Vanadium; Its Extraction and Uses	1183	Sperry, E. A. Batteries; Secondary — (P)	482
Smith, J. Cruickshank. "Manufacture of Paint"	843	Spica, M. Citric Acid in Wine; Detection of —	1030
Smith, J. L. See Saniter, F. L.	903	Saccharin; New Reactions for Detection of —	1146
And others. Steel Process; New Open-Hearth — (P)	724	Spirek, V. Mercury; Metallurgy of —, in Italy	831
Smith, R. F. Wood, and Jenks, R. L. Arsenic in Coal and Coke	437	Springhorn, E. Fuel, Artificial; Manufacture of — (P)	30
And the Pioneer Investment Trust. Sewage Effluent; Bacterial Treatment of — (P)	61	Sewage; Precipitation of — (P)	272
Smith, T. Copper; Electrolytic Determination of —	750	Springer, G. Caoutchouc; Columbian —	592
Smith, T. J. Bromide Photographic Prints; Treatment of — (P)	609	Cellulith; Preparation of —	602
Smith, Watson. Glycerol Phthalate; A new Glyceride	1075	Celluvert; Obtainment of —	602
Smiths, A., and others. Carbon Monoxide in Coal Gas; Volumetric Determination of — (P)	78	India-Rubber and Sulphur	592
Smyth, J. F. Gas, Acetylene; Apparatus for Generating — (P)	975	India-Rubber; Magnesia employed in —	593
Snell, C. S. Burners for Incandescence Gas-Lighting (P)	32	India-Rubber Waste	593
Snell, J. F. See Sherman, H. C.	590	Para-Rubber Mixings	592
Snowden, E. Stills for Gas-Works and Tar-Works (P)	796	Springer, L. See Georgievics, G. v.	33, 34, 34
Société Anon. Alliance Industrielle, Amylaceous Matter; Rendering — Soluble (P)	492	Sprott, E. W. Gas, Acetylene; Apparatus for Generating — (P)	883
Société Anon. Force. Butter and Animal Fats; Preservation of — (P)	738	Stahl, W. Copper; Influence of Tin, Phosphorus, and Antimony on —	480
Société Chim. des Usines du Rhône. Colouring Matters; Manufacture of Sulphonated Aldehydes and Bluish-Green — (P)	1205	Copper; Occlusion of Gases in —	480
Société des Carb. Métalliques. See Bullier, L. M.	481	Stahlschmidt, F. Ferric Saccharate; Production of — (P)	1018
Société des Enduits Archambault. Rendering Casks, Bottles, &c. Acid-proof and Fire-proof (P)	252	Stahmer, R. Hydrocellulose; Production of — (P)	926
Société des Piles Electriques. Galvanic Batteries; Depolarising by Liquid Circulation in — (P)	482	Stallman, J. H. Peruvian Bark from a Commercial Standpoint	958
Zinc and other Salts; Electrolysing Process for — (P) ..	484	Stanek, V. Nitrates; Nitrogen in —; Determination of ..	506
Société des Usines et Fond. d'Aluminium. Aluminium and Steel or Iron; Uniting — (P)	369	See Andriik, E.	54, 374, 1225, 1225
Société Electro-Métallurgique Française. Ferro-Chromium; Production of Mild — (P)	996	Stange. See Holde	494
Furnaces; Electric — (P)	907	Stange, M. See Holde, D.	1003
Société Française de Ramie. See Masse, C.	985	Stanger, W. H., and Bloant, B. Cement Manufacture; Rotatory Process of —	1115
		Stanko, S. Sugar Products; Acidity and Alkalinity of — ..	821
		Stanley, J. C. W. Cotton Seed Hulls; Treatment of — (P) ..	710
		Oleaginous Matter; Bleaching of — (P)	910
		And The Cotton-Seed Oil Syndicate. Oils and Fats; Bleaching of — (P)	1122



	PAGE
Stapp, D. W. Unconsumed Products of Combustion; Apparatus for Burning — (P)	30
Starke, J. Albumin; Transformation of —, into Globulin ..	379
Stassfurter Chem. Fab. vorm. Vorster and Grüneberg. Cyanides; Production of — (P)	717, 717
Potassium Cyanate; Production of — (P)	717
Stauber, E. Coke Oven (P)	1100
Peat; Utilisation of —	233
Stauf, R. Blood, Milk, &c.; Obtaining Solid Constituents of —, in Form of Dry Powder	59
Stead, J. E. Alloys of Copper and Iron	995
Manganese and Iron; Crystals of Carbo-Silicide of — ..	721
And Evans, J. Steel Rails and Plates; Influence of Copper on —	722
And Wicham, F. H. Steel; Effect of Copper on —, for Wire-making	995
Steenstrup, C. A. R. India-rubber; Manufacture of Substances similar to — (P)	135
Rubber-like Substance; Production of — (P)	486
Steffen, C. Steam or Vapour of a Dry Desired Pressure; Production and Application of (P)	562
Sugar; Extraction of —, from Lime Scum and Sediment (P)	916
Vapour at desired Pressure; Production of —, and Apparatus therefor (P)	878
Vapours of Sugar and other Factories; Utilising — (P) ..	268
Steffens, C. Portland Cement from Blast Furnace Slag ..	581
Portland Cement from Blast Furnace Slag; Manufacture of —, by the Forell Process	44
Stein, E. H. Furnace; Iron Shaft —, for Burning Cement, Lime, &c. (P)	1115
Stein, L., and Storr, W. Glass and Porcelain: Uniting Pieces of (P)	900
Stein, V. See Ruff, O.	834
Steinberg, A. Alizarin Sky-Blue and its Application	805
Woolen Industry; Scaps and Turkey-Red Oils in the — ..	470
Steiner, G. See Kehrman, F.	115, 113, 1104
Steingraber. Petroleum; Inflammability of Light	352
Steinhart, O. J. Arsenic; Discussion on Occurrence and Detection of —	192
Steinmetz, C. P. Electric Furnaces (P)	977
Stainweg, C. E. Matrices: Separation of —, from Galvanoplastically Precipitated Metals (P)	608
Stephan, K. Sweet Orange Oil	275
Sterba, J. Cerium Oxide; Preparation of Pure —	927
Stern. Arsenic; Discussion on Presence of —, in Beer	208
Stern, A. L. Yeast; Nutrition of —, Part III.	600
Sterne, L., and Cowper-Coles, S. Silver; Rendering, — Un-tarnishable (P)	1003
Steuart, D. R. See Henderson, N. M.	978
Steuermann, J. See Kostanecki, st. v.	355
Stevenson, G. Acetylene Gas; Apparatus for Generating and Storing — (P)	351
Stevenson, J. Pigments and Dyes with Relation to Production of Designs (P)	1208
Stevenson, J. L. Blast Furnaces; and Casting the Metal therefrom (P)	481
Open-Hearth Tilting Furnaces (P)	481
Steel; Direct Continuous Manufacture of Open-Hearth — (P)	450
Stewart, C. G. See Rideal, S.	841
Stewart, J. K. Gas-Furnaces and their Air-Compressors; Construction of (P)	234
Stewart, R. Basic Superphosphate; Discussion on —	331
Marsh Test; Discussion on Effect of Selenium and Tellurium on —	324
Stewart-Wallace, J. S., and Cowell, W. B. Oil Distillates or Residues; Treatment of — (P)	434
Stamer, R. Hydrocellulose; Preparation of —	469
Hydrocellulose; Production of — (P)	1133, 1133
See under Fabrik Chemischer	833
Stiasny, E. Leather; Analysis of Chrome-Tanned —	1026
Stirk. Arsenic; Discussion on Presence of —, in Beer	208
Stock, A. Arseniuretted Hydrogen; Action of —, on Boron Bromide	756
And Blix, M. Bromide; Preparation of —	1252
And Massau, C. Chromium and Iron; Determination of —	301
Stocker, J., and Zanler, H. Insulating and Steam-Packing Substance (P)	727
Stoeder, N. Aconitine, Belladonna, and Henbane; Determination of the Alkaloids in Extracts of —	1143
Belladonna and Henbane Extracts; Differentiation of — ..	1146
Mycauhana Root; Determination of Alkaloids in —	1147
Pomegranate Bark and Extract; Alkaloid Determination of —	1150
Stoermer, M. Lead Oxide; Volatility of —	1113
Silicate Analyses	1143
Stoermer, R., and Bartsch, F. Cumarononé and its Homologues; Synthesis of —	114
Stokes, H. N. Pyrite and Marcasite; Distinction of —	1211

	PAGE
Stoklasa, J. Nitrate Fermentation	1224
Soil Inoculation: New Problems in —	487
Stolaroff, W. N. Black Acid-Proof Cotton Dye; Manufacture of (P)	240
Stolle, F. Bone-Black; Sulphides in —	263
Caramelan; Investigations on —	1127
Invert Sugar; Determination of —	843
Raffinose, Octabenzoyl Ester of; Preparation of —	292
Sugar Filtration through Animal Charcoal	54
Storer, F. H. Sugars other than Xylose and Dextrose in Products of Hydrolysis of Wood	822
Storer, T., and McAlley, R. Distillery Refuse; Treatment of — (P)	737
Storey, J. H., and McCalla, W. E. Glass, Metal, &c., with Surface capable of Adhering to Cement; Plates of — (P)	126
Storr, W. See Stein, L.	900
Story, Principal. Speech at Annual Dinner	684
Strache, H., and Jahoda, R. Water-Gas; Illuminating and Heating Value of —	791
Straetz, H. See Wulkan, H.	824
Strandb, A. Disinfectant "Lettubrin." Composition of — (P)	1230
Strauss, E. See Hofmann, K. A.	76, 290, 357, 625
Strecker, O. C. Metals or Alloys; Electrolytic Preparation of (P)	727
Street, J. P. Fertilisers; Determination of Availability of Organic Nitrogen in —	731
Stricker, T. Azo-Colours; Application of — on Manganese Brown	712
Struthers, J. "The Mineral Industry: its Statistics, Technology, and Trade"	945
Strzelecki, J. H. See Wisniewska, M.	369
Stuart, C. E. Du Pont's Nitrometer; Discussion on —	102
Stuehlik, L. Papaverinol; Characteristics of —	65
Stutzer, A. Nitrification; Organisms of —	597
And others. "Alinit" Bacillus; Nature of —	597
St. v. Kostanecki and others. 3-Hydroxychromone; Synthesis of —	1106
St. v. Niementowski. See Miklaszewski, B.	1202
Sudre, C. G., and Thierry, C. V. Distillers' Spent Residues, Treatment of — (P)	492
And Thierry, C. V. Distillers' Spent Wash; Treatment of (P)	379
And Thierry, C. V. Oxides; Treatment of — and Products therefrom (P)	477
Süvern, K. Silk, Artificial; Dyeing of —	243
Sugg, W. T. Gas-Burners; Incandescence — (P)	977
Suler, B. Nitrites; Electrolytic Reduction of —	1000
Sulzer, Gebrüder. Beer; Manufacture of Non-Alcoholic — (P)	1011
Sunder, C. See Binder, F.	1108
Sunderland, A. E. Sulphide Blacks	243
Sunderland, R. H. and F., and Marshall, G. Acetylene Gas; Apparatus for Generating (P)	351
Sunlight Incandescent Co., The New. See Duncan, J. H. H.	32
Sutherland, G. "Twentieth Century Inventions: A Forecast" ..	946
Swan, J. W. Letter to New York Section	689
Presidential Address	692
Proceedings of Annual Meeting	661, 676, 677, 678
Speech at Annual Dinner	683
Transport of Chemicals; Discussion on —	424
Swinburne, J. Heaters for Incandescence Electric Lamps (P) ..	794
And Asheroit, E. A. Sulphide Ores; Treatment of — (P)	907, 907
Sykes, W. J., and Mitchell, C. A. Melt Extracts; Examination of —	1148
Symmons, G. See Farmer, H.	1019
Szekely, S., and Korács, E. Milk; Separation of Casein and Whey from —	380
Szöll, L. von. Superphosphates; Determination of Water-Soluble Phosphoric Acid in —	936
Szirmay, I., and Kollerich, L. von. Zinc; Coating Metal Goods with — (P)	1093

T

Taddei, G. Metals; Partly Electrolytic Process for Obtaining — (P)	1121
Tafel, J. Sulphuric Acid Solution; Electrolytic Reduction of Substances Reducible with Difficulty in —	49
And Naumann, K. Strychnine and Brucine; Electrolytic Reduction of —	1233
Tagliani, G. See Rigamonti, C.	577
Takamine, J. Suprarenal Glands Extracts of the Active Principle of —	746



	PAGE		PAGE
Takano, S. See Mabry, C. F.	569	Thorne, L. Acetylene Generators, and Apparatus connected therewith (P).....	1101
Talbot, B. Bricks for Lining Metallurgical Furnaces (P)	900	Thorne, L. T. Arsenic; Discussion on Occurrence and Detection of —.....	191, 195, 198
Furnaces; Open-Hearth or Melting — (P)	903	Thornton, J. E., and Rothwell, O. F. S. Films; Transparent Photographic — (P)	68
Iron and Steel; Manufacture of — (P)	369	Thorpe, T. E. Lead Compounds in Pottery; Report on —... Pottery; Use of Lead in Manufacture of —.....	897 475
Iron; Manufacture of — (P)	1118	And Holmes, J. Paraffins in Tobacco Leaf	758
Tambon. Sesamé Oil; Detection of —.....	285	And Simmonds, C. Pottery Manufacture; Lead Silicates in Relation to —.....	476
Tambor, J. See Kostanecski, S. v.	116, 1106	Thovert, J. Gas Burners; Incandescence — (P).....	1190
Tangye, A. W. Gases for Manufacture of Sulphuric Acid; Production of — (P)	256	Thresh, J. C. Phenol mixed with Resinous Substances; Determination of —.....	939
Ores containing Metallic Sulphides; Roasting —, and Apparatus therefor (P)	256	Thrupp, E. C. Air; Apparatus for Liquefying and Separating Oxygen from — (P)	1018
Tarbouriech, J. See Astruc, A.	935	Thuman, F. Gas Liquors; Apparatus for Separating the Tar from — (P)	832
Tarble. Boron Bromide; Compounds of Phosphorus Chlorides with —.....	291	Thurm, C. Brown Colour suitable for being "Over-Dyed" ...	469
Tatham, E. Cement and Insulator, Electrical; Material for use as — (P)	1001	Thwaite, B. H. Blast-Furnace Gases; Charging Motor Engines worked by —, and Apparatus therefor (P) .. Blast-Furnace Gases; Probable Utilisation of Power from —.....	1197 993
Taylor, F., and others. Bleaching; Appliances for use in — (P)	712	Tiemann, F. Citral Series; Inversion of Compounds of the —.....	385
Taylor, J. Authorised English Edition of Landauer's "Blow-pipe Analysis"	843	Cyelo-Citral	355
Taylor, M. Gas-Producers (P)	975, 975	Cyelo-Citral Series; Compounds of the —.....	384
Teisler, E. Silicon Fluoride; Preventing Escape of — in Decomposition of Phosphates (P)	1007	a-Ionone; Constitution of —.....	385
Telle, F. Phenol, Salicylic Acid, and Salol; Determination of —, in Dressings	1140	Tiesenholt, W. von. Chloride of Lime; Composition of —... Hypochlorous Acid; Action of — on Metallic Chlorides.	896 248
Salicylic Acid, Salicylates and Phenol; Determination of —.....	288	Tiffeneau. See Behal	384
Terranova Industrie. Cement; Manufacture of — (P)	478	Tilden, W. A. "Introduction to the Study of Chemical Philosophy"	1256
Tesla, N. Electric Conductors; Insulation of — (P)	258	And Burrows, H. Limettin; Constitution of —.....	1238
Tetley. Beer and Malt, Arsenical; Discussion on —.....	342	Timm, F. C. W. Oxygen Gas; Production of — (P)	1018
Tetmajer, L. Aluminium and its Alloys	506	Timofeeff, P. Stone, Artificial, and Cement; Manufacture of — (P)	125
Teufer, B. Water and Aqueous Solutions; Eliminating Iron from — (P)	602	Tinker, R. E. See Martin, A. H.	1133
Thatcher, R. W. See Hiltner, R. S.	754	Tinsley, H. Cell; a Cadmium Standard	1219
Thénien, G. Resin; New Brazilian —, Resembling Shellac ..	135	Tipler, F. C. Transport of Chemicals; Discussion on —.....	424
Theobald, W. and G. Incandescence Burners; Increasing Illuminating Power of — (P)	32	Tissier, A. Catalytic Substance; Manufacture of a Mineral — (P)	1100
Thesen, J. Iodine, &c., from Sea-weed; Extraction of — (P)	608	Tissier, C. See Magnier, P.	261
Thesmar, G. See Noeltling, E.	797	Tissot, J. See Chauveau, A.	828
Theulier, E. Citraptene or Lemon Camphor	603	Titel, O., and Wolde. Air of Rooms; Purification of the — (P)	381
Licari canali (Bois de Rose femelle); Essential Oil of — Linaloe Oil (Cayenne)	606 745	Toby, F. L., and Borch, O. S. Non-Explosive Mixtures of Calcium Carbide; Manufacture of — (P)	32
Orange Blossom Essence	1017	Toch, L. See Ralli, P. A.	263
Thibault, P. Bismuth; Hydrated Oxide of —.....	119	Törnell, V. See Ljöö, A.	1130, 1131
Bismuth Salicylate; A New Crystalline —.....	1134	Tollens, B. Cellulose, Oxycellulose, Hydrocellulose, Pectins, and Tragacanth	740
Bismuth Salicylate; New Form of —.....	927	See Oshima, K.	757
Thiele. Cellulose; Dissolving —, by Means of Ammonia and Copper	119	See Schöne, A.	54, 55, 208, 735, 821, 1226
Thiele, E. Soda-Cellulose; Composition of —, and Action of Ammonia thereon	890	See Yoder, P. A.	1245
Thiele, F. C. Paper from Sugar-cane Refuse; Manufacture of —.....	495	Tomarschenko, P. See Kowalski, J. de	623
Thiele, J., and Jaeger, C. Dihydroxyfluorescein; Characteristics of —.....	1105	Topham, C. F. Textile Fibres from Solutions of Cellulose; Apparatus for Production of — (P)	1207
Thierry, C. V. See Sudre, C. G.	379, 477, 492	Tortelli, M., and Ruggeri, R. Oil and Tallow of Stillingia Sebifera	261
Thiersant, H. de and Coulson, W. A. Gas, Acetylene; Apparatus for Generating —.....	976	Vegetable Oils; Detection of Heated — in Other Oils ...	753
Thiesing. See Nietner	823	Tory, H. M., and Pitcher, F. H. "A Manual of Laboratory Physics"	946
Thomas, E. G. P. and Bonavita, J. Cellulose Articles; Manufacture of Hollow — (P)	741, 741	Toth, J. Nicotine in Tobacco and Tobacco Extracts; Determination of —.....	942
Thomas, P. Yeast; Nitrogenous Nutrition of —.....	918	Totten, E. M. Aluminium; Composition for Uniting or Soldering — (P)	481
Thomas, V. Filaments for Electric Incandescence Lamps (P) Filaments for Incandescence Electric Lamps (P)	700 795	Tourrou. See Blarez	1030
Thomas, W. Photographic Intensification	154	Trant, L. B., and others. Tanning, and Solution therefor (P) ..	731
Thomas, W. P. Steel and other Metal Plates; Apparatus for Coating — (P)	1119	Treadwell, F. P. Cobalt; Vogel's Qualitative Test for —... Zinc; Separation of — from Nickel and Cobalt	390 392
Thomine, A. E. See Croizier, A. H.	810	Tribelhorn, A. Secondary Batteries, and Electrodes therefor (P)	588
Thompson, A., and Blin, E. Tanning Liquids; Manufacture of — (P)	266	Trier, M., and Wilkinson, A. Hons and other Organic Substances; Preserving — (P)	492
Tanning Liquors; Purification of —.....	729	Trillat, A. Alcohols; Contact Action in the case of Secondary and Tertiary —.....	847
Thompson, E. T. See Southby, A. G.	344	Alcohols; Oxidation of Primary — by Contact	847
Thompson, N. See Woodhead, J.	353	Trippe, W. Sulphite-Cellulose Waste Liquors; Treatment and Utilisation of — (P)	741
Thoms. Cordia Excelsa; Crystalline Body of —.....	1235	Tritton, A. F., and Beyer, L. F. G. Food Product (P)	494
Oil of Rue	603	Troetscher, A. See Panzl, R.	27
Thoms, H. Calamus Oil; Constituents of —.....	1237	Trotman, S. Arsenic in Beer; Discussion on Presence of —... Arsenic in Coke; Discussion on Determination of —.....	203 450
Tobacco Smoke; Chemistry of —.....	626	Tröwbridge, P. F. Sugar-Beets; Analytical Notes on —.....	842
And Beckstroem, R. Calamus Oil; Constituents of —... And Mannich, C. Balsam of Peru	606 806	Truchelut and Rochereau. Photography in Colours	387
And Wentzel, M. Mandragora Root; Bases of —.....	605	Truchon and Martin-Claude. Fruit Juices used in Preserves; Composition of —.....	380
Thomson, J. H., and Redwood, B. "Handbook of Petroleum" ..	843		
Thomson, J. M. "Heat Test" for Explosives; Discussion on the —.....	12		
Thomson, R. Gas; Manufacture of Heating —, and Apparatus therefor (P)	350		
Thomson, W. Arsenic; Discussion on Occurrence and Detection of —.....	192		
Heat Producing Power of Fuel; Discussion on —.....	1084		
And Shenton, J. Porter. Arsenic in Beers, Brewing Materials, and Food; Detection of —.....	204		

	PAGE
Truchou, R. Orseille in Wine; Detection of —	284
Truchot, P. Copper; Analysis of Commercial —	283, 1027
Tschireh, A. Emodin as the Active Constituent of some Drugs	497
Resin of Pinus Sylvestris	729
Resins of the Conifers; Recent Researches on —	51
Storax; Oriental —	1136
And Bruening, G. Bordeaux Turpentine	276
And Itallie, L. van. Rassamala Resin	1122
And Itallie, L. van. Storax: American —	1136
And Klaveness, J. Uganda Aloes	743
And Niederstadt, B. Kauri Bush Copal	729
Tschougass, L. A. Borneol: Purification of —	832
Tschugneff, L. Thujene, a New Tricyclic Terpene	65
Thuyllamine; Transformation of — into Thujene	939
"Triboluminescence"	845
Tucker, A. E. Fuel; Artificial — (P)	343
Tucker, S. A. and Moody, H. R. Acetylene and Ethylene; Solubilities of —	1245
Alumina; Reduction of — by Calcium Carbide	970
Borides; Production of New Metallic —	626
Ethylene; Production of — from Inorganic Sources	971
Tuckwell, J. Marble, Imitation; Manufacture of — (P)	582
Tully, C. B. Gases for Illuminating; Carburetting —, and Appliances therefor (P)	110
Tunncliffe. See Brunton, L.	736
Tunncliffe, F. W., and Rosenheim, O. Selenium Compounds, the Marsh Arsenical Mirror, and the Beer-Poisoning Epidemic	390
Turk, D. and The Actienges. "Lauchhammer." Gases of High-Caloric Value from Low-Caloric Fuel Material (P)	1197
Turley, T. B. See Crawford, W. J.	260
Turnbull, A. Hide-Powder; Report on Effect of Moisture and Time on —	596
Indigo; Natural and Artificial —	979
Tannin Estimation; Comparison of Methods for —	623
Tannin Estimation Results; Comparison of Volumetric Methods with Hide-Powder Method	159
Turner, F. See Siemens Bros. and Co.	789
Turner, T. Steel Production in Basic Siemens-Martin Furnaces	583
Turner, W. Indigo Dye Vats; Hawking Machines Employed in — (P)	247
Tutwiler, C. C. Hydrogen Sulphide in Gas; Determination of —	621
Twynnam, T. Iron and Steel; Direct Production of — (P) .. Zinc-Lead Sulphide Ores and Tailings; Treatment of — (P)	369 905
Tyrer, C. T. Arsenic; Marsh-Gutzeit Test for —, and Apparatus	281
Marsh's Test; New Apparatus for —	250
Tyrer, T. Arsenic; Discussion on Occurrence and Detection of —	191, 199, 200
Marsh Test; Discussion on Effect of Selenium and Tellurium on —	324
Proceedings of Annual Meeting	676, 677
Speech at Annual Dinner	685, 686
Tyrer, T. and C. T. Acids; Effect of Glassware Containers on —	899
Mercury and Bismuth Salts; Determination of —	937

U

Uhland W. H. Starch; Manufacture of — (P)	916
Ulke, T. Electrolytic Refining in the United States	727
Metals; Electrolytic Refining of — in the United States	402
Ulrich, C. See Küttner, S.	919, 1010
Ulzer, F. Air Carburetted with Benzol in Fischer's Apparatus; Behaviour of —	1196
Air; Limits of Explosion of Admixtures with —	1196
Chinese Wood Oil; Attempts to Deodorise	261
Explosive; Composition of a Safety —	155
Kaolin; Levigated —	123
Metals and Alloys; Analysis of —	1216
Portland Cement; Composition of Materials for Making —	125
Tinned-Iron; Rusting of —	127
Waste Products of Mineral Oil Industry; Utilisation of —	112
Umbgrove, H. See Haller, A.	980
Unger, E. Iron Saccharate free from Alkali; Preparation of —	383
United Alkali Co., The. See Carey, A.	474
See Baschen, J.	809
United States Chemico Wood Co. Plastic Composition; Production of — (P)	374
Upsher Smith, F. A. See under Smith.	

	PAGE
Urban. Carbon Tetrachloride; Manufacture of —	1232
Urban, J. See Bronnert, E.	119, 1207, 1231
See Fremery, M.	38
Urban, K. See Andrlík, K.	54, 374, 1225
Usuelli, E. See Kopp, O.	469

V

Valenta, E. Ammonium Sulphide; Influence of — on Fine-grained Silver Emulsion Plates	854
Photographic Sensitiser; New Panchromatic	1020
Potassium Percarbonate for Destroying Thiosulphate in Photographic Films (P)	608
See Eder, J. M.	1239
Valentine, G. Yeast; Utilisation of Pressed — (P)	736
Valentiner and Schwartz. Hides and Skins; Dressing of — (P)	1007
Valentiner, F. Chrome Tanning or Dressing of Skins, &c. (P)	1124
Valette. See Geugnier	886
Vallée, C. Acids; Action of — upon Carbonates of the Alkaline Earths	603
Alkaline Earth Carbonates; Influence of Alcohol on Action of Acid on the —	512
Vaniuo, L. Gunccotton; Action of Aqueous Formaldehyde on —	747
And Griebel, C. Arsenic Sulphide; Action on Ammonium Carbonate on —	1243
And Hauser, O. Bismuth Chloride; Compounds of — with Organic Bases	383
And Seitter, E. Formaldehyde; Determination of —	1251
Van Laer, H. Mycoderma Cerevisiae	1127
Vaubel, von W. "Die Physikalischen und Chemischen Methodender Quantitativen Bestimmung organischer Verbindungen"	1152
Vaubel, W. Indigo; New Hydro-Compound of —	1147
Millon's Reagent	71
Věcek, F. See Biža, E.	914
Veley, V. H., and Manley, J. J. Nitric Acid Solutions; Physical Properties of —	1208
Velvrl Co., Ltd., The. See Reid, W. F.	145
Verbièse, M. Molasses; Application of Yeast in Preparing Spirit from —	378
Yeast inured to Hydrofluoric Acid, in Molasses Distilleries	1227
Vereinigte Chiniinfabriken Zimmer und Co. Quinine and Cinchonidine; Preparation of Carbonic Esters of — (P)	1232
Verley, A., and Bölsing, F. Alcohols and Phenols; Determination of —	1250
Esters; Quantitative Production of —	1250
Eugenol in Clove Oil; Determination of —	1250
Verneuil and Wyruboff. Rare Earth Group; Separation of Members of the —	148
Verneuil, A. Wood Charcoal; Secondary Products of Action of Sulphuric Acid on —	846
Verneuil, A. V. L. See Arnaud, A. L.	373
Verwer, H. Carbon; Formation of — in Electrolysis of Ammonium Oxalate	1120
Vickers, J. W., and Rumsey, H. W. Photo-Printing and Developing; Apparatus for — (P)	68
Victor, E. Cyanides and Cyanates; Determination of — in Admixture	1031
Vieth, P., and Siegfeld, M. Milk; Acidity of —	1131
Viéville, E. See Coiffier, H.	477
Vignon, L., and Gerin, F. Arabitol and Rhamnitol; Nitro-derivatives of —	1254
Nitric Esters; Constitution of certain —	1254
Nitromannitol and Nitrocellulose; Distinction of —	1244
Vilén, N. Peat-Coal and Peat as Coal Substitutes	233
Villejean, E. Zinc-Lead Ores; Ellershausen Process for Treatment of —	254
Villiger, V. See Baeyer, A.	496, 578
Vis, G. N. Brine; Purification of — (P)	897, 1216
Salt; Vacuum Apparatus for Separating —, from Solutions (P)	123
Vacuum Evaporating Apparatus for Separating Salt (P)	250
Vischner, E. See Bamberger, M.	50, 262
Voelcker, J. A. Arsenic; Discussion on Occurrence and Detection of —	199
Basic Superphosphate; Discussion on	328, 331
Voelker, A. Electrical Glass Furnace (P)	476
Voelker, W. L. Filaments for Incandescence Electric Lamps (P)	977
Vogel, E. Photographic Intensification; Mercury-Sodium-Sulphite Process of —	505
Vogelsang, A. Electrodes for Electro-Chemical Processes (P)	49



	PAGE		PAGE
Vogt, G. Sévres Porcelain Works; Ceramic Stoneware of the —	580	Washburn, C. E. Wool; Action of Caustic Soda on —	1206
Volmar, J. Saccharin; Manufacture of — (P)	746	Wasmuth, A. Incandescence Bodies for Gas Lighting; Strengthening — (P)	586
Volney, C. H. Nitric Acid; Manufacture of — Part I.	544	Wass, A. G. See British Oil and Cake Mills	1005
Powder Explosion at Indian Head; Discussion on —	103	Wassell, E. D. Iron, Wrought; Manufacture of — (P)	903
Volney, C. W. Nitric Acid; Manufacture of —	1189	Wasserzug, D. See Rupe, H.	1200
Sodium Nitrate; Decomposition of — by Sulphuric Acid	886	Watenburger, F. Picric Acid; Tanning with —	586
Vongerichten, E. Apin and Apiose	1034	Waterman, C. H. Enamelling Apparatus for Refractory Materials (P)	531
Morphenol; Preparation of —	1135	Watkin, H. Kilns; Indicating Temperatures in — (P)	477
Thebenidine; Characteristics of —	501	Watson, G. Refuse Destructors (P)	1132
Vorländer, D. and Drescher, R. Indoxyl and Indoxyl Acid; Acyl Derivatives of —	800	Watsor, S. G. Acetylene and other Gases; Generators for — (P)	794
And Schubart, P. Indigo-Carmine; Constitution of —	800	Watts, G. E. and C. J. Fuel; Machine for Agglomeration of — (P)	974
Voitček, E. and Fric, V. Xanthorhammin and Quercitrin; Sugar Constituents of —	76	Weber, C. O. Textile Fabrics; Shower-proofing of —	804
And Jehinek, J. Malachite Green; Hydroxy-Derivatives of —	1106	Waddell, E. G. Water; Purification of Greasy — (P)	601
And Potměšil, R. Carbon Bisulphide in Benzol; Determination of —	1147	Weddell, G. Table-Salt; Manufacture of — (P)	823
Vreven, S. Tropine; Detection of —	285	Wedding, H. Nickel Alloys	1218
Vulitch, D. de, and D'Orlovsky, J. Calcium Carbide; Production of —, and Apparatus therefor (P)	1198	Wedge, U. Oxidising Chemical Compounds to a Higher Oxide (P)	626
Vulté, H. T., and Gibson, H. W. Maize Oil; Composition of —	370	Weeks, F. W. Manifold Paper; Production of — (P)	148
And Logan, L. Oils; Bromine and Iodine Values of —	590	Weems, J. B., and Brown, J. C. Water Analysis; Influence of Chlorides in Determination of "Oxygen Consumed"	1025
W			
Wachtel, D., and Co. Lime, Slacked; Production of — (P)	582	Wehmer, Yeast; Action of Various Substances upon —	597
Sandstone, Artificial; Manufacture of — (P)	719	Wehmer, G. Butyric Acid; Influence of — upon Yeast, Mould Fungi, and Bacteria	268
Stone, Artificial; Manufacture of — (P)	478	"Chinese Yeast and Amylomyces" (<i>Mucor Rouxii</i>)	377
Wacker, C. Oil; Apparatus for Extracting — from Fish, &c. (P)	818	Wehry, A. M. G. See Arnaud, A. L.	373
Wade, E. J. Accumulators; Present and Future of —	253	Weichelt, A. Papers; Deodorising Sized —	1014
Wadsworth, F. L. O. Glass; Manufacture of Prism —, and Apparatus therefor (P)	125	Weidner, R. Alloy; An Improved — (P)	369
Wagner, E. and Lorenz, G. Glass Mirrors with Translucent Decorations (P)	477	Weightman, A. T. Anodes for Electrolytic Alkali Cells	588
Wagner, H. See Bulow, C.	704, 799	Weil, H. Rosaniline Base	114
Wagner, J. Indicators; Classification of —	747	Weil, L. Saponine from Horse-Chestnuts; Obtainment of — (P)	608
Wagner, W. See Bornträger, H.	828	Weil, R. Solanine; Formation of — in Potatoes	384
Wahlberg, A. Steel Ingots; Variations of Carbon and Phosphorus in —	904	Weiler-ter-Meer. Nitro-, Azoxy-Azo-, and Hydrazo-Compounds; Reduction of — (P)	1108
And Heyn, E. Steel; Influence of Silicon on Blast	901	Weis, F. Barley; Proteolytic Enzyme of Germinating —	141
Waite, C. N. Lactic Acid; Manufacture of Purified — (P)	931	Weisberg, J. Beet Molasses; Lactic Acid in —	375
Waldron. See Melland	1213	Beetroot Juice; Krause's Method for Determining Purity of —	488
Walker, M. See Lamb, C. G.	811	Sugar Solutions Saturated with Lime; Action of Carbonic Acid on — Saturated with —	488
Walker, M. S. Bunsen Gas Burners (P)	1101	See Pellet, H.	733
Walker, P. H. Zinc; Volumetric Determination of —	935	Weiskopf, A. Mercury and its Production	534
Waljaschko, N. A. Adonidin; Characteristics of —	150	Mercury Production	640
Wall, E. J. Ozo-type; The Chemical Processes of —	834	Weiss, J. Muffles or Furnaces; Electric — (P)	697
Wallace, E. C. See Richardson, C.	690	Weiss, R. Textiles; Treatment of — with Circulating Fluids (P)	469
Wallach, J. See Dutoit, M.	1105	Weiss, Von F. J. "Condensation"	1151
Wallach, O. Terpenes and Essential Oils	64	Weissgerber, R. See Kraemer, G.	795
Walsen, G. C. van. Halation in Micro-Photography; Prevention of —	278	Welcome and Co. Fuel; Incorporating Volatile Liquids with Solids for Production of Solid Portable — (P)	461
Walser, C. and Cartier, T. Acetylene Gas; Apparatus for Generating — (P)	111	Weldon, K. Mercerising Apparatus (P)	709
Walter, J. Auramine from Tetramethyldiamidodiphenylmethane	31	Weldon, L. Leather Board; Sheets or Continuous Lengths of — (P)	382
Walther, J. Carvone in Essential Oils; Determination of —	289	Paper and Paper Board; Sheets or Continuous Lengths of — (P)	382
Wanklyn, J. A. "Arsenic"	397	Wells, H. L. Cesium Material; Purification of —	1014
Ward, J. Beer and Malt, Arsenical; Discussion on —	342	And Metzger, F. J. Tungstic and Silicic Acids; Separation of —	740
Dyeing Wool and Silk Union Fabrics; Discussion on —	232	Wells, J. G. Arsenic; Discussion on Presence of — in Beer	209
Leeds Gas Liquor; Discussion on Analysis of —	226	Weilmans, P. Dextrin in Cocoa and Chocolate; Detection and Determination of —, by Polarisation	288
Ward, Mr. Heat Producing Power of Fuel; Discussion on —	1084	Peppermint Oil; Colour Reaction of —	933
Ward, G. Beer and Malt, Arsenical; Discussion on —	343	Welsbach, C. Acar von. Filaments; Osmium Illuminating — (P)	236
Ward, J. See Emmerson, G. W.	344	Incandescence Gas-Lighting; Discovery of —	1097
Ward, W. J. Material for Wrapping Purposes; Manufacture of — (P)	62	Lamps; Manufacture of Vacuum Osmium — (P)	32
Mineral Oil, Grease, Soap, &c.; Manufacture of — (P)	831	Wenghöffer, L. Gluten or Glutenous By-Products; Treatment of — (P)	827
Paper, Waterproof; Manufacture of — (P)	831	Picric Acid; Manufacture of —	570, 932
Wartel, R. R. See Naves, W. A.	928	Wentzel, M. See Thoms, H.	605
Warren, G. Cement; Manufacture of —, and Apparatus therefor (P)	582	Wenzel, A. See Nobis, L.	562
Warren, J. W. Oils; Clarifying Hydrocarbon — (P)	352	Werk, A. van de. See Lich, M. L. H.	924
Wartenberg, H. and Miller, A. M. Carbons for Electric Lighting; Manufacture of — (P)	111	Werner and Pleiderer. Mixing, Kneading, and Triturating Machines (P)	789
Warwick, A. W. and Kyle, T. D. Bismuth in Ores; Determination of —	620	Wescott, W. Wynn. See Martindale, W.	627
Washburn, C. D. See Bond, G. R.	698	Westlake Co., The. Furnaces for Burning Powdered Fuel (P)	340
		Westman, G. M. Ores; Treatment of —, and Apparatus therefor (P)	367
		Wetzel, J. Geissler's Potash Bulbs; Modification of —	279
		Wetzko, T. Cognac; Significance of Furfural Reaction in Valuation of —	378
		Weyland, A. See Bradenburg, H.	998, 1216
		Wesel, J. Glue; Substitute for Animal — (P)	374
		Wheatley, R. B. Alloys, Metallic; Manufacture of — (P)	724

	PAGE
Wheeler, H. J., and Hartwell, B. L. Fat; Apparatus for Determination of —	753
White, A. H. Nitrogen; Oxidation of — as a Source of Error in Determination of Hydrogen and Methane	937
White, E., and Humphrey, J. "Pharmacopœia: a Commentary on the British Pharmacopœia, 1898"	1152
White, G. Fuel Injectors (P)	350
White, H. A. Carbonated Beverages; Apparatus for Racking — (P)	827
White, J. Arsenic; Discussion on Presence of — in Beer — See Child, J.	274, 274
White, W. G. and R. A. A. Polychromatic Printing; Compounds and Machines for — (P)	714
Whittaker, C. J. Fuel Blocks from Sewage Sludge of Bacterial Process — (P)	882
Wichelhaus, H. Diazobenzene Sulphonic Acid; Explosion of —	354
Widrin, L. See Saxl, H.	374
Wiedermann, F. See Libbermann, C.	569, 1104
Wigham, F. H. See Stead, J. E.	995
Wild, W. See Nernst, W.	234
Wildridge, G. J. Paper; Manufacture of — (P)	603
Wilhelm, H. Albumin; Peptonised Preparation of — (P)	924
Wilke, W. See Krafft, F.	113
Wilkinson, A. See Trier, M.	492
Wilkinson, J. Vaporised Oil and Air; Producing and Utilising — (P)	881
Will, W. Nitrocellulose; Researches on the Stability of — Nitrocellulose; Stability of —	932, 609
Willcox, F. A. Du Pont's Nitrometer; Discussion on —	101
Willenz. Lead in Galena; Determination of —	284
Williams, C. B. Phosphoric Acid; Kilgore's Method of Determining —	392
Williams, F. H. Copper; Influence of — in Retarding Corrosion of Steel and Soft Wrought Iron. Soft Steel and Wrought Iron; Influence of Copper in Retarding Corrosion of —	127, 44
Williams, H. C. Casks, Milk Churns, &c., Treating and Preserving — (P)	143
Williams, W. J. Powder; Essential Requisites of —	505
Wills, B. L. Iron and Iron Alloys; Effect of Temperature on Magnetic Properties of —	44
Willstätter, R. Synthesis in the Tropine Group — Tropidine; Conversion of — into Tropine — And Bode, A. <i>d</i> -Cocaine; Transformation of Tropinone into —	1015, 1135, 832
Wilson, D. Waste Liquids of Whisky Distilleries; Discussion on Composition and Disposal of —	458
Wilson, M. Toning Baths for Gelatino-Chloride Prints.	834, 932
Wilton, G. Sulphuretted Hydrogen and other By-Products; Treatment of — (P)	111
Wimmenauer, K. Bismuth; Quantitative Determination of — by Electrolysis	620
Wimperis, H. E. Iron Rods; Measurement of Young's Modulus for —	723
Winde, O. Malt for Aromatic Dark Beers; Kilning of —	1227
Windisch, Zymase, Buchner's; Enzyme Theory versus Plasma Theory	56
Windisch, K. Cherry Syrup in Raspberry Syrup; Detection of —	1146
Windisch, W. Barley; Treatment of — with Lime in the Steep — And Hasse, R. Barley and Malt; Pentosan Content of —	1226, 1129
Wingham, A. Iron and Steel; Internal Strains of —	1214
Winkelmann, M. Laes; Production of — (P)	729
Winkler, H. Gas-Burners; Incandescence — (P)	1101
Winkler, L. W. Water, Calcium and Magnesium in —; Volumetric Determination of — Waters; Determination of Nitric and Nitrous Acid in —	507, 937
Winteler, F. Perchlorates; Electrolytic Production of —	725
Winter, R., and Pappenheim, V. Electric Furnaces for Dental Purposes (P)	1120
Wintgen, M. Alkaloids of Chelidonium Majus.	1016
Wirth, E. Anthracene; Purification of — and Recovery of the Agent (P) — Carbazole; Nitro-derivative of — from Nitroscarbazole (P)	464, 890
Wirthle, F. Morphine; Detection and Determination of — Saccharin in Wine and Beer; Detection of —	511, 72, 1146
Wislicenus, H. Ash; Determination of —, and Apparatus therefor	1030
Wislicki, F. Wool and other Fibrous Materials; Treatment of — (P)	119
Wissell, L. von. Saltpetre, Nitrogen in; Determination of —	156
Wissenschaftliche Station für Brauerei in München. See Aubrey, L.	737
Wiszniewska, M., and Strzelecki, J. H. Aluminium or Alloys; Welding — (P)	339

	PAGE
Withers, W. A., and Fraps, G. S. Fertilisers; Rate of Nitrication of —	731
Witt, O. N. "Die Chemische Industrie auf der Internationalen Weltausstellung zu Paris, 1903"	1035
Wittmann, J. F. Fermentation Gas; Treatment and Utilisation of — (P)	736
Wittich, E. See Neumann, B.	943
Woda, F. See Fischer, G.	564
Wöhler, L. Detonators (P)	388
Woge, A. Pulp Strainers; Upward Flow — (P)	741
Wohl, A., and Aue, W. Nitrobenzene; Action of —, on Aniline in Presence of Alkali — And Kolrepp, A. Saccharine Solutions; Desaccharifying — (P)	887, 376
Wohlgemuth, J. See Neuberg, C.	825
Wohlwill, E. Anodes; Disintegration of —	1221
Wolde. See Titel, O.	381
Wolf, A., jun., and Co. Gas, Acetylene; Treatment of — (P)	976
Wolf, J. Fruit Juices; Presence of Methyl Alcohol in Fermented — Salicylates of Sodium and Ammonium; Solubility of Metallic Hydroxides in —	270, 1150
Wolfenstein, R., and Bumcke, G. Cellulose; Research on —	925
Wolfs, H. See Behrend, P.	623
Wood, J. T. Arsenic; Discussion on Presence of —, in Beer — Dung-Bate; Action of — Heat Producing Power of Fuel; Discussion on — Tanning Extracts; Discussion on — And Fopp, and Becker. Leather Bating Investigations	209, 137, 1084, 1087, 203
Wood, T. J. See Major, J.	121
Woodcock, W. H., and Harper, W. A. Sodium Nitrate; Extraction of —, and Apparatus therefor (P)	363
Woodhead, J., and Thompson, N. Silk Waste; Preparation of —, for Spinning (P)	358
Woodman, A. G., and Cayvan, L. L. Phosphates in Potable Waters; Determination of —	506
Woods, A. R. T. See Simpson, F.	233
Wool, Hide, and Skin Syndicate. See Riches, H. R.	913, 1124
Woolley, H. S. Furnaces; Construction of — (P)	788
Worsey, J. W., and Lancashire, J. H. Ores; Treatment of Complex —, and Apparatus therefor (P)	367
Worstell, R. A., and Hackathorn, C. P. Varnish; Manufacture of — (P)	263
Woy, R. Sugar; Kjeldahl's Method for Determination of —	395
Wrampelmeyer, E. Cotton-seed Oil; Halphen's Reaction for —	285
Wright, A., and The Mutual Electric Trust. Electrolytic Meters (P)	49
Wright, L. T. Stirrers, Rotary, for Roasting Furnaces (P)	256
Wright, S. B. Gold Ores at Deloro, Ontario; Cyanide Treatment of —	812
Wright, W. Cements; Setting for — (P)	478
Wroblewski, A. Yeast; Buchner's Expressed Extract of —	1009
Wrochem, J. von. See Mylius, F.	249
Wünsch, A. Hides; Use of Spirit in Removal of Fat from —	52
Wüste, F. See Paulitschky, C. and R.	912
Wulkan, H., and Straetz, H. Starch, Starch Sugar, and Albumin; Preparation of Dry — (P)	824
Wunschheim, O. von. Antiseptics; Influence of Glycerin on Disinfecting Power of —	331
Wurts, A. J., and others. Nerust Electric Lamps, and Heaters therefor (P)	566
Wylie, W. Gold Dredging in New Zealand	901
Wyronboff. See Verneuil	148

Y

Yarnold, R. J. Disinfectant and Antiseptic Preparations (P) — Ozonising Apparatus (P)	1013, 1120
Yeadon, S. N., and Mason, W. D. Gas-Lime; Apparatus for Revivifying — (P)	793
Yeo, J. A. A. See Patent Agglomeration Fuel Syndicate	350
Yoder, P. A., and Tollens, B. Dehydromucic Acid; Preparation and Reactions of —	1245
Youl, J., and Griffith, R. W. Tanning Materials; Relative Leather-forming Value of the Different —	426
Youtlen, W. Wood and other Fibres; Impregnating — with Solutions (P)	810
Young, S. W. Stannous Chloride and Oxygen; Reaction between — Stannous Chloride Solutions; Oxidation of —	943, 625



Z		PAGE	PAGE
Zacharias, P. D. Dyeing Process; Theory of the	804	Ziegler, M. Peat; Cooking of —, and Apparatus therefor (P)	793
Zänker, W. Indigo Carmine and Indigotin; Decrease in Use of	33	Zielenziger, S. Gas Lamps; Incandescent — (P)	236
Zander, H. See Stocker J.	727	Lamps; Incandescence Gas — (P)	884
Zanner, A. Sulphuric Acid; Manufacture of Concentrated — (P)	717	Zimmer, C. L. V. Coating for Metal, Stone, &c.; Materials for Use as — (P)	719
Zdanowicz, A. W. Nickel Steel; Metallurgy of —	1215	Zimmerman, W. Dyestuffs; Pyrogen (Sulphur) —	466
Steel; Compression of —	1117	Zipperer, P. "Die Schokoladen Fabrikation"	293
Zega, A. Brandies from Damsons and Grape Marc; Examination of —	1130	Zirner, J. H. See Kornfeld, A.	1230
And Knez-Milojkovic, D. Water-Nut; Composition of —	270	Zohrab, E. T. Furnaces for Smelting and Dephosphorising Ores (P)	587
Zehnpfund, K. Bunsen-Burners for Lighting or Heating (P)	975	Zohrab, G. T. Peat or other Materials; Pulping, Mashing, and Moulding — (P)	1099
Zehrlaut, H. Phenol; Electrolysis of — in Presence of Halogen Acids	369	Zollna, H. Heat Economiser	279
Zeidler, A. and Nauck, M. Worts; Albumose Contents of —	269	Zopf, W. Lichens; Composition of	77
Zeidler, R. Furnace for Manufacture of Press Glass (P)	477	Zschebye, Sugar Liquors; Influence of Alkalinity on —	53
Zeitschel, O. See Hesse, A.	239, 1138	Zschimmer, E. Boric Acid, Crude Italian; Analysis of —	283
Zelikow, J. See Zelinsky, N.	1253	Glass; Influence of Air and Dust on Decomposition of —	988
Zelinsky, N., and Zelikow, J. Unsaturated Hydrocarbons; Conversion of Alcohols into —	1253	Zschocke, G. Gas Washer; Rotatory —	879
Zellner, H. Fluorescein as an Indicator	389	Zucker, A. Gelatin Dry Plates; "Fogging" of —	278
Zengels, O. Iron and Tin; Volumetric Determination of —	840	Zühl, E. Celluloid-like Material; Manufacture of — (P)	831
Zicart, A. See Bate, J. A.	734	Celluloid-like Products (P)	273
Ziegenbruch, L. Pigments or Lustres for Use on Porcelain, Glass, &c. (P)	477	Celluloid; Manufacture of — (P)	926
Ziegler. See Fellner	810	Celluloid-like Substance; Manufacture of a — (P)	741
Ziegler, H. Priming Compositions (P)	933	Celluloid-like Substances; Production of — (P)	603
		Celluloid; Production of — (P)	741
		India-Rubber and Gutta-Percha; Substitute for — (P) ..	52
		Zugger, A. Tin; Influence of — on Quality of Iron and Steel	583
		Zuklowski, K. Hydraulic Cements; Theory of Hardening of —	990
		Zundel, C. See Binder, F.	712, 1108
		Zwergler, R. See Skraup, Z. H.	69



INDEX OF SUBJECTS.

N.B.—In this Index, (P) indicates that the matter referred to is an abstract of a patent; (T.R.) indicates that the matter referred to is in the Trade Report.

A		PAGE
Abraham and Marmier Process for Sterilising Lille Water. (Krull)	271, 381	
Abrasive Material from Bauxite, &c.; Manufacture of —. (P) Mills. From The General Electro-Chemical Co.	78	
Absorption Spectra; Plates for Photographing —. (Miethe)	67	
Acacia; Bark of Robinia Pseud —. (Power)	1018	
Acetic Acid, Lactic Bacteria of —; Production of, in Milk. (Bartel)	77	
Manufacture of —. (P) Boessneck	123	
Manufacture of Chemically Pure —. (P) Behrens	474	
Manufacture of —, from Calcium Acetate. (P) Behrens	806	
Of High Percentage; Production of —. (P) Edwards. From The Krauschwitzer Thonwaarenfabrik	42	
U.S. Consuls' Reports on —. (T.R.)	297	
Acetic Anhydride exempt from Duty in the Netherlands. (T.R.)	759	
Acetic Ether Purchase by Spain. (T.R.)	865	
Acetochloralactose; Characteristics of —. (Skraup and Kremann)	513	
Acetochloroglucose; Characteristics of —. (Skraup and Kremann)	513	
Acetochlorolactose; Characteristics of —. (Skraup and Kremann)	513	
Acetone; Action of Hypophosphorous Acid on —. (Marie) ..	944	
Acetophenone, 3,4-dihydroxybenzylidene- <i>m</i> -nitro —. (Rupe and Wasserzug)	1201	
<i>p</i> -Dimethylaminobenzylidene- <i>m</i> -nitro —. (Rupe and Wasserzug)	1200	
<i>m</i> -Nitrobenzylidene- <i>m</i> -nitro —. (Rupe and Wasserzug) ..	1200	
Acetyl-Cellulose; Manufacture of —. (P) Lederer	741	
Acetylene; Analysis and Purification of —. (Rossel and Landriscot)	345	
Dissolved —. (Fouché)	1196	
Electro-Chemical Behaviour of —. (Coehn)	905	
Explosive Properties of Compressed and Liquefied — ..	1021	
Flame; Study of the —. (Nichols)	29	
Flame; Temperature of the —. (Nichols)	109	
For Lighthouses. (T.R.)	853	
Industry in Germany; Report on —. (Rose)	28	
Manufacture; Calcium Carbide Mass for —. (Desq. and Franco)	109	
Phosphorus and Sulphur in; Determination of —. (Eitner and Keppeler)	938	
Reactions of —, with Cuprous Chloride. (Chavastelon) ..	841	
Solubility of —. (Tucker and Moody)	1245	
Acetylene-Black for Calico Printing. (Dépierre)	890	
In Germany. (T.R.)	955	
Acetylmethylcarbinol; Production of —, by Bacillus Tarricus. (Grimbert)	491	
Acetylphenylglycine- <i>o</i> -Carboxylic Acid; Neutral Esters of —. (P) Newton. From The Farbwerke vormals F. Bayer and Co.	277	
Acetylphenylglycooll- <i>o</i> -Carboxylic Acid; Manufacture of —. (P) Willcox. From The Badische Anilin und Soda Fabrik	803	
Acetyltropic Acid. (Hesse)	1135	
Acidity in Colour Sugar Solutions; Determination of —. (Pellet)	458	
Acid-proof Substance, and Manufacture thereof. (P) Stocker and Zander	727	
Proof Vessels and Articles. (P) Lefelmann	253	
Waste Neutralisation. (T.R.)	400	
Acids. (Class VII.)	42, 81, 121, 163, 247, 297, 360, 400, 473, 517, 577, 714, 764, 805, 855, 893, 953, 985, 1039, 1112, 1158, 1208, 1258	
Acids; Action of — on Carbonates of Alkaline Earths. (Valldé)	603	
Analogous to Sulphuric Acid; Sodium Salts of Dibasic —. VI. (Funk)	291	
Effect of Glassware Containers on —. (Tyrer and Tyrer) ..	899	
Micro-chemical Detection of —. (Emich)	1142	
Soluble in Ether derived from Molasses Residues. (Herzfeld)	1127	
Acker Cell; The —. (Kershaw)		1219
Aconine, Methylbenz-; Pharmacology of —. (Cash and Dunstan)		928
Aconitine, Alkaloids in Extracts of —; Determination of. (Stoeder)		1146
Pseud- and Jap-; Pharmacology of —. (Cash and Dunstan)		928
Pyr-; Pharmacology of —. (Cash and Dunstan)		928
Address; Changes of —.	3, 98, 183, 315, 419, 533, 659, 787, 877, 969, 1050, 1176	
Address Presented on Ninth Jubilee of Glasgow University ..		560
Presidential —		662
Adhesive Compound. (P) Bouthillier		266
Adonidin. (Waljaschko)		150
Aerating Apparatus. (P) Kasper		1094
Aérogen Gas. <i>See under</i> Gas.		
Africa, East; Mafoureira Nuts in —. (T.R.)		955
East; Match Imports of Chinde —. (T.R.)		1049
East; Oil-Seed Exports of Chinde —. (T.R.)		1043
East; Rubber Collection in —. (T.R.)		955
East; Tanning Plants in German —. (T.R.)		520
French; Exports from —. (T.R.)		851
German East —; Colouring Plants in. (T.R.)		514
German; Imports from —. (T.R.)		851
Guano at the Cape. (T.R.)		861
Resin and Rubber Industries of German East —. (T.R.) ..		770
Trade of the United Kingdom with —. (T.R.)		851
Air and other Gases; Liquefaction of —. (P) Joly and Richardson		1095
And Vapour of Volatile Liquids; Apparatus for Producing Constant Mixture of —. (P) Haddan. From Guy ..		976
Apparatus for Carburetting —:		
(P) Hauslich		463
(P) Parves and The Noekin Sydicate		462
(P) Rudolph		462
Apparatus for Liquefying and Separating Oxygen from —. (P) Thrupp		1018
Apparatus for Mixing and Burning — with Gas and Vapours. (P) Bower		697
Apparatus for Pumping —. (P) Hilliard		843
Carburetted; Apparatus for Cold Production of —. (P) Lothammer		31
Carburetted with Benzol; Behaviour of — in Fischer's Apparatus. (Ulzer)		1196
Carburetted —. <i>See also under</i> Gas, Aérogen.		
Carburetting —, and Apparatus therefor. (P) van der Made		976
Compressed; Carbon Dioxide in —. (T.R.)		775
Drying —, and Apparatus therefor. (P) Gayley		27
Enriched —. (T.R.)		654
Expired; Regeneration of —, by Sodium Peroxide. (Desgruz and Balthazard)		1229
Limits of Explosion of Admixtures of Benzol with —. (Ulzer)		1196
Liquid; Apparatus for Manufacture of —. (P) Claude ..		1018
Liquid; Preservation of —. (P) Joly		695
Non-Poisonous Character of Exhaled —. (Nussbaum) ..		1013
Obtaining gas or liquid rich in Oxygen from —. (P) Thompson. From Le Sueur		931
Of Rooms; Purification of the —. (P) Howorth. From Titel and Wolde		381
Pyrometers. (P) Mills. From The Bristol Co.		28
Akee Oil; Characteristics of —. (Garsed)		134
Notes on —. (Holmes)		134
Alaska; Tin Deposits in —. (T.R.)		1260
Albumin and Meat Extract; Preparation of —. (P) Deycke ..		59
And Starch or Starch Sugar; Preparation of —. (Wulkan and Straetz)		824
Determination of —. (Barnstein)		160
Easily Digestible Peptonised Preparation of —. (P) Wilhelm		924
Formation of an Isatin Derivative of —. (Gnezda)		1254
Gelatin Substituted for —, in Calico Printing. (Binder and Sunder)		1108
Trade of Wuhu, China. (T.R.)		862
Transformation of —, into Globulin. (Starke)		379
Albuminoids; Chemistry of —. (Kosset)		1228
Determination of Decomposition Products of —. (Hart) ..		1149



	PAGE		PAGE
Albuminoids—cont.		Alkali—cont.	
Precipitation of —, by Chloroform:		Silicate; Production of a Dry —. (P) Reim	898
(Krüger)	923	Titration of Free —. (von Huber)	283
(Salkowski)	379	Works; Chief Inspector's Annual Report on	893
Albumose Contents of Wort. (Zeidler and Nauck)	269	Works Regulation Act; Amendment of —. (T.R.)	514
Alcohol and Extract in Beer; Tornøe's Method of Determining		Works Regulation Bill. (T.R.)	705
— (Ling and Pope)	755	Works Regulation Bill; Withdrawal of —. (T.R.)	835
And Pressed Yeast; Production of —. (P) Barbet	270	Alkalis. (Class VII.)	42, 81, 121, 166, 247, 297, 360, 400, 473, 517, 577, 714, 764, 805, 855, 893, 953, 1039, 1112, 1156, 1208, 1258
And Water; Boiling Point Curve for Mixtures of —.		Caustic; Manufacture of —. (P) Wetter. From Besen-	
(Noyes and Warfel)	928	felder	987
As Fuel in Germany. (T.R.)	952	Electro-Production of —. (Kershaw)	402
Derived from Limonene; A New —. (Genyresse)	385	Microchemical Detection of —. (Emich)	1142
Duty-free —, in the United States. (T.R.)	168	Titration of —, by Coloured Indicators. (Berthelot)	938
Duty on —, in Japan. (T.R.)	294	Alkaline Amalgams; Decomposition of —, and Apparatus	
Etherification of Triphenylcarbinols by —. (Fischer)	53	therefor. (P) Thompson. From Litzelmann and	
For Toilet Soap Industry; Denaturing. (Hirsch)	134	Tailler	717
Herbs in; U.S. Customs Decision on —. (T.R.)	1261	Amides; Preparation of —. (P) Ewan and Pfeizer	833
In Cider. (Allen)	1011	Earth Dioxides; Manufacture of —. (P) Jaubert	474
In Distilleries during 1900; Causes of Poor Attenuations		Earth Silicides; Manufacture of —. (P) Mills. From	
and Deficient Yields of —. (Heinzelmann)	142	The International Chemical Co.	43
In Ether; Determination of —. (Frayer)	1250	Salt Solutions; Decomposition of —, and Apparatus	
In Spent Distillery Wash. (Heinzelmann)	491	therefor. (P) De Brito e Cunha	1121
Influence of —, on Alkaline Earth Carbonates. (Vallée)		Salts; Electrolysis of —, and Apparatus therefor. (P)	
Methyl; Detection of —, in Presence of Ethyl Alcohol.		Greenwood	1220
(Prescott)	1030	Alkalinity in Coloured Sugar Solutions; Determination of —.	
Methyl, in Mixtures; Detection of —. (Mulliken and		(Pellett)	488
Scudder)	71	Indicators for —. (Köhler)	1147
Methyl, in Vinegar; Detection of —. (Robine)	753	Alkaloid contained in Iboga; Properties of —. (Dybowski	
Methyl; Purification of —. (Rotten)	604	and Landrin)	1234
Obtainment of —, from Molasses. (P) Braunsch	600	From Elder Bark. (Malméjac)	929
Onanthylic; Action of —, on its Sodium Derivative.		Alkaloids. (Class XX.)	62, 148, 188, 273, 383, 408, 494, 603, 742, 775, 831, 864, 926, 958, 1014, 1048, 1134, 1162, 1231, 1261
(Guerbet)	383	Action of the Vegetable —, on Indicators. (Astruc)	841
Of 96°; Action of —, upon Metals. (Malméjac)	365	Cactus —. IV. (Heffter)	1134
Phenylethyl; Occurrence of —, in Rose Oils. (Von		Cinchona; Characteristics of the —. (von Miller and	
Soden and Rojahn)	65, 1136	Rohde)	63
Swiss Duties on Products Manufactured with —. (T.R.)	629	Cinchona; Formation of the —. (Lotsy)	150
Versus Coal in Germany. (T.R.)	853	Cinchona; Perbromides of —. (Christensen)	605
Alcohols, Amyl-, of Fusel Oil; Separation of the —:		Exhausting Drugs for Determination of —. (Linde)	624
(Marckwald)	378	Extraction of —, and Apparatus therefor. (P) Froelching	
(Marckwald and McKenzie)	379	Formation of —, in Cinchona Trees. (Lotsy)	498
Conversion of —, into Unsaturated Hydrocarbons. (Ze-		In Aconitine, Belladonna, and Henbane Extracts; Deter-	
linsky and Zelikow)	1253	mination of —. (Stoeder)	1146
Determination of —. (Verley and Bölsing)	1250	In Cinchona Bark; Determination of —. (van Kettel)	511
Influence of —, on Electrolytic Dissociation of Salts.		In Ipecacuanha Root; Determination of —. (Stoeder)	1147
(Ditz)	389	In Pomegranate Bark and Extract; Determination of —.	
Oxy-; Production of Aromatic —. (Eichengrün)	1239	(Stoeder)	1150
Primary; Action of Calcium Carbide on —. (Lefebvre)	847	Micro-Chemical Detection of —. (Pozzi-Escot)	1030
Primary; Oxidation of —, by Contact. (Trillat)	847	Micro-Chemical Investigation of —. (Pozzi-Escot)	605
Secondary and Tertiary; Contact Action of —. (Trillat)	847	Of Chelidonium Majus. (Wintgen)	1016
Synthesis of —. (Guerbet)	292, 383	Of Corydalis Cava:—	
Alcoholic Liquids, Fusel Oil in; Determination of —. (Beck-		(Dobbie, Lauder, and Palatseas)	66
mann)	1148	(Gadamer and others)	1234
Alcoholometers; Construction of —. (P) Manley	1228	Of Eschscholtzia Californica. (Fischer)	1015
Aldehyde; New Aromatic —, in Eucalyptus Oils. (Smith)	744	Of Glaucium Luteum. (Fischer)	222
Aldehydes; Acidimetry of —. (Astruc and Murco)	161	Of Hyoscyamus and Datura Stramonium grown in Egypt.	
And Ketones; Decomposing the Bisulphite Compounds of		(Dunstan and Brown)	66
— (Freundler and Buel)	832	Of Ipecacuanha. (Paul and Cowley)	500
And β -Naphthol; Reaction between —. (Rogow)	393	Of Mandragora Root. (Hesse)	1135
Of Lemon Oil; New —. (Von Soden and Rojahn)	1136	Of Sanguinaria Canadensis. (Fischer)	1016
Volumetric Determination of —. (Ripper)	288	Of the Cactaceae. (Heyl)	1016
Algae; Soluble Colouring Matter of Blue-Green —. (Kolk-		Of Tobacco; New —. (Pietet and Kotschy)	501
witz)	77	Precipitation of —, by Picric Acid. (Chandelon)	63
Algeria; Beer Imports of Oran —. (T.R.)	1048	Reagent for. (Orlow and Horst)	511
Cement Imports of Oran —. (T.R.)	1040	Solubility of —, in Carbon Tetrachloride. (Schindel-	
Mineral Production of —. (T.R.)	637	meiser)	384
Oils and Soap at Oran —. (T.R.)	1042	Tannin used in Purifying Residues containing —	
Phosphates in —. (T.R.)	1046	(Kippenberger)	74
Sulphate of Copper in —. (T.R.)	1039	Alkylated Aminobenzene Sulphonic Acids and Metamino-	
Alimentary Matters; Drying or Smoking —. (P) Newlands		phenols. (Guehm and Scheutz)	798
See also Foods.	736	Alkyls; Displacement of —, from Phenols by Nitration.	
Alinit; Bacilli of —.	597	(Larter)	745
Alizarin and Buxanthone; Methylation of —. (Graebe and		Alloinchinone; Preparation of —. (Hlavnicka)	499
Aders)	1204	Alloy; Aluminium —:	
Blue Resist under Paranitraniline Red. (Richard)	711, 712	(P) Mach	257
Dyeing Processes. (P) Kornfeld	893	(P) Manhardt)	1219
Products for directly Dyeing Fibres. (P) Imray. From		Aluminium-Antimony; Density of —. (Lippmann)	814
The Farbwerke vormals Meister, Lucius and Brüning		And Production of Same. (P) Hatmaker. From Hennig	
Sky-Blue, and its Application in Dyeing Woollen Goods.		Nickel-coloured —. (P) Ekker and Krajesics	1217
(Steinberg)	805	Of Aluminium and Magnesium; Manufacture of —. (P)	
Use of —, in India. (T.R.)	400	Murmann	905
Alkali; Action of —, on Damasceneine. (Pommerehne)	500	Of Lead and Copper, and Production thereof. (P) Lake.	
Apparatus for Electrolytic Production of —. (P) Maclear		From Hewitt and Coe	724
Chromates and Bichromates; Production of —. (P)		Of Nickel with other Metals. (P) Weidner	369
(Shearer)	718	Silver-coloured. (P) Ekker and Krajesics	1217
Copper Carbonates. (Gröger)	363	Alloys; Aluminium —, containing Tungsten and Copper.	
Cyanides; Apparatus for Obtainment of —. (P) Craig		(P) Berg	1217
and Paterson	809	Aluminium-Magnesium —. (Boudouard)	814
Cyanides; Manufacture of —. (P) Johnson. From		Aluminium-Molybdenum; Characteristics of —. (Guil-	
The Deutsche Gold and Silber Scheibe-Anstalt	1113	let)	814
Cyanides; Obtainment of —. (P) Craig and Paterson	808	Aluminium; Production of —. (P) Baudelot	47
Electrolytic Production of —. (Swan)	667	Analysis of —. (Ulzer)	1216
Electrolytic Production of —, and the Acker Cell.		And Production thereof. (P) Lake. From Simonds	725
(Kershaw)	1219	Cathode Polarisation and Formation of. (Coehn)	1221
Electrolytic Production of —; Investigations on —.		Copper-Tin, Copper-Zinc, and Tin-Zinc; Determination of	
(Adolph)	715	Specific Gravities of —. (Macy)	1117
Nitrates; Determination of Nitric Acid in —. (Perman)		Copper-Tin; Results of Chilling —. (Heycock and	
Process; The Outhenin-Chalandre Electrolytic —.		Neville)	814
(Kershaw)	619	Crucible for Casting — under Pressure. (P) Cothias	997
Salts and Bye-Products; Manufacture of —. (P)		Deposition of —, by Electrolysis. (P) Meurant	370
Hoepfner	987		

	PAGE
Alloys—cont.	
Iron; Manufacture of —. (P) Crean	1218
Made in the Electric Furnace. (Hamilton and Smith)	589
Manufacture of — (P) Wheatley	724
Nickel — (Wedding)	1217
Nickel Coloured and Silvered Coloured —. (P) Ekker and Krajesics	47
Of Aluminium. (Tetrajer)	996
Of Aluminium and Copper. (Guillet)	1217
Of Aluminium and Molybdenum. (Guillet)	902
Of Aluminium and Tungsten. (Guillet)	723
Of Aluminium; Coating of —. (P) Betts	1219
Of Aluminium; Improvement of —. (P) Hyatt	724
Of Aluminium; Welding —. (P) Wiszniewska and Strzelecki	369
Of Copper; Alteration of —, in Contact with Air, &c. (Berthelot)	586
Of Copper and Iron. (Stead)	995
Of Copper; Refining	586
Of Gold and Silver from Egyptian Tombs. (Berthelot)	846
Of Iron and Nickel. (Rudeloff)	127
Of Iron; Effect of Temperature on Magnetic Properties of —. (Wills)	44
Of Manganese; Apparatus for Production of —. (P) Simon	256
Of Metals allied to Nickel; Electrolytic Deposition of —. (P) Kugel	260
Of Nickel, Copper, and Aluminium. (Hantzschel)	1217
Of Rhodium. (Roessler)	128
Of Tungsten and Molybdenum; Production of —, in the Electric Furnace. (Sargent)	134
Precipitation of —, from Solutions. (P) Meurant	370
Production of —. (P) Blackmore	1118
Alluvial Deposits; Extraction of Metals and Minerals from —. (P) Maclear	1217
Aloe Planting in Madras. (T.R.)	1039
Aloes; Uganda —. (Tschirch and Klaveness)	743
Alolin; Oxidation of —, by Potassium Persulphate and Caro's Acid. (Seel)	66
Alum at Civita Vecchia. (T.R.)	1040
Cake; Tariff Valuation of —, in British India. (T.R.)	758
In Wine; Detection of —. (Lopresti)	158
Soda; Manufacture of —. (P) Spence	250
Alumina; Manufacture of —. (P) Hall	808
Obtainment of Pure —, from Bauxite. (P) Hall	808
Reduction of —, by Calcium Carbide. (Tucker and Moody)	970
Aluminium; Abrasive Material from Hydrous Oxides of —. (P) Mills. From The General Electro-Chemical Co.	78
Alloy; Manufacture of —. (P) Mach	257
Alloys; Production of —. (P) Baudelot	47
And its Alloys. (Tetmajer)	996
And its Alloys; Improvement of —. (P) Hyatt	724
And its Alloys; Welding —. (P) Wiszniewska and Strzelecki	369
And Tungsten; Alloys of —. (Guillet)	723
As an Electrical Conductor. (Kershaw)	133
Chloride, Bromide, and Iodide; Preparation of —. (Gustavson)	383
Chloride; Compounds of Ammonia with —. (Baud)	249
Chloride; Properties of Ammoniated —. (Baud)	473
Chlorides; Thermo-chemical Study of Ammoniacal —. (Baud)	363
Coating of —. (P) Betts	1219
Composite Articles of Cast — with other Metals. (P) Baudelot	47
Composition for Uniting or Soldering —. (P) Totten	481
Convention. (T.R.)	1158
Crystallised Metallic Compounds of —. (Brunck)	1117
Durability of — under Atmospheric Exposure. (Kershaw)	133
Electrolytic Production of —. (P) Cohn and Geisenberger	726
Electro-Production of —. (Kershaw)	401
Extraction of —. (Swan)	665
Flux for Soldering —. (T.R.)	954
Galvanic Deposits on —. (Setlik)	260
In India. (T.R.)	767
In Steel; Determination of —. (Spatz)	507
Influence of — on the Carbon in Cast-Iron. (Melland and Waldron)	1213
Mercury Couple. (Cohen and Dakin)	512
Obtainment of —, partly Electrolytic (P) Taudel	1121
Oleate; Preparation of —. (Naylor)	498
Or its Alloys; Coating of —. (P) Lake. From Betts	130
Plant in Canada. (T.R.)	1158
Preparing — for Soldering. (P) Sørensen	1119
Purification of —. (P) Johnson. From the Pittsburg Reduction Co.	727
Reducing Properties of —. (Duboin)	512
Sheets of — covered with Silver. (P) Martin	724
Soldering —:	
(P) Lange	369
(P) Novel	47
Uniting — to other Metals or Aluminium. (P) Johnson. From Heräus	587
Uniting — to Steel or Iron. (P) Soc. Int. des Us. et Fond. d'Aluminium	369
Alumino-thermic Welding and Casting; Improvement in the Goldschmidt Method of —. (Cohn)	996
Aluminous Compounds; Manufacture of —. (P) Spence	364

	PAGE
Amalgamating Plates; Electro-Silvered versus Plain Copper —. (Halse)	259
Amalgams; Alkylammonium —. (Crotagino)	757
Decomposition of —, and Apparatus therefor. (P) Thompson. From Litzelmann and Tailfer	717
Lead; Nature of —. (Fay and North)	479
Amber at Dantzic. (T.R.)	1045
Recent Researches on —. (Tschirch)	51
Substitute for —. (P) Schaal	263
Varnish; Manufacture of —. (P) Flather	372
America; Portland Cement in —. (T.R.)	953
<i>See also under United States.</i>	
American and British Trade for First Seven Months of 1901 Compared. (T.R.)	1153
Amides, Alkaline; Manufacture of —. (P) Ewan and Pfeleger	833
Amido. <i>See also under</i> Amino.	
Amido-ammonium azo-Dyestuffs; Manufacture of —. (P) Abel. From The Actiengesellschaft für Anilin-Fabrikation	708
Amido-benzoic Acids; Manufacture of Substituted —. (P) Ellis. From Pertsch	1204
1·8-Amido-naphthol-4-sulpho Acid and Intermediate Products; Manufacture of —. (P) Wilcox. From The Badische Anilin und Soda Fabrik	889
Amidonaphthol-sulpho Acids; Monazo Dyes derived from —. (P) Ransford. From Cassella and Co.	241
Amido oxanthraquinone Sulphonic Acids; Dyeing with —. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	471
Amine Salts; Action of Bases and Acids on —. (Colson)	832
Amines; Electrolytic Reduction of Nitro-Compounds to —. (Chilesotti)	1001
Production of — from the Corresponding Nitro Compounds. (P) Johnson. From Boehringer and Soehne	118
Tertiary Aromatic —. IV. (Häussermann)	356
Amino. <i>See also under</i> Amido.	
Amino-azo Compounds. (Möhlau and Heinze)	579
Compounds; Fatty Aromatic —. (Praeger)	1202
Aminobenzophenones, Substituted, and Aromatic Amines in Sulphuric Acid Solution; Reaction between —. (Lemoult)	571
m-Aminophenol Ethers; Dyestuffs from Dialkylated —. (Grimaux)	356
Aminophenols, Met-, and Alkylated Aminobenzene Sulphonic Acids. (Gnehm and Scheutz)	798
m-Aminophenols; Preparation of Dyestuffs from Alkylated (Grimaux)	355
β-Aminophenylbenzimidazoles; Comparison of the Three —. VII. (Miklaszewski and St. v. Niementowski)	1202
Ammonia Absorption Process for Cooling and Ice-Making Machines. (P) Osenbrück	974
Ammonia; Action of — on Antipyrine Chloride. (Michaelis and Gunkel)	502
Action of — on Benzyl Chloride. (Dhommée)	1200
Action of — on Metals at High Temperatures. (Henderson and Beilby)	1212
Action of — on Soda-Celulose. (Thiele)	890
And Chlorine; Reaction between —. (Noyes and Lyon)	943
Compounds of — with Aluminium Chloride. (Baud)	249
Drawback on Pure — in the United States. (T.R.)	1156
Ice Machines; Connection between Temperature in Compressor and Quantity of Ammonia in Evaporator. (Habermann)	459
Liquors; Treatment of —. (P) Scott	352
Solution; Influence of Sodium Sulphate on Vapour Pressure of Aqueous —. (Perman)	474
Solution; Vapour Pressure of Aqueous —. (Perman)	473
Treatment of Oak Furniture by —. (Kolitsch)	893
Use of Corrosive Sublimate for Detection of —. (Ferraro)	280
Ammoniacal Salts as Nematocides. (Lonay)	267
Ammoniacum; Pharmacopœia Tests of —	385
Ammonium Carbonate; Action of — on Arsenic Sulphide. (Vanino and Griebel)	1243
Chloride; Apparatus for Crystallising or Freezing. (P) Naef	233
Chloride; Decomposition of Calcium Ammonium and Lithium-Ammonium by —. (Moissan)	1252
Chloride; Electrolysis of —. (Moissan)	1220
Fluoride as a Disinfectant for Hose Pipes. (Schönfeld)	830
Icthyol-Sulphonate; Preparation of —. (McLaughlin)	1280
Imidosulphite; Occurrence of —. (Divers and Ogawa)	716
Oxalate; Formation of Carbon in Electrolysis of —. (Verwer)	1120
Persulphate.	1020
Persulphate as a Photographic Reducer	746
(Myblin)	68
(Namias)	505
Persulphate; Destructive Action of — on Cotton. (Scheurer)	891
Persulphate; Photographic Reduction by —. (Luppocramer)	278
Salicylate; Solubility of Metallic Hydroxides in —. (Wolf)	1150
Sulphate; Manufacture of —. (P) Scott	352
Sulphate; Statistics of —. (T.R.)	81
Sulphide; Influence of — on Fine-grained Silver Emulsion Plates. (Valenta)	834



PAGE	PAGE		
Ampère-Manometer. (Bredig).....	69	Antimony—cont.	
Manometer, and its Applications in Electro-Chemistry. (Job).....	257	Localisation and Dissemination of— in the Organism. (Kühling).....	1253
Amphopeptone and Antipeptone. (Siegfried).....	276	Mines in Salonica and Kossova. (T.R.).....	1259
Preparation of Pure —. (Mühle).....	745	Mining in Bohemia. (T.R.).....	955
Amylaceous Matter; Rendering — Soluble. (P) Société Alliance Industrielle.....	492	Obtainment of —. (P) Armstrong.....	905
Amylomycetes; Investigation of certain Species of —.....	377	Separation of Arsenic from —. (Rohmer).....	282
Amyl-Alcohols. See under Alcohols.		Volumetric Determination of —. (Rohmer).....	749
Anaconda; Electrolytic Copper Refining Plant at —.....	727	Antipeptone and Amphopeptone. (Siegfried).....	276
Anæsthetic; Ethyl- <i>o</i> -Anisidine Formate as an —. (Goldschmidt).....	605	Characteristics of —. (Kutscher).....	384
Analysis; Nitric Acid and Mixed Acid —. (van Gelder)....	339	Reputed Non-existence of —. (Kutscher).....	276
Uniformity in Technical —. (Richardson).....	334	Antipyrin and its Derivatives. (Eccles).....	832
Analytical Chemistry and Apparatus. (Class XXIII.).....	69, 155, 279, 389, 506, 617, 747, 837, 933, 1025, 1141, 1240	Chloride; Action of Aniline and of Ammonia on —. (Michaelis and Gunkel).....	502
Andromedotoxin; Characteristics of —. (Archmagelski)....	1015	Antiseptic Compounds; Manufacture of —. (P) Zimmermann. From The Chemische Fabrik vormals E. Schering.....	382, 603
Anethoil; Isomeride of —, and its Constitution. (Behal and Tiffereau).....	384	Or Detergent Compounds. (P) Billig.....	1133
Anethol.....	1236	Preparation. (P) Bourdil.....	147
Oxidation of — to Anisic Acid. (Bougault).....	502	Antiseptics and Micro-Organisms in Tanning. (Jean).....	265
Angophora; New Species of —. (Baker).....	65	Influence of Glycerin on Disinfecting Power of —. (von Wunscheim).....	381
Anhalamine. (Heffter).....	1134	Apiin and Apiose. (Vongerichten).....	1034
Anhalonidine. (Heffter).....	1134	Apiol; Detection of —. (Jorissen).....	285
Aniline; Action of Nitrobenzene on — in Presence of Alkali. (Wohl and Aue).....	887	Apparatus. (Class I.).....	27, 105, 232, 343, 459, 561, 694, 788, 878, 974, 1094, 1194
Aziline; Action of — on Antipyrine Chloride. (Michaelis and Gunkel).....	502	Aqueous Solutions. See under Solutions.	
And Analogous Bases; Preparation of —. (Sabatier and Senderns).....	978	Arabinose; Behaviour of — in the Animal Organism. (Neuberg and Wohlgenuth).....	825
Black; Dyeing Wool, &c. with —. (P) Bethmann.....	577	Arabinoses; Behaviour of the Three — in the Animal Organism. (Neuberg and Wohlgenuth).....	825
Black, Overdyed with Basic Dyestuffs; Bronzing of —. (Roessler and Hackl).....	39	Arabit; Nitro-Derivatives of —. (Vignon and Gerin).....	1254
Oxidation of —. (Börnstein).....	701	Araroba; Pharmacopoeia Tests of —.....	386
Synthesis of —. (Jaubert).....	464	Ardgowan Distillery; Visit to the —.....	651
Anilines; Reactions of Substituted —. (de Coninck).....	113	Argentina; Salt for Preservation of Hides Duty Free in. (T.R.) Sugar from —. (T.R.).....	951, 919
Anise Camphor. See under Anethoil.		Armies in the Field; Prevention of Water-Borne Enteric Fever amongst —. (Parkes and Ridesal).....	1229
Seed at Pakhoi, China. (T.R.).....	864	Arnica Root; Pharmacopoeia Tests of —.....	385
Anisic Acid; Oxidation of Anethol to —. (Bougault).....	502	Aromatic Compounds and Colouring Matters therefrom; Manufacture of —. Johnson. From The Badische Anilin und Soda Fabrik. (P).....	240
Anisidine; Diazotisation of Dinitro —, and Constitution of the Resulting Product. (Meldola and Eyre).....	572	Arsenic Acid; Acidimetry of —. (Astruc and Tarbouriech) And Antimony in Cupreous Materials; Determination of —. (Gibb).....	935, 184
Dinitro-ortho —. (Meldola and Eyre).....	1204	Apparatus for Gutzet's Test for —. (Kirkby).....	281
Ortho-Nitro-Derivatives of —. (Freys).....	356	Apparatus for Marsh's Test for —. (Tyner).....	250
Annual Meeting; Proceedings of the Twentieth —.....	660	Detection of —. (Helmer).....	280
Anodes; Disintegration of —. (Wohlwill).....	1221	Determination of —. (Ducru).....	69
Anthracene Derivatives; Manufacture of New Halogen —. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	241	Determination of — as Ammonio-Magnesium Arsenate. (Ducru).....	157
Manufacture and Purification of —. (P) Luyten and Blumer.....	756	Determination of — in Small Quantities. (Asterberg).....	391
Nitro-Preparation of —. (Meisenheimer).....	396	Discussion on Need of a Standard Test for —.....	332
Purification of —, with Recovery of the Agent. (P) Wirth.....	464	Effect on Copper of Small Amounts of —. (Lewis).....	254
Anthracite Briquettes; Manufacture of —. (P) de Fauchaux d'Humy and McKenzie.....	687	Gutzet's Test for — Modified: (Bird).....	390
Anthragallol; Autoxidation Products of —. (Bamberger and Praetorius).....	1202, 1103	(Dowzard).....	506
Nitro-Compounds of —. (Bamberger and Böck).....	1103, 1103	In Beer and Peripheral Neuritis.....	1033
Anthranilic Acid; Action of Formaldehyde and Nascent Hydrocyanic Acid on —. (Kohner).....	801	In Beer; Detection and Determination of —. (Jones).....	281
Acid Derivatives; Conversion of — into Indigo. (Erdmann).....	801	In Beer; Detection of —: (Allen).....	158, 281
Acid; Derivatives of —. (Mehner).....	606	(Estcourt).....	158
Acids; Two New Chloro —. (Cohn).....	1204	(Kirkby).....	158
Anthranol and Oxanthranol. See under Phenylanthranol.		In Beer; Discussion on —.....	208
Anthraquinone, Ortho-, Nitro-; Electrolytic Reduction of —. (Möller).....	1001	In Beer; Manchester Commission Report on —. (T.R.) In Beer, Sugar, &c.; Detection of —. (Paul and Cowley).....	644, 158
Anthraquinone Dyestuffs; Production of —. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	357	In Beers, Brewing Materials, and Food; Detection of —. (Thomson and Shenton).....	204
Anthrax Traceable to Tannery Refuse (T.R.) Russell.....	405	In Coal and Coke: (Chapman).....	1241
(Russell).....	494	(Wood, Smith, and Jenks).....	437
Anti-Bacteria System for Use of Brewers. (Bennett).....	737	In Coke; Determination of Minute Quantities of —. (Archbutt and Jackson).....	448
Antidotes for Cyanide Poisoning. (T.R.).....	863	In Fine Lead; Determination of —. (Liebschutz).....	1028
Anti-fouling Coating for Metal Structures. (P) Day. From The Coleman International Ship and Pile Coppering Co.	925, 925	In Malt-Kilns. (Fairley).....	918
Anti-incrustants; Production of: (P) Johnstone.....	233	In Manufactured Products; Discussion on Occurrence and Detection of —.....	188
(P) Hamilton.....	878	In Sugars, Malt, and Beer; Determination of —. (Newlands and Ling).....	748
(P) Garside and Saxon.....	23	Influence of Selenium on Certain Tests for —. (Rosenheim).....	751
(P) Metcalf.....	105	Marsh-Gutzet Test for —, and Apparatus therefor. (Tyner).....	281
(P) Rümmler.....	105	Separation of — from Antimony, &c. (Rohmer).....	282
(P) von Fritz.....	561	Sulphide; Action of Ammonium Carbonate on —. (Vanino and Griebel).....	1243
Antimonic Acid; Iodometric Determination of —. (Rohmer).....	749	Arsenical Poisoning.....	943
Antimony Deposits in Nova Scotia. (T.R.).....	1158	Poisoning from Consumption of Food and Drink; Report of Royal Commission on —.....	916
Detection and Determination of Traces of — in Large Amounts of Arsenic. (Denigès).....	1244	Arsenious Acid; Determination of — by Permanganate. (Kühling).....	391
Electrolytic Deposition of —. (Hollard).....	589	Oxide in Paris Green; Determination of —. (Avery and Beans).....	936
Electrolytic Separation of — from Tin. (Ost and Klapproth).....	1028	Oxide in Paris Green; Soluble —. (Avery and Beans).....	495
In Cupreous Materials; Determination of —. (Gibb)....	184	Oxide Micro-Sublimate. (Delépine).....	281
In Fine Lead; Determination of —. (Liebschutz).....	1028	Artemisin; Characteristics of —. (Fertol).....	1235
Influence of — upon Copper. (Stahl).....	480		

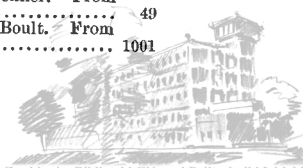


	PAGE
Arum Maculatum; Chemical Changes in the Sap of Cell-Free — (Hahn).....	375
Asarum Canadense; Constituents of Essential Oil of — (Power and Lees).....	1238
Asbestos; Analyses of — (Clayton).....	1212
Deposits in Canada. (T.R.).....	300
Treatment of — (P) Raphael.....	1212
Ash; Exact Determination of —, and Apparatus therefor. (Wislicenus).....	1030
Asparagin as Food: Nutritive Value of — (Rosenfeld)....	271
Aspergillus Niger; Proteolase of — (Malfitano).....	56
Asphalt at Palermo, Sicily. (T.R.).....	1156
Imports of Dantzic. (T.R.).....	1038
In Trinidad. (T.R.).....	1038
Asphalts; Determination of Melting Points of — (Mabery and Sieplein).....	394
Asphalts of Palestine: Sulphur in — (Elschner).....	885
Assay Furnace. (P) Laird.....	255
Office in Ontario. (T.R.).....	351
Platinum-Gold-Silver — (Oehmichen).....	507
Association of Chambers of Commerce of the United Kingdom. (T.R.).....	951
Atcheson Process for Production of Graphite. (Fitzgerald) ..	443
Athabasca Mine, British Columbia; Cyanide Plant at —.....	1215
Atropine Sulphate: Tests for — (Gadamer).....	928
Atroscine; Characteristics of — (Hesse).....	1233
Auramine, Benzene-azo- β -naphthyl — (Möhlau and Graelett).....	1203
Auramine from Tetramethyldiamidodiphenylmethane; Obtainment of — (Walter).....	34
Australia; Mineral Phosphates in Western —.....	945
Products of — (Baker).....	109
South; Copper Ores in — (T.R.).....	1042
Sulfur; Fertilisers in — (T.R.).....	956
Tariff of — (T.R.).....	1155
West; Importation of Dangerous Goods into — (T.R.).....	294
West; Output of Minerals other than Gold. (T.R.).....	401
Western; Customs Decisions in — (T.R.).....	949
Austria; Imports and Exports of Bosnia and Herzegovina — (T.R.).....	1154
Lead and Zinc Production in — (T.R.).....	1259
Hungary; Chemicals in — (T.R.).....	953
Hungary; Sugar Campaign of 1900—1901 in — (T.R.).....	1160
Hungary; Sugar Trade of — (T.R.).....	521
Aviary; a New Gum from Madagascar. (T.R.).....	1045
Azo-Colours; Application of —, on Manganese Brown. (Binder and Zundel).....	712
Colours; Application of —, on Manganese Brown; Report on Binder and Zundel's Process. (Stricker) ..	712
Compounds from <i>m</i> -Toluidine. (Samelson).....	240
Compounds; Reduction of — (P) Johnson. From Boehringer and Son).....	259
Azonium Dye-stuffs; Chloro-Derivatives of — (Kehrmann and Hiby).....	701
(Kehrmann and Krazier).....	703
(Kehrmann and Müller).....	702
Azoxonium Compounds. (Kehrmann).....	709

B

Bacilli of "Alinit".....	597
Bacillus Coli Communis; Action of —, on Carbohydrates, &c. (Harden).....	492
Tartaric; Acetylmethylcarbinol Produced by — (Grimbert).....	491
Bacteria Beds, &c.; Apparatus for Automatically Emptying — (P) Graham.....	261
Influence of Butyric Acid upon — (Wehmer).....	385
Of Acetic Acid: Production of Lactic —, in Milk. (Bartel).....	77
Bacteroids of Micro-organisms; Producing Cultures of — (P) Hartleb.....	374
Baden; Chemical Trade of —, for 1900. (T.R.).....	761
Glass-making in —, during 1900. (T.R.).....	766
Bagasse as Fuel: Approximate Value of — (Gill).....	695
Bakers' Yeast. See under Yeast.	
Balata; Purification of — (Arends).....	51
Rubber in Venezuela. (T.R.).....	771
Balsam of Peru; Analysis of — (Thoms and Mannich) ..	606
Cultivation of — (Preuss).....	606
In Central America. (Preuss).....	150
Balsams; Resins of Copaiba — (Keto).....	1238
Baltimore; Bye-Product Coke-Ovens at — (T.R.).....	1037
Fertiliser Manufacture at — (T.R.).....	521
Barbados; Opium Regulations in — (T.R.).....	818
Barium; Determination of —, as Oxalate. (Peters).....	1143
Manganates. (Kassner and Keller).....	1112
Monoxide and Dioxide; Manufacture of — (Heinz).....	474
Sulphate; Solubility of —, in Solution of Sodium Thio-sulphite. (Dobbin).....	218

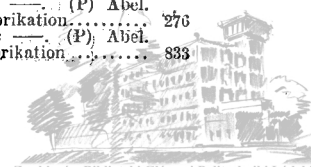
	PAGE
Barium-coated Paper for X-Ray Screens; U.S.A. Customs Decision on — (T.R.).....	1162
Bark of Robinia Pseud-Acacia. (Power).....	1018
Barley ("Biting Test"; Infection with Actinomycosis. (Rosenberg).....	826
Pentosan Content of — (Windsch and Hasse).....	1129
Proteolytic Enzyme of Germinating — (Weis).....	141
Treatment of —, with Lime. (Kajmar).....	141
Treatment of —, with Lime in the Steep. (Windsch).....	1226
Barleys; Valuation of —, for Brewing and Distilling. (Frew) 221	
Baryta; Acidimetry of Phosphoric Acid by Means of — (Cavalier).....	838
Precipitated Carbonate of — (T.R.).....	1258
Base from Cinchonine, Analogous to Nicheine. (Langer)	499
Bases of Mandragora Root. (Thoms and Wertzel).....	605
Basic Bessemer Blow; Spectra of Flames at Different Periods of — (Hartley and Ramage).....	993
Basic Slag in Germany. (T.R.).....	861
Basic Superphosphate. See under Superphosphate.	
Basil Oil; New Terpene in — (van Romburgh).....	744
Bateing Process. (Wood and others).....	263
Bath; Toning and Fixing — (Liesegang).....	153
Baths; Photographic Fixing —.....	68
Toning —, for Gelatino-Chloride Prints. (Wilson).....	334, 332
Batum; Manganese Trade of — (T.R.).....	768
Petroleum Exported from —, in 1900. (T.R.).....	762
Batteries; Various:	
Constant — (P) Francken.....	815
Cuprous Oxide-Alkali-Zinc; Treatment of — (Jordis).....	258
Electric — (P) Heidel.....	907
Electrolytic Apparatus. (P) Haas.....	1120
Galvanic; Depolarising by Liquid Circulation in — (P) Abel. From La Soc. des Piles Electriques.....	492
Primary and Secondary — (P) de Castro and Schlo-mann.....	133
Thermo-Electric — (P) Crawford and Turley.....	260
Thermo-Electric Couples; Manufacture of — (P) Her-mite and Cooper.....	482
Secondary —:	
(P) de Sales and Gueugnon.....	726
(P) Kloth and others.....	815
(P) Thompson. From Sperry.....	482
Secondary Alkaline. (P) Edison.....	1002
Secondary Alkaline-Zincate — (P) Edison.....	589
Secondary; Consolidating the Active Material of —.....	259
Secondary; Present and Future of — (Wade).....	258
Secondary; Replacement of Lead by other Metals in — (St. V. Laszczyński).....	998
Secondary; Resistance of —, and Distribution of the Resistance. (Dolezalek and Gahl).....	257
Secondary; Reversible Galvanic Cells or — (P) Edison.....	258
Battery Cells, Plates, Elements, Solutions, &c.:	
Anodes, Carbon; Influence of —, on Electrolysis of Alkali Chloride Solutions. (Foerster).....	999
Anodes; Disintegration of — (Wohlwill).....	1221
Anodes for Electrolytic Alkali Cells. (Weightman).....	588
Anodes for Electrolytic Apparatus. (P) Thompson. From Becker.....	133
Cathode, Iron, in Ammonium Nitrate Solutions; Action on — (Kaufmann).....	909
Cell; Acker's —, for Production of Alkali and Chlorine (Kershaw).....	1219
Cell; Alkaline Nickel Oxide — (Marsh).....	998
Cell; Cadmium Standard — (Tinsley).....	1219
Cells; Electrolytic — (P) Noble and Merry.....	1121
Cell; Hermetically Sealed Electrolysing — (P) Barnes.....	49
Cell; Irregularities in the Weston Cadmium — (Jaeger).....	999
Cells; Oscillating Electrolytic — (P) Justice. From The Castner Electrolytic Alkali Co.	907
Compounds for Electric Batteries. (P) Blumenburg, jun.	725
Diaphragms; Electrolytic — (Le Blanc).....	815
Diaphragms; Manufacture of Acid-proof — (Le Blanc).....	132
Diaphragms; Porous —, for Electrolytic Apparatus. (P) Holland and Laurie.....	370
Electrodes and Electrical Resistances. (P) Kent.....	260
Electrodes; Connections for Carbon — (P) Baker.....	370
Electrodes Containing Zinc; Production and Use of — (P) Erny.....	1001
Electrodes for Arc Lamps; Carbon — (P) Alexandroff.....	816
Electrodes for Electric Furnaces, (P) Imray. From The Soc. Electro-Metallurgique Francaise.....	907
Electrodes for Electrolytic Cells; Carbon — (P) Justice. From The Castner Electrolytic Alkali Co.	1002
Electrodes for Electrolytic Apparatus. (P) Schoop.....	906
Electrodes for Secondary Batteries:	
Production of. (P) Luckow, jun.	49
(P) Tribelhorn.....	588
Electrodes; Forming of — (P) Boulé. From Andreas.....	816
Electrodes; Graphitising of — (P) Justice. From The International Acheson Graphite Co.	258
Electrodes; Negative —, for Secondary Batteries. (P) Jungner.....	482
Electrodes; Production of — (P) Lanckner. From Vogelsang.....	49
Plates; Forming of Metallic — (P) Boulé. From Andreas.....	1001



	PAGE		PAGE
Battery Cells— <i>cont.</i>		Beetroots, Composition of — (Pagnoul).....	732
Plates for Secondary Batteries:		Influence of Desiccation of — on Storage in Silos. (Levesque-Hérault).....	1125
(P) Garassino.....	726	Sugar in; Rapid Determination of —:	
(P) Kuettner.....	1120	(Ewell).....	915
(P) Nodon.....	1120	(Hiltner and Thatcher).....	754
Plates of Secondary Batteries; Composition for Filling the Cells of Reticulated — (P) Picard and Evans.....	482	Behar Sugar Commission. (T.R.).....	406
Plates; Porous Metal —, for Secondary Batteries. (P) Bühne.....	907	Beirut; Trade of —, in 1900. (T.R.).....	852
Plates; Spongy Lead —, for Secondary Batteries. (P) The Electric Power Storage Co. and others.....	482	Belgium; Artificial Silk Factory in —. (T.R.).....	81
Bau's Method for Determining Beer Yeast in Pressed Yeast. (Langfurth).....	843	Benzene for Lighting Mines in —. (T.R.).....	1038
Baumert and Bode's Method for Determining Starch in Potatoes. (Behrend and Wolfs).....	623	Cement Trade of —. (T.R.).....	300
Bauxite; Abrasive Material from —. (P) Mills. From The General Electro Chemical Co.....	78	Transport of Inflammable Liquids in —. (T.R.).....	296
In New South Wales. (T.R.).....	954, 1039	Belladonna and Henbane Extracts; Differentiation of —. (Stoeder).....	1146
Obtainment of Pure Alumina from —. (P) Hall.....	808	Extract; Determination of Alkaloids in —. (Stoeder).....	1145
Bauxites from the Var, France. (T.R.).....	855	Bendigo Victorian Gold Jubilee Exhibition.....	627
Bayonne; Chemical Industries of —. (T.R.).....	632	Benzaldehyde; Action of —, on Sodium Compounds of Menthol. (Martine).....	944
Beam House Tanning Experiment.....	594	Benzene, Deodorisation of —.....	238
Bean Oil and Cake at Swatow, China. (T.R.).....	642	Benzene-azo- β -naphthylauramine. (Möhlau and Graefert).....	1203
Beaumont Oil Fields, Texas. (T.R.).....	635	Propyl; Formation and Preparation of —. (Bodroux).....	237
Petroleum Deposit at —. (T.R.).....	165	Sulphonic Acids, Alkylated Amine —, and Metamino Phenols. (Gnehm and Scheutz).....	798
Petroleum from —. (Richardson and Wallace).....	690	Trinitro; Reduction of —, with Hydrogen Sulphide. (Cohen and Dakin).....	1254
Spouting Petroleum Well at —. (Lucas).....	855	Benzidine; Electrolytic Production of —. (Löb).....	138, 700
Beer, Alcohol and Extract in; Tornøe's Method of Determining — (Ling and Pope).....	755	Benzine for Lighting Mines in Belgium. (T.R.).....	1038
And Ale; Means for Converting Wort into —. (P) Allison. From Selg and Guntrum.....	1012	Prize for a Substitute for —.....	162
And Malt; Arsenical —. (Murphy).....	340	Benzoic Acids, Amido; Manufacture of —. (P) Ellis. From Pertsch.....	1204
And Pressed Yeast; Simultaneous Production of —. (P) Sauer.....	920	Manufacture of —. (P) Inray. From the Basle Chem. Co.....	1189
Anti-Bacteria System for Use in Brewing —. (P) Bennett.....	737	Benzoin; Pharmacopoeia Tests of —.....	385
Arsenic in — and Peripheral Neuritis.....	1083	Benzol; Carbon Bisulphide in —; Detection of. (Votocek and Potmesil).....	1147
Arsenic in —; Detection and Determination of. (Jones).....	281	Sulphur in —; New Test for. (Irwin).....	410
Arsenic in; Detection of —:		Benzols; Statistics of —. (Frank).....	563
(Allen).....	158, 281	Benzophenones, Substituted Amino-; Reaction of —, with Aromatic Amines in Sulphuric Acid Solution. (Lemoult).....	571
(Estcourt).....	158	1,4-Benzopyranol; Derivatives of —:	
(Kirkby).....	158	(Bülow and von Sicherer).....	1106
(Paul and Cowley).....	158	(Bulow and Wagner).....	704, 739
Arsenic in; Determination of —. (Newlands and Ling).....	748	Benzoylbenzoic Acid; New Derivatives of Dimethylamino —. (Haller and Guyot).....	465
Arsenic in; Discussion on.....	208	Conditions of Formation of —. (Dhommée).....	1200
Arsenic in; Manchester Commission Report on —. (T.R.).....	644	Benzyl Chloride; Action of Ammonia on —. (Dhommée).....	1209
Atmospheric Infection of —. (Fernbach).....	921	Benzylamine Bases, Hydrogenised; Manufacture and Transformation of —. (P) Inray. From The Farb. vorm. Meister, Lucius, und Brüning.....	152
Biological Examination of —. (Prior).....	490	Benzylidenementhone; Preparation of —. (Martine).....	944
Control of the Keeping Qualities of —. (Bergsten).....	919	Berberine; Gaze's pure Base. (Gordin and Merrell).....	1235
Filtering of —. (Lamont).....	921	Bergamot Oil; New Adulterant of —, and its Detection. (Gulli).....	1017
Glucose and Invert Sugar in —. (T.R.).....	1046	New Crystalline Constituent of —. (Von Soden and Rojahn).....	1236
Imports of Oran, Algeria. (T.R.).....	1048	Production of —, in 1900. (T.R.).....	776
Lactic Acid Bacteria of —. (Henneberg).....	920	Thymoquinone in Wild —. (Brandel and Kremers).....	744
Nathan's Process for Brewing —. (Lindner).....	919	Berlin House Refuse; Disposal of —.....	145
Nature of the Carbonic Acid in —. (Huntke).....	143	Beverage; Fermented Non-Alcoholic —. (P) Pitoy.....	826
Non-Alcoholic; Manufacture of —. (P) Bloxam. From Gebrüder Sulzer.....	1011	Beverages; Apparatus for Backing Carbonated —. (P) (White).....	827
Poisoning and Selenium Compounds. (Tunnicliffe and Rosenheim).....	390	Dulcine in —; Detection of. (Bellier).....	72
Poisoning; Royal Commission on —. (T.R.).....	85	Purification of —. (P) Thompson. From The Société Mangané Electrique.....	494
Preservation of —. (P) Crötte.....	492	Bichromates, Alkali; Production of —. (P) Shearer.....	718
Production of —. (P) Hobson.....	1131	Binding Substances for Colouring Matters. (P) Gerhardt.....	372
Saccharin in —; Detection of. (Wirthle).....	72, 1146	Bismarck Steel in Germany. (T.R.).....	859
Starchy and Dextrinous Cloudiness in —. (Kurz).....	921	Bismuth-Albuminoid Compounds; Preparation of —. (P) Kalle and Co.....	383
Sterilisation of — in Transport Casks. (P) Berliner and Herbert.....	744	Basic Nitrates of —. (Allan).....	603
Sucramine in; Prohibition of —. (T.R.).....	1261	Chloride; Compounds of —, with Organic Bases. (Vanino and Hauser).....	383
Use of Oats in Manufacture of —. (Rüffer).....	1008	Determination of —. (Grabill).....	1144
Wort; Mash Tuns for Use in Preparing —. (P) Debeil.....	1131	Determination of —, by Electrolysis. (Wimmenauer).....	620
Beers, Arsenic in —; Detection of —. (Thomson and Shenton).....	204	Extraction of —, from its Ores. (Eulert).....	902
Beeswax; Analysis of —. (Buchner).....	256	Hydrated Oxide of —. (Thibault).....	149
Beetroot; Apparatus for Extracting the Cane Sugar from the Sugar —. (Herzfeld).....	753	In Fine Lead; Determination of —. (Liebschutz).....	1028
Colouring Matter in Wine; Detection of —. (Bellier).....	284	In Ores; Detection of —. (Warwick and Kyle).....	620
Diffusion Juice; Warm Diffusion and Warming —. (Melichar).....	54	Oleate; Preparation of —. (Naylor).....	498
Juice; Apparatus for Removal of Air from —. (Poupcé).....	267	Salicylate; A New Crystalline —. (Thibault).....	1134
Juice; Determination of Purity of —. (Claassen).....	843	Salicylate; Basic. (Martinotti and Cornelio).....	603
Juice; Determination of Purity of — by Krause's Method. (Ehrlich).....	268	Salicylate; Preparation of —. (Thibault).....	927
Juice; Krause and Perroche Methods for Determining Purity of —. (Pellet).....	488	Salts; Determination of —. (Tyrer and Tyrer).....	937
Juice; Krause's Method for Determining Purity of —: (Claassen).....	53	Subnitrate; Experiments with Commercial —. (Upsher Smith).....	149
(Drenckman).....	1125	Sulphide; Action of Hydrogen on —. (Pelabon).....	255
(Ehrlich).....	754	Volumetric Determination of —. (Frerichs).....	156
(Hinze).....	843	Bisulphite Compounds of Aldehydes and Ketones; Decomposing the —. (Freunder and Buel).....	832
(Weisberg).....	488	Bitumen; Production of —, in Turkey. (T.R.).....	399
Juice; Liming and Carbonating —. (Arnaud).....	821	Blackening for Foundry Purposes; Manufacture of — (P) Dunn.....	1119
Molasses; Presence of Lactic Acid in —. (Schöne and Tollens).....	54		
Sugar, in Alkali Soil. (Myers).....	445		
Sugar in Spain. (T.R.).....	303		
Sugar Industry in Canada. (T.R.).....	303		
Sugar Industry in the United States. (T.R.).....	406		



PAGE	PAGE
Blast-Furnace Bosh; A Water cooled — (Sahlin)	720
For Dusty and Fine Granular Iron Ore. (P) Goedecke ..	255
Gases; Dust in — (Greiner)	721
Gases; Use of —, in Gas Engines. (Richards)	108
Gases; Utilisation of Power from — (Thwaite)	993
Bleach; Electro-Production of — (Kershaw)	402
Bleaching Agent; Manufacture of. (P) Depangher and Pon-	
tini	728
And Dyeing, and Apparatus therefor. (P) Mather	360
And Dyeing Apparatus. (P) Mather	359
Apparatus:	
(P) Brandwood	472
(P) Hadfield	246
(P) Taylor and others	712
Apparatus; Electrical — (Engelhardt)	131
Apparatus; Electrical —, of Haas and Oettel	130
Apparatus. See also under Dyeing.	
Electrolytic — (Fürth)	359
Kiers. (P) Rigamonti and Tagliani	377
Liquor; Electrolytic Preparation of —	715
Notes on — (Saget)	359
Sliver Cans for Use in — (P) Honczger	41
Works; Prevention of Fog in — (Milius)	574
Bleaching-Powder; Electrolytic Production of — (T.R.) ..	1040
Formation and Composition of — (Ditz)	247
See also Chloride of Lime.	
Blood in Form of Dry Powder; Obtaining Solid Constituents	
of — (P) Stauff	59
Preparations; Production of — (P) Dietrich and	
Langer	145
Blotting Paper in Germany. (T.R.)	863
Blown Oil; Obtainment of — (P) Joselin and Crichton ..	495
Blowpipe; A Kerosine Oil — (Richardson)	747
Analysis; Use of Sodium in — (Parsons)	618
Board of Trade Returns. 86, 169, 304, 408, 522,	
646, 777, 865, 958, 1049, 1162, 1262	
Bohemia; Antimony Mining in — (T.R.)	955
Glass Industry of — (T.R.)	953
Paper Trade of — (T.R.)	957
Sugar Industry of — (T.R.)	613, 957
Boiler for Rosin Soap. (P) Erfurt	1004
Boilers; Composition for Preventing or Removing Incrustation	
in —:	
(P) Garside and Saxon	28
(P) Hamilton	878
(P) Johnstone	233
(P) Metcalf	105
(P) Rümmler	105
Removal of Incrustation from — (P) Elliott	878
Boiling Pans and similar Apparatus. (P) Cox	878
Vessels; Manufacture of — (P) Nobis and Wenzel ..	562
Bois de rose femelle. See under Licari canali.	
Bolivia; Copper Exports of — (T.R.)	1042
Exports of —, through Antofagasta. (T.R.)	1037
Tin Production of — (T.R.)	391
Bone-Black for Sugar Works; Sulphides in — (Stolle) ..	268
Bone-Glue. See under Glue.	
Bone-Meal Phosphoric Acid; Citrate Solubility of —	
(Methner)	374
Bone; Substitute for — (P) Lake. From The United	
States Chemicco-Wood Co.	374
Bonus for the Production of Mercury in New Zealand	1034
Bookbinders' Leathers	264
Bookbindings; Preservative Compositions for Leather —	
(H. G.)	486
Books; New —. See Special Index.	
Boot and Shoe Industry of the United States. (T.R.)	302
Boraginaceæ; Poisonous — (Greimer)	65
Borate of Lime at Saltai. (T.R.)	1939
Of Lime from Antofagasta. (T.R.)	1939
Of Lime Shipments from Mollendo. (T.R.)	764
Borates of Magnesium and of the Alkaline Earth Metals.	
(Ouvrard)	363
Borax; Behaviour of —, on Distillation with Methyl Alcohol.	
(Polenske)	273
In Oregon. (T.R.)	855
Manufacture of — (Newton)	324
Substitute for — (P) Alpe	1219
Value of — as a Flesh Preservative. (Lange)	923
Bordeaux; Trade of —, in 1900. (T.R.)	631
Turpentine:	
(Tschirch)	51
(Tschirch and Bruening)	276
Boric Acid; Analysis of Crude Italian — (Zschimmer) ..	283
Determination of — (Parthiel)	1244
Direct Gravimetric Determination of — (Parthiel and	
Bose)	1244
Exports of Leghorn. (T.R.)	764
Value of —, as a Flesh Preservative. (Lange)	923
Volatility of —, with Steam. (Skirrow)	805
Borides; Production of New Metallic — (Tucker and	
Moody)	626
Borimide; Preparation of — (Stock and Blix)	1252
Borneol; Purification of — (Tschougaff)	832
Boron Bromide; Action of Arseniuretted Hydrogen on —	
(Stock)	756
Bromide; Compounds of Phosphorous Chlorides with —	
(Tarible)	291
Impurities in Commercial Amorphous — (Orlow)	845
Boronatocalcits. See under Ulexite.	
Bosh; A Water-cooled Blast-Furnace — (Sahlin)	720
Bosnia, Alluvial Gold Deposit in; Composition of — (Kat-	
zer)	813
Chemical Works in — (T.R.)	168
And Herzegovina; Mineral Output of —, during 1899.	
(T.R.)	167
Bottle Caps; Manufacture of — (Granja)	1191
Brandy, Essences for "Strengthening" — (Beythien and	
Bohris h)	378
Examination of Bulgarian — (Kaliandjief)	1010
From Damsons and Grape Marc; Examination of —	
(Zega)	1130
See also under Cognac.	
Brasilin and Hematoxylin; Research on — (Herzig and	
Pollak)	700
See also under Hydroxychromone.	
Brass Lacquers; Action of Light on Coloured — (Smith) ..	1183
Brassica Napus; Mustard Oils from Seeds of — (Sjollema) ..	833
Brazil; Adulteration of Food in — (T.R.)	1161
Cement Imports of Rio Grande do Sul and Santa Catharina.	
(T.R.)	1040
Chemical Industries of Pernambuco — (T.R.)	680
Drug and Chemical Imports of — (T.R.)	1162
Earthenware at Porto Allegre — (T.R.)	686
Hides at Bahia — (T.R.)	1045
Manganese in — (T.R.)	1159
Manganese Ore Exports of Bahia — (T.R.)	1041
Matches at Rio Grande — (T.R.)	1019
Mauzite Sands at Espirito Santo — (T.R.)	1162
Paper Imports of — (T.R.)	1162
Photographic Chemicals, &c., at Rio Grande — (T.R.) ..	1049
Photographic Supplies in — (T.R.)	1262
Rubber Exports of Bahia — (T.R.)	1045
Soap and Candle Imports of — (T.R.)	1159
Sugar Exports of Bahia — (T.R.)	1047
Sugar in — (T.R.)	1161
Sugar Industry of — (T.R.)	1047
Sugar Industry of Pernambuco — (T.R.)	643
Tallow Imports of Bahia — (T.R.)	1043
Tiles, Earthenware and Glassware, Imported by —	
(T.R.)	1157
Brazing; Flux for — (P) Huth	369
Bread; Yield of —, from Flour. (Balland)	923
Bremen; Oil Mills at —, in 1900. (T.R.)	769
Breweries; Risk of Microbial Infection in Top-Fermentation	
— (Schönfeld)	920
Brewers; Anti-Bacteria System for Use of — (P) Bennett	
737	
Brewers' Grains; Pentosans of — (Schöne and Tollens) ..	1226
Spent Grains; Food from — (P) Schroeder and Die-	
fenthal	59
Brewery Vessels; Cleansing Material for — (P) Ljöö and	
Törnell	1130
Brewing. (Class XVII.)	55, 86, 141, 268, 376, 489, 597, 614,
734, 824, 916, 1008, 1048, 1127, 1226, 1261	
Materials; Arsenic in —, Detection of. (Thomson and	
Shenton)	204
Saccharometer Readings in — (Pfahler)	269
Valuation of Barleys for — (Frew)	221
Bricks and Blocks for Lining Furnaces; Preparation of —	
(P) Talbot	900
Apparatus for Making — (P) Coiffier and others	477
Artificial —, from Lime and Sand	252
From Glass-Works Refuse. (T.R.)	81
Glazed; Manufacture of — (P) Solon	126
Or Building Blocks; Manufacture of — (P) Pilkington	
and Ormandy	900
Refractory; Manufacture of — (P) Rawson and Lit-	
tlefield	992
Brine; Purification of — (P) Vis	897, 1210
Briquettes; Combustible. (P) Faucheur	30
From Commiuted or Pulverulent Ore. (P) Ronay	723
Briquetting Pulverised Material. (P) The Edison Ore Milling	
Syndicate. From Edison	997
Britannia Pottery (Messrs. Cochran and Flemming); Visit to	
—	679
British Columbia; Cement Imports of — (T.R.)	933
Columbia; Cyanide Plant at Ahbabasca Mine	1215
Columbia; Sulphur in — (T.R.)	1040
Guiana; China Clay in — (T.R.)	983
Bromates; Detection of — by Means of Strychnine. (Fages)	
280	
Bromide Prints; Permanence of Toned — (Gaedicke)	154
Bromine; Action of — on Metallic Silver. (von Cordier) ..	1150
Action of — on Strychnine and Brucine. (Kippenber-	
ger)	64
Extraction of — (Béts)	851
Bromo-Compounds; Manufacture of New — (P) Abel.	
From The Actieniges für Anilin Fabrikation	276
Compounds; Manufacture of Organic — (P) Abel.	
From The Actieniges für Anilin Fabrikation	833



	PAGE
Broom; Dangerous Substitution of Spanish — for Common — (Perrot).....	944
Brown-Coal Tar Purification; Chemical Function of Sulphuric Acid in — (Pauli).....	32
Brucine; Action of Bromine on — (Kippenberger).....	64
Electrolytic Reduction of — (Tafel and Naumann).....	1233
Bucco Leaves; Essential Oil of — (Kondakow and Bachtshchiew).....	386
Buchner's Expressed Extract of Yeast. (Wroblewski).....	1009
Buenos Ayres; Quebracho Exports from — (T.R.).....	642
Building Blocks; Hollow Cement —.....	125
Blocks; Manufacture of — (P) Pilkington and Ormandy.....	900
Blocks of Artificial Stone. (P) Güssow.....	125
Materials. (Class IX.).....	43, 81, 252, 364, 477, 517, 581, 718, 810, 900, 990, 1114, 1211, 1253
Materials; Manufacture of — (P) Boas.....	719
Stones for Walls of Reservoirs at Gotha; Experiments on —.....	1211
Bulgaria; Drugs and Chemicals at Varna — (T.R.).....	1049
Otto of Rose in — (T.R.).....	1162
Bullion Refining. (Swan).....	665
Bunsen-Burners for Lighting or Heating. (P) Zehnpfund.....	975
Burner; Hydrocarbon —, constructed without Solder. (P) Petréano and La Comp. Gén. d'Incandescence par le Pétrole.....	234
Burners and Incandescible Elements; Manufacture of — (P) de Lery.....	884
Bunsen — (P) Kemp and Denny.....	1198
Bunsen, — for Incandescence Lighting. (P) Ihle.....	1199
For Combustible Liquids. (P) Rey.....	976
For Combustion of Gas or Vapours in Furnaces. (P) Fletcher, Neil, and Fletcher, Russell and Co.....	31
For Gas and Vapour. (P) Hayes.....	1198
For Hydrocarbon Vapours. (P) Luke. From Rein.....	350
For Hydrocarbons. (P) Groves. From The Pan-American Light Co.....	1199
For Incandescence Gas-Lighting. (P) Hooker.....	699
For Incandescence Oil Lamps. (P) Schapiro.....	1199
For Oil Lamps with Incandescing Mantles. (P) Nielsen.....	1199
For Producer-Gas for Boilers. (P) Humfray.....	1198
Hydrocarbon — for Use in Furnaces. (P) Bosier.....	110
Hydrocarbon Vapour — (P) Hartel.....	32
Vapour — (P) Lecomte.....	32
See also under Gas Burners.	
Burnt-Ale; Composition and Disposal of — (Henrick).....	450
See also under Pot Ale.	
Butadien, Di-p-aminophenyl-cyano; Substantive Nature of Azo Dyes from — (Freund).....	1107
Butter, Artificial; Manufacture of — (P) Poppe.....	924
Cocoon Oil in — (Indemais).....	493
Cocoon Oil in; Detection of — (Ranwez).....	1030
Fat; Determination of Commercial — (von Klénze).....	396
Low Reichert-Meissl Value of Dutch — (Reicher).....	379
Manufacture of — (P) Poppe.....	1132
Manufacture of — (P) von Bühler and Bernstein.....	827
Preservation of — (P) Marks. From Société Anon. Force.....	738
Purity of — (T.R.).....	774
Substitutes for — in the United States. (T.R.).....	407
Butters; Composition of — (Pagnoul).....	1228
Butyric Acid; Influence of — upon Yeast. (Wehmer).....	265
Influence of — upon Yeast, Mould, Fungi, and Bacteria. (Wehmer).....	265
Bye-Laws of London Section; Addition to —.....	322

C

Cacao Butter; Mixed Glycerides in — (Klimont).....	1121
Fermentation. (Preyer).....	735
Cacodylic Acid and Cacodylates. (Martindale).....	149
Acid; Cinnamo — (Astruc and Murco).....	274
Acid; Toxicological Investigation of — (Barthe and Péry).....	513
Cactaceae; Alkaloids and Saponins of the — (Heyl).....	1016
Cactus Alkaloids. IV. (Heffter).....	1134
Cade Oil; Products of Fractionation of — (Cathelineau and Hauser).....	502
Cadmium Compounds for India-Rubber Pigments.....	137
New Use for — (T.R.).....	588
New Use for — (T.R.).....	519
Obtainment of — (P) Armstrong.....	905
Oxide; Natural — (Neumann and Wittich).....	943
Quantitative Determination of — (Miller and Page).....	1029
Selenide; Characteristics of — (Fonzes-Diacon).....	76
Cæsium Bismuth Nitrate. (Jamieson).....	1014
Material; Purification of — (Wells).....	1014
Caffeine; Determination of — (Beitler).....	1149
Calamine; Production of —, in Spain in 1899. (T.R.).....	301
Calamus Oil; Chemistry of — (von Soden and Rojahn).....	833
Constituents of —:	
(Thoms).....	1237
(Thoms and Beckstroem).....	696

	PAGE
Calcium Acetate; Manufacture of Acetic Acid from — (P) Behrens.....	803
-Ammonium; Decomposition of —, by Ammonium Chloride. (Moissan).....	1252
As a Weighting Material for Textiles. (Fürth).....	212
Carbide; Action of —, on Primary Alcohols. (Lefebvre).....	847
Carbide as a Reducing Agent for Oxides, Salts, and Earths. (Neumann).....	46
Carbide; Electro-Production of — (Kershaw).....	402
Carbide; Electrolytic Production of — (Swan).....	670
Carbide; Furnace for Manufacture of — (P) Emmer-son and Ward.....	344
Carbide in Germany. (T.R.).....	853
Carbide in Norway. (T.R.).....	853
Carbide Industry of Sweden. (T.R.).....	635
Carbide Mass for Acetylene Manufacture; Preparation of — (Desq and Franco).....	109
Carbide; Mixtures of —, free from Danger of Explosion in Generating Gas. (P) Toly and Borch.....	32
Carbide; Production of —, and Apparatus therefor. (P) de Vulitch and P'Orlowsky.....	1198
Carbide; Reducing Power of — (von Kügelgen).....	582
Carbide; Reduction of Alumina by — (Tucker and Moody).....	570
Carbide; Reduction of Silver Chloride by —.....	1020
Carbide; Reductions effected by — (von Kügelgen).....	126
Carbide; Retarding Decomposition of — (P) Lancaster Carbide Syndicate. (T.R.).....	1087
Chlorate; Decomposition of — (Sodeau).....	42
Chloride; Manufacture of — (Kershaw).....	108
Chromate; Five Modifications of — (Mylius and von Wrochem).....	249
Determination of — as Oxalate. (Peters).....	1143
Determination of — by the Citrate Method. (Passon).....	507
Fluoride; Treatment of — for Production of Silico-Fluorides. (P) Sllar.....	718
Glycero-arsenate. (Pagel).....	742
Hydrate; Production of —, and Apparatus therefor. (P) Schulthess.....	717
In High-Grade Ferro-Silicon. (Watson Gray).....	1027
In High-Grade Ferro-Silicon; Determination of — (Gray).....	538
In Water; Volumetric Determination of — (Winkler).....	507
Iodate; Preparation of — (Mackie).....	149
Oxalate; Occlusion of Magnesium Oxalate by — (Richards and others).....	1026
Oxalate; Solubility of — (Richards and others).....	1026
Sulphate; Reaction of —, with Cements. (Deval).....	991
Sulphide; Apparatus for Revivifying — (P) Yeardon and Mason.....	793
Sulpho-Aluminate; Action of Sea Water on — (Rebuffat).....	581
Calico Printing; Application of Irisamine in — (Hofacker).....	40
Printing; Application of Lactic Acid in — (Oswald).....	40
Printing; Production of White Discharge Effect in — (Scherdel).....	576
Printing with Sulphide Colours. (P) Green and others.....	713
California; Oil Fuel in —.....	234
Calkin's Umpire Ore Sampler.....	617
Calorimeter; The Flame — (Hempel).....	881
Camphene; Preparation of — (Semmler).....	150
Camphor and Camphor Oil in Formosa. (T.R.).....	1045
Camphor; Anise —. See under Anethoil.	
Compound of —, with β -Oxy- α -Naphthoic Aldehyde (Helbronner).....	930
In Formosa. (T.R.).....	1261
In Spirit of Camphor; Determination of — (Schmaltolla).....	756
Manufacture of — (Ampère Electrochemical Co.).....	604
New Derivative of — (Goldschmidt).....	833
Oil. (Shimoyama).....	776
Oil, Camphor in; Determination of — (Löhr).....	510
Oil; Composition of —.....	137
Oil or Refuse; Duty on —, in the United States. (T.R.).....	759
Production of — (P) Mills. From The Ampère Electrochem. Co.....	67
Canada; Aluminium Plant in — (T.R.).....	1158
Asbestos Deposits in — (T.R.).....	300
Balsam. (Tschiren).....	51
Beetroot Sugar Industry in. (T.R.).....	303
Cement Imported by — (T.R.).....	933
Cement in — under the Preferential Tariff. (T.R.).....	857
Corundum in — (T.R.).....	855
Fish Waste Utilisation in — (T.R.).....	773
Mineral Production of — for 1900. (T.R.).....	397
Molybdenite in Ontario. (T.R.).....	954
Petroleum in — (T.R.).....	1256
Platinum in — (T.R.).....	1259
Wood-Pulp in — (T.R.).....	1161
Canarin and Pseudosulphocyanogen (Pseudothiocyanogen). (Goldberg).....	238
Canarine; New Formation of — (Pawlewski).....	113
Canary Islands; Chemical Imports of the — (T.R.).....	630
Dyestuff Imports of the — (T.R.).....	952
Manures in the — (T.R.).....	1046
Candle Imports of Brazil. (T.R.).....	1159
-Nut Oil. (Lewkowitzsch).....	909
Trade in the South of Europe. (T.R.).....	167



	PAGE		PAGE
Candles and Grease in Egypt. (T.R.)	955	Carburetted Apparatus:	
And other Illuminants for Christmas Trees. (P)		(P) Bower	698
Oelbermann	1200	(P) Firth and Jackson	697
For Spring Lamps. (P) Palmer and Calderwood	910	(P) Hauslich	462
In the Crimea. (T.R.)	1043	(P) Karfunkelstein	1100
Cantharides; Valuation of — (Dieterich)	1235	(P) Kurz	583
Caoutchouc; Apparatus for Vulcanising Articles of — (P)		(P) Purves and The Notkin Syndicate	462
Barnet	486	(P) Rudolph	462
Columbian — (Springer)	592	Cardamom Seeds; Pharmacopœia Tests of —	385
Export of —, from The Congo. (T.R.)	83	Cardboard, Waterproof: Manufacture of — (P) Joseph	1231
From the Congo	911	Carmine, Indigo; Constitution of — (Vorländer and Schu-	
Hamburg Trade in — (T.R.)	83	bart)	800
Of French Indo-China	1123	Carminone Compounds. (Liebermann and Landau)	856
Substitute for — (T.R.)	83	Carnegie Scholarship; Iron and Steel Institute	396
Tozo — (Schumann)	135	Caro's Acid; Characteristics of — (Baeyer and Villiger)	578
"Root" — in the Kunene District. (Baum)	135	Oxidation of Aloin by — (Seel)	66
<i>See also under</i> India-Rubber and Rubber.		Carpet Works at Greenhead (Messrs. Templeton and Co.);	
Cape Breton Coals; Effect of Washing — (Poole)	562	Visit to —	681
Colony; Drug and Chemical Imports of — (T.R.)	1043	Carriages; Copper Coverings for Railway — (T.R.)	770
Colony; Trade of — (T.R.)	1036	Carvone; Auto-oxidation of — (Harries)	929
Caramelan; Investigations on —, IV. Products of Hydrolysis		In Essential Oils; Determination of — (Walther)	289
of Caramelan. (Stolle)	1127	Oils containing; Analysis of — (Kremers)	16
Carbazole Derivatives; Sensitiveness of — to Light. (Ruff		Cascara Sagrada; Essential Oil of — (Haensel)	1234
and Stein)	834	In Oregon. (T.R.)	864
Nitro-derivative of — from Nitrocarbazole. (P) Wirth	890	Cascarella Oil; Composition of — (Fendler)	274
Carbide and Acetylene Industries in Germany; Report on		Casein; Compound of —, with Phosphoric Acid; Production	
— (Rose)	28	of a Soluble — (P) Chemische Fabrik Rhenania	1229
Carbides, Metallic, and Derivatives therefrom; Production of		For Technical Purposes. (Fasetti)	1014
(P) Limb	463	Glue; Composition of — (P) James, From Hall	597
Carbinols, Triphenyl; Etherification of — by Alcohol.		Separation of — from Milk. (P) Székely and Kovács	380
(Fischer)	33	Casks and other Vessels; Purification of —, and Apparatus	
Carbohydrates; Action of Bacillus Coli Communis, etc., on		therefor. (P) Hill	1230
— (Harden)	492	Apparatus for Sterilising and Lining — (P) Lancaster	826
Action of Hypochlorites upon —, Bräutigam	1007	Treatment and Preservation of — (P) Williams	143
Of Leguminous Seeds; Saccharification of — (Hrissey)	944	Treatment of —, and Composition therefor. (P) Mills.	
Carbolic Acid; Carriage of — (T.R.)	849	From La Société des Enduits Archambault	252
Customs Decision on — in New Zealand. (T.R.)	1038	Cassava; Hydrocyanic Acid in Sweet — (Carmody)	502
Determination of Crude —:		Cassia Fistula; Volatile Oil of — (Haensel)	386
(Schlechter)	1251	Cassie Flowers; Oil of —	833
(Seiler)	1251	Cast Iron. <i>See under</i> Iron.	
Carbolineum. <i>See under</i> Tar Oil.		Castor Oil Manufacture at Marseilles. (T.R.)	859
Carbon Anodes; Influence of —, on Electrolysis of Alkali		Pharmacopœia Tests of —	385
Chloride Solutions. (Foerster)	999	Physical and Chemical Constants of — (Dowzard)	370
Bisulphide in Benzol; Detection of — (Votocek and		Catalase; An Enzyme in Cured Tobacco, etc. (Loew)	598
Potměšil)	1147	Catalysis in Concentrated Solutions. (Crafts)	796
Dioxide; Decomposition of —, by Electric Discharge.		Catalytic Substance for Use as a Gas Condenser. (P) Bout.	
(Collie)	696	From Tissier	1100
Dioxide; Examination of Commercial Liquid —		Catechu; Substitutes for —, and their Application.	
(Lange)	122	(Grieder)	246
Dioxide in Compressed Air. (T.R.)	775	Cathedral, Glasgow; Visit to —	682
Dioxide; Manufacture of — (Schmatolla)	121	Cathodic Depolarisation; Disturbance of — by Potassium	
Dioxide; Means for Indicating and Recording Amount of		Chromate. (Müller)	257
—, in Products of Combustion. (P) Ericsson	110	Cattle-Food; Effect on — of Alcohol in Distillery Wash.	
Direct Union of —, with Hydrogen.—II. (Bone and		Heinzelmann)	491
Jerdan)	696	Caustic Soda. <i>See under</i> Soda.	
Electrodes for Arc Lamps. (P) Alexandroff	516	Cay-doc Oil of Tonkin	1122
For Electric Light Carbons; Manufacture of — (P)		Cellulose; a Bi-rose from Cellulose. (Skraup and König)	740
Haddan. From Wartenberg and Miller	111	Cellulith; Production of — (Springer)	602
Formation of —, in Electrolysis of Ammonium Oxalate.		Celluloid Compounds and High Explosives; Manufacture of	
(Verwer)	1120	— (P) Blomén	1140
In Cast Iron; Influence of Aluminium on the — (Mel-		In Films, Pellicles, &c.; Manufacture of — (P) Imray.	
land and Waldron)	1213	From The Farbwerke vormals Meister, Lucius und	
In Ferrochrome; Determination of — (Blair)	70	Brüning	62
In Steel and Iron; Determination of — (Schmitz)	934	-like Products; Production of — (P) Zühl 273, 603, 741, 831	
In Steel Ingots; Variation of — (Wahlberg)	994	Manufacture of —:	
In Steel; Rapid Determination of — (Job and Davies)	156	(P) Goldsmith and others	741
Monoxide and Silver. (Berthelot)	128	(P) Zühl	741, 926
Monoxide in Coal-Gas; Volumetric Determination of —		Material Resembling; Production of. (P) Hellriegel	62
(Smits, Raken and Meerum Terwoegt)	73	Cellulose, Acetyl-; Manufacture of — (P) Lederer	741
Oxysulphide. (Hempel)	1033	Alkaline Process of Boiling — (Schacht)	1230
Reducing Action of —, on Metallic Compounds.		Apparatus for Production of Filaments from — (P)	
(Boudonard)	478	Topham	1207
Tetrachloride; Manufacture of — (Urban)	1232	Articles; Manufacture of Hollow — (P) Thomas and	
Tetrachloride; Solubility of Alkaloids in — (Schindel-		Bonaviti	741, 741
meiser)	384	Cellose, a Bi-rose obtained from — (Skraup and König)	740
Carbonaceous Materials; Destructive Treatment of Waste —		Converting — into Sugar (Dextrose). (P) Classen	734
(P) Duff	272	Dissolving — by Means of Ammonia and Copper.	
Carbonate of Baryta; Precipitated — (T.R.)	1258	(Thiele)	119
Carbonate of Soda. <i>See under</i> Sodium Carbonate.		History of Manufacture of — from Wood. (Gottstein)	495
Carbonates; Alkali-Copper — (Gröger)	363	Mixed Esters of — (Cross, Bevan, and Jenks)	1133
Alkaline Earth —; Influence of Alcohol with regard to		Oxy-, Detection of — (Phillip)	393
Action of Acid on — (Vallée)	512	Preparation of Hydrocellulose from — (P) Schamer	489
Of Alkaline Earths; Action of Acids on — (Vallée)	603	Presence of — in Oxycellulose, &c. (Tollens)	740
Carbonating Apparatus. (P) Murphy	59	Reactions of — with Nitrating Acid. (Cross, Bevan, and	
Carbonic Acid; Action of — on Sugar Solutions Saturated		Jenks)	1183
with Lime. (Weisberg)	488	Solution; Manufacture of — (P) Imray. From Bron-	
In Beer; Nature of — (Hantke)	143	nert and others	1231
In Germany. (T.R.)	856	Sugars from — (Fenton)	767
In Water; Determination of — (Ellms and Beneker)	937	Thread from Solutions of — (P) Imray. From Bron-	
Carbonic Oxide; Production of — (P) Engels	356	nert and others	1207
Carbons; Electric Light — (P) Browne. From Sanders	236	-Xanthogenic Acid. (Cross and Bevan)	740
Carboxylic Acid; Neutral Esters of Acetylphenylglycine-o		Celluloses; Classification of — (Woffenstein and Bumcke)	925
(P) Newton. From The Farbenfabriken vormals F.		Cellulvert; Characteristics of — (Springer)	602
Bayer and Co.	277	Cements. (Class I.X.)	
Acid Phenylglycine; Derivatives of — (P) Lake.		43, 81, 252, 300, 364, 477, 517, 581, 718, 766,	
From The Farbenfabriken Mulheim vormals Leonhardt		813, 857, 900, 953, 990, 1010, 1114, 1157, 1211, 1259	
and Co.	277		

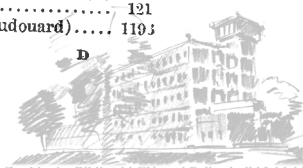


	PAGE		PAGE
Cement and Electrical Insulator; Material for Use as — (P) Tatham.....	1001	Chemicals; Transport of — (Muspratt).....	420
Apparatus for Calcining — (P) Lithbury and Spackman.....	582	Used in South Carolina. (T.R.).....	517
Apparatus for Separating the Finer Particles of — (P) Goreham.....	1115	Chemistry; Improvement of Instruction in Technical — (Lachmann).....	546
At San Francisco, Cal. (T.R.).....	857	Cherry Syrup in Raspberry Syrup; Detection of — (Windisch).....	1146
Blocks; Hollow — for Building Purposes.....	125	Chicory; Spirit from — (Lange).....	2011
Burning — and Apparatus therefor. (P) Lessing and Rheinfeld.....	253	Chile; Borate of Lime from Antofagasta — (T.R.).....	1039
Exported to Para. (T.R.).....	518	Cobalt Ores from Caldera — (T.R.).....	1042
For Building, Paving, and Railway Sleepers. (P) Timofeoff.....	125	Copper Exports of — (T.R.).....	1042
For Metals; Duty on — in Germany. (T.R.).....	848	Exports of — (T.R.).....	1037
For Shipbuilding Purposes. (P) Thompson. From Johannsen.....	582	Guano in — (T.R.).....	1046
Furnaces for Treatment of — (P) Gobbe.....	105	Manganese Ore from — (T.R.).....	1042
Imported by Bangkok, Siam. (T.R.).....	1040	Sulphur and Borate of Lime at Taltal — (T.R.).....	1039
Imports of —, by British Columbia. (T.R.).....	953	Chimney Cleaners; Chemical — (P) Huson.....	30
Imports of —, by Canada. (T.R.).....	953	Construction; German Practice in — (Lang).....	1211
Imports of —, by Civita Vecchia. (T.R.).....	1040	China; Albumin Trade of Wuhu — (T.R.).....	862
Imports of —, by Dahomey. (T.R.).....	1040	Anise Seed at Pakhoi — (T.R.).....	864
Imports of —, by Egypt. (T.R.).....	1040	Bean Oil and Cake at Swatow — (T.R.).....	642
Imports of —, by Hong-Kong. (T.R.).....	1041	New Customs Tariff in — (T.R.).....	950
Imports of —, by Oran, Algeria. (T.R.).....	1040	Trade of Wuchow in 1900. (T.R.).....	832
Imports of —, by Rio Grande di Sul and Santa Catharina, (T.R.).....	1040	China at Portland, Oregon. (T.R.).....	857
Imports of —, by United States. (T.R.).....	1040	Colouring or Decorating — (P) Sinclair.....	737
Imports of Portland — by Oregon. (T.R.).....	857	Electro-Deposition of Metals on — (P) Cooke and Parr See also Porcelain.	817
In Canada under the Preferential Tariff. (T.R.).....	837	China-Clay as a Finishing Material for Textiles. (Fürth)....	242
Industry in California. (T.R.) (Grimsley).....	857	In British Guiana. (T.R.).....	953
Industry of the United States. (T.R.).....	766	In the Province of Florence, Italy. (T.R.).....	1259
Manufacture of:		Chinese Wood Oil and Mixtures; Oxidising of — (P) Kronstein.....	485
(P) Goslinz, Fraser, and Booth.....	125	Yeast and the so-called Amylomycetes. (Wehmer).....	377
(P) Müller.....	992	Yeast: Mucor Cambodia. (Chrzaszcz).....	757
(P) Thompson. From The Firm of Terranova Industrie. (Kapferer and Schleuning).....	478	Chloral; Production and Rectification of — (P) Beason.....	1139
Manufacture of —, and Apparatus therefor. (P) Warren.....	582	Chloranthranilic Acids: Two New — (Cohn).....	1204
Manufacture of Solid Blocks of — (P) Bromhead. From Möller and Pfeiffer.....	582	Chlorate Explosives Less Susceptible to Action of Heat. (Bonnet).....	1239
Portland; Action of Sea Water on — (Rebuffat).....	581	Chlorates; Decomposition of — (Sodeau).....	42, 716
Portland; Composition of Material for Making — (Uzer).....	125	Detection of —, by means of Strychnine. (Fages).....	280
Portland —, Exports of Germany. (T.R.).....	1157	Determination of — in Electrolytic Bleach Liquors, &c. (Ditz).....	1026
Portland — from Blast-Furnace Slag. (Steffens).....	581	Electrolytic Production of — (Swan).....	668
Portland; German and American Competition in — (T.R.).....	766	Chloride of Lime; Composition of — (von Tiesenholt)....	896
Portland —, in America and the West Indies. (T.R.)..	953	See also Bleaching-Powder.	
Portland —; Manufacture of:		Chlorides; Action of Hypochlorous Acid on Metallic — (von Tiesenholt).....	248
(P) Gibb.....	810	Decomposition of —, by Ignition with Organic Matter. (Davies).....	98
(P) Von Forell.....	810	Electrolytic Decomposition of Alkaline —, and Apparatus therefor. (P) Gilmour.....	1220
Portland; Manufacture of —, by the Forell Process. (Steffens).....	44	Manufacture of Metallic — (P) Hargreaves.....	364
Powdered Slag in; Detection of — (Fresenius).....	1143	Metallic; Obtainment and Treatment of — (P) Hargreaves.....	808
Production of First Class — (P) Passow.....	923	Of Metals; Electrolysis of —, and Apparatus therefor. (P) Atkins.....	815
Rotatory Process of Manufacturing — (Stanger and Blount).....	1115	Thermo-Chemical Study of Ammoniacal Aluminium — (Band).....	363
Slag — (Hatt).....	1212	Chlorine and Ammonia; Reaction between — (Noyes and Lyon).....	943
Testing; Notes on — (Klein and Peckham).....	539	Apparatus for Electrolytic Production of —:	
Trade of Belgium. (T.R.).....	300	(P) Cohn and Geisenberger.....	726
Trade of Constantinople. (T.R.).....	1158	(P) Mactear.....	1121
Trade of Great Britain. (T.R.).....	300	Electrolytic Production of —:	
Trade of Natal. (T.R.).....	1157	(P) Cohn and Geisenberger.....	123
Valuation Tariff in Egypt. (T.R.).....	1259	(Kershaw).....	1219
Water-Glass as an Addition to — (Bornträger).....	477	(Swan).....	667
Cements; Apparatus for Purifying and Separating — (P) Renault and Cussou.....	460	Electrolytic Production of —, and Apparatus therefor. (P) Atkins.....	815
Hydraulic; Theory of the Hardening of — (Zulkowski).....	990	Gas; Electrical Generation, Treatment and Use of —, and Apparatus therefor. (P) Paramore.....	1002
Improved Setting for — (P) Wright.....	478	In Moorland Waters; Origin of Combined — (Ackroyd).....	491
Reaction of Calcium Sulphate with — (Deval).....	991	Manufacture of —:	
Studies in — (Jex).....	364	(P) Atkins.....	808
Cementation of Iron Finished Goods. (Bildt).....	1215	Atkins.....	897
Ceramic Ware; Apparatus for Dipping — into Glaze or Colour. (P) Ellis and Holt.....	476	Manufacture of —, and Treatment of Ores thereby. (P) Atkins.....	808
Ware; Manufacture of Polychrome, Ornamented, &c. (P) von dem Borne and von Debschutz.....	252	Mercury Cell for Electrolytic — (Franké).....	815
Cereals. Flour of —; Desiccating and Sterilising. (P) Fleurent.....	600	On Silver; Influence of Light on Action of —, II. (v. Cordier).....	67
Cerite Earths of Monazite Sand; Separation of — (Meyer and Marckwald).....	62	Preparation of — from Sodium Chlorate. (Graeb).....	473
Cerium; Experiments on Composition of — (Drossbach).....	273	Production of — by Electrolysis of Ferrous Chloride. (Roubertie and Pepin).....	538
Oxide; Preparation of Pure — (Sterba).....	927	Chlorocarbonic Acid Ethers and Compounds therefrom. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	151
Chalks; Bituminous, of Palestine; Sulphur in — (Elschner).....	835	Chloroform; Electrolytic Preparation of —.....	149
Changes of Address..... 3, 98, 183, 315, 419, 533, 653, 787, 877, 989, 1059, 1176		Leprarin; Formation and Formula of — (Kassner).....	497
Charcoal, Animal; Filtration of Sugar through — (Stolle).....	54	Precipitation of Albuminoids by —:	
Half-Carbonised — (Blacher).....	111	(Krüger).....	923
Secondary Products of Action of Sulphuric Acid on Wood — (Verneuil).....	846	(Salkowski).....	379
Wood —; Manufacture of — by the Van Heidenstam Process. (Jürgensen and Bauschlicher).....	977	Chocolate, Dextrine in; Detection and Determination of — (Welmans).....	288
Chelidonium Majus; Alkaloids of — (Wintgen).....	1016	Cholesterol and Phytosterol in Mixtures; Separation of — (Marcusson).....	484
Chemical and Drug Imports of Egypt. (T.R.).....	166	In Neat's Foot Oil. (Holde and Stange).....	484
Imports of Mexico. (T.R.).....	165	Quantitative Extraction of — from Fats. (Bitter).....	1147
Industry in France. (T.R.).....	517	Christmas Island; Phosphate Industry in — (T.R.).....	167
Industry in Russia; Present State of — (T.R.).....	517	The Phosphates of — (T.R.).....	405, 613
Properties of Elements; Modification of — by Traces of Foreign Substances. (Le Bon).....	290		
Works in Bosnia. (T.R.).....	166		



	PAGE
Chromates, Alkali-; Production of —. (P) Shearer	718
Chrome Liquors; Recovering Products from Partly Spent —	139
Mines in Salonica and Kossova. (T.R.)	1259
Mordants; Action of Alkali Phosphates on —. (Binder and Zundel)	1108
Tanning or Dressing of Skins, &c. (P) Valentiner	1124
Chromic Acid Compounds; Manufacture of —. (P) Shearer	988
Detection of — in Presence of Vanadic Acid. (Reichard)	1241
Electrolytic Regeneration of —. (Le Blanc)	132
In Cotton Dyed with Chrome Yellow; Detection of —. (Cazenouev)	1029
Iodometric Estimation of —. (Seubert)	69
Process for Discharge of Indigo. (Clayton)	934
Chromium and its Alloys; Electrolytic Production of —. (Swan)	670
Determination of — by Potassium Iodide and Iodate. (Stock and Massaci)	391
Electrolytic —. (Neumann)	816
Family; Compounds of the — Sensitive to Light. (Baker)	931
Oxide in Chrome Mordants; Volumetric Determination of —. (Hartmann)	934
Oxide; Means for Extraction and Treatment of —. (P) Wheatley. From The Clyde Chemical Co.	718
Oxide Salts; Electrolytic Oxidation of Solutions of —. (P) Schneider	1221
Phosphate Green on a Chromium Brown Ground. (Scheurer)	891
Chromogen; Producing a Carmine-Red Colouring Matter, —, in <i>Schenckia Blumenaviana</i> . (Molisch)	888
Chromone Group of Dyestuffs. <i>See Hydroxychromone</i> .	
Chromophoric Groups. (Rupe and Wasserzug)	1200
Cider; Alcohol in —. (Allen)	1011
Dry and Sweet —. (Lloyd)	1012
Production of Normandy	735
Cinchona Alkaloids; Characteristics of —. (von Miller and Rohde)	63
Alkaloids; Formation of the —. (Lotsy)	150
Alkaloids; Perbromides of —. (Christensen)	605
Bark, Alkaloids in; Determination of —. (van Kettel). In Java	928
Trees; Formation of Alkaloids in —. (Lotsy)	498
Cinchonidine, Carbonic Esters of; Preparation of —. (P) Vereinigte Chininfabriken Zimmer and Co.	1232
Cinchonine, Allo-; Preparation of —. (Hlavnicka)	439
α - and β -Iso- —; Constitution of β -Isocinchonine (Skraup)	63
Base, Analogous to Nicheine. (Lunger)	499
Characteristics of —. (Jungfleisch and Léger)	1232
Hydro-; Characteristics of —. (Jungfleisch and Léger)	384
Hydro-; Preparation of —. (Jungfleisch and Léger)	499
Purification of —. (Jungfleisch and Léger)	439
Fauto-; Preparation of —. (Langer)	500
Transformation of Haloid Acid Addition Compounds of (Skraup)	743
Transformation by Means of Sulphuric Acid. (Skraup)	499
Cinch toxine; Characteristics of —. (von Miller and Rohde)	63
Cinghalese Oils. (F.R.)	541
Cinnamic Acid in Presence of Benzoic Acid; Detection of —. (Jorissen)	285
Cinnamo-Cacodylic Acid. (Astruc and Murco)	274
Citral, Cyclo-; Characteristics of —. (Tiemann)	335
In Lemon Oil; Determination of —. (Parry)	75, 75
Reagent for Identification of —. (Burgess)	844
Series; Compounds of the Cyclo —. (Tiemann)	384
Series; Inversion of Compounds of the —. (Tiemann)	335
Citrapene or Lemon Camphor. (Theulier)	605
Citric Acid and Citrate of Lime in Messina. (T.R.)	1162
Exports of Sicily. (T.R.)	1167
In Wine; Detection of —. (Spicz)	1039
Citron Oil. (Burgess)	1237
Citronella Oil. (Parry)	930
Citronellal; Constitution of —. (Harries and Schauwecker)	1136
Citronolene; Characteristics of —. (Schmidt)	1017
Cladonia deformis L.; Composition of —. (Zopf)	77
Clays. (Class IX.)	43, 81, 252, 364, 477, 517, 581, 718, 810, 990, 990, 1114, 1211
Clay Presses used in Manufacture of China, &c. (P) Furnival)	364
Refractory; Softening Point of —. (Cramér)	930
Cleansing Material for Brewery Vessels. (P) Ljöo and Tönnell)	1130
Cloth; Machines for Testing —. (Smith)	38
Clove Oil, Eugenol in; Determination of —. (Verley and Bölsing)	1250
Oil Factory at Pemba. (T.R.)	776
Cloves; Approximate Analysis of —. (McGill)	625
Coal; Arsenic in —: (Chapman)	1741
(Wood, Smith, and Jenks)	437
Briquettes; Examination of —. (Le Roy)	285
Briquettes; Manufacture of —. (P) Boulé. From Exbrayat	234
Cargoes; Report on Spontaneous Combustion of —	789
Dust consumed in Germany. (T.R.)	516
In Washington State, U.S.A. (T.R.)	853

	PAGE
Coal—cont.	
Industry in Saghalien Island. (Kleye)	23
Mines in Salonica and Kossova. (T.R.)	1259
Powder; Apparatus for Aerating and Feeding —. (P) Day	851
Substitutes; Peat and Peat-Coal as —. (Hamb)	233
Supplies; Chambers of Commerce Resolution on —. (T.R.)	951
Coals; Effect of Washing Cape Breton —. (Poole)	562
Solvent Action of Pyridine on Certain —. (Baker)	789
Coal-Tar Pitch in Germany. (T.R.)	1253
Cobalt and Nickel; Quantitative Separation of —. (Rosenheim and Hudschinsky)	640
Electrolytic Separation of —, from Nickel. (Balachowsky)	849
Ores from Caldera, Chile. (T.R.)	1042
Production of — in New Caledonia. (T.R.)	769
Reactions of —. (Donath)	618
Salts; Some Reactions of —. (Ditz)	333
Vogel's Qualitative Test for —. (Traidwell)	399
Coca Leaves; Assay of —. (Lamar)	1250
Cocaine; Determination of —. (Garsed and Collie)	511, 1631
Hydrochloride, Di-iodo-; Determination of —. (Garsed and Collie)	511
<i>d</i> -Cocaine; Transformation of Tropinone into —. (Willstätter and Bode)	832
Coccus Cacti; Pharmacopœia Tests of —	383
Cocoa, Dextrin in; Detection and Determination of —. Welnuans)	288
Manufacture of —. (P) Lich and van de Werk	924
Cocoa Butter; Manufacture of — in Mannheim. (T.R.)	520
Oil and Vegetable Tallow in the Straits Settlements. (T.R.)	555
Oil Imports of the Straits Settlements. (T.R.)	1044
Oil in Butter and Margarine. (Indemann)	433
Oil in Butter; Detection of —. (Rauweiz)	1039
Shipments from Mollendo. (T.R.)	776
Cod-liver Oil; Production of —. (T.R.) Lépineis)	865
Coerulein; Constitution of —. (Orndorff and Brewer)	979
Coffee Compound; Production of —. (P) Schutz and Hawley)	1012
From the Comoro Islands; Composition of —. (Bertrand)	271
Cognac; Significance of the Furfural Reaction in Valuation of —. (Wetzke)	378
<i>See also under Brandy</i> .	
Coke; Apparatus for Manufacture of —. (P) Darby	1137
Arsenic in —: (Chapman)	1241
(Wood, Smith, and Jenks)	437
Arsenic in; Determining Minute Quantities of —; (Archbutt and Jackson)	418
Briquettes in Germany. (T.R.)	1033
-Kiln Gases; Recovering By-Products from —. (P) Heinemann	564
Manufacture of —: (P) Cochrane	432
(P) Johnson. From The Deutsche Continental-Gas-Gesellschaft and Bueb	697
Manufacture of —, and Apparatus therefor: (F) Naef	27, 349
(P) Ruppert	1198
Manufacture of — in the United States. (T.R.)	852
-Ovens; Horizontal —. (P) Collin	882
Collieries; Apparatus for Detecting and Indicating Firedamp in —. (P) Rosenthal	350
Colocoin Cotton; Carriage of — on Board Ship. (T.R.)	630
Colocyth; Pharmacopœia Tests of —	365
Colophony; American —. (Tschirch)	51
Hardening of —. (P) Weiser. From The Elektrizitäts Aktienges. vormals Schuckert	729
Colorado; Tungsten Ores in —. (T.R.)	519
Uranium Ore in —. (T.R.)	519
Colour, Brown, Suitable to be Overdyed in the Piece. (Thurm)	469
Change; Theory of —. (Liebermann)	569
-Screen; Green —, and Red Printing Plate. (Miethe)	504
Substance from Ferrous Liquors. (P) Haddan. From Ramage	910
Colouring Matters. (Class IV.)	33, 112, 165, 238, 353, 400, 464, 569, 700, 763, 796, 855, 886, 952, 978, 1038, 1103, 1156, 1209, 1258
Colouring Matter of Blue Green Algæ; Soluble —. (Kolkwitz)	77
Matters; Binding Substances for —. (P) Gerhardt	372
Matters for Use on Porcelain, &c. (P) Ziegenbruch	477
Matters; Manufacture of —. (P) Hagen	728
Matters on the Fibre; Detection of Certain —	49
Matters; Printing of —. (P) Johnson. From Kalle and Co.	577
<i>See also Dyestuffs</i> .	
Colours, Crude; U.S. Customs Decisions on —. (T.R.)	1260
For Chemical Printing. (P) Hoz	585
In Madeira. (T.R.)	860
Regulations Controlling Poisonous — in Japan. (T.R.)	403
Sulphur —; Employment of a New Class of. (Green)	576
Upon Threads; Repetitions of Long Suites of —. (P) Hoffmann	121
Combustion; Phenomena of Furnace —. (Boudouard)	119;



	PAGE		PAGE
Commission on Sewage Disposal; Royal —. (T.R.).....	303	Copper— <i>cont.</i>	
Comoro Islands; Composition of Coffee from the —. (Bertrand).....	271	Production of —, in the Ural. (T.R.)	767
Composition for Manufacture of Tiles, &c. (P) Sohege	582	Production of the World. (T.R.)	519
For Paving Roads. (P) Candenberg	126	Refining —. (Swan)	664
For Removing Scale in Steam Boilers. (P) Rünler	105	Refining Plant at Anaconda; Electrolytic	727
Plastic —; a Substitute for Wood, Bone, &c. (P) Lake. From The United States Chemico Wood Co.	374	Selenides; Formation of —. (Fonzes-Diacon)	161
Compositions for Preserving Leather Book-Bindings. (H.G.) ..	436	Sulphate and Sodium Sulphate; Solubility of Mixtures of —. (Massol and Maldiés)	896
Compound; Adhesive —. (P) Bouthillier.....	266	Sulphate and Sulphuric Acid; Electrolysis of a Mixture of —. (Sand)	725
Concentrates; Agglomerating Comminuted —, and Apparatus therefor. (P) Ruthenburg.....	1218	Sulphate at Leghorn. (T.R.)	764
Concentrating and Crystallising Apparatus. (P) McNeil.....	53	Sulphate; Dissociation of —, under Influence of Water and Temperature. (Hensgen)	943
System; The "Crown" Dry —	811	Sulphate; Electrolytic Production of —. (P) Palas and Cotta	906
Apparatus. <i>See under</i> Cooling, Condensing, Heating, and Evaporating.		Sulphate; Treatment of —, in Greece. (T.R.)	79
Concentration; Waring System of Magnetic —	1116	Sulphate; Use of —, in Greece. (T.R.)	517
Concrete Articles; Manufacture of —. (P) Rouse.....	810	Volumetric and Gravimetric Determination of —. (Cohn) ..	1243
Improved Setting for —. (P) Wright	478	Wire; Tariff on —, in Spain. (T.R.)	950
In Mines. (T.R.)	81	Coppers; Recovering and Producing —, from Waste, and Apparatus therefor. (P) Geilsthörpe	453
Condensing Apparatus:		Copra Imports of the Straits Settlements. (T.R.)	1044
(P) Guttman	937	Cordia Excelsa; Crystalline Body of. (Thoms)	1235
(P) Parker	694	Corea; Quinine in. (T.R.)	958
Towers for Noxious Gases. (Clemmer)	1208	Coriamyrtin compared with Tutin. (Easterfield and Aston) .	67
Conductivities of Double Salts as compared with those of Mixtures of their Constituents. (Lindsay).....	258	Corrosive Sublimite; Use of —, for Detection of Ammonia. (Ferraro)	280
Of Solutions of Potassium Chloride, &c.; Influence of Cane Sugar on —. (Martin and Masson)	482	<i>See also under</i> Mercuric Chloride.	
Conductors; Insulation of Electric —. (P) Lake. From Tesla	238	Corsica; Gallic Acid Industry of —. (T.R.)	771
Congo; Export of Caoutchouc from the —. (T.R.)	83	Corundum in Canada. (T.R.)	855
Contact Operations; Materials with Platinum Surfaces for Use in —. (P) Johnson. From The Chemische Fabrik vormals Goldenberg, Geromont, and Co.	250	Corybulbine; Conversion of —, into Corydaline. (Dobbie and others)	66
Cooling and Concentrating Apparatus. (P) Schaffstädt.....	105	Corydaline; Conversion of Corybulbine into —. (Dobbie and others)	66
Apparatus:		Corydalis Cava; Alkaloids of: (Dobbie, Lauder, and Paliatseas)	66
(P) Kasper	1094	(Gadamer and others)	1234
(P) Moodie	694	Costus Root Oil; Isolation of Iso-Irone from —. (P) Haarmann and Reimer	745
(P) Parker	694	Cotton. (Class V.)	38, 81, 119, 242, 358, 469, 573, 709, 804, 855, 890, 932, 932, 1108, 1206
Apparatus; Ammonia Absorption Process for Working —. (P) Osenbrück	974	Cloths; Assessment of Duty on —. (T.R.)	162
By Water Circulation. (P) Inray. From Morani	588	Coated with Nitrocellulose; Duty on —, in France. (T.R.)	849
Copaiba Balsams; Resins of — (Keto)	1258	Destructive Action of Ammonium Persulphate on —. (Scheurer)	891
Copal; Kauri Bush —. (Tschirch and Niederstadt)	729	Goods; Detection of Oxycellulose in —. (Philip)	358
Copals; Fusion of — under Pressure. (Lippert)	1122	Goods; Yellow Stains on Hot-Calendered —. (Philip) ..	358
Copper; Aluminium Alloys containing —. (P) Berg	1217	Mercurisation of —. (P) Simons)	242
Analysis of Commercial —:		Mercurising Short-Staple —. (P) Golby. From Reichmann and Lagerqvist	469
(Holland)	840	Pods; Food for Animals from —. (P) Philips and Müller	738
(Truchot)	283, 1027	Printing —, with Sulphur Dyestuffs. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	1110
And its Alloys; Refining of —	566	Production of Grounds on —, in Dyeing or Printing with Azo-Colouring Matters. (P) Shillito. From Geigy and Co.	41
And Oxygen; Fusibility of Mixtures of —. (Heyn)	996	-Seed Hulls; Treatment of —. (P) Stanley	710
And Silver; Cyanogen Compounds of —, in Gravimetric Analysis. (Brunck)	749	-Seed Oil; Halphen's Reaction for Detection of —: (Soltzien)	398
As Oxalate; Volumetric Determination of —. (Peters) ..	157	(Wrampelmeyer)	285
Coverings for Railway Carriages. (T.R.)	770	-Seed Oil Production in Mexico. (T.R.)	167
Deposits of Cerro de Pasco, Peru. (T.R.)	768	-Seed Products in the United States. (T.R.)	403
Effect of — on Steel for Wire Making. (Stead and Wig-ham)	995	Council; Election of —	660
Effect of Small Amounts of Arsenic on —. (Lewis)	254	Report of —	661
Electrolytic Determination of —. (Smith)	750	Coverings for Drawing Bolls used in Spinning. (P) Reid and others	148
Electrolytic Estimation of —. (Reinke)	283	Cream and Milk Regulation; Report of Committee on — ..	493
Electrolytic Separation of —, from Mercury. (Spare and Smith)	1027	Creosote; Determination of —. (Hafner and Kreissl)	1251
Electro-Metallurgy of —. (Codara)	816	For Therapeutic Purposes; Examination of —. (Mercklen)	1245
Electro-Production of —. (Kershaw)	402	Cresol; Determination of: (Ditz)	394
Exports of Bolivia. (T.R.)	1042	(Russig and Fortmann)	394
Exports of Chili. (T.R.)	1042	Cresols, Metacresol in Mixtures of —, Determination of. (Ditz)	73
Extraction of —. (Swan)	666	Cripple Creek; Sampling and Milling Gold Ores —. (Hazlehurst)	44
Extraction of —, from Cuprous Pyrites. (Delplace) ..	128	Telluride Gold Ores of —. (Rickard)	45
Frasch Electrolytic Process for Refining —	483	Croton Oil; Pharmacoposia Tests of —	385
Imported by Java. (T.R.)	859	"Crown" Dry Concentrating System; The —	811
In Pyrites; Determination of —. (Heidenreich)	253	Crucible for Casting Alloys and Fusible Metals under Pressure. (P) Cothias	997
Influence of —, in Retarding Corrosion of Soft Steel and Wrought Iron. (Williams)	44, 127	Crucibles and Crucible Furnaces. (P) Reynolds	47
Influence of —, on Steel Rails and Plates. (Stead and Evans)	722	For Glass Melting. (P) Régie	252
Metallic, and Oxygen; Relation of —. (Heyn)	723	For Smelting. (P) Mather	723
Mines in Italy. (T.R.)	769	For Treatment of Ores. (P) Crosby	587
Mining in Mexico. (T.R.)	955	Manufacture of —. (P) Rawson and Littlefield)	992
Obtainment of —, from Ores, and Recovery of By-Products. (P) Simon	368	<i>See also under</i> Furnaces.	
Occlusion of Gases in —, and Influence of Tin, Phosphorus, and Antimony upon —. (Stahl)	480	Crushing Apparatus. (P) Askham and Keevil	694
Oleate; Preparation of —. (Naylor)	493	Cryolite; Treatment of —. (P) Doremus	589
Ores. <i>See under</i> Ores.		Crystalline Bodies containing Water; Solidification of —. (P) Thompson. From Haravodine	832
Oxide; Determination of Cuprous Oxide in Commercial —. (Miklosich)	934		
Oxide for Glass-making. (Raufer)	899		
Oxide for Glass Manufacture; Cuprous Oxide in —. (Drawe)	800		
Oxide; Simultaneous Reaction of Carbonic Acid and Salts of the Alkali Metals on —. (Kühling)	1253		
Oxygen in Commercial; Determination of —. (Lucas) ..	157		
Precipitation of —, by Ferrous Salts. (Biddle)	1217		
Prices of —, since 1885. (T.R.)	1041		
Production of —, at Ashio, Japan. (Bahlsen)	902		
Production of —, in Spain in 1899. (T.R.)	801		
Production of —, in the United States. (T.R.)	768		



	PAGE
Crystallisation from Complex Salt Solutions. (van't Hoff) ...	715
Method for Inducing —. (Rümpler).....	291
Of Liquors, and Apparatus therefor. (P) Bock	250
Products; Removal of —, from Carriers. (Bornett).....	1127
Rapid Process of —. (P) Kaufmann.....	230
Crystallising or Freezing Process and Apparatus. (P) Naef.....	253
Crystals of Manganese and Iron Carbo-Silicides. (Stead).....	721
Cuba; Chemical Trade of —. (T.R.).....	851
Sugar Machinery in —. (T.R.).....	1161
Cumaronone and its Homologues; Synthesis of —. (Stoermer and Bartsch).....	114
Cuprammonia Solution; Manufacture of —. (P) Imray. From Bronnert, Frémery, and Urban	119
Solutions; Preparation of —. (Frémery, Bronnert, and Urban).....	38
Cupri-Ammonia Sulphate; Influence of Temperature on Dissociation of —. (Dawson and McCrae).....	758
Cupric Hydroxide; Action of —, on Solutions of Metallic Salts. (Mailhe).....	943
Oxide; Production of —. (P) Adcock.....	718
Selenide; Formation of —. (Fonzes-Diacon).....	161
Cuprous Chloride; Reactions of Acetylene with —. (Chavastelton).....	841
Selenide; Formation of —. (Fonzes-Diacon).....	161
Curative Substances; Preparation of —. (P) Clark. From Blum	746
Customs Decision in New Zealand. (T.R.).....	79, 949
Decisions in Portugal. (T.R.).....	850
Decisions in the United States. (T.R.).....	79, 294, 515, 629, 848, 950, 1048, 1258
Decisions in Victoria. (T.R.).....	1035, 1153
Decisions in Western Australia. (T.R.).....	949
Decision on Indigo Powder in U.S.A. (T.R.).....	1039
Decision on Magnesite in United States. (T.R.).....	1157
Decision on Platinum Scrap in U.S.A. (T.R.).....	1259
Decision on Platinum Scrap in U.S.A. (T.R.).....	1042
Regulations.	75, 162, 294, 397, 515, 528, 758, 848, 946, 1035, 1154
Regulations in the United States. (T.R.).....	397
Regulations of Russia. (T.R.).....	1154
Tariff in China, New —. (T.R.).....	950
Tariff of Newfoundland; New —. (T.R.).....	1035
Cyanamide and its Compounds; Manufacture of — (P) Johnson, From The Deutsche Gold und Silber Scheide-Anstalt.....	1139
Cyanates and Cyanides; Determination of —, in Presence of each other. (Mellor).....	284
And Cyanides in Admixture; Determination of —. (Victor).....	1031
Cyanic Acid in Commercial Cyanides; Determination of —. (Herting).....	838
Cyanide Plant at Athabasca Mine, British Columbia.....	1215
Poisoning; Antidotes for —. (T.R.).....	843
Process at Deloro, Ontario. (Wright).....	812
Process; Determination of the Zinciferous Precipitates obtained by the —. (Pulton and Crawford).....	749
Solutions containing Zinc; Testing —. (Green).....	1144
Tailings; Treatment of —. (Crowther).....	127
Cyanides, Alkali; Apparatus for Obtainment of —. (P) Craig and Paterson	809
And Cyanates; Determination of —, in Presence of each other. (Mellor).....	284
And Cyanates in Admixture; Determination of —. (Victor).....	1031
Cyanic Acid in Commercial; Determination of —. (Herting).....	838
Isopurpuric Acid Test for —. (Reichard).....	935
Manufacture of —. (P) Johnson. From The Chem. Fabrik vormals Vorster und Grüneberg.....	717, 717
Manufacture of Alkali —. (P) Johnson. From The Deutsche Gold und Silber Scheide-Anstalt.....	1113
Manufacture of —, and Apparatus therefor. (P) Raschen and others.....	809
Obtainment of Alkali —. (P) Craig and Paterson	808
γ-Cyano-stilbene; Isomeric Diamino Bases of —. (Freund).....	1107
Cyanogen Compounds; Manufacture of —. (P) Besemfelder	1210
Compounds of Silver and Copper in Gravimetric Analysis. (Brunck).....	749
Haloid Compounds of; Manufacture of —. (P) Kirkpatrick-Picard.....	717
Pseudosulpho —, and Canarin. (Goldberg).....	238
Cyclo-Citral; Characteristics of —. (Tiemann).....	385
-Citral Series; Compounds of —. (Tiemann).....	384
Cylinders for Use in Printing Textiles. (P) Dejeu	360

D

Dahomey; Cement Imports of —. (T.R.).....	1040
Imports of —. (T.R.).....	1037
Palm Oil Exports of —. (T.R.).....	1044
Rubber Exports of —. (T.R.).....	1045
Dalmarnock Sewage Works; Visit to —.....	679
Damascenine; Action of Alkali on —. (Pommerehne).....	500

	PAGE
Datura Stramonium grown in Egypt; Alkaloids of —. (Dunstan and Brown).....	66
Deaths; Lists of.	5, 98, 184, 318, 420, 534, 787, 877, 970, 1060, 1176
Decanting Apparatus for Liquids. (P) Gorianinoff.....	344
Dehydromucic Acid; Reaction and Preparation of —. (Yoder and Tollens).....	1245
Denitrification; Study of —. (Beddies).....	820
Densimeter for Valuation of Wheaten Flour. (Pleurent).....	941
Density of Liquids; Apparatus for Regulating the —. (P) Domergue.....	695
Deodorisers. See under Disinfectants.	
Deodorising Agent; Manufacture of —. (P) Depangher and Pontini.....	728
Dephosphoration Scoriac; Determination of Phosphoric Acid in. (Palmaus).....	267
Destructive Distillation. (Class III.).....	32, 80, 111, 165, 237, 295, 352, 369, 464, 596, 635, 700, 762, 795, 854, 885, 977, 1038, 1102, 1200
Detergents and their Manufacture. (P) Bamberg.....	1122
Detonating Materials; Examination of New —. (Alvisi)....	837
Detonators; Manufacture of —. (P) Wöhler.....	388
See also Explosives.	
Developers. See under Photographic.	
Dextrin as a Finishing Materials for Textiles. (Füth).....	242
Honey-; Nature of —. (Beckman).....	1131
In Cocoa and Chocolate; Detection and Determination of —. (Weltmans).....	288
Dextrose; Bi-rotation of —. (Osaka).....	395
Diacetyldiamidouracil; Manufacture of —. (P) Johnson. From Boehringer and Söhne.....	931
Dialkylamino Anthraquinones and Dialkylamino-oxanthraquinones; Production of —. (Haller and Umbgrove).....	980
Dialkylaminobenzoylbenzoic Acids; New Derivatives of —. (Haller and Umbgrove).....	980
Diamonds; Artificial Production of —. (P) Ludwig.....	1034
Diaphragms; Electrolytic —. (Le Blanc).....	815
Manufacture of Acid-proof —. (Le Blanc).....	132
Porous —, for Electrolytic Apparatus. (P) Holland and Laurie.....	370
Diastase; Examination of Commercial —. (Barth).....	490
Diastatic Actions of Colloidal Platinum and of Organic Diastases; Analogy between —. (Bredig).....	376
Diazine Blue; White Discharge Effect Produced by —. (Scherdel).....	576
Diazo Compounds; Action of —, on Wool. (Braudt).....	711
Compounds; Sensitiveness of —, to Light. (Ruff and Stein).....	834
Diazobenzene; Action of —, on Phenol. (Bamberger).....	115
Sulphonic Acid; Explosion of —. (Wichelhaus).....	354
Diazoimides (Triazo Compounds). (Rupe and von Majewski).....	151
Diazo-Nitrogen in Diazo-Amino Compounds; Apparatus for Determination of —. (Mehner).....	623
Sulphonates and Phenols or Amines; Action of Light on Compounds of —. (Seyewetz and Blanc).....	1103
Dichlorotoluenes; Constitution of the —. (Cohen and Dakin).....	512
Didymium; Separation of —, from Cerite Earths. (Meyer and Marekwald).....	63
Diffusion Juice, Beetroot; Warm Diffusion and Warming —. (Melichar).....	51
Juice; Organic Acids Extracted by Ether from —. (Andriik, Urban, and Stanek).....	54
Juice; Purification of —. (A.V.).....	53
Digitalinum Germanicum; Obtaining the Valuable Constituents of —. (Kiliani).....	1234
Digitalis Glucosides; Preparation and Composition of —. (Cloetta).....	743
Digitoflavone and Luteolin; Identity of —. (Kiliani and Mayer).....	1202
Digitonin; Preparation of Amorphous —. (Cloetta).....	743
Preparation of Crystallised —. (Cloetta).....	743
Dihydroxyfluorescein: (Liebermann).....	1104
(Thiele and Jaeger).....	1105
Di-iodo-cocaine Hydrochloride; Determination of —. (Garsed and Collie).....	511
Dimethyl Sulphate; Injurious Action of —, on Respiratory Organs.....	161
4-Dimethylamido-1-Phenyl-2,3-Dimethyl-5-Pyrazolone; Salicylate of —. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning.....	504
Dimethylaminebenzoylbenzoic Acid; New Derivatives of —. (Haller and Guyot).....	465
Dinitroanisidine; Diazotisation of —, and Constitution of the Resulting Product. (Meldola and Eyre).....	572
Dinitro-ortho-anisidine; Chemical Reaction in which one of the Products continues the same Reaction. (Meldola and Eyre).....	1204
Dinuer; The Annual.....	682
Dioxides, Alkaline Earth; Manufacture of —. (P) Jaubert.....	474



	PAGE
Di- <i>p</i> -aminophenyl-cyano-butadien; Substantive Nature of Azo-Dyes from —. (Freund)	1107
Diphenylamine; New Derivatives of —. (Cohn)	978
Two New Nitro-amine Derivatives of —. (Kehrmann and Steiner)	1104
Diphenylcarbazine; Chroma Dyestuffs derived from —. (Cazeneuve)	980
Diphenylene Oxide from Coal Tar, and Diphenol therefrom (Kraemer and Weissgerber)	795
Diphenylenephenylmethane; Dyestuff derived from —. (Haller and Guyot)	798
Diphenylmethane Derivatives. (Cohn)	464
Dipping Apparatus for Skins and Fabrics. (P) Ruttenau and Hahlo)	713
Disalicylide; Characteristics of —. (Binhorn and Pfeiffer)	1134
Disease Germs; Means for Destroying —. (P) (Johnson)	60
Disinfectants. (Class XVIII.)	61, 147, 272, 381, 495, 521, 739, 830, 925, 1013, 1048, 1133, 1230
Disinfectant; An Improved —. (P) Strandh	1230
And Antiseptic Preparations. (P) Yarnold	1013
Composition; Manufacture of —. (P) Gordon	61
Compound; Manufacture of —. (P) McClellan	61
Pocket Handkerchief, and Production thereof. (P) Just	739
Sulphuric Acid as a Typhoid —. (Bideal)	1133
Disinfecting, and Apparatus therefor:	
(P) Blackmore	739
(P) Fournier	147
Distillation; Destructive —. (Class III.)	32, 90, 111, 163, 237, 295, 352, 399, 461, 536, 635, 709, 762, 795, 854, 885, 977, 1093, 1200
Distilleries: Employment of Yeast injured to Hydrofluoric Acid in Molasses —. (Verbiése)	1227
Treatment of Waste Products from —. (P) Ferguson	144
Use of Wheat Germs in —. (Lindet)	490
Distillers' Residues; Treatment of —. (P) Sudre and Thierry	379
Spent Wash; Treatment of —. (P) Sudre and Thierry	492
Distillery Fermentation Vats; Tar Coating for —. (Heinzelmann)	56
Refuse; Treatment of —. (P) Storer and McAlley	737
Visit to the Arzgowan	631
Wash; Alcohol in Spent —. (Heinzelmann)	491
Waste Liquids; Composition and Disposal of —. (Hendrick)	450
Distilling Apparatus:	
(P) Crépelle-Fontaine	143
(P) Edwards. From Krauschwitzer Thonwaarenfabrik	460
Distilling; Valuation of Barleys for —. (Frew)	221
Dithionic Acid; Formation of —. (Meyer)	1252
Divkaduru Oil. (T.R.)	642
Dogwood, Jamaica —; Constituents of. (Freer and Clover)	605
Dolomite; Furnaces for Treatment of —. (P) Gobbe	105
Domba Oil. (T.R.)	642
Donar. See under Explosives.	
Dorana Oil. (T.R.)	642
Dormy's Apparatus for Mechanical Enamelling. (Livache)	251
Drainage; Report on Experiments on Purification of Town —. (Nietner, Thiesing, and Baier)	828
Drawing Rolls used in Spinning; Coverings for —. (P) Reid and others	148
Dressings; Determination of Phenol, Salicylic Acid, and Salol in —. (Telle)	1149
Drug and Chemical Imports of Brazil. (T.R.)	1162
And Chemical Imports of Cape Colony. (T.R.)	1048
Imports in Natal. (T.R.)	951
Drugs and Chemicals at Varna, Bulgaria. (T.R.)	1049
And Medicines in Nicaragua. (T.R.)	1048
Emodin as the Active Constituent of some —. (Tschirch)	497
Drying Apparatus:	
(P) Bault. From The Roller Maschinenfabrik	694
(P) Hecking	344
(P) Hoch	487
(P) Lake. From Hiorth	1095
(P) Naef	1210
(P) Thompson. From Mallinson	577
For Air. (P) Gayley	27
Duhdu Oil. (T.R.)	641
Dulcine in Foods and Beverages; Detection of —. (Bellier)	72
Dung-Bate; Action of —. (Wood)	137
Du Pont's Nitrometer. (Lunge)	100
Dust from Various Sources; Mineral Constituents of —. (Hurtley and Ramage)	513
In Blast-Furnace Gases. (Greiner)	721
Dutch Metal Free of Duty in United States. (T.R.)	1041
Duties on Russian Petroleum. (T.R.)	162
Duty on Mercerised and other Cotton Cloths. (T.R.)	162
Dyed Goods; Production of Discharge Effects on —. (P) Johnson. From Kalle and Co.	985
Dyeing and Bleaching Fabrics. (P) Armitage	471
And Printing with Sulphide Dyestuffs. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	577

Dyeing—cont.

	PAGE
Apparatus:	
(P) Bernheim	471
(P) Major and Wood	121
(P) Mather	359
(P) Morgan and Menzies	472
(P) Obermaier	1207
(P) Ruttenau and Hahlo	713
(P) Schirp	471
(P) Schule	577
(P) Thompson. From Mallinson	577
Black with Sulphide Colours. (P) Green and others	713
Compositions; Manufacture of —. (P) Aloy	193
Effect of Temperature in —. (Brown)	574
Fast, with Dyestuffs containing Sulphur. (P) Ransford. From Cassella and Co.	247
For Slubbings and Rovings. (P) Heys. From Schmitt	713
Gloves and the like. (P) Müller	713
Indigo-Vat —. (P) Imray. From The Farbwerke vormals Meister, Lucius and Brüning	472
Machines; Apparatus connected with Swift Hank —. (P) Burrows	1109
Machines for Yarns. (P) Hussong	247
Of Metallic Oxide Mordants. (Buntrook)	933
Of Oxide Mordants. (Liebermann)	710
Of Textile Fabrics. (P) Schreiner	713
Patterns on Fabrics. (P) Bolland	1110
Potassium Permanganate Applied in —. (Saget)	575
Power —, for Yarns, &c. (P) Preston	1119
Process; Theory of the —. (Zacharias)	804
Sliver Cans for Use in —. (P) Honegger	41
Solution Theory of —. (Brown and McCrae)	1092
With Amido-oxanthraquinone Sulphonic Acids. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	471
With New Insoluble Azo-Dyestuffs. (Kaysers)	983
With Sulphur Dyestuffs. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	1208
With Sulphur Dyestuffs. (P) Imray. From The Farbwerke vormals Meister, Lucius and Brüning	41
Works; Prevention of Fog in —. (Milius)	574
See also under Bleaching.	
Dyeings; Fixing of — on Vegetable Fibre. (P) Lake, From The Farbenfabriken vormals Leonhardt and Co.	893
Dyestuff Imports of Italy. (T.R.)	952
Imports of the Canary Islands. (T.R.)	952
Yielding Trees of Pemba. (T.R.)	763
Dyestuffs. (Class IV.)	33, 112, 165, 238, 353, 400, 464, 569, 700, 767, 796, 875, 886, 952, 978, 1038, 1103, 1153, 1200, 1258
Dyestuffs; Various:—	
Alkylated — from <i>m</i> -Aminophenols; Preparation of. (Grünberg)	355
Amido ammonium-azo — (Yellow, Orange, Red, Violet) (P) Abel. From The Actiengesellschaft für Anilinfabrikation	708
Amido-benzoic Acids, Anthranilic Acid, and Dyestuffs therefrom. (P) Ellis. From Pertsch	1204
1'S-Amido-naphthol-4-sulpho Acid and Intermediate Products. (P) Willcox. From The Badische Anilin und Soda Fabrik.	889
Amines from Corresponding Nitro Compounds; Production of —. (P) Johnson. From Boehringer und Soehne.	118
Amines; Tertiary Aromatic —. IV. (Häussermann)	356
Amino azo Compounds. (Mahlau and Heinze)	670
Amino-azo Compounds; Fatty Aromatic —. (Prager)	1202
Aminobenzene Sulphonic Acids; Alkylated —. (Gnehm and Scheutz)	798
β -Aminophenylbenzimidazoles; Comparison of the Three —. VII. (Miklaszewski and St. v. Nienentowski)	1202
Aniline and Analogous Bases; Preparation of —. (Sabatier and Senderens)	673
Aniline; New Synthesis of —. (Jaubert)	434
Aniline; Oxidation of —. (Börnstein)	701
Anilines; Reactions of Substituted —. (de Coninck)	113
Anisidine, Ortho; Nitro-Derivatives of —. (Preys)	356
Anthracene Series of Halogen Derivatives, and — therefrom. Johnson. From the Badische Anilin und Soda Fabrik.	241
Anthragallol; Autoxidation Products of —. (Bamberger and Praetorius)	1203
Anthragallol; Nitro-Compounds of —. II. (Bamberger and Böck)	1103, 1109
Anthranilic Acid; Action of Formaldehyde and Nascent Hydrocyanic Acid on —. (Kohner)	801
Anthraquinone —; Production of New. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	36
Aromatic Amines and New —. (P) Willcox. From The Badische Anilin und Soda Fabrik.	981
Aromatic Compounds, and — therefrom; Production of. (P) Johnson. From The Badische Anilin und Soda Fabrik	240
Auramine from Tetramethyldiamidodiphenylmethane (Walter)	34
Azo —, and Intermediate Products for Use therein. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	982
Azo —, Black, for Cotton; Manufacture of. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	708
Azo — (Brown), Mordant-Dyeing; Manufacture of. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	467

	PAGE
Dyestuffs; Various— <i>cont.</i>	
Azo-Compounds from <i>m</i> -Toluidine. (Samelson).....	240
Azo —, from β -Naphthol and α -Naphthylamine Sulphonic Acids; Behaviour of —, to Wool. (von Georgievics and Springer).....	34
Azo — (Orange, Bluish-Red), and Intermediate Products. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	982
Azo —, prepared from Di- <i>p</i> -aminophenyl-cyano-butadien Substantive Nature of —. (Freund).....	1107
Azo (Red) —, and Lakes therefrom. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	240
Azo (Red) —, and Lakes therefrom; Production of. (P) Willcox. From The Badische Anilin und Soda Fabrik.....	35
Azo (Red, Brown, Blue-Black); Production, Use and Treatment of. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	117
Azo — (Red, Orange), and Intermediate Products. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	503
Azo (Red, Violet) —, for Cotton; Production of. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	117
Azo — (Violet, Blue), and Material for Use therein. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	708
Azo — (Violet); Manufacture of. (P) Willcox. From The Badische Anilin und Soda Fabrik.....	981
Azo (Yellow) —, and Materials for Use therein; Production of. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	33
Azo (Yellow, Red, Violet) —, and Intermediate Products. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	117
Azonium —; Chloro Derivatives of:	
(Kehrmann and Hily).....	701
(Kehrmann and Krazler).....	703
(Kehrmann and Müller).....	702
Azoxonium Compounds. (Kehrmann).....	709
Azoxybenzene; Transformation of —. (Bamberger).....	115
Basic and Acid; Determination of —. (Seyewetz).....	334
Benzene- <i>azo</i> β -naphthylamine. (Möhlan and Graeert).....	1203
Benzidine; Electrolytic Production of —. (Lob).....	709
1'-4-Benzopyranol; Derivatives of —. III. (Bülow and von Sicherer).....	1106
1'-4-Benzopyranol; Derivatives of —. (Bülow and Wagner).....	704, 703
Benzylamine; Conditions of Formation of —. (Dhomée).....	1200
Black Acid Proof Cotton —; Manufacture of Permanent. (P) Stolaroff.....	240
Black —, and Condensation Products from Para-amidophenol. (P) Rudolph.....	468
Black —, Directly Dyeing Cotton; Manufacture of. (P) Abel. From The Actiengesellschaft für Anilinfabrikation.....	33, 241, 241, 467, 457, 467
Black Disazo —; Manufacture of. (P) Abel. From The Actiengesellschaft für Anilinfabrikation.....	573
Black —; Manufacture of; and Products for Use therein. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	35
Black —; Production of. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	35
Black —; Production of New. (P) Leviustein and others.....	1107
Blue —, and Products for Manufacture thereof. (P) Willcox. From The Badische Anilin und Soda Fabrik.....	880
Blue-Green —, of the Anthraquinone Series, and Intermediate Products. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	889
Blue —; Manufacture of. (P) Ransford. From Cassella and Co.....	889
Blue Mordant —, of the Anthraquinone Series; Production of. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brünig.....	37
Blue —, of the Triphenylmethane Series. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	981
Blue —; Production of. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	357
Blue Sulphurised —; Manufacture of. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brünig.....	467
Blue Trisazo —; Manufacture of. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	358
Blue-Violet —; Manufacture of. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brünig.....	37
Braasilin and Haematoylin. (Herzig and Pollak).....	700
Brown and Black — for Wool. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brünig.....	890
Brown and Grey — for Wool; Manufacture of. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brünig.....	468
Brown —, containing Sulphur, and Material for Use therein. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	708
Brown —, deriving from 2'-amino-naphthol-disulpho Acid. (P) Ransford. From Cassella and Co.....	118
Brown —, Directly Dyeing Cotton; Manufacture of. (P) Abel. From The Actiengesellschaft für Anilinfabrikation.....	839, 880
Brown —, for Cotton, from 1'-8-dinitronaphthalene. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brünig.....	468

	PAGE
Dyestuffs; Various— <i>cont.</i>	
Brown —; Production of. (P) Ransford. From Cassella and Co.....	37
Brown —, Substantive; Manufacture of. (P) Johnson. From Kalle and Co.....	467
Canarin and Pseudosulphocyanogen —. (Goldberg).....	238
Canarine; New Formation of —. (Pawlewski).....	113
Carbazole; Nitro-derivative of —, from Nitrosocarbazole. (P) Wirth.....	880
Carminone Compounds. (Liebermann and Laudau).....	886
Catalysis in Concentrated Solutions. Sulphonations. (Crafts).....	796
Chloranthranilic Acids; Two New —. (Cohn).....	1204
Chrome —, derived from Diphenylcarbazide. (Caze-neuve).....	980
Chronogen; Production of —, from Schenckia Blumenaviana. (Molisch).....	888
Chromophoric Groups. (Rupe and Wasserzug).....	1200
Colour Change; Theory of —. (Liebermann).....	569
Containing Sulphur; Production of. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.....	1205
Cumarone and its Homologues from Phenoxycetic Acids; Synthesis of —. (Stoerner and Bartsch).....	114
7-Cyano-stillbene; Isomeric Diamino Bases of —. (Freund).....	1107
Detection of —, Applied to Indophenols. (Camichel and Bayrac).....	621
Dialkylamino-anthraquinone and Dialkylamino-oxy-anthraquinones. (Haller and Umbroge).....	980
Dialkylaminobenzoylbenzoic Acids; New Derivatives of —. (P) Haller and Umbroge.....	980
Diazobenzene; Action of —, on Phenol. (Bamberger).....	115
Diazobenzene Sulphonic Acid; Explosion of —. (Wichel-haus).....	354
Diazo-Sulphonates and Phenols or Amines; Action of Light on Compounds of —. (Seyewetz and Blanc).....	1103
Dihydroxyfluorescein:	
(Liebermann).....	1104
(Thiele and Jaeger).....	1105
Dimethylaminobenzoylbenzoic Acid; New Derivatives of —. (Haller and Guyot).....	465
Dinitroanisidine. Diazotisation of —, and Constitution of the Resulting Product. (Meldola and Eyre).....	572
Dinitro ortho-anisidine. Chemical Reaction in which one of the Products continues the Reaction. (Meldola and Eyre).....	1204
Diphenylamine; Derivatives of —. (Cohn).....	978
Diphenylamine; Two New Nitro-amino Derivatives of —. (Kehrmann and Steiner).....	1104
Diphenylmethane Derivatives; New —. (Cohn).....	464
Disazo — (Brown), from 1,5-Naphthylene Diamine. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	468
Disazo — (Red, Brown, Violet, Blue); Manufacture of. (P) Johnson. From The Badische Anilin und Soda Fabrik.....	893
Disazo — (Red, Violet); Manufacture of. (P) Lake. From Oehler.....	803, 803
Erica Pink. (Knecht).....	806
Eupitton and Pittakall. (Liebermann).....	569
Eupitton Derivatives. (Liebermann and Wiedermann).....	569
Exanthone and Alizarin; Methylation of —. (Graebe and Aders).....	1204
Extraction of —. (P) Gulden.....	38
Flavindulines; Nitro- and Amino- —. (Kehrmann and Eichler).....	705
Fluorescein and its Derivatives, &c.; Sensitiveness of — to Light. (Gros).....	888, 1104
Fluorindines. (Kehrmann and Guggenbeim).....	706
From Coal-Tar; Duty on —, in the United States. (T.R.).....	79
From Dialkylated <i>m</i> -Aminophenol Ethers. (Grimaux).....	356
Gallanide Derivatives. (Gnehm and Gaus-er).....	354
Gallein and Coerulein; Constitution of —. (Orndorff and Brewer).....	979
Greenish-Black Sulphurised Direct-Dyeing —. (P) Bloxam. From The Chemische Fabrik Brugg.....	1205
Hydro-sulphurous Acid; Application of the Reducing Action of —. (Goldberger).....	112
<i>o</i> -Hydroxyazobenzene; Synthesis of —. (Bamberger).....	115
β -Hydroxychomone; Synthesis of —. (St. v. Kostanecki and others).....	1106
In Egypt. (T.R.).....	166
In Japan. (T.R.).....	922
Indandion (Diketohydrindene); Derivatives of —. (Noelting and Blum).....	1106
Indazol Derivatives, and Brown —, therefrom; Production of. (P) Ransford. From Cassella and Co.....	36
Indigo-Carmine and Indigotin; Decrease in Use of —. (Zanker).....	33
Indigo-Carmine; Constitution of —. (Vorländer and Schubart).....	800
Indigo; Conversion of Anthranilic Acid Derivatives into —. (Erdmann).....	801
Indigo; Electrolytic Reduction of —. (Haber).....	1103
Indigo; Extraction of — from the Plant. (P) Calmeite.....	886
Indigo Fermentation. (Bejericzek).....	112
Indigo; History of the Manufacture of Synthetic —. (Brurek).....	239
Indigo in an Anhydrous Medium; Reduction of —. (Bluz).....	886
Indigo Industry; Report of Meeting on — at Calcutta.....	333



Dyestuffs—cont.

PAGE

Indigo —; Intermediate Products, and Indigo; Production of. (P) Willcox. From The Badische Anilin und Soda Fabrik	839
Indigo Leuco Compounds and other Indigo Products. (P) Johnson. From The Badische Anilin und Soda Fabrik	35, 35
Indigo Leuco Compounds; Conversion of — into Indigo. (P) Willcox. From The Badische Anilin und Soda Fabrik	1205
Indigo; Manufacture of —. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	951
Indigo; Manufacture of —. (P) Willcox. From The Badische Anilin und Soda Fabrik	803
Indigo; Manufacture of — from Naphthalene. (Levinstein)	802
Indigo; Manufacture of Natural —. (Gallenkamp)	466
Indigo; Material for Production of —. (P) Willcox. From The Badische Anilin und Soda Fabrik	1205
Indigo, Monobrom-, and Di-brom-, &c.; Production of —. (P) Rahtjen	1205
Indigo; Natural and Artificial —. (Turnbull)	979
Indigo; Oxidation of —. (von Georgievics and Springer)	33
Indigo Paste; Production of —. (P) Johnson. From The Badische Anilin und Soda Fabrik	116
Indigo; Physical Condition of Two Preparations of Synthetic —. (Binz and Ruzg)	116
Indigo Plant; Treatment of — by Diastase. (P) Geugnier and Valette	886
Indigo Powder; Production of —. (P) Willcox. From The Badische Anilin und Soda Fabrik	981
Indigo; Reduction of —. (P) Thompson. Chem. Fab. Opladen vorm. Gebr. Flick	802
Indigo; Transforming Difficultly Reducible Crystalline — into Easily Reducible Paste. (P) Shillito. From Geigy and Co.	37
Indophenolthiosulphonates from Sulphurised Indophenols (P) Imray. From The Society of Chemical Industry, Basle	803
Indophenols; Absorption of Light by —. (Bayrac and Camichel)	355
Indoxyl and Indoxic Acid; Acyl Derivatives of —. (Vorländer and Dressler)	800
Intermediate Products for Production of —. (P) Green and others	118
<i>a</i> -Isatine anilide and of Indigo; Production of Homologues of —. (P) Shillito. From Geigy and Co.	357
Isoresinduline and Isoresindone Reaction. (Fischer)	571
Isoresinduline No. 8, and Derivatives of Trinitro- <i>a</i> -Naphthol; Constitution of —. (Kehrmann and Misslin)	706
Isoresinduline No. 9; Constitution of —. (Kehrmann and Steiner)	115
Isoresinduline; 12th Isomeride of —. (Kehrmann and Steiner)	115
Isoresindulines and 5 Acetamino- <i>β</i> -naphthoquinone. (Kehrmann and Denk)	115
Ketones; Electro-chemical Reduction of —. (Elbs)	700
Luteolin and Digluflavone; Identity of —. (Kiliani and Mayer)	1202
Luteolin; Report on Prize Essay on —. (Noelting and Freyss)	354
Luteolin; Synthesis of —. (von Kostanecki and others)	116
Malachite Green; Etherification of — by Alcohol. (Fischer)	33
Malachite Green; Hydroxy-Derivatives of —. (Votocek and Jelinek)	1106
Marking Inks; Coloured —. (P) Raynes	1108
Metaminophenols. (Gnehm and Scheutz)	798
Monazo (Blue) —, derived from Amidonaphtholsulpho Acids. (P) Ransford. From Cassella and Co.	241
Mordant —. (Noelting)	1204
Mordant —; Orange-Yellow to Red; Manufacture of —. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	982
Naphthol; Action of Nitrous Acid on <i>α</i> - and <i>β</i> -. (Schmidt)	113
Nitrated Azo —; Reduction of. (Roseustiel)	570
Nitro-, Azo-, and Hydrazo-Compounds; Reducing —. (P) Urquhart	1108
Nitrobenzene; Action of — on Aniline in Presence of Alkali. (Wohl and Aue)	837
Nitronaphthalene Derivatives from 1,4-Chloronitronaphthalene. (P) Johnson. From The Chem. Fabrik Griesheim	358
Of the Anthracene Series; Production of —: (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	357, 1205
(P) Willcox. From The Badische Anilin und Soda Fabrik	1205
Of the Esculetin Series. (Liebermann and Weidemann)	1104
Orange-Red and Blueish-Green — of the Anthracene Series. (P) Johnson. From The Badische Anilin und Soda Fabrik	707, 708
Orange-Yellow — of the Acridine Series. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	898
Orange-Yellow — of the Acridine Series; Manufacture of (P) Abel. From The Actiengesellschaft für Anilinfabrikation	37
Oxyhydroquinonephthalic; Fluorescent Esters of —. (Feuerstein Dutoit, and Wallach)	1105
Parafoluidine; Oxidation of —. (Börnstein)	701
Phenylglycine- <i>c</i> -carboxylic Acid Esters; Preparation of —. (P) Chem. Fabrik von Heyden	979

Dyestuffs—cont.

PAGE

Picric Acid; Manufacture of —. (Wenghöffer)	570
Products Useful in the Manufacture of —. (P) Johnson. From The Badische Anilin und Soda Fabrik	36
Pyrogen (Sulphur) —; Characteristics of. (Zimmermann)	466
Rendering — faster to Water, Soap, and Acids. (Bampf)	983
Rhodamine Sulphonic Acids; Manufacture of New. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	709
Rosaniline Base. (Weil)	114
Rosaniline Bases. (von Georgievics)	34
Rosinduline, No. 13. (Kehrmann and Silberstein)	116
Rosinduline, No. 14. (Kehrmann and Ott)	1201
Rosinduline, No. 15. (Kehrmann and Nüesch)	1201
Sodium Tetrazotylsulphite; Compound of — with Ethyl <i>β</i> -Naphthylamine. (Seyewetz and Blanc)	888
Stilbene Series; Derivatives of the —. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	982
Substituted Aminobenzophenones and Aromatic Amines in Sulphuric Acid Solution; Reaction between —. (Lemoult)	571
Sulphide —; Analysis of. (Meyenberg)	508
Sulphide Colour (Blue) and its Leuco Compound; Manufacture of —. (P) Ransford. From Cassella and Co.	1205
Sulphide; Dyeing and Printing with —. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	577
Sulphinic Acids, Aromatic —; Manufacture of. (P) Imray. From The Basle Chemical Works	119
Sulphocyanogen and Pseudosulphocyanogen. (Goldberg)	798
Sulphonated Aldehydes and Bluish-Green —. (P) Ellis. From The Société des Usines du Rhône	1205
Sulphonated Oxyazo — and their Salts. (Sisley)	1203
Sulphonic Acids; Separation of —. (Krafft and Wilke)	113
Sulphur — (Black, Blue, Brown) and Materials therefor. (P) Lake. From The Chemical Works formerly Sandoz	982
Sulphur —; Constitution of. (Geigy)	981
Sulphurised Black —; Direct-Dyeing. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	982
Sulphurised Leuco-Compound; Manufacture of a —. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	573
Sulphurised — (Reddish-Violet) directly Dyeing Cotton. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	982
Tecomin; a Derivative from "Bignonia tecoma." (Lee)	116
Tetrachlorodialkylamino- <i>o</i> -oxybenzoylbenzoic Acids; Derivatives of —. (Haller and Umbgrove)	930
Tetramethyldiaminophenyl-anthranol and -oxanthranol; Formation and Properties of —. (Haller and Guyot)	465
Thionine —. (Kehrmann and Schaposchnikoff)	116
Toluene; Electrolytic Oxidation of —. (Puls)	464
Transformation Products of Coal-Tar —. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	117
1,3,3'-Trioxylavone. (St. v. Kostanecki and Steurmann)	355
Triphenylcarbinols; Etherification of — by Alcohol. (Fischer)	33
Triphenylchloromethane; Formation of —. (Gomberg)	114
Triphenylchloromethane; Preparation of —. (Gomberg)	33
Triphenylmethane — (Grimaux and Lefèvre)	355
Triphenylmethane —; Absorption Spectra of Aqueous Solutions of. (Camichel)	114
Triphenylmethane — (Blue). (Grimaux)	355
Triphenylmethane Derivatives. (Grimaux)	355
Triphenylmethane —; Manufacture of. (P) Johnson. From Boehringer und Soehne	358
Triphenylmethane —; Relation between Chemical Constitution of, and Absorption Spectra of their Aqueous Solutions. (Lemoult)	33
Trisazo (Blue) —; Production of. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co.	118
Violet and Blue —; Production of. (P) Ransford. From Cassella and Co.	803
Violet-Black Azo — for Wool; Manufacture of. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	240
Violet —; Manufacture of. (P) Ransford. From Cassella and Co.	889
Violet — of the Diphenyl- <i>α</i> -naphthylmethane Series. (P) Abel. From The Actiengesellschaft für Anilinfabrikation	1168
Violet, Red, and Blue — of the Anthracene Series. (P) Newton. From The Farbwerke vormals F. Bayer and Co.	890
Xylidines; Nitro- and Bromo-Derivatives of the —. (Noelting, Braun, and Thesmar)	797
Yellow and Orange —; and Production thereof. (P) Lange	241
Yellow and Orange — for Cotton; Manufacture of Substantive. (P) Imray. From The Farbwerke vormals Meister, Lucius und Brüning	468
Yellow — obtained from Sulphocyanide Salts. (Goldberg)	798, 1103
Yellow — of the Acridine Series; Manufacture of. (P) Newton. From The Farbwerke vormals F. Bayer and Co.	573
Dyewoods; Importation of — by Havre. (T.R.)	490



	PAGE	PAGE
E		
Earth-Nut Trade of Gambia. (T.R.).....	860	
-Nuts. Exported by Senegal. (T.R.).....	1260	
Earth, Unwrought; Duty on — in United States. (T.R.)..	1260	
Earths; Combination of Hydrogen with Metals of the Rare		
— (Matignon).....	63	
Luminescence Spectra of the Rare —. (Baur and Mare)	1698	
Rare —, and Radio-Active Lead. (Hofmann and		
Strass).....	76	
Rare; Direct Combination of Nitrogen with —. (Matig-		
non).....	63	
Rare; Separation of —. (Verneil and Wrouboff).....	148	
Separation of the Yttrium —. (Meyer and Marckwald).....	62	
Earthenware at Portland, Oregon. (T.R.).....	837	
At Porto Alegre, Brazil. (F.R.).....	616	
Electro-Deposition of Metals on —. (P) Cooke and		
Parr.....	817	
Imported by Brazil. (T.R.).....	1157	
In the United States. (T.R.).....	1040	
With Honeycombed Surface. (P) Storey and McCalla...	126	
Effluent of Beetroot Sugar Factories; Purification of —.		
(Pritzkow).....	1226	
Effluents; Apparatus for Purifying —. (P) Schmidt.....	381	
Apparatus for Treating Trade —. (P) Desrumaux and		
Norman.....	233	
Purification of — and Apparatus therefor. (P) Frey-		
soldt.....	61	
Purification of Industrial —. (P) Bayer.....	830	
See also under Sewage and Waters.		
Egg Albumin; Formation of α -Pyrrolidincarboxylic Acid and		
Phenylalanine by the Hydrolysis of —. (Fischer).....	1151	
Eggs; Preservation of —:		
(P) Frykholm.....	1220	
(P) Jonsen.....	738	
(P) Wise. From Kache-Wigg.....	924	
Preservation of — in Germany. (Guenther).....	1012	
Egypt; British Trade with —. (F.R.).....	761	
Candles and Grease in —. (T.R.).....	955	
Cement Imported by —. (T.R.).....	1040	
Cement Valuation Tariff in —. (T.R.).....	1259	
Chemical and Drug Imports of —. (T.R.).....	166	
Dyestuffs in —. (T.R.).....	166	
Glass Imports of —. (T.R.).....	166	
Hides and Leather Imports of —. (T.R.).....	956	
Leather Goods in —. (T.R.).....	771	
Phosphate Discoveries in —. (T.R.).....	83	
Starch Trade of —. (T.R.).....	1047	
Tariff Valuation in —. (T.R.).....	949	
Trade of —. (T.R.).....	1152	
Elastic Material; Sheets of Flexible —. (P) Tavernier.		
From Belleidii.....	266	
Elder Bark; Alkaloid from —. (Malméjac).....	929	
Electric Cables, Wires, &c.; Covering —, with India rubber.		
(P) Heyl-Dia.....	593	
Conductors; Insulating Coatings for —. (P) Peust and		
Apel.....	365	
Conductors; Insulation of —. (P) Lake. From Tesla.		
Energy; Generation of —. (P) Guild.....	258	
Illuminating Bodies; Manufacture of —. (P) Boehm.		
Lighting, Heating, and Resistance Bodies; Manufacture		
of —. (P) Boehm.....	884	
Power Station, Pinkston; Visit to the —.....	1190	
Power Station, Pinkston; Visit to the —.....	63	
Electrical Conductors. (P) Lake. From Hungerford.....	729	
Electro-Chemical Industries of the World. (Kershaw).....	401	
Industry. (Swan).....	663	
Industry in France. (Guillet).....	43	
Units; Proposed —. (T.R.).....	420	
Electro-Chemistry. (Class XI.) 48, 130, 257, 369, 401, 481, 520, 538,		
725, 815, 905, 908, 1119, 1219		
Electro-Metallurgy. (Class XI.) 48, 133, 259, 370, 402, 483, 533, 727,		
816, 907, 1002, 1121, 1221		
Electro-Metallurgical Industries of the World. (Kershaw).....	401	
Electro-motive Behaviour of Substances capable of Different		
Stages of Oxidation. (Luther).....	1119	
Electro-Plating. (Swan).....	663	
Electro-thermal Reactions and Syntheses. (Löb).....	1119	
Electrodes for Arc Lamps; Carbon —. (P) Alexandroff.....	816	
Forming of —. (P) Boult. From Andreas.....	816	
Electrolysis, and Apparatus therefor. (P) Newton. From The		
National Electrolytic Co.	482	
Future of —. (Swan).....	671	
Electrolytic Apparatus:		
(P) Barnes.....	49	
(P) Schoop.....	903	
Electrolytic Apparatus; Porous Diaphragms for —. (P)		
Holland and Laurie.....	370	
Meters. (P) Wright and The Mutual Electric Trust.....	49	
Phenomena at the Interface between Two Solvents.		
(Riesenfeld).....	726	
Reduction of Substances Difficultly Reducible in Sulphuric		
Acid Solution. (Tafel).....	43	
Electrolytical Apparatus for Stripping Tin Scrap. (P) Mat-		
thews and Davies.....	550	
Electroplating Apparatus. (P) Morrison.....	134	
Element; A New —, Associated with Thorium. (Baskerville).....	1231	
Elements; Electrolytic Obtainment of Volatile. (P) British		
Aluminium Co. From Cowlles.....	908	
Modification of Chemical Properties of —, by Traces of		
Foreign Substances. (Le Bon).....	290	
Emodin as the Active Constituent of some Drugs. (Tschirch)		
.....	497	
Emulsions; Photographic —. (P) Mills. From Lumière.....	278	
Enamel for Leather. (P) Mohr.....	497	
Enamelled Articles; Manufacture of —. (P) Rapoport.....	1211	
Enamelling Metal; Means and Apparatus for —. (P)		
Dormoy.....	364	
Report on Dormoy's Apparatus for Mechanical —. (Liv-		
ache).....	251	
Surfaces of Refractory Materials; Apparatus for —. (P)		
Bromhead. From Waterman.....	581	
Ware.....	1113	
Enamels. (Class VIII.) 43, 123, 166, 250, 364, 475, 580, 636, 718, 809,		
897, 953, 988, 1113, 1157, 1210, 1258		
Fusibility of; Estimation of —. (Kochs and Seyfert).....	989	
Production of Clouded —. (P) Lenchs.....	990	
Endowment of Technical Research. (Frew).....	219	
Engine; The Waste-Heat Auxiliary —. (Mason).....	1194	
Enteric Fever amongst Armies in the Field; Prevention of		
Water-borne —. (Parkes and Rideal).....	1229	
Enzyme Action. (Brown).....	1129	
Of Germinating Barley; The Proteolytic —. (Weis).....	141	
Erdmann's Method; Examination of Drinking-Water by —.		
(Fernau).....	381	
Erica Pink; Note on —. (Knecht).....	500	
Erodiin; Use of —, in Tanning. (Becker).....	138	
Erysimin; New Glucoside from Erysimum Seeds. (Schlagden-		
haufen and Keeb).....	66	
Erythritol in Trentepohlia Joffinus. (Bamberger and Land-		
stedl).....	77	
Eschscholtzia Californica; Alkaloids of —. (Fischer).....	1015	
Essence of Cannes Geranium. (Jeancard and Satie).....	607	
Of Orange Blossoms. (Theulier).....	1017	
Essences. (Class XX.) 62, 148, 168, 273, 383, 408, 493, 603, 742, 775,		
831, 864, 926, 1014, 1048, 1134, 1162, 1231, 1261		
For "Strengthening" Brandy. (Beythien and Bohrisch).....	378	
Of Thyme. (Jeancard and Satie).....	1237	
Ester of Raffinose; Preparation of the Octabenzoyl —.		
(Stolle).....	292	
Esters; Constitution of certain Nitric —. (Vignon and		
Gerin).....	1254	
Of Acetylphenylglycine- <i>c</i> -carboxylic Acid; Neutral —.		
(P) Newton. From The Farbenfabriken vormals		
F. Bayer and Co.	277	
Quantitative Production of —. (Verley and Bölsing).....	1250	
Ether, Alcohol in; Determination of —. (Freyer).....	1250	
Ethers; Chlorocarbonic Acid —, and Compounds therefrom.		
(P) Newton. From The Farbenfabriken vormals		
F. Bayer and Co.	151	
Dialkylated <i>m</i> -Aminophenol —, Dyestuffs from. (Gri-		
maux).....	356	
Production of —, by Means of Inorganic Salts. (Oddo).....	1014	
Ethoxy-Isocougenol; Preparation of —. (Pommeranz).....	1135	
Ethyl- <i>o</i> -anisidine Formate; A New Anaesthetic. (Gold-		
schmidt).....	605	
- β -Naphthylamine; Compound of —, with Sodium		
Tetrazotolylsulphite. (Seyewetz and Blanc).....	888	
Nitrite Solutions; Causes of Instability in —. (Harvey)		
.....	742	
Ethylene; Laboratory Preparation of —. (Newth).....	757	
Production of —, from Inorganic Sources. (Tucker and		
Moody).....	971	
Solubility of —. (Tucker and Moody).....	1245	
Eucalyptus Oil containing 60 per cent. of Geranyl Acetate.		
(Smith).....	275	
Oil; Terpeneless —.....	1236	
Oils; New —. (Baker).....	1235	
Oils; New Aromatic Aldehyde in —. (Smith).....	744	
Eugenol in Clove Oil; Determination of —. (Verley and		
Bölsing).....	1250	
Eupiton and Pittakall. (Liebermann).....	569	
Derivatives. (Liebermann and Wiedermann).....	569	
Euxanthone and Alizarin; Methylation of —. (Graebe and		
Aders).....	1204	
Evaporating Apparatus:		
(P) Edwards. From Krauschwitzer Thonwaren-		
fabrikation.....	460	
(P) Foster.....	562	
(P) Kershaw.....	878	
(P) McNeil.....	460	
(P) Morrison.....	694	
(P) Simpson and Woods.....	233	
(P) Sloan. From Martin.....	694	
(P) Vis.....	250	
See also Concentrating Apparatus.		
Apparatus; Vacuum —:		
(P) Allcott and Paton.....	1194	
(P) Scott.....	105	
Evevia furfuracea L.; Composition of —. (Zopf).....	77	
Excursion on Firth of Clyde.....	686	



	PAGE		PAGE
Exhibition; Glasgow International ———	687	Fats. (Class XII.)	50, 82, 184, 167, 267, 362, 370, 438, 434, 520, 593, 727, 769, 817, 908, 955, 1008, 1042, 1121, 1139, 1221, 1260
Organised by the Société Industrielle de Rouen	627	Alimentary —; Manufacture of. (P) von Bühler and Bernstein	827
Victorian Gold Jubilee —, Bendigo	627	Animal —; Preservation of. (P) Marks. From Société Anon. Force	738
Expenditure for the Year 1900; Statement of	534	As Finishing Materials for Textiles. (Fürth)	242
Explosion at the Griesheim-Elektron Chemical Works	569	Bleaching of —. (P) Stanley and others	1122
By Ignition; Apparatus for Preventing —. (P) Scheuffgen	974	Elimination and Determination of Water in —. (Davis) Liquid Fatty Acids in some — and their Iodine Values (Lane)	941 1083
Of Potassium Chlorate at St. Helens. (T.R.)	81	Manufacture of Oxidising Agents from —. (P) von Graeve and Keenecken	261
Explosive; A New —. (P) Imray. From Norris	1140	Mixed Glycerides in Natural —. (Holde and Stange) ..	1403
Charges for Guns. (P) Scott	617	Optical Examination of —. (Marpmann)	509
Compositions (Primings). (P) Zieger	933	Quantitative Extraction of Cholesterol and Phytosterol from —. (Ritter)	1147
Compounds; Machines for Mixing —. (P) Schrader ..	389	Refining of —. (P) Crichton and Joselin	372
Compounds; Manufacture of —. (P) Cepek	1240	Treatment of — to Improve their Taste. (Huth)	371
Material; Sheds for Manufacture or Storage of —. (P) Nahlsen	155	Use of Iodine Monobromide in Analysis of —. (Hanus) Vegetable; Detection of — in Animal Fats. (Bömer) ..	1246 1147
Resembling Dynamite; Manufacture of a Safety —. (P) Kändler	1240	Fatty Acids; Action of Zinc Dust on —. (Hebert)	513
Safety —, Composition of a. (Ulzer)	155	Acids; Manufacture of Oxidising Agents from —. (P) von Graeve and Keenecken	263
Substances; Manufacture of —. (P) Bonnet	1024	Matters; Extraction of — and Apparatus therefor. (P) Abel. From Délainage Verviétois et Cie.	591
Explosives. (Class XXII.)	68, 154, 278, 304, 388, 405, 609, 747, 777, 835, 865, 922, 1020, 1019, 1140, 1239, 1032	Substances; Saponification of —. (P) Magnier and others	261
Analysis of —. (Smith)	1032	Felspar; Obtainment of Soluble Potash Salts from —. (Rhodin)	439
Chlorate, less Susceptible to Action of Heat; Manufacture of —. (Bonnet)	1239	Ferment Action; Reversed —, and Taka-diastase. (Hill) ..	796
Examination of New —. (Alvisi)	837	Processes; Theory of —. (Oppenheimer)	735
Factories for Manufacture of —. (P) Beneke	279	The Mannitol —. (Gayon and Duburg)	1010
From Solidified. (P) Girard	603	The "Tourne"; Influence of Composition of Wine on the — (Laborde)	921
Heat Test for —. (Cullen)	8	Ferments; Inorganic —. (Bredig and Reinders)	845
High —, and High Explosive Shells	835	Of Vinegar; Biochemical Distinction between the Two Chief —. (Bertrand and Sazerac)	316
High; Manufacture of —, and Celluloid Compounds. (P) Blomé	1140	Fermentation, Alcoholic, without Yeast Cells. Part X. (Bueh- ner and Eapp)	734
Manufacture of —	952	Apparatus. (P) Béchaux	270
(Bonnet)	1240	Apparatus for — and Collecting the Gas. (P) House and Lancaster	600
(P) Curtiss and others	68	Continuous — in Molasses Distilleries. (Sor.)	143
(P) Fuehrer	68, 69	Gas; Treatment and Utilisation of —. (P) Wittmann Gases; Utilisation of — in the United States. (Med- inger)	736 56
(P) Gathmann	155	Heat of —. (Brown)	376
(P) Girard	1141	Industries; Clean sing in —. (P) Sjöo and Törnell ..	1131
(P) Mackenzie. From The Robin Hood Powder Co. ..	617	Of Cacao. (Preyer)	735
(P) Skoglund	609	Of the Pentoses. (Schöne and Tollens)	735
Manufacture of —, from Solidified Oil. (P) Girard ..	1240	Fermented Beverages; De-alcoholising —, and Apparatus therefor. (P) Müller	600
New or Improved —. (P) da Silva	279	Fermenting Vats; Tar Coating for —. (Heinzelmann) ..	56
Nitro-; Manufacture of —. (P) Borland	617	Vats; Varnished —. (Braud)	921
Production of a New Class of —. (P) de Macar	1020	Vessels. (P) Meyer	1228
Report of H. M. Inspector of —, for 1900	837	Vessels; Means for Pumping and Rousing Wort in —. (P) Overbeck	737
Safety; Manufacture of — ("D nar"). (P) Fiedler ..	617	Ferrates; Electro-Chemical Production of —. (Pick)	905
Smokeless, or Colloids; Production of —. (P) Bernadou War Office Letter on Improvement of —. (T.R.)	304	Ferric Oleate; Preparation of —. (Naylor)	498
See also under Gun cotton, Gunpowder, Nitro-compounds, Powder, and Priming.		Oxide and its Hydrates. (Ruff)	1252
Extract from Beer-Yeast, &c.; Preparation of —. (P) Aubry and others	737	Saccharate; Production of —. (P) Stahlschmidt	1018
In Beer; Ternoe's Method of Determining —. (Ling and Pope)	755	Salts in Solution; Physical and Chemical Alteration of — (Schaer)	742
Extraction Apparatus:		Salts; Reduction of —. (Morgan)	1143
(P) Abel. From Délainage Verviétois et Cie.	591	Ferrite Solutions. (Haber)	406
(P) Bensch	889	Ferrochrome, Carbon in —; Determination of. (Blair) ..	70
(P) Boulé. From Wacker	818	Ferro-Chromium; Making Mild —. (P) Armengaud. From La Société Electro-Métallurgique Française	926
(P) Chatelan	933	Ferro-Ferric Oxide; Obtainment of —. (P) Haddan. From Ramage	809
(P) Haddan. From Edson	261	Ferroflux; Soldering Experiments with —. (P) Pich	1215
(P) Jerwitz	618	Ferro-Manganese; Apparatus for Production of —. (P) Simon	256
(P) Neufeld	279	Cause of Disintegration of —. (Dubois)	1215
(Sinnhold)	748	Manganese in; Determination of —. (Norris)	551
Method of —. (P) Gulden	28	Ferro-Silicon; Analysis of —. (Watson Gray)	1027
Extracts. (Class XX.)	62, 148, 168, 273, 383, 408, 476, 603, 742, 775, 831, 864, 926, 1044, 1048, 1134, 1162, 1231, 1261	Calcium in High Grade —. (Watson Gray)	1027
Apparatus for Preparing —. (P) Johnson. From The Actiengesellschaft Maschinenbau vormals Venuleth und Ellenberger	144	Calcium in High Grade —, Determination of. (Gray) ..	538
Meat —; Food Value of. (Fürst)	58	Electrolytic Production of —. (Swan)	670

F

Fabrics and Articles from Fibre, and an Adhesive; Manu- facture of —. (P) Oesterheld	1222
Apparatus for Dyeing and Bleaching —. (P) Mather ..	359
Dyeing and Bleaching —. (P) Armitage	471
Impermeable; Production of —. (P) Heys. From Sénéchal de la Grange	59
Sensitive, for Use in Photography; Preparation of —. (Junk)	154
Treatment of — with Liquids. (P) France	1207
See also under Fibres, Textile, and Textiles.	
Factories for Manufacture of Explosives. (P) Beneke	279
Utilisation of Vapours of —. (P) Steffen	268
Faraday's Law; Influence of Electrolysis of Fused Lead Iodide and Lead Chloride on —. (Auerbach)	1001
Fat; Apparatus for Determination of —. (Wheeler and Hartwell)	753
Apparatus for Extracting —. (Jerwitz)	613
Determination of Commercial Butter —. (von Klenze) ..	396
Removal of — from Wool, and Apparatus therefor. (P) Abel. From Délainage Verviétois and Peltzer & Co. ..	891
"Fat Liquor"; Preparation and Use of —. (Jettuar)	373



PAGE

Fibre for Spinning and Weaving; Extraction and Treatment of — (P) Dymond. From Cruz - Pasqual - de Bonanza and others 33
 Machine for Treating Slivers of —, with Liquids. (P) à Brassard 832
 Production of Fast Shades on the —. (P) Newton. From The Farbenfabriken vormals F. Bayer and Co. 1207
 Fibres. (Class V.) 38, 81, 119, 242, 358, 469, 573, 709, 804, 853, 890, 952, 982, 1039, 1108, 1206
 Apparatus for Treating Animal —. (P) Maertens 1.9
 Cleaning Animal —, with Volatile Solvents. (P) Maertens 119
 Compounds for Washing and Bleaching —. (P) Bartelt. See also Fabrics and Textiles. 392
 Fibrous Compositions; Manufacture of —. (P) Lake. From The National Package Co. 273, 603
 Material; Coating —, with Metal. (P) James. From Robertson and others 260
 Material; Drying of —, and Apparatus therefor. (P) Lake. From Hiorth 1095
 Materials; Apparatus for Treatment of —. (P) Lester. 53
 Materials; Impregnation of — with Substances of Low Melting Point. (Rudolf) 38
 Materials; Purifying —. (P) Goldzweig 119
 Materials; Removal of Fat from —. (P) Boul. From Wislicki 119
 Materials; Treatment of —. (P) Boul. From Masse and La Société Française de Ramie 985
 Pulp; Cleaning and Treating —. (P) Koppelman 827
 Substances; Impregnating —, with Solutions. (P) Youlten 810
 Filaments and Conductors for Electric Lamps. (P) Sander 1199
 Artificial; Manufacture of —. (P) Lehner 1206
 For Electric Incandescence Lamps: (P) Thomas 700, 794 (P) Voelker 977 Osmium Illuminating —. (P) von Welsbach 236
 Films. See Photographic.
 Filter; Self-Clearing or Continuous —. (P) Pullon. From van Blarcom 562
 Filters for Photography; Colour — 1020 Sand —; Working of. (Rutter) 1230 Vacuum —. (P) Symonds. From Breakell and Hopwood 562
 Filtering Apparatus: (P) Atkins 635 (P) Desrumeaux 233, 235 (P) Fox and Kingscote 344 (P) Green 272 (P) Riley 344 Media. (P) Sharples 601 Media; Cleaning and Treating —. (P) Koppelman 827 Media; Manufacture of —. (P) Bayer 830 Medium; Production of —. (P) Nordtmeier 27
 Filter-Press. (P) Sommer 106 High Pressure —. (P) Southby and others 344
 Filter-Presses and Material for Use therewith. (P) Enzinger For Use in Manufacture of China, &c. (P) Furnival 364
 Fine Chemicals. (Class XX.) ... 62, 148, 168, 273, 383, 408, 496, 603, 742, 775, 831, 864, 926, 958, 1014, 1048, 1134, 1162, 1231, 1261 Chemicals at Glasgow Exhibition 688
 Finishing Materials and their Application. (Firth) 242
 Materials containing Starch, &c. (Saare) 1206
 Finland; Ozokerit Deposits in —. (T.R.) 1043
 Fire-arms; Preparation for Protecting or Cleaning the Barrels of —. (P) Beck 1240
 Fire-blocks. See under Fuel, Artificial.
 Fire-damp in Collieries; Apparatus for Detecting and Indicating —. (P) Rosenthal 350 Indicating Presence of —, in the Atmosphere. (P) Lyncker and Mohr 30
 Fire-engines, Chemical —, for Hayti. (T.R.) 1152
 Fire-extinguishing Substances. (P) Hoult 809
 Fire-kindling Substances. (P) Lake. From Jørgensen 30
 Fireproof Coating for Walls, Floors, &c. (P) Gabrielli 126 Substance and Manufacture thereof. (P) Stocker and Zander 727
 Fireproofing and Rot-proofing Composition. (P) Lebioda. Compositions for Iron Constructions. (P) Koslowsky 582 Wood and other Combustibles. (P) Lake. From The American Wood Fireproofing Co. 126
 Fires in Vessels containing Inflammable Liquids; Extinguishing —. (P) Shuman 626
 Firth of Clyde; Excursion on the — 686
 Fish Guano; Production of —. (P) Corstairs 820 Preservation of —, for Food. (P) Danilevsky 738 Waste; Utilisation of —, in Canada. (T.R.) 773
 Flavindulines; Nitro- and Amino-. (Kehrmann and Eichler) 705
 Flavone, 1.3.3-Trioxo; Preparation of —. (St. v. Kostanekci and Steurmann) 355
 Flax; Retting or Steeping —, and Apparatus therefor. (P) Badol 38

PAGE

Flesh Preservation; Value of Boric Acid, Borax and Sodium Sulphite for —. (Lange) 923 See also under Foods.
 Floor-Coverings; Manufacture of —. (P) Posener and Clerke 913, 913
 Flour and other Food Material; Medicinal —. (P) Hoffmann 1229
 Desiccation and Sterilisation of —. (P) Fleurent 600
 Maize in Wheatens, Detection of: (Bevan) 72, 72 (Embrey) 72 Wheatens; Densimeter for Valuation of —. (Fleurent) 941 Yield of Bread from —. (Balland) 923
 Flours; Apparatus for Purifying and Separating —. (P) Renault and Cusson 460
 Fluids; Apparatus for Equalising the Temperature of —. (P) Sabroe and Hansen 1194 Apparatus for Purifying —. (P) Brooke 694 Cooling or Condensing —, and Apparatus therefor. (P) Parker 694 Corrosive; Linings for Protecting Vessels from —. (P) Bloxam. From Panzl and Troetscher 27 See also Liquids.
 Fluorene; Manufacture of —. (P) Aktienges. für Theer- und Erdöl Industrie 796 Obtainment of Pure —, from Coal Tar. (P) Wetter. From The Aktienges. für Theer- und Erdöl Industrie 796
 Fluorescein and its Substituted Derivatives, &c.; Sensitiveness of —, to Light. (Gros) 588 As an Indicator. (Zellner) 389 Dihydroxy —. (Liebermann) 1104 Dihydroxy —. (Thiels and Jaeger) 1105 Esters, Oxyhydroquinonephthalein —. (Feuerstein and others) 1105 Sensitiveness of —, to Light; its Substitution Derivatives and Leuco Bases. (Gros) 1104
 Fluorescent Bodies; Antiseptic Action of —. (Raab) 61
 Fluorindines; Research on —. (Kehrmann and Gugenheim) 706
 Fluorine; Apparatus for Electrolytic Production of —. (P) Meslaus 259 In Zinc Blende; Determination of —: (Bullheimer) 282 (Prost) 506 Poulenc and Meslaus Apparatus for Manufacture of —. (Brochet) 481
 Fluorspar; Treatment of —, for Production of Silico-Fluorides. (P) Sel'ar 718
 Flux for Brazing. (P) Huth 369
 Fodder; Apparatus for Making Molasses —. (P) Schrader. Asparagin as —, Nutritive Value of. (Rosenfeld) 271 From Peat; Manufacture of —. (P) Borntraeger and others 823 Production of Molasses —, and Apparatus therefor. (P) Schrader 459
 Fog; Prevention of —, in Dyeing and Bleaching Works. (Milius) 574
 Food; Adulteration of —, in Brazil. (T.R.) 1161 And Drugs Act in Natal. (T.R.) 1049 Arsenic in —; Detection of. (Thomson and Shenton) 204 Extract from Brewery and Distillery Residues. (P) Aubry For Animals; Manufacture of —, from Cotton Pods. (P) Philips and Müller 738 From Brewers' Spent Grains. (P) Schroeder and Diefenthal 59 From Seeds of Horse-Chestnut; Manufacture of —. (P) Flügge 1012 Material; Medicinal —. (P) Hoffmann 1229 Preparations; Manufacture of —. (P) Von Mering 738 Preservation of Articles of —. (P) Wise. From Bache-Wiig 924 Preservatives; Continental Regulations on —. (T.R.) 774 Preserving Media for —. (P) Kullak 1259 Product; Manufacture of —. (P) Tritton and Beyer 494 Products; Preservation and Sterilisation of —. (P) Hengstenberg 738 Utilisation of Waste Products for —. (P) Bell 1012 Value of Meat Extracts as —. (Fürst) 58 Yeast from Grain Distilleries as —. (Rohn) 58 See also Meat.
 Foods. (Class XVIII.) 58, 144, 270, 379, 407, 493, 600, 737, 774, 827, 923, 1012, 1048, 1131, 1161, 1223 Concentrated; Preparation of —. (P) Aikman 1132 Dulcine in —; Detection of. (Bellier) 72 Report of Committee on Use of Preservatives and Colouring Matters in — 1228 Saccharin in —; Determination of. (Defournel) 755 Sweetening Agents in —, Detection of 393 See also under Alimentary and Flesh. See also under Organic Bodies.
 Foodstuffs; Preservation of —, and Apparatus therefor. (P) Möller 58
 Forell Process for Manufacturing Portland Cement. (Steffens) 44
 Formaldehyde; Action of Aqueous —, on Gun cotton. (Vanino) 747 Action of —, on Anthranilic Acid. (Kohner) 801 Characteristics of —. (Harries) 604



	PAGE		PAGE
Formaldehyde—cont.		Furs; Preparing and Dyeing. (P) Ransford. From Cassella and Co.	360
Determination of —:		Treating and Preserving —. (P) Riches and others....	913
(Craig)	1149	Furfural Reaction: Significance of — in the Valuation of Cognac. (Wetzke)	378
(Peska)	1031	Furnace; Assay —. (P) Laird.....	255
(Vanino and Saitter)	1251	Blast; Calculation of Composition of Gases from —, and Volume and Loss of Blast in. (Osann)	1213
Gasometric Determination of —. (Riegler)	510	Blast — for Dusty and Fine Granular Iron Ore. (P) Goedecke.....	255
Generators. (P) Kuhn	272	Crucible —; Construction of. (P) Michel.....	1118
In Milk; Approximate Determination of —. (Liverseege)	344	Crucible Smelting —. (P) Forsbach and Clerc.....	481
In Milk; Detection of —. (Riegler)	285	Electric: Development of the —. (Keller).....	48
In Milk; Modification of Sulphuric Acid Test for —. (Luebert)	1146	Electrical Glass —. (P) Voelker	476
Formates; Bacterial Oxidation of —, by Nitrates. (Pakes and Jollyman)	292	For Burning Cement, Lime, &c.; Iron Shaft —. (P) Stein.....	1115
Formic Acid; Bacterial Decomposition of —. (Pakes and Jollyman)	292	For Ignition of Magnesium Ammonium Phosphate. (Schaller)	1025
Formosa; Camphor and Camphor Oil in —. (T.R.)	1048	For Manufacture of Calcium Carbide and Melting Metals (P) Emerson and Ward	344
Camphor Exports of —. (T.R.)	1261	For Manufacture of Press Glass. (P) Zeiler	477
France; Bauxites from the Var —. (T.R.)	855	For Oxidising Iron and Steel Surfaces. (P) Meikie.....	904
Beetroot Sugar Industry of —. (T.R.)	85	For Roasting Sulphide Ores. (P) Tangye	256
Chemical Industry in —. (T.R.)	517	Gases; Apparatus for Ascertaining and Recording Composition of —. (P) Arndt.....	1025
Customs Decisions in —. (T.R.)	948	Linings; Manufacture of Refractory —. (P) Rawson and Littlefield.....	992
Dyewoods Imported at Havre. (T.R.)	400	Melting —. (P) Essner and Laurans.....	480
Electro-Chemical Industry in —. (Guillet)	48	Regenerative Retort Heating —. (P) Neureuther.....	462
Fertilisers at Cherbourg —. (T.R.)	861	Smoke-consuming —. (P) Brunn.....	492
Indigo Competition in —. (T.R.)	855	Furnaces, and Means for Recovering By-Products from Fuel Used. (P) Naef.....	463
Maize Starch Manufacture in —, Residuum from. (T.R.)	79	And Muffle-ovens for Liquid Fuel. (P) Eanson	882
New Liquor Law in —. (T.E.)	294	Apparatus for Burning Uncoursed Products of Combustion from —. (P) Stapp	20
Oil and Seed Trade of Marseilles —. (F.R.)	1043	Apparatus for Effecting More Complete Combustion in —. (P) Davidson	234
Oil Seeds from India in —. (T.R.)	403	Blast —, and Casting the Metal therefrom. (P) Stevenson	481
Salt for Industrial Purposes in —. (T.R.)	1039	Burners for Combustion of Gas or Vapours in. (P) Fletcher, Neil, and Fletcher, Russell and Co.	31
Sugar Bounties in —. (T.R.)	950	Combined Gas — and their Air Compressors, &c. (P) Stewart	234
Sugar Manufacture in Colonies of —, Allowance for Waste in. (T.R.)	73	Construction of —. (P) Woolley	788
Transport of Inflammable Liquids in —. (T.R.)	296	Construction of — and Bricks therefor. (P) Gibbons	344
Frangula Bark; Soluble Active Glucoside of —. (Aweng) ..	66	Continuous Electric Arc —. (P) Parker	977
Frasch Electrolytic Process for Refining Metals	483	Crucible —. (P) Reynolds.....	47
Freezing Process and Apparatus. (P) Naef.....	233	Electric —:	
Freight Rates for Liquids in Tank Waggon in Germany. (T.R.)	399	(P) Benedicks	370
Fruit Juices and Drinks; Production of —. (P) Enoch.....	924	(P) Imray. From La Societe Electro-Metallurgique Francaise.....	907
Juices; Methyl Alcohol in Fermented —. (Wolff)	270	(Swan)	669
Juices used in Manufacture of Preserves; Composition of —. (Truchon and Martin-Claude)	380	(P) The British Thomson-Houston Co. From Steinmetz	977
Preservation of —. (T.R.)	775	(P) Weiss.....	697
Preserving in Victoria. (T.R.)	862	Electric Arc —. (P) Johnson. From The Deutsche Gold und Silber-Scheide-Anstalt.....	370
Fuel. (Class II.)	28, 106, 233, 345, 398, 461, 516, 562, 634, 695, 762, 789, 852, 879, 952, 974, 1037, 1095, 1195, 1256	Electric Crucible —. (P) Jurie	697
Apparatus for Burning Pulverised —. (P) Imray. From Donaldson and others	882	Electric — for Dental Purposes. (P) Winter and Pappenheim	1120
Approximate Value of Bagasse as —. (Gill)	695	Electric: Heat-Producing Devices for Smelting in —. (P) Pierce	1221
Artificial —. (P) von Heydebrand und der Lasa	793	Electric —, of Great Power. (P) Imray. From Morani	588
Artificial; Manufacture of —:		Electric — with Two Bed Plates. (P) Keller	879
(P) Bailey	462	For Annealing Glass. (P) Brearley	581
(P) Dörr	30	For Burning Powdered Fuel. (P) Dymond. From The Westlake Co.	349
(P) D'Humy	1197	For Consuming Refuse:—	
(P) Greenwood.....	975	(P) Glen	60
(P) Kahn and Heberlein.....	1009	(P) Liversedge.....	60
(P) Lewis.....	974	For Refuse Material and Garbage. (P) Lester and Dean.	147
(P) Macalpine	974	For Smelting and Dephosphorising Ores. (P) Zohrab	587
(P) Maingard	697	For Smelting Pyritic Ores: Hot-Blast —. (P) Rondebush. From Bradford	1117
(P) Springborn	30	For Treatment of Lime, Cement, &c. (P) Gobbe	105
(P) Tucker	349	Glass; and the Cause and Composition of Chimney Incrustations in —. (Dralle)	251
Artificial, Manufacture of —, and Apparatus therefor. (P) The Patent Agglomeration Fuel Syndicate and others	350	Melting or Smelting —. (P) Gibb	723
Artificial, Material for Manufacture of —. (P) Petolite Fuel Syndicate and Johnson.....	563	Open-Hearth Melting or other. (P) Talbot.....	908
Blocks; Utilising Sewage Sludge in Preparation of —. (P) Whittaker	882	Open-Hearth Steel —. (P) Saniter and others.....	903
Briquettes of —. (P) Chailly	1197	Open-Hearth Tilting —. (P) Stevenson	481
Distilling and Gasifying Bituminous —. (P) Naef.....	366	Preparation of Bricks or Blocks for Lining —. (P) Talbot.....	900
From Moor Earth and Moor Moss. (P) Hasselmann.....	793	Products of Electrical —. (Swan)	689
Gases and Fuel Tests in Germany	790	Smoke-consuming —. (P) Crawford.....	1099
Heat Producing Power of —. (Adams)	972, 1084	Zinc and other Distillation —. (P) Ferraris.....	897
Injectors. (P) White	350	<i>See also under Crucible and Muffles.</i>	
Liquid —, and Products for Producing same. (P) Bonal and Fietz	110	Fusel Oil in Alcoholic Liquids; Determination of —. (Beckmann)	1143
Liquid —; Apparatus for Burning. (P) Rein	563	Oil; Separation of the Amyl Alcohols of —:	
Liquid — in Java. (T.R.)	853	(Marekwald)	378
Liquid —; Means for Supplying — to Burners. (P) Armstrong, Whitworth and Co., and Orde.....	109	(Marekwald and Mackenzie)	379
Machine for Agglomerating —. (P) Watts	974		
Oil —, in California	234		
Oil; Separation of — from Water. (P) Armstrong, Whitworth and Co., and Orde.....	882		
Patent — at Civita Vecchia. (T.R.)	1038		
Patent — at St. Malo. (T.R.)	853		
Peat — (Bache)	1195		
Peat —; Preparation of —. (P) McNamee	882		
Solid Portable — Incorporating Substances for Production of —. Fowler, Welcome and Co.	461		
Sulphur in —; Determination of the Total. (Dubois) ..	1241		
Fuels, Calorific Power of; Determination of —. (Rebuffat) ..	563		
Employed in Malting; Examination of — for Arsenic. (Ling and Newlands)	1008		
Fuller's Earth; Production of — in the United States. (T.R.) ..	81		
Fungicide; Manufacture of a —. (P) Abel. From The Bayerische Actiengesellschaft	495		
Fur; Dyeing Mixtures of Rabbit —	119		
		Galactose; Derivatives of —. (Koenigs and Knorr)	626
		Galangal Oil. (Horst)	833
		Galbanum; Pharmacopoeia Tests of —	835

G



	PAGE
Galena, Lead in; Determination of —. (Willeuz).....	254
Galipot; Recent Researches on —. (Tschirch).....	51
Gallimide Derivatives; Preparation of —. (Gnehm and Ganser).....	354
Gallein; Constitution of —. (Orndorff and Brewer).....	979
Gallic Acid Industry of Corsica. (T.R.).....	771
Gallotannin; Constitution of —. (Pottevin).....	486
Galls at Baghdad, Turkey. (T.R.).....	1045
Gambia; Earth-Nut Trade of —. (T.R.).....	860
In Sarawak. (T.R.).....	1045
Gas. (Class II.).....	28, 106, 233, 345, 398, 461, 516, 562, 634, 695, 763, 789, 852, 879, 952, 974, 1037, 1095, 1195, 1256
Acetylene and other; Purification of —. (P) Smith.....	1102
Acetylene: Apparatus for Generating, &c.:	
(P) Adolfsen.....	31
(P) Beggs and Fielding.....	976
(P) Belin.....	1198
(P) Blériot.....	1102
(P) Bond and others.....	698
(P) Brunschwyler and Pärli.....	111
(P) Busch.....	1198
(P) Clark.....	853
(P) Chauvin.....	111
(P) Coghlan.....	883
(P) Cook and Heusner.....	564
(P) Csáky and others.....	883
(P) Deike and others.....	361
(P) de Thiersant and Coulson.....	976
(P) Edmundson.....	91
(P) Fajole.....	885
(P) Fazan.....	31
(P) Forbes.....	236
(P) Gustafson.....	236
(P) Haddan. From The Adams and Westlake Co.....	794
(P) Hennings.....	638
(P) Javal.....	351
(P) Kautny and Lotz.....	463
(P) Kieny.....	31
(P) Martin.....	564
(P) McDonald.....	111
(P) Meissner.....	31
(P) Messer.....	110
(P) Morelle.....	236
(P) Predmerszky.....	111
(P) Railsback.....	111
(P) Ross.....	564
(P) Seagrave.....	564
(P) Sharpe and Code.....	1102
(P) Shepherd.....	351
(P) Smyth.....	975
(P) Sprott.....	883
(P) Sunderland and Marshall.....	351
(P) Thorne.....	1101
(P) Walser and Cartier.....	111
(P) Watson.....	794
(P) Wise. From Klinger.....	794
Acetylene; Apparatus for Carburetted —. (P) Kurz.....	883
Apparatus for Generating and Burning —. (P) Hender and Reeves.....	564
Apparatus for Generating and Lighting —. (P) Johnson. From La Compagnie Française de l'Acetylene Dissous.....	564
Apparatus for Generating and Storing —:	
(P) Schmitt.....	1102
(P) Stevenson.....	351
Apparatus for Generating —, with Automatic Carbide Supply. (P) Gosswiler.....	1102
Apparatus for Generating —, without Gasometer. (P) Holub and Dvorák.....	351
Apparatus for Purifying —. (P) Lancaster.....	463
Manufacture of —, and Apparatus therefor. (P) Atkins.....	883
Manufacture of —, and By-Products. (P) Atkins.....	31
Purification of —, and Apparatus therefor. (P) Chicken and Smith.....	110
Treatment of —. (P) Johnson. From Wolf, jun., and Co.....	976
Aérogen: Apparatus for Production of —. (P) Fischer and others.....	564
Aérogen (Carburetted Air); Production of —. (De Perrodil and De Morsier).....	563
Air; Apparatus for Production of —:	
Analysis by Electricity. (Berthelot).....	1025
Analysis by Spectroscopy. (Berthelot).....	1025
And By-Products; Manufacture of — and Apparatus therefor. (P) Naef.....	235, 235
And By-Products; Production of —. (P) Naef.....	349
Apparatus for Condensing or Purifying —. (P) Boulton. From Audouin.....	350
Apparatus for Manufacture of —:	
(P) Boulton. From Perrier.....	30
(P) Gerdes.....	697
(P) Göhler.....	351
(P) Johnson.....	699
(P) Johnstone.....	698
(P) Schiewind.....	1197
Apparatus for Producing Perfect Combustion of —. (P) Bennett and Fowler, jun.....	699
Apparatus for Purifying —:	
(P) Prégardien.....	1101
(P) Sasse.....	564
Apparatus for Scrubbing —. (P) Chandler, S. and J., and Kirkham, Hulet, and Chandler.....	30

	PAGE
Gas—cont.	
Apparatus for Self-Ignition of —. (P) Prescher.....	699
Apparatus for Washing —. (P) Creeke.....	1198
Burning of —. (P) Clarkson and The Clarkson and Capel Steam Car Syndicate.....	349, 349
Coal and Water; Supply of Mixtures of —. (Bunte).....	28
Coal; Carbon Monoxide in —; Volumetric Determination of. (Smits, Raken and Meerum Terwogt).....	73
Coal; Sulphuretted Hydrogen in —; Determination of: (Greville).....	73
(Müller).....	73
Compressed; Production of —. (P) Hoffmann.....	564
Condenser; Catalytic Substance for Use as. (P) Boulton. From Tissier.....	1100
Enrichment of —. (P) Schiewind.....	31
Enrichment of — and Apparatus therefor. (P) Murray. From McLean.....	351
Fermentation; Treatment and Utilisation of —. (P) Wittemann.....	736
Fixed; Manufacture of —, and Apparatus therefor. (P) Cornell and Alderson.....	1197
For Illuminating and Heating. (P) Boehndel.....	30
For Power Purposes; Generation and Supply of —. (P) Pintsch.....	699
For Regenerative Furnaces; Production of. (P) Pantagwyn.....	350
From Gas Producers; Apparatus for Purifying, and for Heating the Air Supply to Producer. (P) Crossley and Atkinson.....	1100, 699
Governor and Enricher of —. (P) Jennings.....	621
Hydrogen Sulphide in; Determination of —. (Tutwiler).....	235
Illuminating and Heating —. (P) Arzt.....	1096
Illuminating, from Coke Ovens; Production of —. (Schiewind).....	1257
Industry in Germany. (T.R.).....	791
Light; Theory of the Auer —. (Nernst and Bose).....	791
Light; Theory of the Incandescent —. (Bunte).....	791
Lights; Self-igniting Incandescence —. (P) Rosenberg.....	1199
Lighting; Apparatus for Incandescence —. (P) Brookes. From The Incandescent Gas Light Co.....	463
Lighting; Discovery of Incandescence —. (von Welsbach).....	1097
Lighting; High Pressure Accumulator for Incandescence —. (P) Howell.....	977
Lighting; Incandescence —. (P) de Lery.....	884
Lighting Plant; Incandescence High-Pressure —. (P) Boulton. From Société Lumière Boule.....	794
Lighting Torches. (P) Glover.....	698
Liquor; Analysis of the Leeds —. (Cooke).....	225
Liquor; Valuation of —. (Carulla).....	23
Liquors; Apparatus for Treating —. (P) Thuman.....	582
Liquors; Treatment of —. (P) Koppers.....	579
Manufacture of —:	
(P) D'Altoff.....	793
(P) Johnson. From The Deutsche Continental-Gas-Gesellschaft and Bueb.....	697
(P) Lewes.....	350
(P) Schill and Primrose.....	975
Manufacture of —, and Apparatus therefor:	
(P) Bronson.....	698
(P) Lane.....	1101
(P) Naef.....	27
(P) Ruppert.....	1198
Manufacture of Heating —, and Apparatus therefor. (P) Thomson.....	350
Mixing Oxygen with —. (P) Danner.....	976
Mixture for Incandescence Lighting. (P) St. C. Legge.....	564
Modern Practice in Manufacture and Distribution of —. (Jones).....	1196
Mond —. (Rollason).....	106
Mond —, and its Application to Gas Engines. (Humphrey).....	107
Mond, Consideration of Bill for Authorising Supply of —. (T.R.).....	762
Oil; Apparatus for Generating and Burning —. (P) Bennett.....	1100
Purification of —. (P) Danner and Kubelka.....	884
Vapours and Air; Apparatus for Mixing and Burning —. (P) Bower.....	697
Water; British Practice in —. (Porter).....	790
Water; Comparison of —, with other Combustible Gases. (Körting).....	879
Water; Illuminating and Heating Value of —. (Strache and Jahoda).....	791
Water; Production of —. (P) Boulton. From Fleischer.....	110
Water; Production of Enriched —. (T.R.).....	854
Water; Utilisation of —, in Destructive Distillation of Coal. (Lewes).....	1095
Gases; Action of Reducing —, on Sulphocyanides. (Conroy and others).....	320
And Vapours; Igniters for —. (P) Thompson. From Simorini.....	236
Apparatus for Extracting Naphthalene from —. (P) Breittmayer.....	1101
Apparatus for Generating and Burning —. (P) Hender and Reeves.....	564
Apparatus for Generating Combustible —, from Hydrocarbon Liquids. (P) Lazareff.....	883
Apparatus for Indicating Presence of Dangerous —. (P) Prested.....	350
Apparatus for Mixing —. (P) Boulton. From Mole.....	882
Apparatus for Pumping —. (P) Hilliard.....	345



PAGE	PAGE
<i>Gases—cont.</i>	
Apparatus for Saturating Liquids with —. (P) Fisher and Kiefer	1094
Apparatus for Washing —. (P) Humfrey	1198
At High Pressure; Vessel for Reception of —. (P) Ludwig	878
Blast-Furnace; Charging Motor Engines with —, and Apparatus therefor. (P) Twaite	1197
Blast-Furnace; Dust in —. (Greiner)	721
Blast-Furnace; Use of —, in Gas Engines. (Richards) ..	108
Blast-Furnace; Utilisation of —, in Germany. (T.R.) ..	854
Blast-Furnace; Utilisation of Power from —. (Thwaite) ..	993
Calorific Power of; Determination of —. (Hempel)	830
Coke-kiln; Recovering By-Products from —. (P) Heinemann	564
Combustible; Determination of Phosphorus and Sulphur in —. (Bitner and Keppeler)	938
Combustible; Production of —, from Peat, &c. (P) Harrison	697
Condensing Towers for Noxious. (Clemmers)	1208
Device for Maintaining the Temperature, Pressure, and Humidity of —. (P) Schütz	788
Explosion of Mixtures of Inflammable — with Air. (Kubierschky)	345
Explosive Mixture of; Device for Indicating Presence of —. (P) Rhodin	31
For Illuminating Purposes; Enriching or Carbureting —. (P) Tully	110
From Blast-Furnace; Calculation of Composition of —. (Osann)	1213
Generated in Electrolytic Apparatus; Carrying off the —. (P) Bein	49
Generator; Production of — by means of "Linde" Air Indicating Presence of — in the Atmosphere. (P) Lyncker and Mohr	30
Liquidified; Filling Vessels with —. (P) Graaug	1018
Liquidified; Manipulation of — in Sealed Tubes. (Moissan)	1252
Liquidified; Preservation of —. (P) Joly	695
Of High Caloric Value; Production of —. (P) Boulton ..	1197
From Turk and others	1197
Recovery of Sulphur Compounds from Waste —. (P) Carey and others	474
Sensitiveness to Explosion of Mixtures of —. (Emich) ..	278
Separation of — from their Mixtures, and Apparatus therefor. (P) Pictet	1194
Treating Liquids with —, and Apparatus therefor. (P) Naef	28
<i>Gas-Burners, Acetylene, for Use with Incandescence Mantles.</i>	
(P) Law	834
Apparatus for Supplying Air to Incandescence —. (P) Boulton. From The New Process Lighting Co.	1101
Bunsen —. (P) Walker	1101
<i>For Heating Purposes:</i>	
(P) Heidemann and Axdorfer	883
(P) Seifert	975
<i>Incandescence —:</i>	
(P) Busch	371
(P) Carpenter	236
(P) Fischer	884
(P) Fuestenheim	565
(P) Mallot	1199
(P) Snell	32
(P) Sugg	977
(P) The Portable Gas Fountain Syndicate. (P) From Thovert	1199
(P) Winkler	1101
Incandescence; Increasing Power of —. (P) Theobald ..	32
Incandescence or Bunsen. (P) Boulton. From Société Lumière Boule	794
Gas-Engines; Use of Blast-Furnace Gases in —. (Richards) ..	108
<i>Gas-Generators:</i>	
(P) Fichet and Heartey	1197
(P) Leroy	255
(P) McClurg	975
(P) Poetter	883
(P) Watson	794
<i>Gas-Igniters:</i>	
(P) Martini	884
(P) Prescher	699
<i>Automatic:</i>	
(P) Bleichrode	977
(P) Mette	1101
(P) Thompson. From Simonini	1198
Gas-pipes; Destruction of —, by Electricity. (Leybold) ..	1096
Gas-plants for Gas-engines; Efficient Working of —. (Dowson)	974
Gas-Producer; Gobbe's "Quenching" —. (Bruyère)	1095
Riché —. (Corbier)	563
<i>Gas-Producers:</i>	
(P) Crossley and Atkinson	1197
(P) Duff	110, 110, 975
(P) Garrett and Cromwell	698
(P) Taylor	975, 975
Construction of —. (P) Laugblin	462
Gas-Valve which Prevents Passage of Liquids. (Scholvien) ..	748
Gas-Washer; Rotary —, with Loose Filling Material. (Zschocke)	879
Gasworks; Danger Incidental to Gas-firing in Small —. (Jones)	535
Gasoline exempt from Consumption Duty in Spain. (T.R.) ..	759
Geissler's Potash Bulbs; Modification of —. (Wetzell)	279
Gelatin; Apparatus for Extraction of —. (P) Haddan. From Edson	261
-Chloride Prints; Development of —	278
Conversion of — into Food Products. (P) Brat	923
Dry Plates; "Fogging" of —. (Zucker)	278
Indirect Action of Sulphite on —. (Lüppo-Cramer)	1140
Manufacture of — and Apparatus therefor. (P) Edson ..	140
Preparation of Food from —. (P) Brat	828
Substitution of — for Albumin in Calico Printing. (Binder and Sunder)	1108
<i>Generators and Burners for Hydrocarbon Vapours. (P) Lake.</i>	
From Bein	350
Genoa; Chemical Imports of —. (T.R.)	850
Chemical Imports of —, for 1900. (T.R.)	856
Gentianose; Constitution of —. (Bourquelot and Hérissey) ..	336
And Sucrose in Fresh Gentian Root; Simultaneous Presence of —. (Bourquelot and Hérissey)	76
<i>Geranium; Development of Terpene Compounds in the —.</i>	
(Charabot)	64
Essence of Caunes —. (Jeancard and Satie)	697
Oil	1237
<i>Germany, Acetylene and Carbide Industries in —; Report on. (Rose)</i>	
Acetylene Black in —. (T.R.)	955
Alcohol as Fuel in —. (T.R.)	952
Alcohol versus Coal in —. (T.R.)	853
Amber at Dantzig —. (T.R.)	1045
Applications for Patents in — during 1900. (T.R.)	515
Artificial Building Stone in —. (T.R.)	517
Artificial Wines in —. (T.R.)	774
Asphalt Imports of Dantzig —. (T.R.)	1058
Basic Slag in —. (T.R.)	861
Beet Sugar Exports of — in 1900. (T.R.)	862
Beetroot Sugar Industry of —. (T.R.)	84
Bismarck Steel in —. (T.R.)	859
Blotting Paper in —. (T.R.)	863
Calcium Carbide in —. (T.R.)	853
Carbonic Acid in —. (T.R.)	856
Chambers of Commerce Resolution on Tariff of —. (T.R.)	951
Chemical Instruction and Chemical Industries in —. (Rose)	849
Coal Dust consumed in —. (T.R.)	516
Coal-Tar Pitch in —. (T.R.)	1258
Cocoa-nut Butter Manufacture at Mannheim. (T.R.)	520
Coke Briquettes in —. (T.R.)	1038
Customs Decisions in —. (T.R.)	848
Freight Rates for Liquids in Tank Waggons. (T.R.)	399
Fuel Gases and Fuel Tests in —. (T.R.)	790
Gas and Oil Industry in —. (T.R.)	1257
Indigo in —, during 1900. (T.R.)	855
Leather Trade of —, in 1900. (T.R.)	860
Lubricating Oils in —. (T.R.)	860
Mercerising and Millerainising in —. (T.R.)	953
Mineral Production of —. (T.R.)	515
New Wine Law in —. (T.R.)	862
Ochre in —. (T.R.)	83
Paper in —, in 1900. (T.R.)	863
Paper Industry of —. (T.R.)	863
Patents in —, in 1900. (T.R.)	850
Peat Fibre in —. (T.R.)	804
Perfumery in —. (T.R.)	864
Perfumery Industry of —. (T.R.)	408
Pharmaceutical Chemicals of —, in 1900. (T.R.)	864
Portland Cement Exports of —. (T.R.)	1157
Potash in —. (T.R.)	856
Potato Products of —, in 1900. (T.R.)	774
Pumice-Stone Bricks in —. (T.R.)	1158
Regulations in —, for Construction and Management of Tank Waggons. (T.R.)	398
Starch Industry of —. (T.R.)	85
Sugar Exports of Dantzig —. (T.R.)	1047
Sugar Production in —, during 1900-01. (T.R.)	957
Trade of Dantzig —. (T.R.)	1036
Utilisation of Blast-Furnace Gases in —. (T.R.)	654
Utilisation of Peat in —. (T.R.)	790
Workshops and Workmen of —. (T.R.)	762
Xanthorrhoea Resin in —. (T.R.)	1260
Germination in Distilled Water. (Dehéran and Demoussy) ..	381
Germs, Disease; Means for Destroying —. (P) Johnson ..	60
Glacé Leather. <i>See under Leather.</i>	
<i>Glandular Extractive Products from the Suprarenal Glands.</i>	
(P) Takamine	746
Glasgow Cathedral; Visit to —	682
International Exhibition	687
University; Address Presented on Ninth Jubilee of — ..	590
Glass. (Class VIII.)	43, 123, 166, 250, 364, 475, 580, 636, 718, 766, 869, 897, 953, 988, 1040, 1113, 1157, 1210, 1258
And China Trade with Mexico. (T.R.)	166
And Glassware in the United States. (T.R.)	1040
Coloration of —, by Iron and Manganese. (Dralle)	124
Colouring of —. (Meurer)	1210
Colouring —, Yellow, Red, Brown, and Black. (P) Meurer	477
Constitution of —. (Jackson and Rich)	555
Copper Oxide for Manufacture of —. (Raufer)	899
Expansion of —, at High Temperatures. (Holborn and Grüneisen)	988
Facing Tiles or Plates; Opal —. (P) Davis	477

	PAGE
Glass— <i>cont.</i>	
For Thermometers at Higher Temperatures. (McClellan)	899
Furnace; Electrical —. (P) Voelker	476
Furnace for Manufacture of Press —. (P) Zeiler	477
Furnaces for Annealing —. (P) Brearley	581
Imports of Egypt. (T.R.)	166
Imports of Nagasaki, Japan. (T.R.)	953
Imports of Sicily. (T.R.)	1157
Industry: New Products in the —. (T.R.) Appert	636
Industry of Bohemia. (T.R.)	953
Influence of Air and Dust on Decomposition of —. (Zschimmer)	988
Machines for Blowing —:	
(P) Sievert	124
(P) The Automatic Glass-Blowing Patents Syndicate. From Bock	125
(P) The Automatic Glass-Blowing Patents Syndicate. From Colburn	125
Making in Baden in 1900. (T.R.)	768
Manufacture in Japan. (T.R.)	953
Melting Pots or Crucibles. (P) Regle	252
Mirrors with Colour Decorations. (P) Wagner and Lorenz	477
Opal and Alabaster; Manufacture of —	899
Plasticity and Adhesiveness of Diamond-Cut —. (Piccard)	1210
Plates or Tablets with Honeycombed Surface. (P) Storey and McCalla	126
Pressing or Moulding —. (P) Froyck	124
Printing or Transferring on —. (P) Gaunlett and Lloyd	718
Prism —; Manufacture of, and Apparatus therefor. (P) Wadsworth	125
Rolling —, and Apparatus therefor. (P) Appert	252
Separation of Molten —, from Impurities. (P) Garrison	1114
Sheet; Manufacture of —. (P) Sievert	124
Tiles; Manufacture of —. (P) Inray. From The Opalite Tile Co.	364
Uniting Pieces of —. (P) Stein and Storr	900
Vessels: Treatment of, and Composition therefor. (P) Mills. From La Société des Enduits Archambault	252
-Ware; Apparatus for Dipping —, into Glaze or Colour. (P) Ellis and Holt	476
-Ware Imported by Brazil. (T.R.)	1157
Glasses; Phosphatic —. (Cedivoda)	580
Production of Clouded —. (P) Lenchs	990
Glass-Works; Bricks from Refuse of —. (T.R.)	81
Glaucium Luteum; Alkaloids of —. (Fischer)	1016
Glazes; Solubility of Lead Glasses or Frits used in Pottery —. (Jackson and Rich)	43
Globulin; Transformation of Albumin into —. (Starke)	379
Glove Stock; Preparing "Schmaschen" Skins for —	913
Gloves; Dyeing of —. (P) Müller	713
Glow-Bodies; Production of —. (P) Boehm	884
Glucamine; New Base Derived from Glucose. (Maquenne and Roux)	605, 847
Glucose; Analysis of Commercial —. (Pellet)	754
And Invert Sugar in Beer. (T.R.)	1046
Derivatives of —:	
(Colley)	1125
(Koenigs and Knorr)	626
Determination of Value of Liquid Commercial —. (Coupland)	160
Drawback on —. (T.R.)	629
Duty on —. (T.R.)	628, 774
Glucamine, a New Base Derived from —. (Maquenne and Roux)	605, 847
Isomeric Acetohalogen Derivatives of —. (Fischer and Armstrong)	1151
Manufacture of —, and Apparatus therefor. (P) Calmette	1127
Production of —, by Aid of Mucedine. (Calmette)	149
Utilising Mucedine in Manufacture of —. (Calmette)	732
Glucoside from Erysimum Seeds: Erysimin. (Schlagdenhauffen and Beeb)	66
Glucosides, Digitalis —; Preparation and Composition of, (Cloetta)	743
Identification of —, by Aid of Emulsin. (Bourquelot)	1244
Of Frangula, Sagrada, and Rhuibarb. (Aweng)	66
Synthesis of —. (Fischer and Armstrong)	1151
Glue. (Class XIV.)	52, 137, 263, 302, 373, 486, 593, 729, 771, 818, 913, 1005
Apparatus for Determining Melting Point of Solutions of —. (Cherchetsky)	731
Apparatus for Testing —. (Kissling)	509
Casein; Composition of —. (P) James. From Hall	597
Determination of Viscosity of —. (Fels)	139
Extraction of —, from Waste, and Apparatus therefor. (P) Powder	485
For Leather Industry	820
Frothing of Bone —	1014
Manufacture of —, and Products therefrom. (P) Kelsey	267
Paste; Preparation of —, from Bone-Glue. (Borntraeger)	139
Substitute for Animal —. (P) Wezel	374
Gluten; Manufacture of —. (P) Morel	738
Or Glutinous Products; Treatment of —, with Albumins. (P) Wenghofer	827
Glycerofornate: U.S.A. Customs Decision on —. (T.R.)	1045

	PAGE
Glycerides in Reeswax; Detection of —. (Buchner)	286
In Cacao Butter; Mixed —. (Klimont)	1121
Mixed, in Natural Fats. (Holde and Stange)	1003
Glycerin, Crude; Dialysis of —. (Auzenat)	484
Determination of —. (Lewkowitsch)	395
In Iron Drums; Duty on —, in the United States. (T.R.)	848
Influence of —, on the Disinfecting Power of Antiseptics. (von Wunschheim)	381
Glycerol Phthalate: A New Glyceride. (Watson Smith)	1075
Glycerophosphorous Acid and Glycerophosphites. (Lumière and Perrin)	1232
Glycogen in Yeast; Appearance and Disappearance of —. (Meissner)	55
Goat Skins; Treatment of Pickled Indian —	263
Gobbe's "Quenching" Gas Producer. (Bruyère)	1095
Gold, Alluvial Deposit of, in Bosnia; Composition of —. (Katzner)	813
Apparatus for Precipitation of —, from Solution. (P) James	129
Buttons in Blow-pipe Assays; Measurement of —. (Richards)	839
Chloride; Titration of —. (Reeb)	629
Curious Occurrence of —. (Bennetts)	1117
Dredging for —, in New Zealand. (Wylie)	901
Extraction of —, at Florence, Colorado. (Rothwell)	812
Extraction of —, by Sodium Hyposulphite. (Janitzky)	901
Extraction of —, from Sea Water or Solutions. (P) Duke	1218
Gr Let's Method for Recovery of —. (Griveau)	127
Halides. (Lenzfeld)	1216
Industry in Japan. (Bahlsen)	479
Melting Point of —. (Holborn and Day)	365
Ores. <i>See under Ores.</i>	
Recovery of —, from Cyanide Solutions. (Swan)	667
Salts; Duty on —, in Sweden. (T.R.)	515
Sodium Chloride; Assay of —. (Johnson and Sons)	210
Goldschmidt's Method of Alumino-thermic Welding and Casting; Improvements in —. (Cohn)	926
Gotha; Experiments on Building Stones and Mortar Materials for Walls of Reservoirs at —	1211
Government Laboratory; Report for the Year ending March 1901. (T.R.)	946
Grains; Food from Brewers' Spent —. (P) Schroeder and Diefenthal	59
Granite; Reconstructed —. (T.R.)	518
Reconstructed —, as Insulating Material	477
<i>See also under Stone.</i>	
Grapes; Invertin or Invertase in —. (Martinaud)	57
Graphite; Bavarian — <i>versus</i> Ceylon —. (T.R.)	517
Discovery in Godavery District, India. (T.R.)	186
Manufacture of —. (P) Inray. From Acheson Graphite Co.	462
Production of —, by the Acheson Process. (Fitzgerald)	443
Grease; Extraction of —, from Waste, and Apparatus therefor. (P) Powder	485
Manufacture of —. (P) Ward	881
Rosin —. (Archbutt)	1193
Greasy Matters; Apparatus for Liberating —, from Liquids. (P) Delatre	371
Greece; Copper Sulphate used in —. (T.R.)	517
Decrease as to Importation of Indigo. (T.R.)	849
Demand for Sulphate of Copper in —. (T.R.)	1039
Mining in Laurium and Euboea. (T.R.)	641
Treatment of Copper Sulphate in —. (T.R.)	79
Greenhead Carpet Works; Visit to —	681
Greenland; Seal Oil in —. (T.R.)	82
Griesheim-Elektron Chemical Works; Explosion at —	609
Griess' γ -Diaminobenzoic Acid, for Identifying Sugars, &c. (Schilling)	621
Grinding Apparatus. (P) Ashkan and Keevil	694
Grosse's Process; Boiling and Crystallising Low Products by —. (Carlson)	1123
Guaiacol; Approximate Determination of —. (Adrian)	1251
Caodylate; Characteristics of —. (Astruc and Murco)	274
Guaiakanol; Properties of —	274
Guano and Oil Trade of Gothenburg. (T.R.)	957
At the Cape. (T.R.)	861
Fish; Production of —. (P) Carstairs	820
In Chili. (T.R.)	1045
Guiana, French; Rhodium Oil Manufacture in —. (T.R.)	1262
Gum. (Class XVI.)	53, 84, 140, 267, 303, 374, 487, 597, 733, 778, 820, 914, 1007, 1046, 1124, 1224
Arabic; Amount of Pentosans in —. (Hefelmann)	822
Arabic; Valuation of —. (Fromm)	624
Copal; Substitute for —. (P) Schaal	263
Elastic; Manufacture of —. (P) Prampolini	373
Exports of Senegal. (T.R.)	1260
Industry of Persia. (T.R.)	770
Tragacanth; Constituents of —. (O'Sullivan)	733
Gums at Glasgow Exhibition	638
Guncotton; Action of Aqueous Formaldehyde on —. (Vanino)	747
Purchase by Spain. (T.R.)	865
Schuble Nitrocellulose in; Estimation of —. (Quinay)	844



	PAGE		PAGE
Gunpowder; Manufacture of — (P) Cartis and André	1240	Honey; Artificially Coloured — (Bömer)	600
Smokeless — (Bernadou)	154	Dextrin; Nature of — (Beckman)	1131
Gunpowders; Smokeless — (P) Edwards. From Kent	932	Hong Kong; Cement, Imports of — (T.R.)	1041
Guns; Explosive Charges for — (P) Scott	617	Hops; Drying, Curing, and Sterilising — (P) House and Lancaster	492
Preventing Erosion of — (P) Armstrong, Whitworth, and Co., and Noble	506	Drying or Roasting — (P) Newlands	736
Gutta-Percha; Artificial — (T.R.)	955	Preservation of — (Kleinke)	1008
Extraction of — (P) Mitchell	912	Preserving — (P) Trier and Wilkinson	492
From Eucommia Ulmoides	1123	Horn; Dyeing and Bleaching —	1111
Manufacture of — (P) Siemens Bros. and Co., and Dieselhorst	51	Horse Chestnuts; Obtainment of Saponine from — (P) Weil	608
Purification of — (Arends)	51	Horse Hair; Manufacture of Artificial — (P) Lehner	1109, 1206
Substitute for —		Hose-Pipes; Ammonium Fluoride as a Disinfectant for — (Schönfeld)	830
(P) Boulé. From Ralli and others	263	Hubl's Method for Determining Acid Value of Wax; Modification of — (Eichhorn)	74
(P) Zühl	52	Solutions; Improving the Stability of — (Kitt)	940
Guttman's Filling Material for Reaction and Absorption Towers. (Heintz)	363	Huelva; Industries of — (T.R.)	82
Gutzeit's Test for Arsenic; Apparatus for — (Kirkby)	291	Hungary; Chemical Preparations in — (T.R.)	1155
Test for Arsenic; Modification of —		Hurter Memorial Lecture; The Second —	1060
(Bird)	390	Hydrastine; Characteristics and Determination of — (Maben)	942
(Doward)	506	(Resinoid); Preparation of — (Ough)	929
Gypsum. See also under Plaster of Paris.		Hydrate of Sulphuryl Chloride. (Baeyer and Villiger)	496
Burning —, and Apparatus therefor. (P) Lessing and Rheinfeid	253	Hydrates of Sodium Peroxide; Preparation and Properties of — (Jaubert)	273
Gyrophora vellea Ach.; Composition of — (Zopf)	77	Of the Peroxides of Lime, Baryta, Magnesia, &c.; Production of — (P) Jaubert	42
		Hydrobromic Acid; Preparation of — (Marshall)	926
		Hydrocarbon Oils; Clarification of — (P) Warren	352
		Vapours; Apparatus for Mixing and Burning with Air. (P) Bower	697
		Hydrocarbons; Auto-oxidation of Unsaturated — (Engler and Frankenstein)	1151
		Burning of Liquid — (P) Clarkson and The Clarkson and Capel Steam and Car Syndicate	349, 349
		Chlorination of Aromatic — (Cohen and Dakin)	512
		Decomposition of — at High Temperatures. (Bone and Jerdan)	696
		From Menthol. (Kursanoff)	1236
		Manufacture of —; and By-Products. (P) Atkins	31
		Obtainment of Pure — from Coal Tar. (P) Wetter.	796
		From The Aktienges. für Theer- und Erdöl-Industrie.	796
		Rendering Sulphurised — Soluble in Water. (P) Fränkel and König	277
		Unsaturated; Conversion of Alcohols into — (Zelinsky and Zelikow)	1253
		Hydrocellulose and Oxycellulose. (Murumow, Sack, and Tollens)	739
		Preparation of — from Cellulose. (P) Sthamer	469
		Presence of Cellulose in — (Tollens)	740
		Production of —	
		(P) Lake. From Sthamer	926
		(P) Sthamer	1133, 1133
		Hydrochloric Acid free from Sulphuric Acid; Preparation of — (P) Scheuer	1112
		Acid; Manufacture of Chemically Pure —	
		(P) Wetter. From de Haen	474
		(Haen)	123
		(P) Wetter. Preparation of Standard — (Meade)	987
		Acid; Rate of Dissolution of Iron in — (Conroy)	748
		Acid; Rate of Dissolution of Iron in — (Conroy)	316
		Hydrocinchonine; Characteristics of — (Jungfleisch and Léger)	384
		Preparation of — (Jungfleisch and Léger)	409
		Hydrocyanic Acid; Action of Nascent — on Anthranilic Acid. (Köhner)	801
		Acid; Action of — on Finely Divided Silver. (Haddon)	931
		Acid in Sweet Cassava. (Carmody)	502
		Acid; Preparation of Official — (Prunier)	273
		Hydrofluosilicic Acid; Action of — upon Potassium Ferrocyanide. (Matuschek)	363
		Acid; Action of — on Potassium Ferricyanide. (Matuschek)	579
		Hydrogen; Absorption of — by Metals of the Rare Earths. (Martignon)	160
		Action of — on Bismuth Sulphide. (Pelabon)	255
		And Silico; Combination of — (P) Mills. From The International Chemical Co.	43
		And Silver. (Berthelot)	128
		Arsenuretted; Action of — on Boron Bromide. (Stock)	756
		Combination of — with Metals of the Rare Earths. (Martignon)	63
		Commercial Electrolytic Manufacture of — (Schoop)	258
		Direct Union of Carbon with — Part II. (Bone and Jerdan)	696
		In Gas Mixtures; Determination of — (Phillips)	752
		Obtained by Electrical Decomposition of Water; Lighting with —	109
		Oxide higher than the Dioxide; Supposed Formation of an — (Ramsay)	1254
		Peroxide; Action of — on Silver Oxide. (Berthelot)	625
		Peroxide; Action of — Thiosulphates. (Nabl)	76
		Peroxide; Determination of Value of Commercial — (Sisley)	1028
		Peroxide; Gold Catalysis of — (Brediff and Reinders)	845

H

Hæmatoxylin and Brasilin; Research on — (Herzig and Pollak)	700
See also under Hydroxychromone.	
Halation in Micro-Photography; Prevention of — (van Walsem)	278
Halphen's Reaction for Cotton-seed Oil. (Wrampelmeyer)	285
Reaction for Detection of Cotton-seed Oil. (Soltsien)	393
Hamamelins of Commerce. (Barrie)	929
Hamburg; Artificial Manure Trade in — for 1900. (T.R.)	773
Caoutchouc Trade of — in 1900. (T.R.)	83
Sodium Nitrate Trade of — in 1900. (T.R.)	773
Tanning Materials at — in 1900. (T.R.)	771
Trade in Indigo, during 1900. (T.R.)	763
Hams; Drying or Smoking — (P) Newlands	736
Hats; Use of Lactolin in Dyeing —	470
Hawking Machines employed in Indigo Dye Vats. (P) Turner	247
Hayti; Chemical Fire Engines for — (T.R.)	1152
Heat Economiser. (Zollna)	279
Non-conductors; Manufacture of — (P) Horstmann	907
Obtainment of Intense — for Limelight, &c. (P) Münsterberg	351
Of Fermentation. (Brown)	376
Of Formation of Iron Carbides and Silicides. (Campbell)	721
Producing Devices for Smelting in Electric Furnaces. (P) Pierce	1221
Test for Explosives; Notes on the — (Cullen)	8
Heating Apparatus. (P) Kershaw	878
Apparatus; Electrical — for the Laboratory. (Sebenlien)	837
Hemp; Indian — (T.R.)	168
Henbane and Belladonna Extracts; Differentiation of — (Stoeder)	1146
Extract; Determination of Alkaloids in — (Stoeder)	1146
Heptane from Coniferous Trees. (Blasdale)	604
Herbs in Alcohol; U.S. Customs Decision on — (T.R.)	1261
Heteroalbumose; Hexone Bases in — Determination of. (Haslam)	494
Hexone Bases in Heteroalbumose and Peptone; Determination of — (Haslam)	494
Hide and Skin Industry of Mexico. (T.R.)	956
Powder, Chromed; Application of — in Analysis of Tanning Materials. (Paessler and Appellus)	1249
Powder; Effect of Moisture and Time on. (Jurnbull)	596
Powder; Experiments with Freiberg — (Paessler)	395
Hides and Leather Imports of Egypt. (T.R.)	956
And Skins at Libau, Russia. (T.R.)	1645
And Skins; Tanning of — (P) Bez	1124
Apparatus for Treating and Colouring — (P) Allison. From the Scott Leather Machine Co.	913
Apparatus for Treatment of — (P) Lester	53
At Bahia, Brazil. (T.R.)	1045
Disinfection of Imported — in U.S.A. (T.R.)	956
Dressing of — (P) De Mestral. From Valentiner and Schwartz	1007
Exported by Bangkok. (T.R.)	1045
Removing Hair, Wool, &c. from — (P) Riches and The Wool, Hide, and Skin Syndicate	1124
Treating and Preserving — (P) Riches and others	913
Treatment of —, and Apparatus therefor. (P) Forbes	487
Treatment of Raw — (P) Crossdale	1224
Use of Spirit in Removal of Fat from Raw and Tanned — (Wütsch)	52
See also under Skins and Leather.	

	PAGE
Hydrogen—cont.	
Peroxide in Aqueous Solution; Sensitiveness of — to Light when Prussiates are added. (Kisliakowsky) ...	387
Peroxide; Reduction of Mercury Salts by —. (Kolb) ...	743
Reduction of Silver Chloride by —. (Jouinaux) ...	814
Sulphide Apparatus; Continuous —. (Koch) ...	1141
Sulphide in Illuminating Gas; Determination of —. (Tutwiler) ...	621
Sulphuretted, in Coal-Gas, Determination of —: (Greville) ...	73
(Müller) ...	73
Sulphuretted; Means for Desulphurisation of —. (P) Dewrance and Paul ...	110
Sulphuretted; Obtainment of — as Saturated Aqueous solution or as Gas. (Perkin) ...	438
Sulphuretted, and other Bye-Products; Treatment or Utilisation of —. (P) Wilton ...	1112
Hydrolysis; Influence of Temperature upon —. (Madsen) ...	512
Hydrosulphides co-existing with Sulphides, &c.; Determination of —. (Gautier) ...	392
Hydrosulphites; Manufacture of Solid —. (P) Johnson: From The Badische Anilin und Soda Fabrik ...	43
Rendering Solid — Stable. (P) Willcox. From The Badische Anilin und Soda Fabrik ...	988
Hydrosulphurous Acid; Application of the Reducing Action of —. Goldberger ...	112
Hydroxide, Metallic; Action of — on Salts of other Metals (Recoura) ...	806
Metallic; Action of — on Solution of Metallic Salts. (Sabatier) ...	806
<i>o</i> -Hydroxyazobenzene; Synthesis of —. (Bamberger) ...	115
3-Hydroxychromone; Synthesis of —. (St. v. Kostauecki and others) ...	1106
Hyosine; Characteristics of —. (Hesse) ...	1233
Hyoscyamus Mucosus; Alkaloids of —. (Dunstan and Brown) ...	58
Hypochlorites; Electro-Production of —. (Kershaw) ...	402
Production of —. (Swan) ...	668
Hypochlorous Acid; Action of — on Metallic Chlorides. (v. Tiesenholz) ...	248
Hypophosphorous Acid; Action of — on Acetone. (Marie) ...	944
I	
Iboga; Properties and Composition of —, and its Alkaloid. (Dybowski and Landrin) ...	1234
Ice Colours"; Formation of — upon Wool and Silk. (Reisz) ...	243
Ice Machines; Connection between Temperature in Compressor and Quantity of Ammonia in Evaporator. (Habermann) ...	459
Manufacture; Treatment of Water for —. (P) Otto ...	147
Ichthyol; United States Customs Decision on —. (T.R.) ...	1262
Igniters for Gases and Vapours. (P) Thompson. From Simonini ...	236
Igniting Composition for Matches, free from Phosphorus. (P) Purgotti ...	747
Ignition Material for Matches. (P) Deissler ...	506
Imidosulphites; Occurrence of Ammonium and other —. (Divers and Ogawa) ...	716
Immunifying Substances; Preparation of —. (P) Clark. From Blum ...	746
Imperial Institute; Research at the ...	626
Imports Free into Yucatan. (T.R.) ...	1036
Incarescence Bodies, Electrical; Heating Bodies for Exciting —. (P) Peeny. From Allgemeine Elektrizitäts Ges ...	237
Bodies for Electric Lamps. (P) Just and Falk ...	1199
Bodies for Gas-Lighting. (P) Knöfler ...	463
Bodies for Lighting Purposes. (P) Meyer ...	1101
Bodies for Use with Gas-Burners. (P) Duncan and The New Sunlight Incandescent Co. ...	32
Bodies; Manufacture of —: (P) de Lery ...	884
(P) Schultze ...	565
Bodies; Manufacture of Electric —. (P) Dannert ...	977
Bodies; Strengthening of —. (P) Thompson. From Wasmuth ...	566
Gas-Burners. See under Gas Burners.	
Gas-Lighting. (P) Richardson ...	566
Lighting; Gas Mixture suitable for —. (P) St. C. Legge ...	564
Lighting; Media for —. (P) Nielsen ...	565
Incandescent Gas Light; Theory of the —: (Bunte) ...	791
(Nernst and Bose) ...	791
Lighting; Apparatus for Producing —. (P) Leroux and Carmien ...	1101
Substances; Apparatus for Determining the Temp. of —. (P) Wise. From Morse and others ...	343
Incrustation; Compound for Removal of —. (P) Hamilton. In Steam Generators; Mixture for Preventing —. (P) von Fritz ...	878
Of Steam Boilers; Composition for Removing —. (P) Johnstone ...	233
Removal of —, from Boilers, &c. (P) Elliott ...	878
Incrustation from Stone Gallery of St. Paul's Cathedral. (Clayton) ...	1212

	PAGE
Incrustation. See also under Scale.	
Incrustations in Glass Furnaces; Cause and Composition of —. (Dralle) ...	251
Indandion (Diketohydrindene); Derivatives of —. (Noelting and Blum) ...	1106
Indazol Derivatives and Dyestuffs therefrom; Production of —. (P) Ransford. From Cassella and Co. ...	36
India: Alizarin Used in —. (T.R.) ...	400
Aloe Planting in Madras —. (T.R.) ...	1039
Aluminium Goods Manufactured in —. (T.R.) ...	767
British; Countervailing Duties on Dutch Sugars —. (T.R.) ...	628
British; Duties on Sugar imported from Italy —. (T.R.) ...	919
British; Tariff Valuation of Alum Cake —. (T.R.) ...	758
British; Tariff Valuations of certain Goods in —. (T.R.) ...	163
Graphite Discovery in Godavery District —. (T.R.) ...	166
Indigo in —. (T.R.) ...	952, 1039, 1156
Indigo Industry of —. (Rawson) ...	165
Legislation on Hemp Drugs in —. (T.R.) ...	168
Linseed and Rapeseed in —. (T.R.) ...	1043
Match Trade of —. (T.R.) ...	958
Mineral Production of —. (T.R.) ...	1256
Oil Seeds from —, in France. (T.R.) ...	403
Paper Mills in —. (T.R.) ...	775
Research on Indigo in —. (T.R.) ...	406
India; Tea-seed Oil in —. (T.R.) ...	1043
Trade Descriptions of Linseed Oil, Turpentine and Paints in —. (T.R.) ...	294
Use of Artificial Manures in —. (T.R.) ...	405
India-rubber. (Class XIII.)... 50, 83, 135, 263, 378, 486, 592, 729, 770, 818, 911, 955, 1045, 1123, 1160, 1222	
And Sulphur. (Springer) ...	592
At Zanzibar. (T.R.) ...	1160
Behaviour of —, towards Nitrous Acid. (Harries) ...	1123
Caustic Alkali Bath used in the Manufacture of — ...	136
Colouring of —. (Markfeldt) ...	592
Employment of Magnesia in —. (Springer) ...	593
Exhibition of Specimens of —. (Schneider) ...	1222
Fixing of —, on Iron ...	136
For Rubber Shoes ...	136
From Different Species of Sapium. (Thomson) ...	51
Industry; Materials used in the — ...	137
Manufacture of —. (P) Arnaud and others ...	373
Mixings; Para —. (Springer) ...	592
Pigments; Cadmium Compounds for — ...	137
Recovery of —. (Brimmer) (P) ...	818
Substances similar to —; Manufacture of. (P) Steens-trup ...	135
Substitute for —: (P) Oesterheld ...	1222
(P) Prampolini ...	373
(P) Zuhl ...	52
Waste. (Springer) ...	593
See also under Caoutchouc and Rubber.	
Indian Head, Maryland; Powder Explosion at —. (Kniffen) ...	102
Indicator; Luteol, a New. (Glass and Bernard) ...	155
Indicators; Classification of —. (Wagner) ...	747
Employment of certain — with Artificial Light. (Kufferath) ...	1142
For Alkalinity. (Köhler) ...	1147
Indigo Carmine and Indigotin; Cause of Decreased Use of —. (Zänker) ...	33
Chromic Acid Process for Discharge of —. (Clayton) ...	984
Competition in France. (T.R.) ...	855
Constitution of —. (Vorländer and Schubart) ...	800
Containing Notable Amounts of Indirubin; Analysis of —. (Gardner and Denton) ...	939
Conversion of Anthranilic Acid Derivatives into —. (Erdmann) ...	801
Decree as to Importation of — into Greece. (T.R.) ...	849
Determination of Value of —. (Manchof and Herzog) ...	841
Dye Vats; Hawking Machines employed in —. (P) Turner ...	247
Electrolytic Reduction of —. (Haber) ...	1103
Export of —. (T.R.) ...	166
Extraction of — from the Plant. (P) Calmette ...	886
Fermentation. (Beijerinck) ...	112
Hamburg Trade in —, during 1900. (T. R.) ...	762
History of Manufacture of Synthetic —. (Brunck) ...	239
History of the Artificial Production of —. (Bedson) ...	209
In an Anhydrous Medium; Reduction of. (Binz) ...	886
In Germany in 1900. (T.R.) ...	855
In India. (T. R.) ...	952, 1039, 1156
In Java. (T.R.) ...	855
Industry of India. (Rawson) ...	165
Industry; Report of Meeting on — at Calcutta. ...	353
Leuco Compounds and Indigo Products; Manufacture of —. (P) Johnson. From The Badische Anilin und Soda Fabrik ...	35
Leuco Compounds; Conversion of — into Indigo, and Use of. (P) Willcox. From The Badische Anilin und Soda Fabrik ...	1205
Manufacture of —: (P) Imray. From The Farb. vorm. Meister, Lucius und Brüning ...	981
(P) Willcox. From the Badische Anilin und Soda Fabrik ...	803
Manufacture of —, from Naphthalene. (Levinstein) ...	802
Manufacture of —, Material for. (P) Willcox. From The Badische Anilin und Soda Fabrik ...	1205



	PAGE		PAGE
Indigo—cont.		Iodo-Compounds; Manufacture of New Organic —, (P)	
Manufacture of —, Natural. (Gallenkamp)	466	Abel. From the ActienGes. für Anilin Fabrikation	276
Natural and Artificial —. (Turnbull)	979	Derivatives of Phenol. (Brennans)	496
New Hydro-Compound of —. (Vaubel)	1147	Tannin Compounds; Chemical Character of —. (Power and Shedd)	1015
Notes on —. (Levinstein)	332	Iodol; Action of Nitric Acid on —. (Cousin)	497
Or Indigo Colouring Matters; Printing of —. (P)		Iodolactic Acid as a Reagent for Starch. (Lagerheim)	1245
Johnson. From Kalle and Co.	577	Ionone; Constitution of —. (Tieman)	385
Oxidation of —. (Von Georgievics and Springer)	33	Preparation of —. (P) Haarman and Reimer	1018
Paste; Preparation of Soluble —. (P) Thompson.		Preparation of — from Cyclo-Citral and Acetone.	150
From Gebrüder Flick	472	Ipecacuanha; Alkaloids of —. (Paul and Cownley)	500
Badische Anilin und Soda Fab.	116	Chemistry of —. (Paul and Cownley)	500
Phenylglycine-o-carboxylic Acid for Esters for Preparation		Roots; Determination of Alkaloids in —. (Stoeder)	1147
of Indigo. (P) Chem. Fabrik von Heyden	979	Iraldeine; Duty on — in the United States. (T.R.)	79
Physical Condition of Two Commercial Preparations of		Iridium in Platinum Ores; Determination of —. (Lelié and Quennessen)	1242
Synthetical —. (Binz and Rung)	116	Irisamine; Application of — in Calico Printing. (Hofacker)	40
Plant; Treatment of —, by Diastase. (P) Geugnier and		Irya Oil. (T.R.)	641
Valette	886	Iron and its Alloys; Effect of Temperature on Magnetic Properties of —. (Wills)	44
Powder; Production of —. (P) Wilcox. From The		And Nickel; Electro-deposition of —, from a Solution of the Sulphates. (P) Küster	50
Badische Anilin und Soda Fabrik	951	And Nickel; Simultaneous Electro-deposition of —.	907
Powder; U.S.A. Customs Decision on — (T.R.)	1039	Küster	1118
Production of —. (P) Wilcox. From The Badische		Apparatus for Re-carburising —. (P) Davis	721
Anilin und Soda Fabrik	889	Carbides and Silicides; Heat of Formation of —.	721
Production of Homologues of —. (P) Shillito. From		(Campbell)	721
Geigy & Co.	357	Carbo-Silicide; Crystals of —. (Stead)	721
Reduction of —. (P) Thompson. From the Chem. Fab.		Carbon in; Determination of —. (Schmitz)	934
Opladen	802	Cast; Coppering of —. (Dessolle)	254
Research on —, in India. (T.R.)	400	Cast; Influence of Aluminium on the Carbon in —.	1213
Statistics of —. (Lavers.) (T.R.)	1038	(Melland Waldron)	1213
Synthesis of —. (Merritt Matthews)	551	Cast; Soldering Experiments on — with "Ferrolix"	1215
Transforming Difficultly Reducible Crystalline into Easily		(P) Pich	903
Reducible Form. (P) Shillito. From Geigy & Co.	37	Cast; Treatment of — for obtaining Alloy. (P) Grunauer	999
-Vat Dyeing. (P) Imray. From The Farb. vorm. Meister,		Cathode in Ammonium Nitrate Solution; Action on an —. (Kaufmann)	484
Lucius und Brüning	472	Cleaning — and Coating with Zinc. (P) Cowper Coles.	582
White; Oxidation of —, by Oxygen. (Manchot and		Constructions; Fireproofing Compositions for —. (P) Koslowsky	145
Herzog)	841	Crystalline in Contaminated Waters; Reaction of Sodium-Benzene Sulphonate on —. (Causse)	955
Indigos, Monobrom-, Dibrom-, Monochlor-, Dichlor-, and		Deposits of — in Norway. (T.R.)	301
Monochlor-monobrom; Preparation of —. (P)	1205	Determination of — by Potassium Iodide and Iodate.	44
Rabhtjen		(Stock and Massicot)	563
Indigotin and Indigo Carmine; Cause of Decreased Use of —. (Zänker)	33	Direct Production of —:	813
Indium; Characteristics of —. (Benz)	1145	(Otto)	1321
Detection of —, Micro-chemically. (Kley)	934	(P) Twynam	989
Indoine Blue; Discharging —. (Grosbeintz)	891	Electric Manufacture of — by the Stassano Process. (Luchini)	478
Indophenols; Absorption of Light by —. (Bayrac and Camichel)	355	Electrolytic Manufacture of —. (P) Simon	1215
Detection of —. (Camichel and Bayrac)	621	Enamelling of —. (Caye)	136
Indophenolthiosulphonates; Manufacture of —. (P) Imray.	803	Films of Oxide on Sheet —. (Kamps)	254
From the Society of Chem. Industry, Basle		Finished Goods; Cementation of —. (Bildt)	503
Indoxyl and Indoxyl Acid; Acyl Derivatives of —. (Vorländer and Drescher)	860	Fixing India Rubber on —	126
Inflammable Liquids. See under Liquids.	295	Hardened by Overstrain; Tempering of —. (Muir)	126
Ink; Manufacture of Printing —. (P) British Oil and Cake Mills and Wass.	1005	Hardening of —. (P) Schramm	126
Marking —, and Vessel for holding same. (P) Raynes	1108	In Magnetite Ores; Determination of —, by Sp. Gr. Test. (Richards)	48
Inorganic Chemistry—Qualitative. (Class XXIII.)	69, 156, 280, 389, 506, 618, 748, 938, 1240	In Sulphuric Acid for Secondary Batteries; Effect of —. (Elbs)	598
Chemistry—Quantitative. (Class XXIII.)	69, 156, 281, 391, 506, 619, 748, 838, 934, 1025, 1142, 1241	In Turkey-Red Oil; Detection of —. (Von Forsselles)	366
Ferments; Gold Catalysis of Hydrogen Peroxide. (Bredig and Reinders)	845	Industry; New Process in the —. (Von Forsselles)	583
Insecticide. (P) Kornfeld and Zirner	1230	Influence of Tin on the Quality of —. (Zugger)	811
Compounds for Use as —. (P) Richards	1133	Instrument for Measurement of Permeability of —. (Lamb and Walker)	1214
Insecticides used in the West Indies. (T.R.)	521	Internal Strain of —, and its Bearing on Fractures. (Wingham)	903
Insulating and Packing Material. (P) Raphael and Elias	582	Introducing Carbon and Fluxes during Manufacture of —. (P) Foster	1118
Coatings for Electric Conductors. (P) Peust and Apel	365	Manufacture of —:	369
Composition, and Use thereof. (P) Lake. From Hungerford	729	(P) Justice. From Talbot	366
Material. (P) Nixon	729	Mass of Meteoric — from the Soudan. (Mounier)	1118
Material. (P) Tatham	1001	Melting of —, and Materials Employed therein. (P) Maddison and Rhodes	77
Material; Application of Steatite as —. (P) de Mare and Frémy	133	Nitride; Characteristics of —. (Powler)	575
Material; Covering Electric Wires, &c., with —. (P) Heyl-Dia	538	Nitrosulphide; Dyeing Wool Black by means of —. (Prud'homme)	1218
Material; Reconstructed Granite as —. (P) Horstman	477	Or Iron Alloys; Manufacture of —. (P) Crean	364
Materials; Manufacture of —:		Oxides; Manufacture of —. (P) Hargreaves	1116
(P) Claremont	1220	Passivity of —. (Heathcote)	721
(P) Horstman	907	Phase-Doctrine Applied to —. (Von Jonstorff)	126
Substance, and Manufacture thereof. (P) Stocker and Zander	727	Pig; Irregular Distribution of Sulphur in —. (Bolling)	721
Intensification. See under Photographic.		Pig; Significance of High Silicon in —. (Sahlin)	905
Intensifier; Mercuric Sulphocyanide —. (Eberhard)	387	Plates covered with Copper; Manufacture of —. (P) Martin	639
Intestines; Glacé Leather from —. (Cohen)	822	Production of Bilbao, Spain. (T.R.)	478
Inversion; Studies on —. (Cohen)	822	Properties of Vanadium —. (Baxeres)	129
Invertase; Action of Reagents on the Activity of Yeast towards —. (Bokorny)	824	Puddling; —. (P) Roe	903
In Grapes; Presence of —. (Martinand)	57	Purification of —, in Molten State. (P) Greenway	301
In Industrial Fermentations. (Dejonghe)	1130	Pyrites; Production of —, in Spain in 1893. (T.R.)	316
In White Wines. (Fallot and Michon)	491	Rate of Dissolution of —, in Hydrochloric Acid. (Conroy)	723
Of Yeast. (Salkowski)	489	Rods; Measurement of Young's Modulus for —. (Wimperis)	276
Preparation of —. (Issaw)	239		
Invertin or Invertase in Grapes; Presence of. (Martinand)	57		
Iodic Acid; Preparation of —. (Scott and Arbuckle)	123		
Iodine; Extraction of — from Sea Weed. (P) Thesen	608		
Occurrence of Free — in Chili Saltpetre. (Dajert and Halla)	914		

	PAGE
Iron—cont.	
Saccharate free from Alkali; Preparation of —:	
(Brunns)	383
(Unger)	383
Salts: Heating or Roasting Powdered —, and Apparatus therefor. (P) Hinchley	1222
Salts; Some Reaction of —. (Ditz)	359
Separation of —. (Nicolardot)	1242
Silicides. (Jouve)	479
State of Combination of —, with the Rare Elements in Steel. (Carnot and Goutal)	583
Sulphur in; Determination of. (Noyes and Helmer)	1143
'Tinned'; Rusting of —. (Ulzer)	127
Toughening, Hardening, or Annealing —. (P) Holzer and Frith	1218
Volumetric Determination of —, by Stannous Chloride. (Zengilis)	840
Wire, Rods, &c.; Forming a Protective Coating on —. (P) Moseley	46
Wrought-; Influence of Copper in Retarding Corrosion of —. (Williams)	44, 127
Wrought-; Manufacture of —. (P) Wassell	903
Wrought-, Sulphur in; Determination of —. (Auchy)	620
Iron, Iso-; Isolation of — from Costus Root Oil. (P) Haarman and Reimer	745
Isatin-Derivative of Albumin; Formation of —. (Gnezda)	1254
α-Isatine-amide; Production of Homologues of —. (P) Shillito. From Geigy and Co.	357
Isocinchonine, α- and β-; Characteristics of —. (Skraup, and Zwienger)	63
β-; Constitution of —. (Skraup, Copony and Medanich)	63
Isaconine; Existence of —. (Ladenburg)	1232
Isoeugenol a Constituent of Ylang-ylang Oil	1237
Iso-Irone; Isolation of — from Costus Root Oil. (P) (Haarman and Reimer)	745
Isonitrosocinchotoxine; Characteristics of —. (von Miller and Rohde)	63
Isorosinduline and Isorosindone Reaction. (Fischer)	571
No. 8; Constitution of —. (Kehrmann and Misslin)	706
No. 9; Constitution of —. (Kehrmann and Steiner)	115
12th. Isomeride of —. (Kehrmann and Steiner)	115
Isorosindulines and 5-Acetamino-β-Naphthoquinone. (Kehrmann and Denk)	115
Italy; Alum at Civita Vecchia —. (T.R.)	1040
Boric Acid Exports of Leghorn. (T.R.)	764
Cement Imports of Civita Vecchia. (T.R.)	1040
China-Clay in the Province of Florence. (T.R.)	1259
Copper Sulphate at Leghorn. (T.R.)	764
Dyestuff, Imports of —. (T.R.)	952
Imports and Exports of — for 1890. (T.R.)	632
Lead and Copper Mines in —. (T.R.)	769
Leather Imported free Temporarily. (T.R.)	397
Manganese Ore Production in —. (T.R.)	1260
Mercury in Tuscany. (T.R.)	767
Metallurgy of Mercury in —. (Spirek)	831
Oil and Soap Works in South —. (T.R.)	860
Paper Industry of the Province of Florence. (T.R.)	1261
Patent Fuel at Civita Vecchia. (T.R.)	1638
Perfumes of the Province of Florence. (T.R.)	1262
Phosphate Imports of Civita Vecchia —. (T.R.)	1046
Phosphates at Genoa, in 1900. (T.R.)	862
Photographic Plates and Vegetable Tallow; Duties on —. (T.R.)	950
Prize offered by the Federation of Agricultural Unions of —.	513
Sienna Earths, Ochres and Umbers at Leghorn (T.R.)	770
Soap Manufacture in the Province of Florence. (T.R.)	1260
Sodium Carbonate at Leghorn. (T.R.)	764
Sugar Industry in —. (T.R.)	1161
Tanneries in the Province of Florence. (T.R.)	1260
Tartaric Material Exported from —, 1899–1900. (T.R.)	160
Ivory; Dyeing and Bleaching —	1111

J

Jalap; Determination of —. (Schweissinger)	756
Jamaica Dogwood; Constituents of —. (Freer and Clover)	605
Janthone; Preparation of —. (P) Durand and others	503
Japconitine; Pharmacology of —. (Cash and Dunstan)	928
Japan; Consumption of Sulphuric Acid in —. (T.R.)	299
Copper Production at Bahls Ashio —. (Bahlsen)	902
Duties on Alcohol and Tinctures in —. (T.R.)	291
Dyestuffs in —. (T.R.)	952
Glass Imports of Nagasaki —. (T.R.)	953
Glass Manufacture in —. (T.R.)	953
Gold Industry in —. (Bahlsen)	479
Imports of —. (T.R.)	1154
Lacquer Exports of —. (T.R.)	860
Mineral Production of —. (T.R.)	1159
Nori from —. (Oshima and Tollens)	737
Paint Imports of Nagasaki —. (T.R.)	955
Paper-making Industry in —. (T.R.)	408
Petroleum Industry of —. (T.R.)	1088
Regulations controlling Poisonous Colours in —. (T.R.)	403
Sugar Trade of Nagasaki — in 1900. (T.R.)	937

	PAGE
Japan—cont.	
Sulphur Deposits in —. (T.R.)	300
Sulphur in —. (T.R.)	1156
Tanning Materials of —. (Von Schroeder)	205
Vegetable Wax in —. (T.R.)	1159
Japanese Ware; Duty on — in Germany. (T.R.)	848
Jasmine Flowers; Essential Oil of —:	
(Eidmann)	930
(Hesse)	275, 1137
Java; Cinchona and Quinine in —.	928
Copper imported by —. (T.R.)	859
Exports from —. (T.R.)	851
Fertilisers at Batavia —. (T.R.)	882
Indigo in —. (T.R.)	855
Liquid Fuel in —. (T.R.)	853
Quinine Sulphate in —. (T.R.)	894
Juglans Nigra, L.; Walnut Oil from —. (Kebler)	727
Juice, Fermented Fruit —; Methyl Alcohol in. (Wolff)	270
Jura Turpentine. (Tschirch)	51
Jute Fibres, &c.; Treatment of —. (P) König	892
Pentosans of —. (Schöne and Tollens)	1226

K

Kalgoorlie; Telluride Gold Ores of —. (Rickard)	45
Kanik (Blue Cotton) in Pemba. (T.R.)	63
Kaolin; Levigated —. (Ulzer)	123
Karlik's Process of Triple Saturation; Chemical Effect of —. (Andriik)	374
Kauri Bush Copal. (Tschirch and Niederstadt)	729
Kekuaa Oil. (T.R.)	642
Kelp Exports from Stavanger, Norway. (T.R.)	856
Kerosene;	
Distillates; Preliminary Neutralisation of —. (Charitschkoff)	700
Methods of Testing —. (Charitschkoff)	352
Ketocumarane. See under Cumarone.	
Ketones; Acidimetry of —. (Astruc and Murco)	161
And Aldehydes; Decomposing the Bisulphite Compounds of —. (Freundler and Bunel)	832
Electro-chemical, Reduction of —. (Etbs)	700
Kiers for Bleaching and Treating Textiles. (P) Jackson	712
For Bleaching Textile Fabrics. (P) Rigamonti and Tagliani	577
For Boiling, Bleaching, and Dyeing. (P) Lishman and others	892
Kilgore's Method for Determination of Phosphoric Acid. (Williams)	392
Kilns and Appliances for Treating Mineral Substances. (P) Meldrum Brothers and Orton	694
Continuous Gas Muffle —. (P) Lake. From Souvero and Co.	581
For Burning Limestone, &c. (P) Spencer	344
For Cement and Lime. (P) Schmidt	532
For Cement and the like. (P) Lake. From Fellner and Ziegler	810
For Firing Ceramic Ware. (P) Czerny and Schlimp	252
Means for Indicating the Temperature in —. (P) Watkin	477
Potters' —. (P) Bettaney	477
Quartz Shale versus Firebrick as Material for —. (Jochum)	1212
Utilising Waste Heat from "Dutch" or "Scotch." (P) Briggs	126
Kjeldahl's Method for Determination of Sugar. (Woy)	395
Kneading Apparatus. (P) Lake. From Werner and Pfeiderer	789
Kohomba Oil. (T.R.)	642
Kon Oil. (T.R.)	642
Krause and Perroche Methods for Determining Purity of Beetroot Juice. (Pellet)	438
Krause's Method for Determining Purity of Beet Juice; Experiments on —. (Ehrlich)	754
Method for Determining Purity of Beetroot Juice:	
(Claassen)	53
(Ehrlich)	268
(Weisberg)	438
Kubel-Tiemann Method of Determining Organic Matter in Waters; Source of Error in —. (Duyk)	756
Kunene District; Root Caoutchouc in the —. (Baum)	135

L

Lacquer Exports of Japan. (T.R.)	860
For Leather. (P) Mohr	487
Lacquers; Action of Light on Coloured Brass —. (Smith)	1198
Lacquered or Polished Surfaces: Removing Brilliance of —. (P) Buyten	373



	PAGE		PAGE
Lacs: Production of —. (P) Winkelmann	729	Lead— <i>cont.</i>	
Lactic Acid: Application of — in Dyeing Aniline Black. (Scheurer and Schoelkopf)	710	Refining of —. (P) Lake. From Betts	724
Acid as a De-liming Agent	713	Removing — from Crude Zinc; Theory of Method for —. (Heyn)	128
Acid Bacteria of Distillery Mastics, Milk and Beer (Hennebère)	420	Separation of — from Zinc in Solution. (P) Davis	47
Acid; Bleaching Skins with —	730	Silicates in Relation to Pottery Manufacture. (Thorpe and Simmonds)	476
Acid; Determination of —. (Partheil)	1244	White. <i>See under</i> White Lead.	
Acid in Beetroot Molasses: (Schöne and Tollens)	51	Leather. (Class XIV.)	52, 137, 263, 302, 373, 405, 486, 593, 642, 729, 771, 818, 800, 913, 956, 1005, 1043, 1124, 1160, 1223
(Weisberg)	375	Artificial: Manufacture of —	52
Acid in Calico Printing; Applications of —. (Oswald)	40	(P) Bauer, Imrie, and Co. From Gevaert-Naert	597
Acid in the Manufacture of Leather. (Claffin)	210	(P) Boulé. From Poppe	373
Acid in the Tanning Industry	586	(P) Boulé. From the Fossilitch Leather Co.	373
Acid; Manufacture of Purified. (P) Waite	931	(P) Duvinage. From Gevaert-Naert	1007
Acid; Percentages by Weight and Volume in Sale of — (Eberhard)	470	(P) Marks and Clerk. From Falkenstein	731
Acid; Use of —, in Yeast Manufacture. (Bücheler)	376	(P) Posener and Clerke	913, 913
Lactolin: Use of —, in Dyeing Hats	470	Bating Process (Wood and others)	265
Lactose in Milk; Determination of —. (Scheibe)	287	Bating of Sole	731
Lamp; Gas-Referees' Pentane Ten-Candle —. (Clowes)	762	Black Glycerin	913
Immersion Acetylene —. (Rosenfeld)	345	— Board; Sheets or Continuous Lengths of —. (P) Lake, From Weldon	382
Welsbach's Osmium Incandescence —. (Scholz)	348	Book-bindings; Preservative Compositions for —. (H.G.)	486
Lamps; Acetylene —:		Brown Shoe Calf; Manufacture of —	52
(P) Urquhart. From Kubin	794	Chemical Study of —. (Nihoul)	1249
(P) Beck	794	Chrome-tanned; Analysis of —. (Stiasny)	1626
Behaviour of Electrolytic Incandescent —. (Nernst and Wild)	234	Colouring —. (Class VI.)	1111, 1208
Electric Incandescence —:		Currying of Bark-tanned and Mill Lace	264
(P) Fessenden	352	Currying of Waxed Shoe Butts	139
(P) Drake and the Nernst Electric Light Co.	565	Drying Apparatus for Production of Enamelled —. (P) Hoch	487
Electric; Portable Photometers for —. (P) Deshier and McAllister	352	Drying; Application of Titanium Salts for —. (Lamb)	1111
Filaments for Incandescence Electric —. (P) Thomas. For Acetylene Gas. (P) Budzinski	976	Dyeing, Staining, and Finishing of —. (Lamb)	41, 129
For Burning Oil or Spirit. (P) Notley and Frost	464	Effect on —, of Tanning Extracts containing Bisulphites. (Gordon, Parker, and Gansser)	1085
For Colour Matching and General Lighting. (P) Duffon and Garbner	237	For Book-binding; Report of Committee on —. -Forming Value of Various Tanning Materials. (Youl and Griffith)	423
Glow Bodies for Electrolytic Nernst —. (P) Drake and The Nernst Electric Light Co.	884	Glacé — from Intestines	598
Heaters for Incandescence Electric —. (P) Swinburne Incandescence Gas —:	794	Goods in Egypt. (T.R.)	771
(P) Dymond. From Zielenziger	236	Grease Polish for Dull Black Chrome	731
(P) Thompson. From Zielenziger	884	Imported free by Italy. (T.R.)	397
Incandescence Gas and Vapour. (P) Niemann	794	Industry; Glue for —	820
Incandescence Oil —. (P) Denayrouze	565	Lacquer or Enamel for —. (Mohr.) (P)	487
Incandescence Oil and Spirit —. (P) Thompson. From Rubenstein	565	Lactic Acid in the Manufacture of —. (Claffin)	210
Increasing Efficiency of Electric Incandescence —. (P) Bushe	700	Manufacture and Treatment of —. (P) Clowse	139
Nernst Electric —, and Heaters therefor. (P) Wurts and others	566	Manufacture; Research on —. (Bruel)	138
Refractory Oxide Arc —, for Electric Lighting. (P) Rasch	699	Marbled —. (Collin)	595
Vacuum Osmium; Manufacture of —. (P) von Welsbach	32	Mineral Acids in; Determination of —. (Procter and Searle)	287
Lanthanum; Separation of —, from Cerite Earths. (Meyer and Marckwald)	63	Patent Chrome Goat and Calf; Manufacture of —	595
Lard Oil; Examination of —. (Duyk)	530	Porosity of; Device for Testing —. Kennedy. (P)	731
Lards; Behaviour of some American —. (Soltsien)	393	"Spueing" of —. (Litner)	594
Lavender Oil; Examination of —. (Kebler)	756	Substitute for —. (P) Oesterheld	1222
Solubility Test for —, of the German Pharmacopoeia	1236	Tawing Skins in Manufacture of —, and Apparatus therefor. (P) Adler	53
Law of Patents. (Levinstein)	13	Trade of Germany in 1900. (T.R.)	860
Lead Amalgams; Nature of —. (Fay and North)	479	Trade of Minorca. (T.R.)	861
Compounds in Pottery; Report on —. (Thorpe)	897	Trade of the United States. (T.R.)	302
Dezincing of Zinc Desilverized —. (P) Barton and McGhie	1219	Treatment of —. (P) Arthur	731
Electrolytic Deposition of Metallic — from Solutions, and Formation of Spongy Lead. (Glaser)	259	Leathers, Bookbinders'	264
Electrolytic Separation of —, from Manganese. (Moltke-Hanson)	750	Composition of Belgian. (Nihoul)	1223
Fine; Determination of Arsenic, Antimony, Tin and Bismuth in —. (Liebschutz)	1028	Influence of Nature of the Tannery Water on —. (Nihoul)	1223
In Galena; Determination of —. (Willenz)	284	<i>See also under</i> Hides and Skins.	
In Potable Water. (Cables)	145	Leeds Gas Liquor; Analysis of the —. (Cooke)	225
In the Pottery Manufacture; Report on Use of —. (Therpe)	475	Leighorn; Boric Acid Exports of —. (T.R.)	764
Iodide, Fused, and Lead Chloride; Electrolysis of —. (Auerbach)	1001	<i>See also under</i> Italy.	
Mines in Italy. (T.R.)	769	Leguminosæ; Producing Cultures of Bacteroids of Micro-organisms of the —. (P) Hartleb	374
Mining in England. (T.R.)	1259	Lemon Camphor or Citraptene. (Theulier)	605
Oleate; Preparation of —. (Naylor)	498	Oil, Citral in —; Determination of —. (Parry)	75, 75
Oxide; Volatility of —. (Stærner)	1113	Oil Industry; The —. (Burgess and Child)	1176
Peroxide in Red Lead; Volumetric Estimation of —. (Liebig)	1027	Oil; New Aldehydes of —. (von Soden and Rojahn) ..	1136
Persulphate; Preparation and Characteristics of —. (Elbs and Fischer)	132	Oil; Preparation of —. (Child and White)	274
Plating; Electrolytic —. (Glaser)	253	Oil; Production of — in 1900. (T.R.)	776
Poisoning and Pottery Manufacture	990	Oil; Two New Substances in —. (Burgess)	745
Poisoning in the Potteries. (T.R.)	1258	Lepraria latebrarum Ach; Composition of —. (Zoppi) ..	77
Prices of —, since 1835. (T.R.)	1041	Lepraria-Chloroform; Formation and Formula of —. (Kussner)	497
Production in Austria. (T.R.)	1259	Letter from New York Section to the President	689
Production of —, in Spain in 1899. (T.R.)	301	From the President to the New York Section	689
Radio-Active: (Giesel)	290	Leuco Compound; Manufacture of a Sulphurised —. (P) Abel. From the Actienges. für Anilin Fabrikation ..	573
(Hofman and Strauss)	290, 625, 1153	Leyes; Dialysis of Soap — (Crude Glycerin). (Auzenat) ..	484
And Rare Earths. (Hofman and Strauss)	76	<i>See also</i> Lyes.	
Refining Furnace; Separation of a Mass Rich in Copper in the —. (Schertel)	366	Licari canali (Bois de Rose femelle); Essential Oil of —. (Theulier)	606
Red —. <i>See under</i> Red Lead.		Lichens and their Characteristic Constituents. (Hesse)	161

	PAGE
Ligneous Acid Exempt from Duty in the Netherlands. (T.R.).....	628, 759
Lignite Tar; Extraction of Paraffin from —. (P) Pauli.....	978
Little Water. <i>See under Water.</i>	
Linze; Apparatus for Slaking —. (P) Beny and Heimigs..	810
For Mortar; Valuation of —. (Bender).....	477
For Tanners' Purposes; Analysis of a —. (Flower)....	224
Furnaces for Treatment of —. (P) Gobbe.....	105
Gas-Apparatus for Revivifying —. (P) Yeaton and Mason.....	793
-Light; Obtaining Intense Heat for —. (P) Münsterberg.....	351
Milk of; Apparatus for Removing Grit from —. (Biza and Vecek).....	914
Scum and Sediment of Sugar Factories; Extraction of Sugar from —. (P) Steffen.....	916
Slaked; Production of —. (P) Lake. From Wachtel & Co.....	582
Solubility of —, in Sugar Solutions. (Pellet and Weisberg).....	733
Solubility of —, in Water at Different Temperatures. (Guthrie).....	223
Treatment of —. (P) Thompson. From Dodge.....	717
Limexilas; Construction of —. (P) Siepen.....	1115
Limestone; Calcining —, with Recovery of By-Products. (P) Naef.....	366
Manufacture of —. (P) Schwartz.....	810
Limestones; Composition of some Canadian —. (Donald).....	810
Limettin; Constitution of —. (Tilden and Burrows).....	1238
Limone; New Alcohol derived from —. (Genvresse).....	385
Linaloe Oil; Cayenn —. (Theulier).....	745
Linde and Hess Process for Removal of Iron from Water.....	145
Linen Dyeing; Notes on —.....	40
Linings to Protect Vessels from Corrosive Fluids. (P) Bloxam. From Panzl and Troetscher.....	27
Linoleum; Coating Material for —. (P) Ammundsen and Rasmussen.....	135
Manufacture of —. (Ammundsen, Rasmussen, and Hirt).....	148
Linseed Exports of Pernau, Russia. (T.R.).....	1043
In India. (T.R.).....	1043
Oil; Analytical Contents of Boiled —. (Kitt).....	484
Oil and its Adulterants; Report on —. (McElhinney).....	909
Oil in Portland, Oregon. (T.R.).....	860
Oil; Substitute for Boiled —. (P) Ammundsen.....	1005
Oil; Trade Description of —, in India. (T.R.).....	294
Lippmann's Colour Process; Sensitisation of Gelatin Plates for —. (Neuhaus).....	154
Liquid and Gas; Treating Materials with —, and Apparatus therefor. (P) Naef.....	1195
Extraction of —, from Substances. (P) Schwerin.....	726
Liquids; Apparatus for Decanting —. (P) Gorianoff.....	344
Apparatus for Concentrating and Crystallising —. (P) McNeil.....	55
Apparatus for Extraction of —. (Neufeld).....	279
Apparatus for Liberating Greasy Matters from —. (P) Delattre.....	371
Apparatus for Preservation of —. (P) Freeman.....	827
Apparatus for Regulating the Density of —. (P) Domergue.....	605
Apparatus for Saturating — with Gases. (P) Fischer and Kiefer.....	1094
Apparatus for Separating —. (P) Lake. From Powter.....	788
Apparatus for Separating Solids from —. (P) Markel and Crossfield.....	1094
Boiling of Frothing —, and Apparatus therefor. (P) Erfurt.....	531
Concentration of —. (P) Kaufmann.....	987
Device for Constantly Maintaining the Temperature, Pressure, and Humidity of —. (P) Schultz.....	788
In Tank Waggons; Freight Rates for — in Germany. (T.R.).....	399
Non-Explosive Vessels for Inflammable —.....	293
Purification of —. (P) Thompson. From the Société Mangano Electricque.....	494
Separating Mechanical Admixtures from —, and Apparatus therefor. Füllner.....	1194
Sterilisation of — with Ozone. (P) Bloxam. From Dillan.....	830
Sterilising and Cooling —, and Apparatus therefor. (P) Miller.....	924
Transport of Inflammable —. (T.R.).....	295
Treatment of Waste —. (P) Burmeister.....	739
Treatment of — with Gases, and Apparatus therefor. (P) Naef.....	28
Vessels for Mixing or Treatment of —. (P) Boul. Hromadnik.....	233
Vessels for Storing Inflammable —. (Ernst).....	459
<i>See also Fluids.</i>	
Liquor Law in France; New —. (T.R.).....	294
Liquors, Ammonia; Treatment of —. (P) Scott.....	332
Aromatic Alcoholic; Preventing changes in — during Sterilisation. (P) Gronwald.....	827
Crystallisable; Transformation of — into Large Lumps. (P) Beck.....	220

	PAGE
Liquors—cont.	
Heating of — for Purpose of Decomposing, Drying, &c., (P) and Apparatus therefor. Naef.....	1210
Sulphite-Cellulose Waste —; Treatment and Utilisation of. (P) Brookes. From Trippe.....	741
Lists of Members Elected.....	3, 97, 183, 315, 429, 533, 659, 969, 1059, 1175
Lithium-Ammonium; Decomposition of — by Ammonium Chloride. (Moissan).....	1252
Lloyd's Reaction for Morphine. (Mayer).....	933
London Purple; Composition and Analysis of —. (Haywood).....	157
London Section; Addition to Bye-laws of —.....	322
Loofah; Pentosan of —. (Schöne and Tollens).....	1226
Lotus Arabicus Poison; Nature and Origin of —. (Dunstan and Henry).....	929
Lubricant, and Process of Making Same. (P) Hudnall and Calvert.....	910
For Fibres. (P) Hutchinson.....	242
Lubricating Oil. <i>See under Oil.</i>	
Luminescence Spectra of the Rare Earths. (Baur and Marc).....	1098
Lustres for Use on Porcelain, &c. (P) Ziegenbruch.....	477
Luteol; Preparation of —. (Glaess and Bernard).....	155
Luteolin and Digtolflavone; Identity of —. (Kilian and Mayer).....	1202
Report on Prize Essay on —. (Noelting and Freyss).....	354
Synthesis of —:	
(St. v. Kostanecki).....	354
(von Kostanecki, Rozycki and Tambor).....	116
Lyes; Concentration of Heavy —. (P) Kaufmann.....	937
<i>See also Lays.</i>	
Lyons; Tar Products at —. (T.R.).....	854

M

Machinery. (Class I.).....	27, 105, 232, 343, 450, 531, 694, 788, 878, 974, 1094, 1194
Madagascar; Aviary, a New Gum from —. (T.R.).....	1045
Madeira; Manures in —. (T.R.).....	861
Paints and Colours in —. (T.R.).....	860
Photographic Goods and Chemicals in —. (T.R.).....	865
Madol Oil. (T.R.).....	642
Mafoureira Nuts in East Africa. (T.R.).....	955
Magnalium; Characteristics of —.....	815
Magnesia Carbonate; Manufacture of —. (P) Marsh.....	1113
Employment of — in India-Rubber. (Springer).....	593
In Boiler Feed Water; Behaviour of —.....	232
Magnesite; United States Customs Decision on —. (T.R.).....	1157
Magnesium-Ammonium-Phosphate; Furnace for Ignition of —. (Schaller).....	1025
Borate; Preparation of —. (Ouvrard).....	803
Electrolytic Extraction of —. (Swan).....	666
For Weighing Textiles. (Fürth).....	242
In Water; Volumetric Determination of —. (Winkler).....	507
Reducing Properties of —. (Duboin).....	512
Sulphate in the United States. (T.R.).....	950
Magnetic Separation; The Wetherill Process of —. (Ingall).....	478
Maize in Wheat Flour; Detection of —:	
(Bevan).....	72
(Embrey).....	72
Oil; Composition of —. (Vulte and Gibson).....	370
Starch Manufacture in France; Residuum from —. (T.R.).....	79
Makulu Oil. (T.R.).....	641
Malachite Green; Etherification of — by Alcohol. (Fischer).....	33
Malic Acid; Determination of —. (Hilger).....	288
Malt and Beer; Arsenical —. (Murphy).....	310
Arsenic in; Determination of — (Newlands and Ling).....	748
Coloured; Production of —. (P) Flessa.....	736
Determination of Available Extract of —. (Briant).....	160
Drying or Roasting —. (P) Newlands.....	736
Extracts; Examination of Commercial —. (Sykes and Mitchell).....	1148
For Aromatic Full-bodied Dark Beers; Kilning of —. (Winde).....	1227
Influence of Moisture in — on the Grist. (Diehl).....	1227
-Kilns; Arsenic in —. (Fairley).....	918
Pentosan Content of —. (Windisch and Hasse).....	1129
Wheat —; Manufacture of —. (Rudolph).....	141
Worts; Analysis of Saccharified —. (Petit).....	142
Maltase; Action of Reagents on Activity of Yeast towards —. (Bokorny).....	824
Malting; Examination of Fuels Used in, with Reference to Arsenic. (Ling and Newlands).....	1008
Experiments on —. (Evans).....	825
Maltol; Presence of — in Needles of White Fir. (Feuerstein).....	826
Maltose; Isolation of —, when Mixed with Glucose. (Hill).....	491
Mandarin Oil; Artificial —.....	1237
Mandragora Root; Alkaloids of —. (Hesse).....	1135
Bases of —. (Thoms and Wentzel).....	605



	PAGE		PAGE
Manganates; Purification of Liquids by Means of — (P) Thompson. From the Société Mangano Electricque...	494	Matrices; Separation of — from Galvanoplastically Precipitated Metals. (P) Steinweg	908
Manganese; Apparatus for Production of — (P) Simon	256	Maumené Test for Oils. (Mitchell)	939
Brown; Potassium Permanganate, Used in Producing — (Saget)	575	Mauritius; Sugar Export Duty of — (T.R.)	949
Carbo-Silicide; Crystals of — (Stead)	721	Me Oil. (T.R.)	642
Citrate; Soluble — (Power)	927	Meat Extract and Albumin; Preparation of — (P) Deycke	59
Compounds of —, with Iron. (Power)	927	Extract; Apparatus for Preparing — (P) Johnson. From The Actien Maschinenbau vorm. Venuleth und Ellenberger	144
Electrolytic Separation of Lead from — (Moltke-Hansen)	750	Extract; Preparation of — (P) Heyen	924
In Brazil. (T.R.)	1159	Extract; Substitute for —, prepared from Yeast. (Lebbin)	825
In Ferro-Manganese; Determination of — (Norris)	551	Extracts; Food Value of — (Furst)	58
Ore Exports of Bahia, Brazil. (T.R.)	1041	See also Foods.	
Ore from Chile. (T.R.)	1042	Meeting; Proceedings of the Twentieth Annual —	660
Ore Production in Italy. (T.R.)	1260	Melitriose; Micro-Organisms of —. Is Special Enzyme Required for Hydrolysis by — (Bau)	57
Production of —, in Spain in 1899. (T.R.)	301	Members Elected; Lists of — 3, 97, 183, 315, 419, 533, 659, 969, 1059, 1175	
Russian Trade in — (T.R.)	1041	Menthol; Action of Benzaldehyde on Sodium Compounds of — (Martine)	944
Trade of Batoum. (T.R.)	768	Halogen Derivatives of —, and Hydrocarbons therefrom. (Kursanoff)	1236
Manganic Acid and Barium Manganates. (Kassner and Keller)	1112	Mercurising and Millerainising in Germany. (T.R.)	953
Manganous Salts at the Anode; Behaviour of — (Elbs)	49	Mercurising Apparatus: (P) Crompton and Horrocks	985
Mangrove Bark; Duty on —, in Germany. (T.R.)	848	(P) Eoch	359
Manufacturing Paper. See under Paper.		(P) Jackson and Hunt	120
Manjak in Trinidad. (T.R.)	1038	(P) Lake. From Weldon	709
Manna; Production of —, by Olive Trees. (Battandier)	875	(P) Macconel	39
Mannitol Ferment, The —. (Gayon and Dubourg)	1010	(P) Morgan and Menzies	472
Mannose in Cane Sugar Products; Detection and Determination of — (Pellet)	754	(P) Ross and Schneider	709
Mantles for Incandescence Gas-Lighting: (P) Berend. From Schauer	1199	(P) Shuman	574
(P) Bloxam. From Phlox-Glühlicht-Gesellschaft	794	Stretching Apparatus for Use in — (P) Johnson. From Hasslacher	359
(P) Hill	699	Mercuric Chloride. See also under Corrosive Sublimate.	
(P) Kohl	699	Oleate; Preparation of — (Naylor)	493
(P) Plassetty	699	Oxide; Action of — on Aqueous Solutions of Metallic Salts. (Mailhe)	806, 846
(P) Thompson. From Karsten	351	Oxide; Action of — on Organic Substances. (Lumière and Perrin)	497
Incandescence; Photometric Examination of —	1098	Sulphocyanide Intensifier. (Eberhard)	387
Of Incandescence Lamps; Manufacture of Fabric for — (P) Radcliffe	111	Mercurous Nitride. (Ray)	742
Manure; Preparation and Use of Basic Superphosphate as — (Hughes)	325	Mercury; Alteration in Volume on Melting, and Thermal Expansion when Solid. (Grunmach)	1253
Manures. (Class XV.) 83, 167, 267, 303, 374, 405, 487, 520, 597, 643, 731, 772, 820, 861, 914, 956, 1007, 1045, 1224		Bonus for Production of — in New Zealand	1034
Artificial; Improvement of — (P) Roth	914	Cell for Electrolytic Soda and Chlorine. (Franke)	815
Artificial, in Spain. (T.R.)	1046	Compounds of — with Silver. (Berthelot)	365
Artificial; Trade in —, at Hamburg. 1800. (T.R.)	775	Electrolytic Purification of — (Johnson)	1002
Artificial; Use of —, in India. (T.R.)	405	Electrolytic Separation of — from Copper. (Spare and Smith)	1027
At St. Malo. (T.R.)	861	Exports of San Francisco. (T.R.)	859
In Madeira. (T.R.)	861	In Combination with Chlorine, Iodine, or Cyanogen; Determination of — in Antiseptic Solutions. (Meillère)	1243
In the Canary Islands. (T.R.)	1046	In Texas. (T.R.)	82
Phosphoric Acid in Various; Determination of — (Ledoux)	936	In Tuscany. (T.R.)	767
Manurial Salts and Products at Glasgow Exhibition	687	Intensification; Chemical Process in — (Novak)	1140
Marble, Artificial; Manufacture of — (P) Hertwig and Liebaug	1212	Iodo-antimonide. (Granger)	757
Imitation; Manufacture of — (P) Tuckwell	582	Metallurgy of — in Italy. (Spirek)	831
Imitation; Production of — (P) Sborowitz	992	Obtainment of — (P) Armstrong)	905
See also Stone.		Organo-Metallic Compounds of — (Lumière and Chevrotier)	273
Marcasite and Pyrite; Distinguishing between — (Stokes)	1241	Production of — (Weiskopf)	584
Margarine; Cocoa-nut Oil in — (Indemans)	493	Production of — in Spain in 1899. (T.R.)	301
Manufacture of —: (P) Neisse and Boll	1229	Production of Europe and America. (Weiskopf) (T.R.)	640
(P) Pellerin	1229	Salicylate; Determination of Mercury in — (Rupp)	604
(P) Poppe	824	Salicylate; Solubility of — (Larin)	927
Substitute for —: "Vegetaline." (T.R.)	862	Salts; Determination of — (Tyrrer and Tyrrer)	937
Margosa Oil. (T.R.)	642	Salts; Reduction of — by Hydrogen Peroxide. (Kolb)	148
Marseilles; Castor Oil Manufacture at — (T.R.)	859	Sodium-Sulphite Process of Photographic Intensification. (Vogel)	505
Marsh Arsenical Mirror and Beer-Poisoning. (Tunnicliffe and Rosenheim)	390	Statistics of — (T.R.)	82
Marsh-Gutseit Test for Arsenic, and Apparatus therefor. (Tyrrer)	281	Volumetric and Gravimetric Determination of — (Cohn)	1243
Marsh Test; Effect on —, of Products containing Selenium and Tellurium. (Berry)	322	Metaeresol in Mixtures of Cresols; Determination of — (Ditz)	73
Marsh's Test for Arsenic; New Apparatus for — (Tyrrer)	280	Metallurgy. (Class X.) 44, 81, 126, 167, 253, 300, 365, 401, 478, 518, 582, 636, 719, 767, 811, 858, 901, 954, 992, 1041, 1115, 1153, 1212, 1259.	
Mashes; Lactic Acid Bacteria of Distillery — (Henneberg)	920	Metal; Casting of — (P) Elmqvist	998
Mashing and Fermenting Vessels. (P) Meyer	1228	Coating Fibrous Material with —, (P) James. From Robertson and others	260
Massecuttes; Determination of Purity of — (Arnault)	755	Mechanically Enamelling; Means for — (P) Dormoy	364
Organic Acids Extracted from —, by Ether. (Andrik, Urban, and Stanek)	54	Plates; Apparatus for Coating with Tin, &c. (P) Thomas	1119
Real and Apparent Purity of — (de Jongh)	488	Plates with Honeycombed Surface. (P) Storey and McCalla	126
(Pellet)	489	Production of the United States. (T.R.)	79
Match Igniting Composition free from Phosphorus. (P) Furgott	747	Reduction of — from Ores and Concentrates. (P) Ruthenburg	1218
Imports of Chinde, S. Africa. (T.R.)	1049	Metals Accompanying Platinum; Separation of — (Leidié)	45
Trade of India. (T.R.)	958	Action of Alcohol of 95° upon. (Malméjac)	365
Matches. (Class XXXI.) 68, 154, 278, 304, 388, 505, 609, 747, 777, 835, 932, 958, 1020, 1040, 1140, 1239		Action of Ammonia on —, at High Temperatures. (Henderson and Beilby)	1212
and Striking Compositions; Manufacture of — (P) Bale	155	Allied to Nickel; Electrolytic Deposition of — (P) Kugel	260
At Rio Grande, Brazil. (T.R.)	1049	Analysis of — (Ulzer)	1216
Ignition Material for — (P) Deissler	506		
Netherlands Prohibition as to — (T.R.)	1049		
Phosphorus-free —, to Strike on any Surface. (P) Fog and Kirschner	1024		
Prohibition of White Phosphorus — in the Netherlands. (T.R.)	777		
Materials Proof against Moisture and Chemicals; Rendering — (P) Kronstein	460		



	PAGE
Metals—cont.	
And Compounds thereof; Converter Treatment of — and Apparatus therefor. (P) Reynolds	587
Apparatus for Electro-deposition of — (P) Cowper-Coles	1002
Apparatus for Refining —, by Electrolysis. (P) Lake. From Betts	1121
Cellular Structure of —. (Cartaud)	811
Coating with —. (P) Harz and von Miller	587
Crucible for Casting Fusible — under Pressure. (P) Cothias	997
Deposition of —, by Electrolysis. (P) Meurant	370
Deposition of —, on other Metals. (P) Jassett and Cinquandre	369
Distilled —. (Kahlbaum)	1213
Durability of —, under Atmospheric Exposure (Kershaw)	133
Electro-deposition of —. (P) Punnett	50
Electro-deposition of —, upon China, &c. (P) Cooke and Parr	317
Electrolytic Cleansing of —. (Reyval)	50
Electrolytic Obtainment of Volatile. (P) British Aluminium Co. From Towles	908
Electrolytic Refining of —, in the United States. (Ulke)	462
Electrolytically Preparing —, for Lithography. (P) Streckler	727
Extraction and Recovery of —, from Sulphide Ores. (P) Clancy and Marsland	481
Extraction and Reduction of —, by Electrolysis. (P) Frasch	370
Extraction of —, by means of Calcium Carbide. (Frölich)	719
Extraction of —, from Alluvial Deposits. (P) Mactear	1217
Extraction of —, from Sulphide Ores. (P) Clancy and Marsland	904
Hardening Compounds for Alloying with —. (P) Baker	256
In Cyanide Solutions; Electro-motive Force of —. (Christy)	259
Minute Structure of —. (Beilby)	992
Obtainment of —, from Ores, and Recovery of By-Products. (P) Simon	368
Obtainment of —, partly Electrolytic. (P) Taddei	1121
Of the Rare Earths; Absorption of Hydrogen and Nitrogen by —. (Matignon)	160
Of the Rare Earths; Combination of Hydrogen with —. (Matignon)	63
Of the Rare Earths; Direct Combination of Nitrogen with —. (Matignon)	63
Oleates of the; Preparation of —. (Naylor)	498
Precious, and Minerals in New South Wales. (T.R.)	767
Precipitation of —, from Solutions; and Deposition of —, on other Metals or Alloys. (P) Meurant	370
Production of —, in the United States. (T.R.)	760, 761
Recovering and Separating —, from Ores and Concentrates. (P) Frasch	907
Reduction of —, and Production of Alloys. (P) Blackmore	1118
Relation between Expansibilities and Fusing Points of —. (Lémeray)	253
Secondary Radio-Activity of —. (Becquell)	365
Transparency of —, to Radium Rays. (Mizuno)	291
Treatment of Mixed Ore for Separation of —. (P) Ferraris	1117
Uniting or Welding —. (P) Griffiths	905
Volatile; Obtainment of —. (P) Armstrong	905
Metal-Ammonia Compounds in Aqueous Solution. Part IV. (Dawson and McCrae)	758
Metallic Objects; Colouring or Decorating —. (P) Sinclair	727
Metallography; Nomenclature of —	1633
Metallurgical and Chemical Industries of New York. (T.R.)	858
Products; Crushing and Lixiviating —. (P) Pape and Henneberg	587
Metaminophenols. (Gnehm and Schentz)	798
Meters: Electrolytic —. (P) Wright and The Mutual Electric Trust	49
Methylacetylindoxylate; Melting Point of —. (Vorländer and Drescher)	801
Methyl-Alcohol. <i>See under Alcohol.</i>	
Methyl Anthranilate in Essential Oils; Determination of —. (Hesse and Zeitschel)	289
Methylbenzocaine; Pharmacology of —. (Cash and Duistan)	928
Methylenesoreinol as a Mordant for Basic Dyestuffs. (Newjadomsky)	1108
Methylheptenone; Synthesis of —. (Ipatiew)	604
Methyl Methylanthranilate; Preparation of —. (P) Schimmel and Co.	1015
Metal Developer; Limit of Dilution of —. (Kastner)	608
Mexico; Chemical Imports of —. (T.R.)	165
Copper Mining in —. (T.R.)	955
Cotton-Seed Oil; Production in —. (T.R.)	167
Glass and China Trade with —. (T.R.)	166
Hide and Skin Industry of —. (T.R.)	956
New Oil District in —. (T.R.)	80
Oil Duties in —. (T.R.)	1159
Oleomargarine in —. (T.R.)	1048
Paints and Colours in —. (T.R.)	167
Paper Imports of —. (T.R.)	168
Tariff Modifications in —. (T.R.)	1153
Trade of —, in 1900. (T.R.)	951
Mezcaline. (Heffér)	1134

	PAGE
Mica; Influence of Oil on Insulating Properties of —. (Drouin)	482
Scrap; United States Customs Decisions on —. (T.R.)	1259
Micro-Organisms in the Manufacture of Beetroot Sugar. (Schöne)	733
Producing Cultures of Bacteroids of —. (P) Hartleb	1374
Milk; Acidity of —. (Wieth and Siegfeld)	1131
And Cream Regulations; Report of Committee on —	493
Apparatus for Equalising Temperature of —. (P) Sabroe and Hansen	1229
Apparatus for Preservation of —. (P) Freeman	827
Churns; Treatment and Preservation of —. (P) Williams	143
Coagulation of —. (Bokorny)	144
Condensed Humanised —. (P) Sauer	380
Condensed; Production of —. (P) Gürber	58
Diabetic Sugar-free —. (P) Morris	380
Formaldehyde and Milk-Sugar in —; Detection of (Riegler)	285, 285
Formaldehyde in —; Approximate Determination of (Liversage)	844
Formaldehyde in —; Modification of Sulphuric Acid, Test for. (Luebert)	1146
In Form of Dry Powder; obtaining Solid Constituents of —. (P) Stauf	59
Lactic Acid Bacteria of —. (Henneberg)	920
Lactic Bacteria of Acetic Acid Produced in —. (Bartel)	77
Lactose in; Determination of —. (Scheibe)	287
Means for Humanising Cows' —. (P) Cook	738
Of Cows and Goats; Rendering — Digestible. (P) Imray. From the Farb. vorm. Meister, Lucius und Brüning	601
Of Lime; Apparatus for Removing Sand or Grit from —. (Biza and Vecsek)	914
Pasteurising and Sterilising —. (P) von Bühler	58
Preservation of — and Apparatus therefor. (P) Marquardt	924
Preservatives in; Detection and Determination of —. (Blyth)	844
Separation of Casein and Whey from —. (P) Székely Kovács	380
Solidifying and Preserving —. (P) Haddan. From Passburg	827
Standard for —. (Hydrogen Peroxide. (Chick)	1228
Sterilisation of —, by Hydrogen Peroxide. (Chick)	1228
Substitute for Mother's —. (P) Meyenberg	601
Milliau's Reaction for Sesame Oil; Modification of —. (Armani)	752
Millon's Reagent. (Vaubel);	71
Application of —. (Nasse)	393
Milo (Cyclades); Mineral Exports of —, in 1900. (T. R.)	640
Mineral; Acid-proof —, for Paper-making. (T. R.)	408
Acids in Leather; Determination of —. (Procter and Searle)	287
Exports of Milo (Cyclades) in 1900. (T. R.)	640
Imports and Exports of Spain. (T. R.)	302
Output of Bosnia and Herzegovina during 1899. (T. R.)	167
Production in Spain in 1899. (T. R.)	300
Production of Algeria. (T. R.)	637
Production of Canada for 1900. (T. R.)	397
Production of Germany. (T. R.)	515
Production of Great Britain. (T. R.)	636
Production of India. (T. R.)	1256
Production of Japan. (T. R.)	1159
Production of Queensland in 1900. (T. R.)	858
Production of Spain. (T. R.)	637
Production of the United States. (T. R.)	79
Substances; Kilns and Appliances for Treating —. (P) Meldrum Brothers and Orton	694
Minerals and Phosphate in Palestine. (T. R.)	951
And Precious Metals in New South Wales. (T. R.)	767
Electric Disintegration of —. (P) Graham	1221
Extraction of —, from Alluvial Deposits. (P) Mactear	1217
In the Urals. (T. R.)	519
Of Diarbekir, Asiatic Turkey. (T. R.)	859
Other than Gold; Output of —, in W. Australia. (T. R.)	401
Production of —, in the United States. (T. R.)	759
Mineral Oils. See under Oil and Oils.	
Mines; Concrete in —. (T. R.)	81
Mining in Laurium and Euboea, Greece. (T. R.)	641
Industry of Huelva, Spain (T. R.)	637
Industry of North of Spain. (T. R.)	640
Minorca; Leather Trade of —. (T. R.)	861
Mirrors, Glass, with Colour Decorations. (P) Wagner and Lorenz	477
Mixing Apparatus:	
(P) Boulton. From Hromadnik	233, 233
(P) Hecking	314
(P) Lake. From Werner and Pfeleiderer	789
Mixtures of Inflammable Gases with Air; Explosion of — (Kubierschky)	345
Of Three Substances; Solid Solutions of —. (Bruni)	160
Molasses; Alcohol and German Yeast from —; Obtainment of. (P) Bramsch	600
Analysis and Examination of —. (Andrlik and others)	374
Beetroot; Presence of Lactic Acid in —. (Schöne and Tollens)	54
Composition of Insoluble Matter of —. (Pellet)	53
Distilleries; Continuous Fermentation in —. (Sorel)	143



	PAGE		PAGE
Molasses— <i>cont.</i>		Naphthalene— <i>cont.</i>	
Duty on —, (T. B.)	628	Obstructions in Gas Mains; Prevention of —, (Erlenbach)	347
Fermentation of —, (Barbet)	1130	Obstructions in the Mains of Gas-holders; Removal of —	346
Fodder; Apparatus for making —, (P) Schrader	601	Stoppages in Gas Plant; Removal of —	1196
Fodder; Production of —, and Apparatus therefor. (P) Schrader	489	Naphthenic Acids; Utilisation of —, (Ulzer)	112
Lactic Acid in Beet —, (Weisberg)	375	Naphthol α - and β -; Action of Nitrous Acid on. (Schmidt)	113
Obtaining German Yeast from —, (P) Bramsch	736	β - and Aldehydes; Reaction between —, (Rogow)	393
Properties of —, after Substitution of the Potassium. (Seidner)	375	α - and β -; Comparison of —, (Maximowitch)	77
Residues; Acids Soluble in Ether derived from —, (Herzfeld)	1127	β - and α -Naphthylamine Sulphonic Acids. (von Georgievics)	34
Residues; The Ether-soluble Acids of —, (Herzfeld)	1225	β - and α -Naphthylamine Sulphonic Acids; Behaviour of Dyestuffs from — to Wool. (von Georgievics and Springer)	34
Use of Yeast in preparation of Spirit from —, (Verbieke)	378	Naphthol-4-Sulphonic Acid, 1.8-Amido; Manufacture of — (P) Willcox. From the Badische Anilin and Soda Fabrik	880
Molybdate Method of Testing Phosphoric Acid in Basic Slag Powder. (Foerster)	751	Naphthoquinone; 5-Acetamino- β - —, and Isorosindulines. (Kehrmann and Denk)	115
Molybdenite in Ontario —, (T.R.)	954	Naples; Tanneries in —, (T.R.)	861
In Queensland —, (T.R.)	1159	Volcanic Products of the Solfataro —, (T.R.)	856
Molybdenum and its Oxides; Action of Water Vapour on —, (Guichard)	161	Natal; Cement Trade of —, (T.R.)	1157
Blue; Composition of —, (Klason)	262	Drug Imports in —, (T.R.)	1051
Electrolytic Determination of —, (Kollock and Smith)	1145	Food and Drugs Act in —, (T.B.)	1049
Trioxide; Separation of Tungsten Trioxide from —, (Ruegenberg and Smith)	69	Neat's Foot Oil; Cholesterol in —, (Holde and Stange)	484
Monarda Oil. (Brandel and Kremers)	930	Nematocidics; Ammoniacal Salts as —, (Lonay)	287
Monazite Sand; Separation of Cerite Earths of —, (Meyer and Marckwald)	62	Nerium Odorum; Chemistry of the —, (Bose)	503
Sands at Espirito Santo, Brazil —, (T.R.)	1162	Nernst Electric Lamps and Heaters. (P) Worts and others..	566
Mond Gas. <i>See under</i> Gas.		Lamps. <i>See under</i> Lamps.	
Monopersulphuric Acid; Characteristics of —, (Baeyer and Villiger)	578	Netherlands; Acetic Anhydride Exempt from Duty in the —, (T.R.)	759
Montan Wax; Characteristics of —, (von Boyen)	1221	Customs Decisions in the —, (T.R.)	849
Montgomery and Co.'s Report on Sodium Nitrate —, (T.R.)	772	Match Manufacture Prohibited in the —, (T.R.)	1049
Moorland Waters; Researches on —, II. (Ackroyd)	494	Prohibition of White Phosphorus Matches in the —, (T.R.)	777
Mordant for Basic Dyestuffs; A New —, (Favre)	710	Salt as Cattle Food or Manure. (T.R.)	950
Methylenresorcinol as a —, (Newjadomsky)	1108	Salt for Purifying Gum Copal Exempt from Duty. (T.R.)	79
Report on Favre's. (Bourry)	711	Vinegar and Ligneous Acid Exempt from Duty in the —, (T.R.)	628, 759
Mordants, Chrome; Determination of Chromium Oxide in —, (Hartmann)	834	Neutralisation; Studies in —, (Berthelot)	938
Dyeing of Oxide. (Liebermann)	710	New Caledonia; Nickel and Cobalt Production of —, (T.R.)	769
Mordanting Apparatus. (P) Bernheim	471	New South Wales; Bauxite in —, (T.R.)	954, 1039
Morocco; Imports of Tangier —, (T.R.)	1152	Minerals and Precious Metals in —, (T.R.)	767
Morphenol; Preparation of —, (Vougerichten)	135	Nickel-Ore Works at Newcastle —, (T.R.)	167
Morphine; Characteristic Reaction for —, (Fleury)	1146	Zinc Ores in —, (T.R.)	1158
Detection and Determination of —, (Wirthle)	511	New York Section; Letter from the President to the —	689
Determination of: (Orlow and Horst)	511	Letter from —, to the President	689
(Reichard)	160, 624	New Zealand; Bonus for Production of Mercury in —	1034
Extraction of —, from Solutions. (Puckner)	928	Customs Decision on Carbolic Acid in —, (T.R.)	1038
In Opium; Determination of —, (Reichard)	1149	Customs Decisions in —, (T.R.)	79, 949
Lloyd's Reaction for —, (Mayer)	938	Dredging for Gold in —, (Wylie)	901
Researches on —, II. (Schryver and Lees)	50	Osmium Discovered in —, (T.R.)	858
Salts; Impurity of —, (Rössler)	1015	Shale-Oil Works at Orepuki —, (T.R.)	854
Morpholine; Preparation of —, (Marckwald and Chain)	743	Sulphur Production in —, (T.R.)	1258
Mortar for Building Blocks; Manufacture of —, (P) Pilkington and Ormandy	900	Tellurium in the Ores of the Hauraki Goldfields. (Allen)	901
Materials for Walls of Reservoirs at Gotha; Experiments on —	1211	Newfoundland; New Customs Tariff of —, (T.R.)	1035
Production of —, (P) Lorenc	992	Nicaragua; Drugs and Medicines in —, (T.R.)	1048
Valuation of Lime for —, (Bender)	477	Soap Exported to —, (T.R.)	520
Mortars. (Class IX.)	43, 81, 252, 364, 477, 517, 581, 718, 810, 900, 990, 1114, 1211	Nichine; Cinchonine Base Analogous to —, (Langer)	499
Injurious Action of Saline Liquids on Cement —, (Deval)	43	Nickel-Ammonium Sulphate; Electro-Chemical Behaviour of —, (Pfanhauser)	906
Tests of —, (Behrmann)	125	Nickel and Cobalt; Quantitative Separation of —, (Rosenheim and Huldshinsky)	840
Moths; Means for Extermination of —, (P) Kornfeld and Zirner	1230	And Iron; Electro-deposition of —, from a Solution of the Sulphates. (P) Küster	50
Mould Fungi; Influence of Butyric Acid upon —, (Wehmer)	268	And Iron; Simultaneous Electro-deposition of —, Küster	907
Moulding Material for Use in Casting Steel —, (P) Sarg	46	Deposition of — on Metallic Surfaces. (P) Jasset and Cinquabre	369
Mount Morgan; Chlorination of Gold Ores at —, (Nardin)	45	Detection of — in Presence of Cobalt. (Browning and Hartwell)	156
Mucedinae; Producing Glucose by Aid of —, (Calmette)	140	Electrolytic Deposition of —, (P) Kugel	260
Utilisation of —, for Manufacture of Glucose. (Calmette)	732	Electrolytic Separation of Cobalt from —, (Balachowsky)	840
Muffle Kilns. <i>See under</i> Kilns.		Electro Production of —, (Kershaw)	402
Muffles; Electric —, (P) Weiss	697	Extraction of —, (Swan)	666
<i>See also under</i> Furnaces.		Factory at Papenburg. (T. R.)	769
Museum; New Commercial —, at San Francisco. (T.R.)	851	Frasch Electrolytic Process for Refining —	483
Mustard Oil from Seeds of Brassica Napus. (Sjollema)	833	In Steel; Determination of —, (Morris)	551
Mycoderma Cerevisiae. (Van Laer)	1127	-Ore Works at Newcastle, N.S.W. (T. R.)	167
Myrcene and other Olefinic Compounds. (Semmler)	1135	Oxide Cell; The Alkaline —, (Marsh)	998
Myrcenol and its Constitution. (Barbier)	607	Preparation of —, (P) Michaelowsky	1119
Myrrh; Pharmacopœia Tests of —	885	Production in New Caledonia. (T. R.)	769
		Salt, and Manufacture of Same. (P) Frasch	580
		-Steel as Used in Commercial Work. (Porter)	926
		-Steel; Metallurgy of —, (Zdanowicz)	1215
		Nicotine; Characteristics of —, (Pictet and Rotschy)	501
		Nicotelline; Characteristics —, (Pictet and Rotschy)	501
		Nicotine; Characteristics of —, (Pictet and Rotschy)	501
		In Tobacco and Aqueous Extracts; Determination of —, (Toth)	942
		Nigella Damascena Seeds; Damascenine a Constituent of —, (Pommerehne)	500
		Nitrate Fermentation and its Significance. (Stokłaga)	1224
		Of Soda. <i>See under</i> Sodium Nitrate.	

N



	PAGE
Nitrates, Alkali; Determination of Nitric Acid in — (Perman)	619
Bacterial Oxidation of Formates by — (Pakes and Jollyman)	292
In Water; Detection and Determination of — (Caze-neuve and Defournel)	538
In Waters; Determination of — (Heuriot)	619
Manufacture of — (Newton)	324
Nitrogen in; Determination of — (Stanek)	506
Nitric Acid; Action of — on Iodol. (Cousin)	497
And Mixed Acid Analysis. (van Gelder)	339
Condensing Apparatus for Manufacture of — (P) Gattmann	987
Early Manufacture of — (Gattmann)	5
In Alkali Nitrates; Determination of — (Perman)	619
In Natural Waters; Determination of — (Winkler)	937
Manufacture of — (Volney)	514, 1180
Manufacture of — by the Nebel Process	896
Preparation of Standard — (Meade)	748
Solutions; Physical Properties of — (Veley and Manley)	1208
Nitrification; Organisms of — (Stutzer)	597
Study of — (Beddies)	820
Nitrosulphates. (Divers and Haga)	757
Nitrites; Determination of — (Pellet)	150
Determination of —, and Separation from Nitrates. (de Koninck)	156
Electrolytic Reduction of — (Suler)	1000
In Sugar Products; Influence of — (Andriik and Stanek)	1225
Manufacture of — (P) Thompson. From Gebrueder Flick	364
Nitro- and Amino-Flavindulines. (Kehrmann and Eichler)	705
Nitro-Anthracene; Preparation of — (Meisenheimer)	306
o-Nitroanthraquinone; Electrolytic Reduction of — (Möller)	1001
Nitrobenzene; Action of — on Aniline in Presence of Alkali (Wohl and Aue)	887
Nitro-Compounds; Electro-chemical Reduction of — (Elbs and Silbermann)	725
-Compounds to Amines; Electrolytic Reduction of — (Chilesotti)	1001
-Compounds; Electrolytic Reduction of — (Rohde)	132
-Compounds; Reduction of — (P) Johnson. From Boehinger and Son	259
-Explosives. See under Explosives.	
Nitrocellulose and Nitroammitol; Distinguishing — (Vignon and Gerin)	1244
And Similar Compounds; Manufacture of — (P) Baechtch	741
Compounds; Preparation of Non-inflammable — (P) Plaisioty	709
Researches on — (Lunge)	1021
Researches on the Stability of — (Will)	609
Soluble; Estimation of — in Explosives. (Quinan)	844
Stability of — (Will)	932
Nitro Group; volumetric Method for Determination of the — (Altman)	622
Nitrogen; Absorption of — by Metals of the Rare Earths. (Matignon)	160
Compounds; Manufacture of — (P) Johnson. From the Atmospheric Products Co.	726
Diazo- in Diazo-Amino Compounds; Apparatus for Determination of — (Mehner)	623
Direct Combination of — with Rare Earths and Metals. (Matignon)	63
Fixation of Atmospheric — (Swan)	609
In Saltpetre; Determination of — (Böttcher)	156
(von Wissell)	156
Iodide; Characteristics of — (Ruff)	68
Manufacture and Use of. (P) Marston	1209
Organic in Commercial Fertilisers; Determination of Availability of — (Street)	751
Oxidation of —, a Source of Error in Determination of Hydrogen and Methane. (White)	937
Proteid, in Vegetable Matter; Determination of — (Fraps and Bizzell)	74
Nitromannitol and Nitrocellulose; Distinguishing — (Vignon and Gerin)	1244
Nitrometer; Du Pont's — (Lunge)	100
Nitro-naphthalene Derivatives; Production of — (P) Johnson. From the Chem. Fab. Griesheim-Elektron.	358
Nitrosalicylic Acid and Nitro sulphonic-salicylic Acid. (Hirsch)	65
Nitroso Group in Organic Compounds; Determination of — (Clauser)	622
Nitrosulphonic salicylic Acid and Nitrosalicylic Acid. (Hirsch)	65
Nitrous Acid; Action of — on α - and β -Naphthol. (Schmidt)	113
Action of — on Wool. (Lidow)	469
Behaviour of India-Rubber towards — (Harries)	1123
In Natural Waters; Determination of — (Winkler)	937
Oxide; Manufacture and Use of — (P) Marston	1209
Nori from Japan. (Oshima and Tollens)	737
Norway; Calcium Carbide in — (T.R.)	853
Iron Deposits of — (T.R.)	955
Kelp Exports from Stavanger — (T.R.)	826
Wood-Pulp in — (T.R.)	864

	PAGE
Notes; Scientific and Technical — (Class XXIV.)	75, 160, 290, 396, 512, 625, 756, 844, 943, 1033, 1150, 1231
Notices; Official —	3, 97, 183, 315, 419, 533, 659, 787, 877, 969, 1059, 1175
Nova Scotia; Antimony Deposits in — (T.R.)	1153
Nut; Composition of the Water — (Trapa Natans) (Zega and Knez-Milojkovic)	270
Nuts and Nut-like Substances; Preparation of — (P) Bell.	828
Nutmeg-Oil; Pharmacopœia Tests of —	385
Nux Vomica; Determination of — (Bird)	75

O

Oak Furniture; Treatment of —, by Ammonia. (Kolitsch)	893
Oatmeal; Composition of — (Dyer)	827
Oats; Use of —, in the Manufacture of Beer. (Rüffer)	1008
Obituary Notices —	
Armstrong, Lord	25
Barely, Hugh	8, 8
Macadam, Stevenson	105
Parsons, C. Chaucey	104
Shapleigh, Waldron	1082
Ochre in Germany. (T. R.)	83
Or Ochre Earth; Duty on — in the United States. (T. R.)	843
(Enanthic) Alcohol. See under Alcohol.	
Oils. (Class XII.)	50, 82, 134, 167, 261, 302, 370, 403, 484, 520, 590, 641, 727, 789, 817, 859, 908, 955, 1003, 1042, 1121, 1159, 1221, 1260.
Oil, Akee; Characteristics of — (Garsed)	134
Akee —; Notes on. (Holmes)	134
And Air, Vaporised; Production and Utilisation of — (P) Wilkinson	883
And Tallow of <i>Stillingia sebifera</i> . (Tortelli and Ruggeri)	261
Apparatus for Extraction of —	
(P) Boulton. From Wacker	818
(P) Haddan. From Edson	261
Apparatus for Vaporising — (P) Kitson	1100
Basil; New Terpene in — (van Romberg)	744
Bergamot; Production of — in 1900. (T. R.)	776
Bergamot; Thymoquinone in Wild — (Brandel and Kremers)	744
Blown; Obtainment of — (P) Joselin and Crichton	485
Cade; Products of Fractionation of — (Cathelineau and Hausser)	502
Calamus; Chemistry of — (von Soden and Rojahn)	533
Calamus; Constituents of —	
(Thoms)	1237
(Thoms and Beckstrom)	606
Camphor; Characteristics of — (Shimoyama)	776
Camphor; Composition of —	137
Camphor; Determination of Camphor in — (Löhr)	510
Camphorated; Analysis of — (Liverseege)	289
Candle-nut — (Lewkowitzsch)	909
Cascarilla; Composition of — (Fendler)	274
Castor; Physical and Chemical Constants of — (Doward)	370
Cay-doc, of Tonkin	1122
Chinese Wood; Attempts to Deodorise. (Ulzer)	261
Chinese Wood; Oxidising of — (P) Kronstein	485
Citron — (Burgess)	1237
Citronella — (Parry)	930
Clove; Factory at Pemba. (T. R.)	776
Cod-liver; Production of — (Lépinois). (T. R.)	860
Colours in Tubes; A Siccative for — (Kitt)	910
Cotton seed; Halphen's Reaction for — (Wrampelmeyer)	285
Distillates; Solidification of Mineral — (P) Hatmaker. From Just	464
Duties in Mexico. (T. R.)	1159
Essential, Exports of Sicily. (T. R.)	1162
Essential, of Bucco Leaves. (Kondakov and Bachtschiew)	386
Essential — of Jasmine Flowers. (Hesse)	275, 1137
Essential, of <i>Licari canoli</i> . (Theulier)	606
Essential — of Orange Flowers. (Hesse and Zeitschel)	1138
Essential, of <i>Rhamnus Purshianus</i> . (Haense)	1284
Essential, of <i>Sara Asarum Canadense</i> ; Constituents of — (Power and Lees)	1238
Ethereal, from <i>Orchis militaris</i> L.; Preparation of. (Crouzel)	150
Eucalyptus, containing 60 per cent. of Geranyl Acetate. (Smith)	275
Eucalyptus; Terpeneless —	1236
Extraction of — from Dirty Waste. (P) Heywood	50
Extraction of — from Waste Products, and Apparatus therefor. (P) Powder	495
Fields of Beaumont, Texas. (T. R.)	635
Galangal — (Horst)	833
Germanium —	1237
Industry in Germany. (T. R.)	1237
Influence of — on the Insulating Properties of Mica. (Drouin)	482
Lard; Examination of — (Duyk)	590
Lemon; Citral in —; Determination of. (Parry)	75
Lemon; Preparation of — (Child and White)	274
Lemon; Production of — in 1900. (T. R.)	776
Lemon; The Industry of — (Burgess and Child)	1178



Oil—cont.	PAGE	Oils—cont.	PAGE
Lemon; Two New Substances in — (Burgess)	745	Rose; Phenylethyl Alcohol in — (von Soden and Rojahn)	65
Linaloe — (Cayenne) (Theulier)	745	Sandal-Wood, Lavender and Thyme; Examination of — (Kebler)	756
Linseed —; Analytical Constants of Boiled — (Kitt)	484	Sulphur in; Determination of — (Jean)	1147
Linseed; Substitute for Boiled — (P) Amundsen	1005	Treatment of — to improve their Taste. (Huth)	371
Linseed; Trade Description of — in India. (T. R.)	294	Turkey-Red — in the Woollen Industry. (Steinberg)	470
Maize; Composition of — (Vulte and Gibson)	370	Whale and Seal; Bleaching of — (P) Clark. From Rissmuller	1005
Mandarin; Artificial	1237	Oil-Presses; Pressing Plates for Hydraulic — (P) Mackenzie. From The Gesellschaft der Rigner Eisengiesserei	1004
-Mills at Bremen in 1900. (T. R.)	769	Oil-Seed Exports of Chinde, East Africa. (T. R.)	1043
Mineral, Industry at the Glasgow Exhibition	687	Oil-Seeds and Oil-Cake Exports of Libau, Russia. (T. R.)	1043
Mineral —, Industry of the United States. (T. R.)	635	And Oil-Cake Exports of Riga. (T. R.)	1043
Mineral —; Manufacture of — (P) Ward	831	From India in France. (T. R.)	403
Mineral; Utilising Waste Products of — (Ulzer)	112	Oil-Shales of the Lothians, Scotland. (T. R.)	80
See also Oils.		Oil-Works in South Italy. (T. R.)	860
Monarda — (Brandel and Kremers)	930	Oleaginous Compounds for Tinning Baths. (P) Burwell	371
Mustard, from Seeds of Brassica Napus. (Sjollema)	833	Matter; Bleaching of — (P) The Cotton-Seed Co. From Stanley	910
Nutmeg; Pharmacopoeia Tests of —	395	Oleates of the Metals; Preparation of — (Naylor)	498
Of Cassia Flowers	833	Oleic Acid; Conversion of — into Solid Fatty Acids. (P) Magnier and others	261
Of Jasmine Flowers; Essential — (Erdmann)	930	Olein; Import Duty on — in Servia. (T. R.)	79
Of Rue; Algerian — (von Soden and Henle)	930	Oleines; Unsaponifiable Matter in Commercial; Determina- tion of — (Neff)	509
Olive; Exports of — from Spain. (T. R.)	302	Oleomargarine in Mexico. (T. R.)	1048
Olive-leaf — (Hänsel)	1228	Olive-leaf Oil. (Hänsel)	1228
Palm —; Exports of — by Dahomey. (T. R.)	1044	Oil Exports of Spain. (T. R.)	302
Peppermint; Colour Reaction of — (Welmans)	938	Oil in Sicily. (T. R.)	1159
Peppermint; Examination of — (Lifschitz)	151	Trees; Manna Produced by — (Batandier)	375
Production in Mexico; Cotton-Seed — (T. R.)	167	Ontario; Government Assay Office in — (T. R.)	951
Pumpkin-Seed — (Graham)	1003	Open-Hearth and Converter Process; A Combined —	1213
Rape Seed and other Sweet —; Purification of. (P) Linde	591	Opium; Chinese Extract of — (Calvert)	276
Rhodium —; Manufacture of, in French Guiana. (T. R.)	1262	Morphine in; Determination of — (Reichard)	1149
Rue — (Thoms)	606	Regulations in Barbados. (T. R.)	843
Seal; Trade in — in Greenland. (T. R.)	82	Optics of Trichromatic Photography. (Ives)	68
Sesamé; Detection of — (Lambon)	285	Orange Blossom Essence. (Theulier)	1017
Sesamé; Modification of Millau's Reaction for — (Armani)	752	Flowers; Essential Oil of — (Hesse and Zeitschel)	1138
Sesamé; Occurrence and Detection of — in Arachis Oil. (Soltsien)	1121	Oil; Sweet — (Stephen)	275
Strophanthus Seed; Characteristics of — (Bjalo- brsheski)	817	Oranges; Artificial Colouring of — (Pum and Mieko)	58
Sunflower — (Jean)	908	Orchis militaris L; Etheral Oil from — (Crouzel)	150
Sweet Orange — (Stephan)	275	Ore; Briquettes from Comminuted or Pulverulent — (P) Bonay	723
Tea-Seed — in India. (T. R.)	1043	Concentrating Systems	1115
Turkey-Red; Detection of Iron in —	506	Manganese; Production of — in Italy. (T. R.)	1260
Trade of Marseilles. (T. R.)	1043	Mixed; Treatment of — for Separation of Metals. (P) Ferraris	117
Volatile, of Cassia Fistula. (Hänsel)	386	Production of Iron — in the United States. (T. R.)	858
Walnut; Bulgarian — (Petkow)	1122	Refractory; Conversion of — into Free Milling Ore. (P) Boul. From the Honneus Sulphide Co.	724
Walnut — from Juglana Nigra, L. (Kebler)	727	Sampler; The Calkins Umpire	617
Watara	833	Ores; Agglomerating Comminuted —, and Apparatus there- for. (P) Ruthenberg	1218
Wood; Composition of a — (Fraps)	237	Agitation Process for Cyaniding Gold — (Hurter)	253
Oils and Residues thereof; Treatment of — (P) Stewart- Wallace and Cowell	464	And Minerals; Obtaining of Copper and other Metals from — and Recovery of By-products. (P) Simon	368
As Finishing Materials for Textiles. (Fürth)	242	And Tailings; Treatment of Zinc-Lead Sulphide — (P) Twynam	905
At Oran, Algeria. (T. R.)	1042	Bismuth; Assay of — (Kyle)	839
Bleaching of — (P) Stanley and others	1122	Bismuth in; Detection of — (Warwick and Kyle)	620
Bromine and Iodine Values of — (Vulte and Logan)	590	Complex Gold; Assaying of — (Smith)	839
Cinghalese — (T. R.)	641	Copper; Dry and Wet Treatment of — (Longridge)	1117
Containing Carbone; Analysis of — (Kremers)	16	Copper — in South Australia. (T. R.)	1042
Drying and Marine Animal; Detection of — (Hal- phen)	1214	Copper; Leaching — with Sulphurous Acid. (Jennings) Seeman	479
Elimination and Determination of Water in — (Davis) Essential — and Terpenes. (Wallach)	64	Copper; Treatment of —, and Apparatus therefor. (P) Crucibles for Treatment of — (P) Crosby	1218
Essential; Determination of Carbone in — (Walther) Essential; Determination of Methyl Anthranilate in — (Hesse and Zeitschel)	289	Crushing and Lixivating — (P) Pape and Henneberg	587
Essential; Identification of Citral and other Constituents of — (Burgess)	844	Electric Disintegration of — (P) Graham	1221
Essential; Improvement of the Odour of — (P) Lavol- lay and Bourgoin	503	Fine-grained Iron; Briquetting of — (Klein)	901
Essential; Surface Tension and Viscosity of — (Jean- card and Satic)	607	For Cyaniding; Advantages of Roasting — (Janitzky) Furnaces for Smelting, &c. See under Furnaces.	901
Eucalyptus; New — (Baker)	1235	Gold, at Cripple Creek, Colorado; Sampling and Milling of — (Hazelhurst)	44
Eucalyptus; New Aromatic aldehyde in — (Smith)	744	Gold, at Deloro; Treatment of — by Cyanide Process. (Wright)	812
Extraction of Vegetable —, and Apparatus therefor. (P) Froehling	1019	Gold, at Mount Morgan, Queensland; Chlorination of — (Nardin)	45
Filtering Apparatus for — (P) Fox and Kingscote	314	Magnetite; Determination of Iron in — (Richards)	126
For Manufacture of Paints and Varnishes; Manufacture of — (P) Ramage	1005	Or Compounds; Electric Reduction of — (P) Irvine	908
For Tinning Baths. (P) Burwell	371	Production of — in the United States. (T. R.)	759
Heat of Combustion of — as an Analytical Factor. (Sherman and Snell)	590	Reduction of Refractory — (P) Boul. From Polhé and Croasdale	368
Heated Vegetable; Detection of — in other Oils. (Tor- telli and Ruggeri)	753	Smelting and Calcining — with Recovery of By-Pro- ducts. (P) Naef	366
Hydro-Refiner for Refining — (Morgan) (P)	371	Spathic; Determination of Zinc in — (Flath)	935
Hydrocarbon; Clarification of — (P) Warren	352	Sulphide, containing Lead and Zinc; Treatment of Com- plex — (P) Kirkpatrick-Picard	130
Hydrocarbon; Purifying — and Rendering Non Explo- sive. (P) Mason	1100	Sulphide, containing Lead and Zinc; Treatment of Mixed — (P) Davis and Davis	47, 129
Liquid Fatty Acids in some — (Lane) and their Iodine Values	1083	Sulphide; Determination of Silver in — (Holland)	391
Lubricating; Friction of — at High Temperatures. (Kapff)	1222	Sulphide; Eliminating Sulphur from — (P) Guten- sohn and Price	723
Lubricating — in Germany. (T. R.)	860	Sulphide; Elimination of Zinc from — (P) Clancy and Marsland	481
Maumencé Test for — (Mitchell)	939		
Mineral; Manufacture of Saponaceous Products from — (P) Dyson and Gaskell	262		
Mineral; Solidification of — (P) Heibing and Pass- more	50, 50		
Preservative; Treating Tar Oils for Production of — (P) Herborn	1103		
Refining of — (P) Crichton and Joselin	371		
Refining of —, and Apparatus therefor. (P) Rocca	485		
Rose; Comparison of German and Bulgarian — (Schimmel)	744		

	PAGE
Ores—cont.	
Sulphide; Extraction of Metals from —. (P) Clancy and Marsland.....	904
Sulphide; Metallurgical Treatment of —. (P) Bullier and others.....	481
Sulphide; Roasting —, and Apparatus therefor. (P) Tangye.....	256
Sulphide; Treatment of —. Phoenix Process. (Ashcroft)	1216
Sulphide; Treatment of —. (P) Swinburne and Ashcroft.....	907, 907
Telluride Gold, of Cripple Creek and Kalgoolie. (Rickard).....	45
Tin; Lixivation of —. (P) Brandenburg and Weyland	1216
Treatment of —. (P) Seligson.....	587
Treatment of —, and Apparatus therefor. (P) Westman	367
Treatment of Complex —, and Apparatus therefor. (P) Worsley and Lancashire.....	367
Treatment of Complex and Refractory. (P) Ellershausen	47
Treatment of — for Production of Zinc White. (P) Middleton and others.....	911
Treatment of Metallic — by Chlorine. (P) Atkins.....	808
Tungsten in; Determination of —. (Fritchie).....	840
Uranium and Vanadium; Analysis of —. (Fritchie).....	70
Zinc —, in New South Wales. (T.R.).....	1153
Zinc-Lead; Ellershausen Process for Treatment of —. (Viljean).....	254
Zinc; Treatment of —, and Apparatus therefor. (P) Armstrong.....	367
Zinc; Treatment of Complex —. (P) de Bechi and The General Metal Reduction Co.....	47
Organic Acids Extracted by Ether from Diffusion Juice and Mascascuites. (Andriik, Urban and Stanek).....	54
Acids; Titration of — by Coloured Indicators. (Berthelot).....	938
Bodies; Preservation of —, and Apparatus therefor. (P) Mézáros.....	601
Chemistry—Qualitative. (Class XXIII.)..... 71, 158, 284, 393, 507, 621, 752, 841, 937, 1029, 1146, 1244	
Chemistry—Quantitative. (Class XXIII.)..... 73, 159, 285, 394, 508, 622, 753, 841, 938, 1030, 1146, 1245	
Compounds, Nitrous Group in: Determination of —. (Clausner).....	622
Compounds; Pyrogenetic Contact Reactions of —. (Ipatiew).....	1200
Matter in Waters; Source of Error in Kubel-Tiemann Method for Determination of —. (Duyk).....	736
Products; Electrolytic Production of —. (Swau).....	668
Substances; Action of Mercuric Oxide on —. (Lumière and Perrin).....	497
Substances; Preserving —. (P) Trier and Wilkinson.....	492
Organisms of Nitrification. (Stutzer).....	597
Orseille in Wine; Detection of —:	
(Bellier).....	284
(Truchou).....	284
Ortho-Anisidine; Nitro Derivatives of —. (Freyss).....	356
Ortho-Nitro-Anthraquinone and 1'5 and α-Dinitroanthraquinones; Electrolytic Reduction of —. (Möller).....	1001
Orthoclase. See under Felspar.	
Osmium; Discovery of — in New Zealand. (T.R.).....	858
Filaments; Means for Supporting — in Incandescence Lamps. (P) Imray. (From Oesterr. Gasglühl und Electric Ges.....	884
Osmophorous (Scent-forming) Groups. (Rupe and von Majewski).....	151
Osmosis of Liquids through Pig's Bladder. (Plusin).....	292
Otto of Rose in Bulgaria. (T.R.).....	1162
In Eastern Roumelia in 1900. (T.R.).....	776
Outenbin-Chalandre Alkali Process; The —. (Kershaw).....	473
Oven; Coke; Construction of —:	
(P) Koppers.....	882
(P) Stauber.....	1100
Ovens, Coke; Construction of —. (P) Koppers.....	882
Coke; Heating of Pye-Product Saving —. (P) Koppers.....	882
Coke; Horizontal —. (P) Collin.....	882
Coke Regenerative —. (P) Schmiwind.....	462
Muffle — for Burning Liquid Fuel. (P) Fanson.....	882
"Ovos"; Preparation of — from Yeast. (Lebbin).....	825
Oxalic Acid in Saturation Mud (Sugar). (Andriik).....	140
Preparation of Chemically Pure —. (Schmatolla).....	496
Oxide, Ferro ferric; Obtainment of —. (P) Haddan. From Ramage.....	809
Metallic; Action of — on Solutions of Metallic Salts. (Sabatier).....	806
Oxides, Metallic; Manufacture of —. (P) Wetter. From Besemfelder.....	987
Metallic; Obtainment and Treatment of —. (P) Hargreaves.....	808
Of Metals and Metalloids; Treatment of —. (P) Sudre and Thierry.....	477
Oxidising Agents; Manufacture of —. (P) von Greave and Reinecken.....	261
Chemical Compounds to a Higher Oxide. (P) Wedge.....	626
Oxy-Alcohols; Production of Aromatic —. (Eichengrün).....	1239
Oxybenzylamine, Hydrogenised; Manufacture of —. (P) Imray. From the Farb. vorm. Meister, Lucius und Brüning.....	152

	PAGE
Oxycellulose and Hydrocellulose. (Murumow, Sack, and Tollens).....	739
Detection of —. (Philip).....	393
In Cotton Goods; Detection of —. (Philip).....	358
Presence of Cellulose in — (Tollens).....	740
Researches on. (Nastukoff).....	573
Oxydase and Peroxydase Reaction. (Hunger).....	1030
Functions of —. Grüss).....	919
Oxygen; "Active." VII. Auto-Oxidation of Unsaturated Hydrocarbons. (Engler and Frankenstein).....	1151
And Copper; Fusibility of Mixtures of —. (Heyn).....	996
And Metallic Copper; Relation between —. (Heyn).....	723
And Stannous Chloride; Reaction between —. (Young).....	943
Apparatus for Separation of — from Air. (P) Thrupp.....	1018
Commercial Electrolytic Manufacture of —. (Schoop).....	256
Consumed in the Analysis of Water; Influence of Chlorine as Chlorides in Determination of —. (Weems and Brown).....	1625
Dissolved in Water; Colorimetric Method for Determining —. (Ramsay and Homfray).....	1071
Gas; Preparation of —:	
(P) Jaubert.....	931
(P) Timm.....	1018
In Commercial Copper; Determination of —. (Lucas).....	157
In Waters; Determination of —. (Rideal and Stewart).....	841
Oxidation of Indigo White by —. (Manchot and Herzog).....	841
Pictet's Process for Separation of —.....	985
Union of Silver with —. (Berthelot).....	128
Oxyhydroquinonephalein; Fluorescein Esters of —. (Feuerstein, Dutoit, and Wallach).....	1105
Ozokerit Deposits in Finland. (T.R.).....	1043
Ozone; Action of — in Manufacture of Sugar. (Herzog).....	64
Electrolytic Production of —. (Swan).....	58
Formation of —. (Chassy).....	1220
Microchemical Detection of —. (Emich).....	1142
Quantitative Determination of —. (Ladenburg and Quasig).....	749
Ozonisers for Treating Air, Gases, &c. (P) Yarnold.....	1129
Ozotype; Chemical Processes of —. (Wall).....	834
Process; Description of —. (Blackmore).....	154

P

Packing Material. (P) Raphael and Elias.....	582
Material for Gay Lussac and other Towers. (P) Gibson.....	897
Paint for Preserving India-Rubber Tyres. (P) Philp.....	911
Heat-Insulating —. (P) Hommel.....	728
Imports of Nagasaki, Japan. (T.R.).....	955
Industry of the United States. (T.R.).....	403
Paints. (Class XIII.)..... 50, 83, 136, 167, 262, 372, 403, 520, 591, 728, 770, 860, 910, 955, 1005, 1045, 1222, 1260	
Paints and Colours in Mexico. (T.R.).....	167
In Madeira. (T.R.).....	660
Manufacture of —:	
(P) Gerhardt.....	372
(P) Hyndman and Banyard.....	591
Manufacture of in the Crimea. (T.R.).....	1045
Trade Description of — in India. (T.R.).....	291
See also Pigments.	
Palestine; Minerals and Phosphate in —. (T.R.).....	951
Phosphate Deposits in —. (T.R.).....	303
Palladium Toning. (Joë).....	154
Palm Oil Exports of Dahomey. (T.R.).....	1044
Papaverinol; Characteristics of —. (Stuchlik).....	65
Papenburg; Nickel Factory at —. (T.R.).....	769
Paper. (Class XIX.)..... 61, 147, 168, 272, 382, 408, 495, 612, 739, 775, 830, 863, 925, 957, 1014, 1133, 1161, 1230, 1261	
And Similar Material; Treatment of — for Embossing. (P) Marlin and others.....	1133
Barium-Coated for X-Ray Screens; U.S. Customs Decision on —. (T.R.).....	1162
-Board; Sheets or Continuous Lengths of —. (P) Lake. From Weldon.....	392
Colouring —. (Class VI.)..... 39, 119, 242, 359, 469, 574, 710, 804, 1111, 1298	
Copying —, and Ink for Use therewith. (P) Brown.....	272
Deodorising certain sized —. (Weichell).....	1014
Detecting Forgeries on —. (Bryulants and Gody).....	61
For Photographic Copying of Line Drawings. (P) Haecke.....	1140
Hints to Exporters of —. (T.R.).....	168
Imports of Brazil. (T.R.).....	162
Imports of Mexico. (T.R.).....	168
In Germany in 1900. (T.R.).....	863
Industry of Bohemia. (T.R.).....	957
Industry of Germany. (T.R.).....	863
Industry of Roumania. (T.R.).....	957
Industry of Russia.....	61
Industry of the Province of Florence. (T.R.).....	1261
Machines; Purification of Waste Waters from —, and Recovery of Pulp. (Schmidt).....	382
-Making; Acid-proof Mineral for —. (T.R.).....	403
-Making Industry in Japan. (T.R.).....	408



	PAGE		PAGE
Paper— <i>cont.</i>		Pemba; Dyestuff-yielding Trees of — (T.R.)	763
-Making Materials; Washing of —, and Recovery of		"Kaniki" (Blue Cotton) in — (T.R.)	763
Soap and Alkali. (P) Knopf	926	Soap supplied by Germany to — (T.R.)	769
Manufacturing — (P) Weeks	148	Washing-Blue in — (T.R.)	770
Manufacture; Increased Cost of Wood for — (Bühler)	147	Pentosans; Behaviour of —, towards Seeds during Germination. (Schöne and Tollens)	263
Manufacture of:		Determination of. (Fraps)	843
(P) Billing	926	Determination of —, by Phloroglucinol Method. (Kröber)	396
(P) Callender	831	In Gum Arabic. (Hofelmann)	822
(P) Dreher	831	Of Brewers' Grains, Ju'e, and Loofah. (Schöne and Tollens)	1226
(P) Johnsons and Wilcox. From Wildridge	603	Pentoses; Fermentation of the — (Schöne and Tollens)	735
Materials from Wood, and Treatment of the Waste Waters. (Gottstein)	495	Peppermint Oil; Colour Reaction of — (Welmans)	938
Metallised — (P) Haerle	741	Examination of — (Lifschitz)	151
Mills in India — (T.R.)	775	Pharmacopœia Tests of —	385
Mills; Recovering Water and Pulp from Waste Waters of — (P) Faust	496	Peptone, Ampho-; Preparation of Pure — (Mühle)	745
Peat Fibre for Manufacture of — (P) Jensen. From Krause	602	Anti- and Ampho- (Siegfried)	276
-Pulp. <i>See under</i> Pulp.		Anti-; Reputed Non-Existence of — (Kutscher)	276
Rendering —, Temporarily Transparent. (P) Von Grieso	603	Hexone Bases in —; Determination of. (Haslam)	494
Sheets, or Continuous Lengths of — (P) Lake. From Weldon	382	Manufacture of — (P) Mewburn. From Chem. Fab. von Heyden	827
Sizing; Chemistry of — (Friedlaender and Seidel)	602	Perbromides of Cinchona Alkaloids. (Christensen)	60
Specific Gravity of —	928	Perchlorates; Electrolytic Production of — (Winteler)	725
Straw —	148	In Chili Saltpetre; Determination of — (Grimm)	1144
Transfer —	926	Perfume, Artificial Flower; Preparation of — (P) Heine and Co.	745
Treating Peat Turf for Manufacture of — (P) Pollak and Esser	830	Preparation of a New —, "Janthone." (P) Durand and others	503
Waterproof; Manufacture of —:		Perfumes; Improvement of — (Lavolloy and Bourgoin)	601, 1236
(P) Joseph	1231	Of the Province of Florence. (T.R.)	6272
(P) Ward	831	Perfumery Industry of Germany. (T.R.)	408, 864
Papers, Normal, and Mechanical Wood-Pulp. (Herzberg)	739	Periodates; Electrolytic Preparation of the Alkali — (Müller)	369
Opacity of —	739	Permeability of Iron and Steel; Instrument for Measuring the — (Lamb and Walker)	811
Para; Cement exported to — (T.R.)	518	Pernambuco; Chemical Industries of — (T.R.)	630
Paracymene—3-sulphonic Acid; Manufacture of Salts of — (Dinesman)	1019	Peroxides; Some Reactions of — (Ditz.)	339
Paranitraniline Red; Printing of — (Flintoff)	470	"Peroxols"; Disinfecting Properties of the — (Beck)	830
White and Coloured Resists for —	576	Perroche and Krause Methods for Determining Purity of Beet-root Juice. (Pellet.)	458
Paraffin; Extraction of —, from Lignite Tar. (P) Pauli	978	Persia; Gum Industry of — (T.R.)	770
Purification of — (P) Henderson and Calderhead	978	Pertusaria amara (Ach) Nylander; Composition of — (Zopf.)	77
Wax; Determination of Melting Point of — (Kissling)	795	Peru Balsam in Central America. (Preuss.)	150
Wax; Imports of Sicily. (T.R.)	1156	Borate of Lime Shipments from Mellonde. (T.R.)	764
Paraffins in Tobacco Leaf. (Thorpe and Holmes)	758	Cocoa Shipments from Mollendo. (T.R.)	776
Para Rubber Mixings. (Springer)	592	Copper Deposits of Cerro de Pasco. (T.R.)	768
Pariatoluidine; Oxidation of — (Börnstein)	701	Exports of — (T.R.)	1037
Paris Green, Arsenious Oxide in; Determination of — (Avery and Beans)	936	Peruvian Bark; Increased Consumption of — (T.R.)	258
Green; Soluble Arsenious Oxide in — (Avery and Beans)	495	Petroleum. (Class III.)	32, 80, 111, 165, 237, 295, 352, 399, 464, 516, 566, 635, 700, 762, 795, 854, 885, 977, 1038, 1102.
Parmelia incurva; Composition of — (Zopf.)	77	Composition of Californian — (Mabery and Hudson)	568
Pasteboard. (Class XIX.) 61, 147, 168, 272, 382, 408, 495, 612, 739, 775, 830, 863, 925, 957, 1014, 1139, 1161, 1230, 1261		Composition of Japanese — (Mabery and Takano)	569
Paste-Glue. <i>See under</i> Glue.		Composition of Texas — (Mabery)	735
Paste; Liquid — (P) Häckel, Heinrich, and Gumprecht.	141	Deodorization of —	238
Pasteurising Apparatus. <i>See under</i> Sterilising Apparatus.		Deposit at Beaumont, Texas. (T.R.)	165
Patent Law. (Levinstein)	13	Distillation Test <i>versus</i> Flash-Point Test. (Charitschkoff)	238
Patent Law Amendment. (Jekyll.) (T.R.)	1256	Exported from Batoum in 1909. (T.R.)	762
Law Amendment. (T.R.)	951	Filtering — through Fuller's Earth. (Engler and Albrecht)	1102
Law; Report of Sir E. Fry's Committee on — (Levinstein)	1082	For Metallurgical Purposes. (von Ferselles)	461
Laws in Chemical Industry. (Ephraim)	1251	From the Beaumont Field, Texas. (Richardson and Wallace)	690
Patents Acts; Committee on the — (T.R.)	294	In Canada. (T.R.)	1256
In Germany during 1909. (T.R.)	515, 850	Inclusions in the Muschelkalk Formation. (Engler and Albrecht)	1102
Lists of —	87, 171, 306, 409, 523, 647, 778, 866, 959, 1050, 1164, 1264	Industry of Japan. (T.R.)	1038
Novelty in —, According to German Law. (Grossmann)	1078	Industry of Russia. (T.R.)	516
Pauillac; Chemical Industries of — (T.R.)	632	Inflammability of Light — (Steingraber)	352
Paving; Composition for. (P) Candemberg	126	Manufacture of Saponeous Products from — (P) Dyson and Gaskell	262
Peat; Analysis of — (Bornträger)	159	Product of the Solution of Ozone in — (P) Otto	112
As a Substitute for Coal in Sweden. (T.R.)	634	Production in Russia in 1900. (T.R.)	295
Boards and Peat-Litter	739	Refining of — with Lime. (Charitschkoff)	885
Briquettes of —	1095	Russian; Duties on — (T.R.)	162
Carbonisation of — (P) Holm	1197	Spouting Well at Beaumont, Texas. (Lucas)	885
Carbonisation of —, and Apparatus therefore. (P) Holm	793	Texas; Quality of —	237
Charring —, and Apparatus therefore. (P) Von Heidenstam	112	<i>See also under</i> Asphalt, Bitumen, Oil, Oils, Naphtha, Paraffin, and Kerosine.	
Coal and Peat as Coal Substitutes. (Hamb.)	233	Pharmaceutical Chemicals in Germany in 1909. (T.R.)	864
Coking of —, and Apparatus therefore. (P) Ziegler	793	Compounds; Production of New — (P) Newton. From The Farb. vorm. F. Bayer and Co.	1159
Drying of —:		Pharmacopœia Conditions as Tests. (Moor and Priest)	585
(P) Dickson	793	Phellandrene. (Wallach)	64
(P) Dillon	1099	Nitrite. (Schreiner)	527
-Fibre for Paper Manufacture; Production of Purified — (P) Jensen and Son. From Krause	602	Phenacetin; Phenacyl — (Goldschmidt)	929
-Fibre in Germany	804	Phenanthrene; Obtainment of Pure — from Coal Tar. (P) Wetter. From the Aktienges. für Theer- und Erdöl-Industrie.	706
Fodder from; Manufacture of — (P) Bornträger	828	Phenetol-carbamide. <i>See under</i> Dulcine.	
-Fuel; Preparation of — (P) McNamee	882	Pheulol; Detection of — (Maseau)	841
Pulping, Mashing, and Moulding — (P) Zohrab	1099	Determination of — (Telle)	288
Treating and Drying — (P) Sims and Davis	462	Electrolysis of — in Presence of Halogen Acids. (Zehrlaut)	369
Treatment of — (P) Lake. From Jensen	1197	In Dressings; Determination of — (Telle)	1140
Treatment of —, and Apparatus therefor. (P) Jensen. From Heine	1099		
Turf; Treatment of —, for Paper Manufacture. (P) Pollak and Esser	830		
Utilisation of —:			
(Sauber)	233		
In Germany	790		
Pectins; Presence of Cellulose in — (Tollens)	710		

	PAGE
Phenol— <i>cont.</i>	
Iodo-derivatives of — (Brenans).....	496
Mixed with Resinous Substances; Determination of — (Thresh).....	939
Reaction for — (Fiore).....	507
Phenols, Determination of — (Verley and Böising).....	1250
Displacement of Alkyls from — by Nitration. (Larter).....	745
Metamino — (Gnehm and Scheutz).....	798
m-Amino; Preparation of Dyestuffs from Alkylated — (Grimaux).....	365
Rendering — Soluble in Water. (P) Wetter. From the Actienges. für Theer- und Erdöl-Industrie.....	739
Phenylalanine; Formation of — by Hydrolysis of Egg Albumin. (Fischer).....	1151
Phenylanthranol and Oxanthranol; Formation and Properties of Tetramethyldiamino — (Haller and Guyot).....	445
Phenylethyl Alcohol. <i>See under</i> Alcohol.	
Phenylglycine Carboxylic Acid and Derivatives thereof. (P) Lake. From The Farbwerk Mühlheim vorm. Leonhardt and Co.	277
Phenylglycine-o-carboxylic Acid; Neutral Esters of Acetyl — (P) Newton. From the Farb. vorm. F. Bayer and Co.	277
Phenylglycine-o-carboxylic Acid; Preparation of Esters of — (P) Chem. Fabrik von Heyden.....	979
Phenylmethane, Di-; Derivatives of — (Cohn).....	464
Phenylmethane Diphenylene —; Dyestuff derived from. Tri-; Colouring Matters — (P) Johnson. From Boehringer and Soehne.....	790
Phenylmethylechloropyrazol Chloromethylate; Action of Aniline and of Ammonia on — (Michaelis and Gunkel).....	592
Philadelphia; Textile Dyeing in — (T.R.).....	635
Phenix Process for Treating Sulphide Ores. (Ashcroft).....	1216
Phosphate Deposits in Palestine. (T.R.).....	303
Discoveries in Egypt. (T.R.).....	83
Imports of Civita Vecchia. (T.R.).....	1646
Industry in Christmas Island. (T.R.).....	167, 405, 643
Mineral; Detection of — in Thomas Slag. (von Lorenz).....	69
Production of the United States. (T.R.).....	1045
Rock Production of the United States. (T.R.).....	83
Sources of —.....	
Trade of Great Britain. (T.R.).....	363
Phosphates, Action of Alkali — on Chrome Mordants. (Binder and Zundel).....	1108
At Genoa, in 1900. (T.R.).....	862
In Algeria. (T.R.).....	1046
In Cape York Peninsula. (T.R.).....	956
In Potable Waters; Determination of — (Woodman and Cayvan).....	506
In Russia. (T.R.).....	168
In Western Australia; Mineral.....	945
Preventing Escape of Silicon Fluoride in Decomposition of — (P) Teisler.....	1007
Sources of Supply of — (T.R.).....	520
Phosphoric Acid; Acidimetry of — by means of Baryta. (Cavalier).....	833
Citrate Solubility of Bone-meal — (Methner).....	374
Equilibrium between two Bases in Presence of — (Berthelot).....	806
In Basic Slag Powder; Molybdate Method of Estimating — (Foerster).....	751
In Dephosphoration Scorior; Determination of — (Palmans).....	267
In Manures; Determination of — (Ledoux).....	936
In Soils; Determination of — (Schloesing).....	710
Kilgore's Method of Determining — (Williams).....	392
Neutralisation of — (Berthelot).....	803
Water-soluble, in Superphosphates; Determination of — (von Zell).....	936
Phosphorus Chlorides; Compounds of — with Boron Bromide. (Tarible).....	291
Detection of Free — (Muckerji).....	748
Electrolytic Production of — (Swan).....	670
Ignition Temperature of — (Eydmann, jun.).....	617
In Acetylene and other Gases; Determination of — (Eitner and Keppeler).....	933
In Steel Ingots; Variation of — (Wahlberg).....	904
Influence of — upon Copper. (Stahl).....	490
Suboxides; Non-existence of the so-called —, II. (Burgess and Chapman).....	1259
Trichloride; Preparation of — (Graebe).....	473
Photo-Chemical Induction. (Abegg and Immerwahr).....	277
Photographic Chemicals, &c., at Rio Grande. (T.R.).....	1049
Chrome Pictures; Intensifying — (Hauberisser).....	1239
Copying of Line Drawings; Paper for — (P) Haucke.....	1149
Density; Loss of — during Fixing. (Lüppo-Cramer).....	1019
Developer; A New — (Eichenzrün).....	1239
Developer; Limit of Dilution of Metol — (Kastner).....	608
Developer; Sulphite in the — (Liese-gang).....	387
Developers; Action of Sodium Sulphite in — (Liese-gang).....	278
Developers; Misunderstood — (Lüppo-Cramer).....	1019
Developers; Substitution in — (Lüppo-Cramer).....	1140
Development; Theory of — (Lüppo-Cramer).....	1019
Emulsion; Matt-surfaced — (P) Mills. From Lumière Fabrics, and Preparation thereof. (P) Page. From the Grenier Art Co.	278
	1020

	PAGE
Photographic— <i>cont.</i>	
Films and Plates; Protective Paint for — (P) Plagwitz and Freund.....	154
Films; Potassium Permanganate for Destroying Thio-sulphate in — (Valenta).....	608
Films; Transparent. (P) Thornton and Rothweil.....	68
Fixing Baths.....	68
Goods and Chemicals in Madeira. (T.R.).....	865
Image; Variation of Gradation of a Developed — (Abney).....	931
Intensification. (Thomas).....	154
Intensification; Chemical Processes in Mercurial — (Novak).....	1020
Intensification; Mercury - Sodium - Sulphite Process. (Vogel).....	505
Intensifier; Mercuric Sulphocyanide — (Eberhard).....	387
Materials; Receptacles for Small Quantities of — (P) Griffin and Sons and Ibbetson.....	932
Plates and Films; Protective Paint for — (P) Plagwitz and Freund.....	154
Plates; Duties on — in Italy. (T.R.).....	950
Plates, Films and Papers; Drying of — (P) Edwards and Nelson.....	952
For Photographing Absorption Spectra — (Miethe).....	67
Gelatin Dry; "Fogging" of — (Zucker).....	278
Plates; Increasing Sensitiveness of — (Neuhaus).....	67
Plates; Making Ultra-Violet Sensitive — (Schumann).....	1020
Positives; Preparation of Ferrotypes — (Mitth).....	746
Printing and Developing; Apparatus for — (P) Vickers and Kumsey.....	68
Printing Process.....	153
Printing Process, using Iron Sacrate. (Lumière).....	154
Printing Surfaces. (P) Fulton and Gillard.....	388
Prints; Obtainment of — (P) Abel. From the Actienges. für Anilin Fabrikation.....	608
Prints; Rendering Bromide — more Permanent. (P) Smith.....	609
Reducer; Ammonium Persulphate as a —.....	746
(Myblin).....	68
(Namias).....	605
Reducer; Potassium Permanganate as a — (Hands).....	153
Reducer; Production of a — (P) Abel. From The Actienges. für Anilin Fabrikation.....	609
Reducers; Ammonium Persulphate and other — (Lumière).....	1140
Reducers; Production of — (Lumière and Seyewetz).....	153
Reduction by Means of — (Luppo-Cramer).....	278
Reduction; New Process of — (Blanc).....	505
Sensitiser; New Panchromatic — (Valenta).....	1020
Silver Prints; Reducing the Intensity of — (Lumière frères and Seyewetz).....	504
Supplies in Brazil. (T.R.).....	1262
Photography. (Class XXI.).....	67, 153, 277, 386, 504, 608, 746, 835, 865, 931, 1019, 1049, 1140, 1259, 1262
Colour Filters for —.....	1020
In Colours. (Truchelut and Rochereau).....	387
Lighting Apparatus for Instantaneous — (P) Guimaraes.....	237
Of Colour; The — (Abney).....	1060
Optics of Trichromatic — (Farmer).....	387
(Ives).....	68
Practical Tricolour — (Farmer and Symmons).....	1019
Prevention of Halation in Micro — (van Walsen).....	278
Sensitive Fabrics for Use in —; Preparation of (Junk).....	154
Photolithography; New Process of — (Schneider).....	505
Photometer; New (Gas Referees') Table — (Clowes).....	792
Photometers; Portable — (P) Deshler and McAllister.....	352
Phthalic Acid, &c.; Duty on — in the United States. (T.R.).....	79
Manufacture of — (P) Imray. From The Basle Chem. Co.	1139
Physarum Leucophaeum; Yeast-enclosing Amoebæ of — (Henneberg).....	491
Phytolacca in Wine; Detection of — (Bellier).....	284
Phytosterol and Cholesterol in Mixtures; Separation of — (Marcusson).....	484
Quantitative Extraction of — from Fats. (Ritter).....	1147
Picric Acid; Manufacture of — (Wenghöfer).....	570
(P) Wenghöfer.....	932
Production of — (P) Gutensohn.....	837
Tanning with — (Watenburger).....	596
Picrotoxin; New Reaction for — (St. Minovici).....	285
Pictet's Process for Separation of Oxygen from Air.....	985
Piece Goods in the Open State; Treatment of — (P) Jackson and Hunt.....	120
Pig-Iron. <i>See under</i> Iron.	
Pigment, Iron Oxide — (P) Haddan. From Ramage.....	910
Pigments. (Class XIII.).....	50, 83, 135, 167, 262, 372, 403, 520, 591, 728, 770, 860, 910, 955, 1003, 1045, 1222, 1260
Pigments and Dyes with Relation to Production of Designs. (P) Stevenson.....	1208
Cadmium Compounds for India-Rubber —.....	137
For Use on Porcelain, Glass, &c. (P) Ziegenbruch.....	477
Manufacture of — (P) Hyndman and Banyard.....	591
Production of — (P) Hinchley.....	1222
<i>See also</i> Paints,	
Pine Fibre Industry in Oregon, U.S.A. (T.R.).....	855
Pinene; Oxidation of — (Wallach).....	64
Pinkston Electric Power Station; Visit to —.....	680



	PAGE		PAGE
Pinocamphone; Characteristics of —. (Wallach).....	64	Potassium— <i>cont.</i>	
Pins and Small Objects; Apparatus for Electro-Plating —. (P) Morrison.....	134	Cyanate; Production of —. (P) Johnson. From The Chem. Fabrik vorm. Vorster and Grüneberg.....	717
Pinus Sylvestris; Resin of —. (Tschirch and Niederstadt).....	729	Detection of — in Presence of other Alkali Metals. (Reichard).....	933
Pinyl Formate; Production of —. (P) Mills. From The Ampère Electro-Chemical Co.....	67	Electrolytic Production of —. (P) Cohn and Geisenberger.....	726
Oxalate; Production of —. (P) Mills. From The Ampère Electro-Chemical Co.....	67	Ferricyanide; Action of Hydrofluosilicic Acid on —. (Matuschek).....	579
Piperine; Colloid form of —, its Optical Refraction and Dispersion. (Madan).....	607	Ferricyanide Solution; Influence of Light upon —. (Matuschek).....	757
Pipes; Manufacture of —. (P) Coiffier and others.....	477	Ferricyanide Solutions; Formation of Prussian Blue from —. (Matuschek).....	987
Pipette; New Form of —. (Sidersky).....	389	Ferro- and Ferri-Cyanides; Action of Carbon Dioxide on Aqueous Solutions of —. (Matuschek).....	897
Pitch; Coal-Tar — in Germany. (T.R.).....	1258	Ferro- and Ferri-Cyanides; Action of Light on Aqueous Solutions of —. (Matuschek).....	833, 1112
Pittakall and Eupiton. (Liebermann).....	569	Ferrocyanide; Action of Hydrofluosilicic Acid upon —. (Matuschek).....	363
Plant; General. (Class I.).....27, 103, 232, 343, 453, 561, 694, 788, 878, 974, 1094, 1194		Ferrocyanide; Action of Sulphurous Acid on —. (Matuschek).....	897
Plant Growth; Substitution of Soda for Potash in —. (Jordan and Jenter).....	732	Hydroxide; Absorption of — by Silicates. (Rumpler).....	843
Plants; Action of Zinc on —. (Laband).....	846	In Mixtures of Salts; Separation and Determination of —. (van Leent).....	1242
Colouring —, in German East Africa. (T.R.).....	516	Percarbonate for Destroying Thiosulphate in Photographic Films. (Valenta).....	608
Sucrose in; Identification of — by Aid of Invertase. (Bourquelot).....	1244	Permanganate and Alkali Thiosulphates; Interaction of — in Neutral Solutions. (Dobbin).....	212
Plaster; Composition for use as —. (P) Bushman.....	1212	Permanganate; Application of — in Dyeing. (Saget).....	575
Hardening of — and Fixing Colours thereon. (P) Kessler.....	719	Permanganate as a Photographic Reducer. (Hauks).....	153
Plaster of Paris; Determination of Underburnt and Overburnt Portions of —. (Périan).....	156	Permanganate; Determination of —. (Alander).....	1242
See also under Gypsum.		Persulphate; Action of Anhydrous Sulphuric Acid on —. (Bach).....	716
Plates, Amalgamating; Electro-Silvered versus Plain Copper For Photography. See under Photographic.	259	Persulphate; Oxidation of Aloin by —. (Seel).....	66
Platinum; Analogy between Diastatic Action of Colloidal — with that of Organic Diastases. (Bredig).....	376	Potato Products of Germany in 1900. (T.R.).....	774
Enzymatic Actions of Colloidal —. (Bredig).....	376	Spirit from the Mashing Space; High Yields of —. (Schirmann).....	56
Gold-Silver Assay. (Oehmichen).....	507	Potatoes; Formation of Solanine in —. (Weil).....	384
In Canada. (T.R.).....	1259	Starch in; Baumert and Bode's Method of Determining —. (Behrend and Wolfs).....	623
In Platinura Ores; Determination of —. (Leidie and Quennesen).....	1242	Potteries; Lead Poisoning in the —. (T.R.).....	1258
Price of — in United States. (T.R.).....	1041	Potters' Ovens or Kilns. (P) Bettaney.....	477
Production of — in the Ural. (T.R.).....	767	Pottery. (Class VIII.).....43, 123, 166, 250, 364, 475, 580, 636, 718, 809, 857, 897, 953, 988, 1040, 1113, 1157, 1210, 1258.	
Residues; Working-Up —. (Berthold).....	902	Enamelled Articles of —. (P) Rapoport.....	1211
Salts; Duty on — in Sweden. (T.R.).....	515	Flowing Under Glaze Colours in —. (Salt).....	1211
Scrap; United States, Customs Decision on —. (T.R.).....	1042	Glazes; Solubility of Lead Glasses or Frits used in —. (Jackson and Rich).....	43
Separation of the Metals Accompanying —. (Leidie).....	45	Lead Compounds in; Report on —. (Thorpe).....	897
Statistics of —, for 1900. (T.R.).....	82	Manufacture and Lead Poisoning.....	990
Surfaced Materials for Use as Contact Substances in Chemical Operations. (P) Johnson. From Chem. Fab. vorm. Goldenberg and Geromont.....	250	Manufacture; Lead Silicates in Relation to —. (Thorpe and Simmonds).....	476
Poison of Lotus Arabicus; Nature and Origin of —. (Dunstan and Henry).....	929	Pumping Apparatus for Slip and Glazes for —. (P) Schott.....	364
Poisons, Mineral; Destroying Organic Matter in Searching for —. Denigès.....	1142	Treatment of Vessels of, and Composition therefor. (P) Mills. From La Société des Enduits Arahambault.....	252
Within the Meaning of the Pharmacy Act; List of —. (T.R.).....	775	Use of Lead in the Manufacture of —. (Thorpe).....	475
Poisoning; Arsenical —.....	943	Visit to the Britannia —. (Thorpe).....	679
Polishing Tools; Electrolytic Manufacture of —. (Bieder).....	1002	See also China, Earthenware, and Porcelain.	
Polychromatic Printing; Compounds and Machines for —. (P) White.....	714	Poulsen and Meslan's Apparatus for Manufacture of Fluorine. (Brochet).....	481
Polysulphides co-existing with Hydrosulphides, &c.; Determination of —. (Gautier).....	392	Powder as Distinguished from Explosives; Essential Requisites of —. (Williams).....	505
Pomegranate Bark and Extract; Determination of Alkaloids in —. (Stoeder).....	1150	Charges for Guns; Smokeless —. (P) Maxm.....	1140
Porcelain; Colouring or Decorating —. (P) Sinclair.....	727	Explosion at Indian Head, Maryland. (Kniffen).....	102
Expansion of — at High Temperatures. (Holborn and Grünisen).....	988	Smokeless; Apparatus for Manufacture of —. (Guttmann).....	836
Fusing of —. (P) Ott.....	581	Smokeless; Estimation of Soluble Nitrocellulose in —. (Quinan).....	844
Plates with Honeycombed Surface. (P) Storey and McCalla.....	126	Smokeless; Manufacture of — and Apparatus therefor. (P) Justice. From the Smokeless Powder and Dynamite Co.....	388.
Sand, and Composition of Porcelain Pastes. (Lindner).....	364, 900	President; Vote of Thanks to —.....	676
Uniting Pieces of —. (P) Stein and Storr.....	90	President's Address.....	662.
See also China and Pottery.		Primer for Producing Ignition by Electricity. (P) Kändler.....	1140.
Porosity of Fabrics; Device for Testing —. (P) Kennedy.....	731	Priming Compositions. (P) Ziegler.....	933
Portland, Oregon; Trade of —. (T.R.).....	851	For Detonating and Percussion Caps. (P) Bielefeldt.....	1240.
Portugal; Customs Decision in —. (T.R.).....	950	Printing; Compounds and Machines for Polychromatic —. (P) White.....	714.
Saltpetre at Oporo. (T.R.).....	953	Electrolytic —.....	1111
Pot Ale; Treatment of —. (P) Storer and McAlley.....	737	Ink; Manufacture of —. (P) British Oil and Cake Mills and Wass.....	1005.
Potash Bulbs; Modification of Geissler's —. (Wetzel).....	279	Process; Photographic —.....	153.
From Sheep's Wool. (T.R.).....	952	Process; Photographic, using Iron Sacrate. (Lumière).....	154.
In Germany. (T.R.).....	856	Prints; Permanence of Toned Bromide —. (Gaeddicke).....	154.
Salts; Production of Soluble — from Felspar. (Rhodin).....	439	Prize for a Substitute for Benzene.....	162.
Substitution of Soda for —, in Plant Growth. (Jordan and Jenter).....	732	Prizes. Generator Gases produced by Means of Linde Air.....	818
Works; Pollution of Water by Waste Lye from —. (Rubner and Schmidtman).....	738	Offered by Société Industrielle de Mulhouse.....	944
Potassium Bichromate; Action of — on Potassium Iodide, in Presence of Sulphuric Acid. (Seubert and Henke).....	69	Offered by the Federation of Agricultural Unions of Italy.....	513.
Chlorate; Decomposition of —. (Sodeau).....	716	Offered by the Institution of Mining and Metallurgy.....	1255.
Chlorate; Electro-Production of —. (Kershaw).....	402	Particulars of —.....	1631.
Chlorate; Electrolytic —. (Brochet).....	42	Proceedings of the Twentieth Annual Meeting.....	660.
Chlorate Explosion at St. Helens. (T.R.).....	81	Products of Combustion from Furnaces; Apparatus for Burning Unconsumed —. (P) Stapp.....	30
Chlorate; Explosion of —. (Berthelot).....	383	Propene-Pyrocatechin-Oxyethylene. See Ethoxy-Isoeugenol.	
Chlorate Manufacture; Determination of Chlorates in Absorbing Vessels. (Ditz).....	1026	Propyl Glycol; Oxidation of — by Mycoderma Aceti. (Kling).....	941
Chromate and Bichromate; Manufacture of —. (P) Spence and Shearer.....	475	Prophylactic Substances; Preparation of —. (P) Clark. From Blum.....	746
Chromate; Disturbance of Cathodic Depolarisation by —. (Müller).....	257		

	PAGE
Propylbenzene; Formation and Preparation of —. (Bodroux).....	237
Proteid Nitrogen in Vegetable Matter; Determination of —. (Fraps and Bizzell).....	74
Proteids; Chemistry of —. (Kossel).....	1238
Composition of the —. (Kossel and Kutscher).....	270
Proteolase of Aspergillus Niger. (Malfitano).....	56
Protoplasm of Yeast; Extraction of —. (Van Laar).....	376
Prussian Blue; Formation of —, from Potassium Ferricyanide Solutions. (Matuschek).....	987
In Spent Oxide; Rapid Determination of —. (Popplewell).....	225
Reserve under Parantiraniline Red. (Richard).....	984
Prussiate of Potash, Red; Action of Sulphur Dioxide on Aqueous Solution of —. (Matuschek).....	897
Pseudoaconitine and Japaconitine; Pharmacology of —. (Cash and Dunstan).....	923
Pseudosulphocyanogen and Canarin. (Goldberg).....	238
Production of —. (Goldberg).....	1103
Pulp Fibres; Apparatus for Separation of — from Waste Waters. (P) Thompson. From Füllner.....	603
Mechanical Wood — and Normal Papers. (Herzberg).....	739
Paper; Apparatus for Purification of —. (P) Schmolka.....	496
Paper; Manufacture of —. (P) Callender.....	831
Recovery of — from Waste Waters of Paper Mills. (P) Faust.....	496
Strainers; Upward Flow —. (P) Thompson. From Woge.....	741
Wood; Alkaline Process of Boiling —. (Schacht).....	1230
Wood, Fireproof; Manufacture of —. (P) Keyes.....	62
Wood, in Canada. (T.R.).....	1161
Wood, in Gothenburg, Sweden. (T.R.).....	958
Wood, in Norway. (T.R.).....	864
Wood; Specks of Monosulphite in —.....	925
Pulverisation of Materials (Hempel).....	1025
Pulverising and Separating Apparatus. (P) Kitto.....	1193
Pumice-Stone Bricks in Germany. (T.R.).....	1158
Pumpkin-Seed Oil. (Graham).....	1003
Pumps; Construction of —. (P) Siemens and others.....	789
For Air or Gases. (P) Hilliard.....	313
For Fluids of Low Boiling Point. (P) Feeny. From the Abwärme Kraftmaschinen-Ges.....	624
For Slip and Glazes for Pottery. (P) Schott.....	361
Rubber Valve-balls for —.....	488
Purine Derivatives; Pharmacological Action of —. (Schmiedeberg).....	1135
Puzzolane; Experiments on Pulverising —. (Feret).....	252
Puzzolana; New Uses of —. (Leduc).....	1114
Pyraconitine and Methylbenzocaine; Pharmacology of —. (Cash and Dunstan).....	923
Pyranol, 1'4-Benzo; Derivatives of —. (Bülow and Wagner).....	704
Benzo, &c., &c. —. (Bülow and Wagner).....	739
1'4 Benzo-; Derivatives of —. III. Bülow and von Sicherer).....	1106
Pyrethrum; Pharmacopoeia Tests of —.....	386
Pyridine; Solvent Action of — on Coals. (Baker).....	789
Pyrite and Marcasite; Distinguishing between —. (Stokes).....	1241
Pyrites, Copper in; Determination of —. (Heidenreich).....	233
Extraction of the Copper of Cupreous —. (Delplace).....	128
Pyritic Smelting and Hot Blast. (Bretherton).....	123
Smelting; Present Position of —. (Bahlsen).....	814
Pyrogen (Sulphur) Dyestuffs. (Zimmermann).....	466
Pyrogenetic Contact Reactions of Organic Compounds. (Ipatiew).....	1200
Reaction with Aid of Electric Current. (Löb).....	588
Pyrometer; Optical —. (P) James. From the Bethlehem Steel Co.....	459, 460
Pyrometers; Air —. (P) Mills. From the Bristol Co.....	28
Construction of —. (P) Andt.....	788
Pyroxylin; Instructions for Making —.....	1239
o-Pyrrolidinecarboxylic Acid; Formation of — by Hydrolysis of Egg Albumin. (Fischer).....	1151

Q

Quartz and Quartzite; Behaviour of — on Heating. (Cramer).....	900
Schist in Place of Fire-clay in Lime and Cement Furnace Practice. (Cramer).....	1115
Vitrified —. (Shenstone).....	250
Quebracho Exports from Buenos Ayres. (T.R.).....	642
Extract; Analysis of —. (Klenk).....	641, 1249
Extracts Soluble in the Cold, and their Analysis. (Paessler and Appelius).....	1124
Queensland; Mineral Production of — in 1900. (T.R.).....	858
Molybdenite and Wolfram in —. (T.R.).....	1159
Quercitrin; Sugar Constituents of —. (Votocek and Fric).....	76
Quinine Arsenate; Preparation of —. (Guigues).....	499
Basic Saccharinate. (Défournel).....	832
Bisulphate; Examination of —. (Carlinfant).....	1031
Carbonic Esters of; Preparation of —. (P) Vereinigte Chininfabriken Zimmer und Co.....	1232

	PAGE
Quinine—cont.	
In Corea. (T.R.).....	958
In Java.....	928
Sulphate in Java. (T.R.).....	864
Quinotoxine; Characteristics of —. (von Miller and Rohde).....	63

R

Rabbit Fur; Dyeing Mixtures of —.....	119
Radiations; Coloration of Salts by —. (Goldstein).....	1240
Radio-Active Lead and Rare Earths. (Hofmann and Strauss).....	76
Substances. (Giesel).....	290
Substances; Action of Cathode Rays on —. (Hofmann and others).....	387
Radium; Action of Radiation of — on Selenium. (Bloch).....	625
Chemical Effects Produced by Radiation from —. (Becquerel).....	1251
Magnetic Analysis of Radiation from —. (Becquerel).....	845
Physiological Action of Radiation from —. (Becquerel and Curie).....	845
Preparation of —. (Besson).....	845
Rays; Transparency of Metals, &c., to —. (Mizuno).....	291
Salts; Radio-Activity induced by —. (Curie and Debierne).....	396
Raffinose. See also Melitriose.	
Octabenzoyl Ester of; Preparation of —. (Stolle).....	292
Raisin Wines; Composition and Examination of —. (Schneegans).....	599
Rapeseed in India. (T.R.).....	1043
Oil; Purification of —. (P) Linde.....	591
Rare Earth Group; Separation of Members of the —. Verneuil and Wyruboff).....	148
Rassamala Resin. (Tschirch and van Itallie).....	1122
Reaction Velocities; Influence of Chemically Indifferent Solvents on —. (Menschutkin).....	75
Reactions; Change of Weight in Chemical and Physical —. (Heydweiller).....	76
Receptacles for Volatile Inflammable Liquids; Stoppers for —. (P) Schön.....	695
Reception and Conversazione at Annual Meeting.....	678
Rectifying Apparatus. (P) Crépelle-Fontaine.....	143
Red Lead; Determination of Foreign Impurities in —. (Jousser).....	1144
Lead Peroxide in —. (Liebig).....	1027
Reducers. See under Photographic.	
Refining Apparatus for Oils. (P) Morgan.....	371
Electrolytic — in the United States. (Ulke).....	727
Refractory Materials; Apparatus for Enamelling. (P) Bromhead. From Waterman.....	581
Materials for Building; Manufacture of —. (P) Friswell.....	992
Materials; Manufacture of —. (P) Friswell and the British Uralite Co.....	1115
Refuse Destructors:	
(P) Glen.....	60
(P) Liversedge.....	60
(P) Watson.....	1132
Destructors in Combination with Electric Power Stations. (Highfield).....	1012
Destructors; Smoke-consuming Apparatus for —. (P) Ball.....	1132
Disposal of Berlin House —.....	145
Material; Furnaces for Burning —. (P) Lester Dean.....	147
Regenerative Furnaces. See under Furnaces.	
Reinsch's Test for Arsenic. (Delépine).....	281
Rennet Ferment; Preparation of —. (P) Hatmaker. From Just.....	59
Report of Committee on Bookbinding Leather.....	819
Of Committee on Milk and Cream Regulations.....	493
Of Committee on Use of Preservatives and Colouring Matters in Foods.....	1228
Of Council.....	661
Of Hon. Treasurer.....	662
Of Royal Commission on Arsenical Poisoning.....	916
Of Royal Commission on Sewage. (T.R.).....	863
Of Royal Commission on spontaneous Combustion of Coal Cargoes.....	789
Of Sir E. Fry's Committee on Patent Law. (Levinstein).....	1282
On Alkali, etc., Works by the Chief Inspector.....	893
On Arsenic in Beer (T.R.).....	644
On Bacterial Treatment of Crude Sewage. (Clowes and Houston).....	494
On Effect of Moisture and Time on Hide Powder. (Turnbull).....	596
On Freiberg Hide Powder. (Paessler).....	395
On Government Laboratory for Year ending March, 1901. (T.R.).....	946
On Methods in Use for Determination of Tannin. (Procter).....	1246
On Mordant (Farve's) for Basic Dyestuffs. (Bourry).....	711
On Photometric Examination of Incandescence Mantles.....	1098
On Purification of Town Drainage. (Nietner, Thiesing and Baier).....	828



	PAGE		PAGE
Reports; Suggestions as to Foreign Office —. (T.R.)	761	Rubber—cont.	
Research at the Imperial Institute	626	Goods; Manufacture of —	485
Endowment of Technical —. (Frew)	219	Industry of German East Africa. (T.R.)	770
Scholarship Founded by Mr. A. Carnegie	1254	Industry of Rhodesia. (Harding)	912
Resene Resins; Researches on —. (Tschirch)	51	-Like Substance. (P) Steenstrup	486
Residuals from Use of White Metal; Utilisation of —. (Richards)	932	Materials; Vulcanising —. (P) Bourne	912
Residues; Distilleries; Treatment of —. (P) Sudre and Thierry	379	Plants which furnish Congo —	911
Of Breweries and Distilleries; Food Extract from —. (P) Aubry	924	Substitutes; Manufacture of —. (P) Paulitschky and Wüste	912
Resin Industry of German East Africa. (T.R.)	770	Total Crop of —, from the Amazon Valley, 1877—1900. (T.R.)	520
Of Pinus Sylvestris. (Tschirch and Niederstadt)	729	Valve-Balls for Pumps	485
Rassamala —. (Tschirch and van Itallie)	1122	See also under India-Rubber.	
Resembling Shellac; New Brazilian —. (Thenius)	135	Rue: Algerian Oil of —. (von Soden and Henle)	930
Scammony —; United States Customs Decision on —. (T.R.)	1260	Oil; Examination of —. (Thoms)	1237
Xanthorrhoea —, in Germany. (T.R.)	1260	Oil; Examination of —. (Thoms)	606
Resins. (Class XIII.)	50, 83, 135, 262, 372, 729, 770, 818, 1063, 1045, 1123, 1160, 1222, 1260	Rum; Free Sulphuric Acid in a certain —. (Meyer)	826
Resins and Balsams; Manufacture of Products resembling —. (P) Kronstein	1123	Non-Existence of Methyl Alcohol in —. (Quantin)	143
Constituents of the Sandarac —. (Henry)	1222	Russia; Chemical Industry in —. (T.R.)	517
Exudation —. (Bamberger and Vischner)	50, 262	Customs Decisions in —. (T.R.)	849
Of Copaiba Balsams. (Keto)	1238	Customs Regulations of —. (T.R.)	1154
Of the Conifers; Researches on —. (Tschirch)	51	Hides and Skins at Libau —. (T.R.)	1045
Soft; Hardening of —. (P) Wetter. From The Elektrizitäts Aktienges. vorm. Schuckert and Co.	729	Imports at Reval —. (T.R.)	1153
Varnish —; Examination of —. (Lewkowitzsch)	372	Imports at Riga —. (T.R.)	1037
Resist under Paranitraniline Red; Alizarin Blue —. (Richard)	711, 712	Linseed Exports of Pernau —. (T.R.)	1043
Resists for Paranitraniline Red; White and Coloured —. Under Paranitraniline Red; Report on Work of Richard. (Baumann)	576, 712	Manganese Trade of —. (T.R.)	1041
Respiration in Deleterious Atmospheres; Apparatus for —. (Chauveau and Tissot)	823	Oil-Seed and Oil-Cake Exports of Libau —. (T.R.)	1043
Retorts for Distilling Shale, &c. (P) Beveridge	112	Oil-Seeds and Oil-Cake Exports of Riga —. (T.R.)	1043
Revenue for the Year 1900; Statement of —	534	Paints in the Crimea —. (T.R.)	1045
Rhamnitol; Nitro-Derivatives of —. (Vignon and Gerin)	1244	Paper Industry in —	61
Rhamnus Purshianus; Essential Oil of —. (Haense)	1234	Petroleum Industry of —. (T.R.)	516
Rheumatin; Characteristics of —	1232	Petroleum Production in —, in 1900. (T.R.)	295
Rhizocarpon Viridiatrum; Composition of —. (Zopf)	77	Phosphate in —. (T.R.)	168
Rhodamine Sulphonic Acids; Manufacture of New —. (P) Imray. From The Farbwerke vormals Meister, Lucius, und Brünig	703	Platinum and Copper Production in the Ural. (T.R.)	767
Rhodesia; Rubber Industry of —. (Harding)	912	Purification of Sugar Factory Waste Waters in —. (Slasski)	146
Rhodium Alloys. (Roessler)	798	Soap and Candles in the Crimea —. (T.R.)	1043
Oil; Manufacture of —, in French Guiana. (T.R.)	1	Sugar Production of —, for 1900—1901. (T.R.)	1047
Rhododendrin; Characteristics of —. (Archangelski)	1015	Sulphur Ore at Pernau —. (T.R.)	1040
Rhododendrol; Characteristics of —. (Archangelski)	1015	Superphosphates at Odessa —. (T.R.)	1046
Rhubarb; Soluble Active Glucoside of —. (Aweng)	66	Tanning Materials in —. (T.R.)	950
Riché Gas-Producer; The —. (Corbier)	563	Tartrates in Odessa —. (T.R.)	1162
Rolling Mill Practice; Comparison of American and British (Garrett)	722		
Rosaniline Bases: (von Georgievics)	34		
(Weil)	114		
Rose Oils; Comparison of German and Bulgarian —. (Schimmel)	744		
Phenylethyl Alcohol in —. (von Soden and Rojahn)	65, 1136		
Roses, Attar of. See under Otto.			
Rosin Grease. (Archbutt)	1193		
Soap containing Free —. (P) Dreher	435		
Treatment of —, to obtain Low Melting Point. (P) Müller and Rossbach	1123		
Rosindone, Iso-, and Isorosinduline; Reaction producing —. (Fischer)	571		
Rosinduline, Iso-, and Isorosindone; Reaction producing —. (Fischer)	571		
No. 13. (Kehrmann and Silberstein)	116		
No. 14. (Kehrmann and Ott)	1201		
No. 15. (Kehrmann and Nütsch)	1201		
Iso-, and Isorosindone Reaction. (Fischer)	571		
Iso-; Constitution of No. 8 —. (Kehrmann and Misslin)	706		
Iso-; Constitution of No. 9. (Kehrmann and Steiner)	115		
Iso-; 12th Isomeride of —. (Kehrmann and Steiner)	115		
Iso-, and 5-Acetamino- β -Naphthoquinone. (Kehrmann and Denk)	115		
Rouen; Exhibition organised by Société Industrielle of —	627		
Roumania; Paper Industry of —. (T.R.)	937		
Roumelia; Otto of Roses in Eastern —, in 1900. (T.R.)	776		
Rovings; Apparatus for Subjecting —, to the Action of Fluids. (P) Obermaier	984		
Rubber; Balata —, in Venezuela. (T.R.)	771		
Bands	932		
-Coated Materials; Production and Treatment of —. (P) Edwards. From The Oxylin-Werke Actienges	504		
Collection in East Africa. (T.R.)	955		
Culture in Perak. (T.R.)	1180		
Exports of Bahia, Brazil. (T.R.)	1045		
Exports of British Central Africa Protectorate. (T.R.)	1180		
Exports of Dahomey. (T.R.)	1045		
Exports of Senegal. (T.R.)	1290		
		S	
		Saccharifying Action of Wheat Germs, and Use thereof in Distilleries. (Lindet)	1141
		Saccharimeter; A New —. (Horsin-Déon)	1141
		Saccharin and Salicylic Acid; Detection of —, and Mixtures thereof. (Riegler)	284
		Drawback on —. (T.R.)	629
		In Foods, Detection of —	393
		In Foods, Determination of —. (Défournel)	755
		In Wine and Beer, Detection of —. (Wirthle)	72, 146
		Manufacture of —. (P) Reitmayer. From Volmar	746
		Manufacture of —. (P) Thompson. From Gfeller	386
		New Reaction of —. (Leys)	622
		New Reactions for Detection of —. (Spica)	1146
		"Sacramine"; the Ammonium Salt of —. (Bellier)	383
		Saccharinates; Metallic —. (Défournel)	497
		Saccharine Liquids; Crystallisation of —, and Apparatus therefor. (P) McNeil	55
		Notice to Importers of —. (T.R.)	1180
		Solutions; Apparatus for Evaporating —. (P) McNeil	430
		Solutions; Desaccharifying —. (P) Wohl and Kollrepp	376
		Solutions; Purifying and Decolorising —. (P) Lavollay and Bourgoin	489
		Saccharometer Readings. (Pfahler)	269
		Saccharomyces; Variations of the —. (Hansen)	377
		Saccharose; Presence of, — in Panama Wood. (Meillère)	267
		Saffron; Pharmacopœia Tests of —. (Koyan)	386
		Red Sanders Wood in —; Estimation of. (Beythien)	606
		Saghalien Island; Coal Industry in —. (Kleye)	28
		Sagrada; Soluble Active Glucoside of —. (Aweng)	66
		St. Helen's Corporation versus United Alkali Company. Court of Appeal. (T.R.)	765
		St. Malo; Manures at —. (T.R.)	861
		Patent Fuel at —. (T.R.)	853
		St. Paul's Cathedral; Inerustation from the Stone Gallery of —. (Clayton)	1212
		Saké; Chemical and Biological Researches on —. (Kozai)	378
		Salicylate of 4-Dimethylamido-1-Phenyl-2,3-Dimethyl-5-Pyrazolone. (P) Imray. From the Farbwerke vormals Meister, Lucius, und Brünig	504
		Salicylates; Determination of —. (Telle)	288
		Salicylic Acid and Saccharin; Detection of —, or Mixtures thereof. (Riegler)	284
		Determination of —. (Telle)	288
		In Dressings; Determination of. (Telle)	1149
		In Wine; Detection and Determination of —. (Perrara da Silva)	396
		In Wine; Source of Error in Detection of —. (Pellet) 153, 284	153, 284
		In Wines; Sensitiveness of Various Methods of Detecting —. (da Silva)	938

	PAGE
Salicylic—cont.	
Nitro- and Nitrosulphonic —. (Hirsch)	65
Occurrence of —, in Strawberries. (Porcs and Desmoulières)	1229
Salol in Dressings; Determination of. (Telle)	1149
Saloquinine; Characteristics of —	1232
Salt; Apparatus for Separation of —, from Solutions. (P) Vis	123, 250
As Cattle Food or Manure in the Netherlands. (T.R.)	950
Common; Obtainment of Pure —. (P) Lawton	717
For Industrial Purposes in France. (T.R.)	1039
For Preservation of Hides Duty-free in Argentina. (T.R.)	951
For Purifying Gun Copal exempt from Duty in the Netherlands. (T.R.)	79
Production of Spain in 1893. (T.R.)	296
Table —; Manufacture of. (P) Weddell	828
Saltpetre at Oporto. (T.R.)	953
Chili; Determination of Perchlorates in —. (Grimm)	1144
Chili; Occurrence of Free Iodine in —. (Dafert and Halla)	914
Nitrogen in; Determination of —:	
(Böttcher)	156
(von Wissell)	156
Salts. (Class VII.)	42, 81, 121, 166, 247, 297, 360, 400, 473, 517, 577, 714, 764, 893, 855, 893, 953, 955, 1039, 1112, 1156, 1208, 1258
Alkaline; Electrolysis of —, and Apparatus therefor. (P) Greenwood	1220
Amino; Action of Bases and Acid on —. (Colson)	832
And Sodium Dissolved in Liquefied Ammonia; Conductivity of —. (Legrand)	725
Basic Mixed —. (Sabatier)	806
Basic with Two Metals. (Recoura)	806
Coloration of —, by Radiations. (Golástein)	1249
Conductivities of some Double, compared with those of Mixtures of their Constituents. (Lindsay)	258
Constitution of Semi-Complex —. (Rieger)	1001
Crystallisation of —. (P) Kaufmann)	123
In Solution; Influence of Organic Substances on Electrolysis of —. (Ditz)	389
Influence of —, on Rotatory Power of Sugars. (de Kowalsky and Tomarschenko)	623
Metallic; Action of Mercuric Oxide on Aqueous Solutions of —. (Mailhe)	806
Salvosol-Potash and Salvosol-Lithium	1134
Sampling, Averaging, Mixing and Storing Materials in Bulk. (P) The Edison Ore-Milling Syndicate. From Edison	992
San Domingo; Import Duties in —. (T.R.)	951
San Francisco; Commercial Museum at —. (T.R.)	851
San Thomé Balm. (T.R.)	864
Sand; Porcelain —. (Linder)	900
Sandal Wood (Amyrol); West Indian —. (von Soden and Rohahn)	64
Wood Oil; East Indian —. (Potyliet)	1017
Wood Oil; Examination of —. (Kebler)	756
Wood Oil; Extraction of the Alcoholic Constituents of —. (P) Heine and Co.	1017
Sandarac. (Tschirch)	51
Sandarac Resins; Constituents of the —. (Henry)	1222
Sanders Wool; Red — in Saffron. (Beythien)	603
Sandstone, Artificial; Manufacture of —. (P) Lake. From Wachtel & Co.	719
Sandstones; Hardening Calcareous —. (P) Rensing	125
Sanguinaria Canadensis; Alkaloids of —. (Fischer)	1016
Sanitation. (Class XVIII.)	59, 145, 271, 381, 494, 601, 738, 775, 823, 833, 925, 1012, 1132, 1161, 1229
Santalol; Preparation of —. (P) Heine and Co.	150
Santal-wood Oil; Pharmacopœia Tests of —	393
Santonin; The B.P. Test for —. (Pain)	939
Sap of Arum Maculatum; Chemical Changes in the Cell-free —. (Hahn)	375
Saponaceous Products; Manufacture of —. (P) Dyson and Gaskell	232
Saponin; Production of —. (P) Lake. From the Chem. Fab. von R. Stamer	833
Obtainment of —, from Horse-Chestnuts. (P) Weil	608
Saponins of the Cactaceæ. (Heyl)	1016
Sarawak; Gambier in —. (T.R.)	1045
Saturation; Chemical Effect of Karlik's Process of Triple — (Andriik)	374
Mud; Analyses of the First —, of 1899—1900. (Andriik and others)	1225
Oxalic Acid in —. (Andriik)	140
Sauerbeck's "Index Numbers." (T.R.)	104
Scale in Steam Boilers; Compositions for Removing —:	
(P) Metcalf	105
(P) Rümmler	105
See also under Incrustation.	
Scammony; Pharmacopœia Tests of —	386
Resin; United States Customs Decision on —. (T.R.)	1260
Schenckia Blumenaviana; Production of Chromogen in —. (Molisch)	888
Schneider's Method of Photolithography	505

	PAGE
Scholarship Founded by Mr. A. Carnegie	1254
Iron and Steel Institute Research	396
Schulze-Tiemann Method for Determining Nitrogen in Nitrates. (Stanek)	505
Schumburg's Process of Water Purification. (Schüler)	828
Scientific and Technical Notes. (Class XXIV.)	75, 160, 290, 396, 512, 625, 756, 814, 943, 1033, 1150, 1251
Sea Weed; Extraction of Iodine, &c., from — (P) Thesen ..	608
Seal Oil in Greenland. (T.R.)	82
Seed-Oils; Hydro-Refiner for —. (P) Morgan	371
Trade of Marseilles. (T.R.)	1043
Yeast; Lactic Acidification of the —. (Frede)	825
Seeds; Behaviour of Pentosans towards — during Germination. (Schöne and Tollens)	268
Inoculating — with Micro-organisms. (P) Hartleb	374
Leguminous; Saccharification of Carbohydrates of —. (Hérissey)	944
Of the Horse-Chestnut; Manufacture of Food from — (P) Flügge	1012
Oil-yielding; Treatment of —. (P) Bärwinkel	50
Selenium; Action of Radiation of Radium on —. (Bloch)	625
Compounds and Beer Poisoning. (Tanncliffe and Rosenheim)	390
Effect on Marsh Test of Products containing —. (Berry)	322
In Sulphuric Acid; Detection of —. (Jouve)	619
Influence of — on Tests for Arsenic. (Rosenheim)	751
Selenopyrine; Obtainment of —. (Michaëlis)	1234
Senegal; Earth-Nuts, Gum, and Rubber Exports of —. (T.R.)	1260
Separating and Purifying Apparatus for Pulverulent Materials. (P) Renault and Cusson	460
Apparatus:	
(P) Füllner	1194
(P) Lake. From Powder	798
(P) The Edison Ore-Milling Syndicate. From Edison	993, 998
Centrifugal —:	
(P) Lake. From Berrigan	109
(P) Ohlsson	344
For Liquids. (P) Fox and Kingscote	344
Serpentary Root; Pharmacopœia Tests of —	386
Servia; Import Duty on Olein in —. (T.R.)	79
Sesamé Oil; Detection of —. (Tambon)	285
In Arachis Oil; Occurrence and Detection of —. (Soltien)	1121
Modification of Millian's Reaction for — (Armani)	752
Sesamé-seed at Baghdad. (T.R.)	1043
Sesamum and other Seeds; Portuguese Duty on —. (T.R.)	950
Sèvres Porcelain Works; Ceramic Stoneware of the —. (Vogt)	580
Sewage and Effluents from Breweries, &c.; Deodorising and Clarifying —. (Hahn and Leutz)	1013
And Sewage Effluents; Treatment of —. (P) Reeves ..	601
And Waste Liquids; Treatment of —. (P) Burmeister ..	739
Apparatus for Automatic Discharge of —. (P) Kilion ..	61
Apparatus for Regulating Delivery of — to Filters or Land. (P) Cameron, Commin, and Martin	60
Apparatus for Spraying — upon a Filter Bed. (P) Adams	1013
Apparatus for Treatment and Disposal of —. (P) Cameron and others	381
Bacterial Treatment of Crude —; Report on. (Clowes and Houston)	494
Changes in — during Treatment on Bacteria Beds. (Letts and Blake)	1132
Disposal; Royal Commission on —. (T.R.)	303
Effluents; Bacterial Treatment of —. (P) Smith and The Pioneer Investment Trust	61
Effluents; The Aeration Test for —. (Rideal)	1012
Humus and "Irreducible Residue" in Bacterial Treatment of —. (Rideal)	1132
Precipitates; Utilisation of —. (P) Bayer	830
Precipitation of —. (P) Springborn	272
Purification of —. (P) Bayer	830
Purification of —, and Apparatus therefor. (P) Freysoldt ..	61
Report (Interim) of Royal Commission on —. (T.R.) ..	679
Sludge; Treatment of —. (P) Spence and Royley	863
Sludge; Utilisation of —, in Preparation of Fuel Blocks. (P) Whittaker	830
Structures and Apparatus for Bacterial Treatment of —. (P)	495
Treatment of London —. (Clowes)	145
Works. (P) Cameron, Commin and Martin	1132
See also Effluents.	
Sewers; Discharging Chemicals into —. (T.R.)	1161
Seychelle Islands; Soap in the —. (T.R.)	1043
Vanilla-Planting in the —. (T.R.)	1048
Shale-Oil Works at Orepuki, New Zealand. (T.R.)	854
Shales, Oil-, of the Lothians, Scotland. (T.R.)	80
Sheds for Manufacture or Storage of Explosives. (P) Nahsen ..	155
Sheep Dips; Duty Free in United States. (T.R.)	1048
Duty on —, in the United States. (T.R.)	848
Manufacture of —:	
(P) McDougall	495
(P) Roxburgh and Scott	1133



	PAGE		PAGE
Sheepskins; Coloured —	730	Size. (Class XIV.)	52, 137, 263, 302, 373, 486, 593, 729, 771, 818, 913, 1095
Liming of —	730	Skirts; Bleaching — with Lactic Acid	730
Preparation of —, for Dyeing	913	Chrome Tanning or Dressing of —, (P) Valentiner	1124
<i>See also under Skins.</i>		Coloured Sheep —	730
Shellac; Analysis of —, (Parry)	1245	Liming of Sheep —	730
Shoe Butts; Carrying of Waxed —	139	"Re-greening" of —	813
Calf; Manufacture of Boxed —	52	"Schmischen"; Preparation of — Glove Stock	913
Siam; Cement Imported by —, (T.R.)	1040	Sheep; Preparation of — for Dyeing	913
Hide Exports of Bangkok —, (T.R.)	1045	Tanning Sheep — with Wool on —	593
Stielac and Gum-benjamin at Chiengmai —, (T.R.)	1160	Tawing of, and Apparatus therefor. (P) Adler	53
Siccative for Oil Colours in Tubes. (Kitt)	910	Treatment of Pickled Indian Goat —	263
Sicily; Asphalt at Palermo —, (T.R.)	1156	<i>See also under Hides and Leather.</i>	
Chemical Imports of —, (T.R.)	1154	Slag, Basic; Consumption of —, (T.R.)	521
Citric Acid and Citrate of Lime at Messina —, (T.R.)	1162	Blast-Furnace; Manufacture of Portland Cement from —, (Steffens)	44
Essential Oil and Citric Acid Exports of —, (T.R.)	1162	Blast-Furnace; Portland Cement from —, (Steffens)	551
Glass Imports of —, (T.R.)	1157	Cement. (Hatt)	1212
Olive Oil in —, (T.R.)	1159	Thomas; Mineral Phosphate in —; Detection of —, (von Lorenz)	69
Paraffin Wax Imports of —, (T.R.)	1156	Treating Molten Blast-Furnace —, (P) Elbers	1119
Stearic Acid Imports of —, (T.R.)	1159	Vanadium in; Determination of —, (Jouët)	620
Sulphur Industry in —: (Jungfleisch)	714	Slime Fungus; Yeast-enclosing Amoebæ of a —, (Henneberg)	491
(T.R.)	166	Slimes; Agitation Process for Cyaniding —, (Hurter)	253
Sulphuric Acid Plant and Sulphur in —, (T.R.)	1157	Means for Aërating —, (Gwynne and Sargeant.) (P)	368
Sumac Exports of —, (T.R.)	1160	Slip and Glazes for Pottery; Pumping Apparatus for —, (P) Schott	364
Sienna Earths, Ochres, and Umbers at Leghorn. (T.R.)	770	Sliver Cans for Dyeing and Bleaching Liquids or Gases. (P) Honegger	41
Silica; Removal of —, from Alkaline Liquors. (Lunge and Lohöfer)	1231	Slivers from Combing Machines; Apparatus for Dyeing —, (P) Haddan. From Desurmont	985
Separation of Tungstic Acid from —, (Herting)	392	Smelting; Electric —, and Apparatus therefor. (P) British Aluminium Co. From Cowles	817
Silicate Analyses. (Stoermer)	1143	Pyritic —, (Lang)	719
Silicates; Estimation of the Fusibility of —, (Kochs and Seyfert)	989	Pyritic; Present Position of —, (Bahlsen)	814
Potassium Hydroxide Absorbed by —, (Rumpler)	846	Works at Tacoma. (T.R.)	859
Silicic Acid; Quantitative Separation of —, from Tangstic Acid. (Wells and Metzger)	749	Smoke and Products of Combustion; Consuming —, (P) Gallagher	1099
Silicides, Alkaline Earth; Manufacture of —, (P) Mills. From The International Chemical Co.	43	Consuming Apparatus for Refuse Destructors. (P) Ball	1132
Iron —, (Jouve)	479	Soap. (Class XII.)	50, 82, 134, 167, 261, 370, 484, 520, 590, 642, 727, 769, 817, 860, 908, 1003, 1042, 1121, 1159, 1260.
Silico-Fluorides; Production of —, (P) Sellar	718	Apparatus for Making Carpet-cleaning —, (P) Sefton-Jones. From Feder and van de Bücken	1122
Silicon and Hydrogen; Combination of —, (P) Mills. From The International Chemical Co.	43	At Oran, Algeria. (T.R.)	1042
Carbide as a Reducing Agent. (Neumann)	46	Composition of —, (P) Allworth	728
Fluoride; Preventing Escape of —, in Decomposition of Phosphates. (P) Teisler	1007	Containing Free Rosin; Preparation of —, (P) Dreher	485
In Pig Iron; Economical Significance of —, (Sahlén)	721	Effect of Sodium Chloride in Estimation of Free Alkali Hydrate and Carbonate in —, (Robertson)	936
Silk. (Class V.)	33, 81, 119, 242, 353, 469, 573, 709, 804, 855, 890, 952, 982, 1108, 1206	Exported to Nicaragua. (T.R.)	520
And Wool Union Fabrics; Dyeing of —, (Brown)	226	For Use in Sea Water; Composition for Manufacture of —, (P) Baptistine-Blanc-Raynaud	910
Artificial; Dyeing of —, (Sivern)	243	Imports of Brazil. (T.R.)	1159
Artificial; Factory for —, in Belgium. (T.R.)	81	Imports of Zanzibar. (T.R.)	1160
Artificial; Identification and Determination of —, (Duyk)	569	In the Crimea. (T.R.)	1043
Artificial; Production of —, (P) Duquesnoy	469	In the Seychelles. (T.R.)	1043
Discharge Effects on Indigo-Dyed —, (P) Johnson. From The Badische Anilin und Soda Fabrik	121	In Van-Asiatic Turkey. (T.R.)	860
Fibroin of —, (Fischer and Skita)	1108	Industry; Denaturing Alcohol for the —, (Hirsch)	134
Finishing of —	932	Leys; Dialysis of — (Crude Glycerin). (Auzenat)	484
Formation of "Ice Colours" upon —, (Reisz)	243	Manufacture of —: (P) Klumpp	818
Goods; Discharging Indigo-Dyed —, (P) Johnson. From The Badische Anilin und Soda Fabrik	41	(P) Merry and Noble	728
Printing on Raw —, (P) Johnson. From The Badische Anilin und Soda Fabrik	360	(P) Parziale	591
Waste; Preparation of —, for Spinning. (P) Woodhead and Thompson	358	(P) Ward	831
Weighting Matters in; Detection of —, (Romann)	1147	Manufacture of — in the Province of Florence. (T.R.)	1260
Silver; Action of Bromine on Metallic —, (von Cordier)	1150	Market for — in Spain. (T.R.)	642
Action of Chlorine on; Influence of Light on —, II (von Cordier)	67	Resinous; Manufacture of —, (P) Guilbert	818
Allotropic —, (Carey Lea)	386	Rosin —; Production of, and Apparatus therefor. (P) Culmann	591
Allotropic States of —, (Berthelot)	363	Soft; Manufacture of —, (P) Hulme	910, 1005
And Carbon Monoxide. (Berthelot)	128	Structure of —, (Shukoff.)	1004
And Copper; Cyanogen Compounds of —, in Gravimetric Analysis. (Brunck)	749	Supplied by Germany to Pemba. (T.R.)	769
And Hydrogen. (Berthelot)	128	Trade in the South of Europe. (T.R.)	167
Apparatus for Precipitation of —, from Solution. (P) James	129	Works in South Italy. (T.R.)	800
Bromide; Hitherto Unknown Action of Developers on —, (Lüppo-Cramer)	1020	Soaps, Chemical Composition and Disinfecting Properties of —, (Rogenhagen)	371
Buttons in Blow-Pipe Assays; Measurement of —, (Richards)	839	In the Woollen Industry. (Steinberg)	470
Chlorate; Decomposition of —, (Sodeau)	42	Soluble in Sea-Water; Manufacture of —, (P) Kattaire and Cottard	372
Chloride; Action of Solar Radiation on —, in Presence of Hydrogen. (Journiaux)	834	Société Industrielle de Rouen; Exhibition Organised by —	627
Chloride; Reduction of —, by Hydrogen. (Journiaux)	814	Soda; Apparatus for Electrolytic Production of —, (P) Cohn and Geisenberger	726
Chloride; Reduction of —, with Calcium Carbide	1020	Caustic; Action of — on Wool. (Washburn)	1206
Compounds of —, with Mercury. (Berthelot)	365	Caustic; Electrolytic Manufacture of —, (T.R.)	299
Electrolytic Precipitation and Separation of —, Fulweiler and Smith	1002	Caustic; Manufacture of —, (P) Brand	897
Emulsion Plates; Influence of Ammonium Sulphide on Fine-Grained —, (Valenta)	834	Caustic; Manufacture of — by Electrolysis. (P) Cohn and Geisenberger	123
In Sulphide Ores; Determination of —, (Hollard)	391	-Cellulose; Composition of, and Action of Ammonia on —, (Thiele)	890
-Lead Mines in Salonica and Kossova. (T.R.)	1259	Electrolytic Production of —, (T.R.)	1040
Oxide; Action of Hydrogen Peroxide on —, (Berthelot)	625, 1253	Mercury Cell for Electrolytic —, (Franke)	815
Paranuclein; A New —, (P) Imray. From The Basle Chemical Works	504	Nitrate; Decomposition of — by Sulphuric Acid. (Volney)	803
-Plating by Reduction. (Göttig)	901	Production of — by the Ammonia Process. (Bradburn)	442
Surfaces; Rendering — untarnishable. (P) Sterne and Cowper-Coles	1003	Progress of the Ammonia Process for Manufacture of —, (Schreib)	896
Union of — with Oxygen. (Berthelot)	125	Substitution of — for Potash in Plant Growth. (Jordan and Jenter)	732
Sivas, Turkey; Chemical Trade of —, (T.R.)	630	Soda-Alum; Manufacture of —, (P) Spence	250
		Sodium and Salts dissolved in Liquefied Ammonia; Conductivity of —, (Legrand)	725

	PAGE
Sodium—cont.	
Bicarbonate: Precipitation of —. (P) Naef.....	1112
Carbonate at Lexhorn. (T.R.).....	764
Carbonate Crystals: Manufacture of —. (P) Künstner.....	363
Carbonate: Formation of —. (Bodlaender and Breull).....	715
Chloride; Electro-Production of —. (Kershaw).....	402
Chloride; Obtaining of Pure —. (P) Lawton.....	717
Chromate and Bichromate; Manufacture of —. (P) Spence and Shearer.....	475
Chromate; New Hydrate of —. (Salkowski).....	806
Chromates and their Production. (Mylius and Funk).....	249
Electrolytic Extraction of —. (Swan).....	666
Electrolytic Production of —. (P) Cohn and Geisenberger.....	726
Hydroxide; Solid Hydrates of —. Forcrand).....	896
Nitrate at Hamburg in 1900. (T.R.).....	773
Nitrate; Extraction of —, from "Caliche" and "Ripio" and Apparatus therefor. (P) Woodcock and Harper.....	363
Nitrate; Report on —, by Montgomery and Co. (T.R.).....	772
Nitrate; Statistics of —. (T.R.).....	84, 772
Perborate; Preparation of —. (Eder and Valenta).....	1239
Peroxide Hydrates; Preparation and Properties of —. (Jaubert).....	273
Peroxide; Preparation of Compressed —. (F) Jaubert.....	43
Peroxide; Properties of —. (De Forcrand).....	273
Peroxide; Properties of —. (Jaubert).....	273
Salicylate; Solubility of Metallic Hydroxides in —. (Wolf).....	1150
Salts of Dibasic Acids Analogous to Sulphuric Acid. VI. (Funk).....	291
Sulphate and Copper Sulphate; Solubility of Mixtures of —. (Massol and Malde).....	893
Sulphate; Influence of —, on Vapour of Aqueous Ammonia Solution. (Perman).....	474
Sulphite; Action of —, in Photographic Developers. (Liesegang).....	278
Sulphite; Value of —, as a Flesh Preservative. (Lange).....	923
Tetraethylsulphite; Compound of —, with Ethyl β -Naphthylamine. (Seyewetz and Blanc).....	888
Thio-sulphate; Solubility of Barium Sulphate in Solution of —. (Dobbin).....	218
Use of —, in Blow-Pipe Analysis. (Parsons).....	618
Soil Inoculation; Problems in —. (Stoklasa).....	487
Soils; Inoculation of —, with Micro-Organisms. (P) Hartleb.....	374
Phosphoric Acid in; Determination of —. (Schloesing).....	750
Solanine; Formation of —, in Potatoes. (Weil).....	384
Solder for Aluminium. &c. (P) McLeod and others.....	1219
Soldering Experiments with "Ferrofix." (P) Pich.....	1215
Solid Materials; Method and Apparatus for Treating —. (P) Naef.....	27
Solids and Liquors; Heating of —, for Purpose of Decomposing, Drying, &c., and Apparatus therefor. (P) Naef.....	1210
Apparatus for Separating —, from Liquids. (P) Merkel and Crossfeld.....	1094
Centrifugal Apparatus for Separating —, from Liquids. (P) Lake, From Berrizan.....	1035
Solution; Determination of a Dissolved Substance in a —. (Lasne).....	295
Solutions; Crystallisation from Complex Salt —. (van't Hoff).....	715
Eliminating Iron from Aqueous —. (P) Teufer.....	602
Of Mixtures of Three Substances; Solid —. (Bruil).....	160
Saccharine; Desaccharification of —. (P) Wohl and Kolrepp.....	376
Separation of Solvents from Oily and Soapy —. (P) Maertens.....	372
Solvent used in Degreasing Wool; Recovery of —. (P) Erben.....	359
Solvents; Electrolytic Phenomena at the Interface between Two —. (Riesefeld).....	726
Influence of Chemically Indifferent —, on Reaction Velocities. (Menshutkin).....	75
Separation of —, from Oily or Soapy Solutions. (P) Maertens.....	372
Soot from Tar; Manufacture of, and Apparatus therefor. (P) Bente.....	728
From Various Sources; Mineral Constituents of —. (Hartley and Ramage).....	513
Soudan; Cane-Sugar in the —. (T.R.).....	1046
Mass of Meteoric Iron from the —. (Meunier).....	366
South Carolina; Chemicals used in —. (T.R.).....	517
Spain; Artificial Manures in —. (T.R.).....	1046
Chemical Imports of —, in 1899. (T.R.).....	296
Chemical Trade of Motril, Cartagena. (T.R.).....	764
Gasoline Exempt from Consumption Duty in —. (T.R.).....	759
Guncotton and Acetic Ether Purchase by —. (T.R.).....	865
Imports and Exports of —, in 1899. (T.R.).....	295
Iron Production of Bilbao —. (T.R.).....	639
Market for Soap in —. (T.R.).....	642
Mineral Imports and Exports of —. (T.R.).....	302
Mineral Production; in —, during 1899. (T.R.).....	300
Mineral Production of —. (T.R.).....	637
Mining Industry of Huelva —. (T.R.).....	637
Mining Industry of North of —. (T.R.).....	640
Olive Oil Exports of —. (T.R.).....	302
Salt Production of —, in 1899. (T.R.).....	296
Sugar Industry of —. (T.R.).....	774
Tariff on Covered Copper Wire in —. (T.R.).....	950

	PAGE
Spectra of Flames at Different Periods of Basic Bessemer Blow. (Hartley and Ramage).....	993
Spectroscope; Measurement of High Temperatures by the —. (Hempel).....	343
Spent Oxide as a Fertiliser and Pest Destroyer. (P) Nelson.....	495
Rapid Determination of Prussian Blue in —. (P) Poppelwell).....	225
Spent Wash; Treatment of Distillers' —. (P) Südre and Thierry.....	492
Spirit; Apparatus for Vaporising —. (P) Gossweiler.....	1190
From Molasses; Use of Yeast in Preparing —. (Verliese).....	378
Potato, from the Mashing Space; High Yields of —. (Schirmann).....	56
Purification of Crude —. (P) Thompson. From Lavolloy and Bourgoin.....	650
Rectification of —. (P) von Schlichtegroll.....	827
Use of —, in Removing Fat from Hides. (Wünsch).....	52
Spirits. (XVII.) 55, 86, 141, 263, 376, 489, 597, 614, 734, 824, 916, 1008, 1127, 1226, 1261	
Accelerating the Maturing of —. (P) Imray. From Joshua Bros.....	737
Distilling and Treating —. (P) Carroll.....	270
Foreign Colouring Matter in —; Detection of. (Cramp-ton and Simons).....	158
Injurious Constituents of Potable —. (Brunton and Tunnicliffe).....	736
New Law on — in France. (T.R.).....	294
Rapidly Azeing —, and Apparatus therefor. (P) Ivison Solidified Carburetted; Manufacture of —. (P) Denayrouze.....	976
See also under Brandy and Whisky.	
Spirituous Preparations; Export of —. (T.R.).....	628
Sponges; Manufacture of Artificial —. (P) Paulitschky.....	1224
Stannic Acid; Manufacture of —. (P) Bary.....	608
Stannous Chloride and Oxygen; Reaction between. (Young) Chloride for Determining Nitrates in Waters. (Henriot).....	619
Chloride Solutions; Oxidation of —. (Young).....	616
Sulphide; Action of Caustic Potash and Soda on —. (Perkin).....	425
Starch. (Class XVI.) ... 53, 84, 140, 267, 393, 374, 487, 732, 773, 914, 1007, 1046, 1124, 1224	
And Starch Products; Finishing Materials containing — (Saare).....	1206
As a Finishing Material for Textiles. (Fürth).....	242
In Mixed Pressed Yeasts; Determination of —. (Lange).....	395
In Potatoes; Baumert and Bode's Method of Determining —. (Behrend and Wolf).....	623
Industry in Germany. (T.R.).....	85
Iodolactic Acid as a Reagent for —. (Jagerheim).....	1245
Manufacture of —. (P) Umland.....	916
Manufacture of Thin Boiling, or Modified —. (P) Duryea.....	1127
Or Starch Sugar and Albumin; Preparation of Dry —. (Wulkan and Straetz).....	824
Trade of Egypt. (T.R.).....	1047
Starchy Matter; Rendering — Soluble. (P) Société Alliance Industrielle.....	492
Stassano Process; Manufacture of Iron by the —. (Lucchini).....	816
Stavescere; Pharmacopœia Tests of —.....	386
Steam; Apparatus for Purifying —. (P) Brooke -Generators; Mixture for Preventing Incrustation in —. (P) von Eritz.....	561
Or Vapour of Desired Pressure; Method and Apparatus for Production of —. (P) Stellen.....	502
-Packing Substance, and Manufacture thereof. (P) Stocker and Zander.....	727
Superheated; Use of — in Distillation of Brown Coal Tar. (Huth).....	855
Stearic Acid Imports of Sicily. (T.R.).....	1159
Acid in Beeswax; Detection of —. (Buchner).....	286
Stearite; Application of — as Insulating Material. (P) de Mare and Frémy.....	133
Steel; Aluminium in; Determination —. (Spatz).....	507
Apparatus for Re-carburising —. (P) Davis.....	1118
Carbon in; Determination of —. (Schmitz).....	934
Carbon in —; Rapid Determination of. (Job and Davies).....	156
Castings; Properties of —. (Arnold).....	722
-Castings; Tropenas Process for —. (T.R.).....	81
Cleaning and Coating — with Zinc. (P) Cowper-Coles.....	484
Comparison of American and British Rolling Mill Practice. (Garrett).....	722
Compression of —. (Zdanowicz).....	1117
Correct Treatment of —. (Riddale).....	994
Direct Continuous Manufacture of Open-Hearth —. (P) Stevenson.....	460
Direct Production of —: (Otto).....	44
(P) Twyman.....	369
Electrolytic Production of —. (Swan).....	670
For Wire Making; Effect of Copper on —. (Stead and Wigham).....	995
Hardening Compounds for Alloying with —. (P) Baker.....	256
Hardening of —. (Gentsch).....	1116
Influence of Copper in Retarding Corrosion of Soft —. (Williams).....	44



	PAGE		PAGE
Steel—cont.		Strasbourg Turpentine. (Tschirch).....	51
Influence of Silicon on Mechanical Properties of Cast —. (Wahlberg and Heyn).....	901	Strawberries; Salicylic Acid in —. (Portes and Desmoulières).....	1229
Influence of Tin on the Quality of —. (Zugger).....	583, 583	Straw-Paper.....	148
Ingots; Variation of Carbon and Phosphorus in —. (Wahlberg).....	994	Stretching Apparatus for Use in Mercerising. (P) Johnson. From Hasslacher.....	359
Instrument for Measuring Permeability of — (Lamb and Walker).....	811	Stroutia; Action of — on Solutions of Cane Sugar at 125–128 C. (Schöne and Tollens).....	55
Internal Strain of —, and its Bearing on Fractures. (Wigham).....	1214	Action of — on Sugar Solutions. (Schöne and Tollens).....	821
Magnetic Properties of Hardened —. (Kamps).....	254	Strontium; Determination of —, as Oxalate (Peters).....	1143
Manufacture of —:		Strophanthin; Determination of —. (Dohme).....	756
(P) Lake. From Société Forderia Milanese.....	724	Strophanthus Seed Oil; Characteristics of —. (Bjalobrscheski).....	817
(P) Talbot.....	369	Seed; Pharmacopœia Tests of —.....	335
(P) Wheatley. From the Société des Aciers fins.....	724	Strychnine; Action of Bromine on —. (Kippenberger).....	64
Medal Struck in —. (Brough).....	723	Detection of Chlorates and Bromates by means of — (Fages).....	280
Moulding Material for Use in Casting —. (P) Sarg.....	46	Electrolytic Reduction of —. (Tafel and Naumann).....	1233
Nickel —, as Used in Commercial Work. (Porter).....	996	Sucramin in Foods and Drinks; Detection of —. (Blarez and Tourcu).....	1030
Nickel —; Metallurgy of. (Zdanowicz).....	1215	“Sucramine”; a new Sweetening Agent. (Bellier).....	333
Nickel in —; Determination of —. (Norris).....	551	In Beer; Prohibition of —. (T.R.).....	1261
Open-Hearth; Manufacture of —:		Sucrose in Industrial Fermentations. (Dejonghe).....	1130
(P) Muller.....	587	Part Played by —. (Defafond).....	1226
(P) Smith and others.....	724	Sucrose and Gentianose in Fresh Gentian Root; Simultaneous Presence of —. (Bourquelot and Herissey).....	76
Phase Doctrine Applied to —. (von Jonstorff).....	721	In Plants; Identification of — by Aid of Invertase. (Bourquelot).....	1214
Plates covered with Copper; Manufacture of —. (P) Martin.....	905	Sugar. (Class XVI.).....	53, 84, 140, 267, 303, 374, 406, 487, 521, 643, 732, 773, 820, 862, 914, 957, 1007, 1046, 1124, 1160, 1224, 1261
Production of —. (P) Bouit. From Goldschmid.....	1218	Action of Ozone in Manufacture of —. (Herzog).....	54
Production of Highly Carburiised —. (P) Dietrich.....	1118	Alkalinity of —; Revision of Methods for Determining. (Herzfeld).....	1124
Production of — in Basic Siemens-Martin Furnaces. (Poech. From Turner).....	583	Apparatus for Crystallising —. (P) Naef.....	233
Purification of — in Molten State. (P) Greenway.....	908	Apparatus for Dissolving —. (P) de V. Roblé.....	489
Rails and Plates; Influence of Copper on —. (Stead and Evans).....	722	Apparatus for Manufacture of Lump —. (P) Duniczewski.....	823
Soft. Influence of Copper in Retarding Corrosion of —. (Williams).....	127	Apparatus for Refining —. (P) Fuchs.....	1008
State of Combination of Iron with the Rare elements in —. (Carnot and Goutal).....	583	Appointment of Behar Commission on —. (T.R.).....	406
Sulphur in —; Determination of —:		Arsenic in —; Detection of —. (Paul and Cownley).....	158
(Auchy).....	620	Beet; at Los Angeles in 1900. (T.R.).....	862
(Noyes and Helmer).....	1143	Beet; Exports of — from Germany in 1900. (T.R.).....	862
Tool —; Manufacture of —. (P) James. From the Bethlehem Steel Co.....	46	Beetroot; — in Spain. (T.R.).....	303
Tool —; Manufacture of — and Tools therefrom. (P) Inray. From Hay.....	129	Beetroot; Industry in Canada. (T.R.).....	303
Toughening, Hardening, or Annealing —. (P) Holzer and Frith.....	1218	Beetroot; Industry of France. (T.R.).....	85
Treatment of Low-Grade —. (P) Andrew and Bellis.....	369	Beetroot; Industry of Germany. (T.R.).....	84
Wire, Rods, &c., Forming a Protective Coating on —. (P) Moseley.....	46	Beets; Notes on —. (Trowbridge).....	842
		Bounties in France. (T.R.).....	950
Sterilising, and Apparatus therefor. (P) Blackmore.....	739	Campaign of 1900-1 in Austria-Hungary. (T.R.).....	1160
Sterilising Apparatus:		-Candy; Facilitating Removal of — from Carriers. (Bor-nett).....	1127
(P) DeFries and Feeny.....	830	Cane; Action of Strontia on Solutions of —, at 125–128 C. (Schöne and Tollens).....	55
(P) Lancaster.....	326	Cane; Apparatus for Extracting — from the Sugar-Beet. (Herzfeld).....	753
(P) Miller.....	924	Cane; Determination of — in Presence of Levulose, &c. (Pellet).....	754
(P) Naboulex.....	380	Cane; Influence of — on Conductivities of Solutions of Potassium Chloride, &c. (Martin and Masson).....	482
Stielac and Gum—Benjamin at Chiengmai, Siam. (T.R.).....	1160	Cane; in the Soudan. (T.R.).....	1046
Stilbene; 7 Cyano —; Isomeric Diamino Bases of. (Freund).....	1107	Cane; Specific Rotation of —, and its Alterations with Temperature and Wave Length. (Pellet).....	1224
Still for Water. (P) Bessonoff.....	105	-Cane; Coefficient in the Indirect Analysis of —. (Bou-nin).....	487
Stills; Steel or Iron —, for Gas Works, &c. (P) Snowden.....	706	-Cane Factory; Carbonating in the —. (Harloff).....	487
Stillingia Sebifera; Oil and Tallow of —. (Tortelli and Ruggieri).....	261	-Canes; Valuation of —. (Gill).....	915
Stirrers, Rotary, for Roasting Furnaces. (P) Thompson. From Wright.....	256	Constituents of Xanthorrhamin and Quercitrin. (Votocek and Fric).....	76
Stone; Artificial —. (P) Boivic.....	1212	Converting Cellulose into —. (P) Classen.....	734
Artificial; Agglomerating Powdered Materials for Making. (P) Denaeve.....	125	Converting Cellulose Material into —. (P) Classen.....	1008
Artificial — in Germany. (T.R.).....	517	Countervailing Duties on Belgian — in the United States. (T.R.).....	406
Artificial; Manufacture of —:		Countervailing Duties on Russian — in the United States. (T.R.).....	406
(P) Croizier and Thominé.....	810	Diffusion Juice; Organic Acids Extracted by Ether from —. (Andrik, Urban and Stenek).....	54
(P) Lake. From Wachtel and Co.....	478	Diffusion Juice; Purification of —. (A.V.).....	53
(P) Marx.....	810	Drawback on —. (T.R.).....	629
(P) Mat Schougaard and Evans.....	719	Duty on —. (T.R.).....	774
(P) Mathieson-Thom and Oakes.....	719	Export Duty on — in Mauritius. (T.R.).....	949
(P) Timofeeff.....	125	Exports of Bahia. (T.R.).....	1047
Artificial; Manufacture of — and Apparatus therefor. (P) Dünkelberg.....	562	Exports of Dantzig. (T.R.).....	1047
Artificial; Manufacture of Building Blocks of —. (P) Gussow.....	125	Extraction of — from Lime Scum and Sediment. (P) Steffen.....	916
Artificial; Preparation of —. (P) Seifarth.....	365	Factories in Russia; Purification of Waste Waters of —. (Slasski).....	146
Artificial; Production of — free from Air. (P) Grün-berg.....	365	Factories; Utilisation of Vapours of —. (P) Steffen.....	268
Blocks, Artificial; Manufacture of —. (P) Société H. Crozier.....	510	Factory Effluent, Beetroot —; Purification of. (Pritz-kow).....	1226
Blocks or Tiles; Artificial Fireproof —. (P) Boenke.....	810	Filtration of — through Animal Charcoal. (Stolle).....	54
Composition for Use as Artificial —. (P) Bushman.....	1212	From Argentina. (T.R.).....	949
Treatment of —. (P) Lorenc.....	992	German Commission on Normal Standards for —. (Herzfeld).....	268
Stone. See also under Granite.		Import Duties. (T.R.).....	948
Stones; Artificial; Production of —. (P) Schürholz.....	233	Import Duties on Articles containing —. (T.R.).....	1160
Precious; Testing of —. (Friedlaender).....	512	Imports of — 1885 to 1900. (T.R.).....	407
Stoneware, Ceramic — of the Sèvres Porcelain Works. (Vogt).....	580	In Beets; Rapid Determination of —:	
Industry. (Schärtler).....	982	(Ewell).....	915
Storax; American and Oriental —. (Tschirch and van Itallie).....	1136	(Hiltner and Thatcher).....	754
Straits Settlements; Coconut Oil and Vegetable Tallow in the —. (T.R.).....	955	In Brazil. (T.R.).....	1161
Settlements; Copra, Coconut Oil and Vegetable Tallow Imports of the —. (T.R.).....	1044	In Swedes. (Collins).....	536
Settlements; Rubber Culture at Perak —. (T.R.).....	1160		
Settlements; Tin in —. (T.R.).....	1041		

PAGE

Sugar—cont.

Industry in Italy. (T.R.)..... 1161

Industry in the United States; The Beetroot —. (T.R.) 406

Industry of Bohemia. (T.R.)..... 632, 957

Industry of Brazil. (T.R.)..... 1047

Industry of Pernambuco, Brazil. (T.R.)..... 643

Industry of Spain. (T.R.)..... 774

Intermediate Duties on — in the United Kingdom. (T.R.)..... 515

Juice; Continuous Subsiders for Cleansing —. (F) Pickering and MacGregor..... 915

Juices; Alcohol and German Yeast from —. (P) Bramsch..... 600

Juices; Influence of Alkalinity after Second Saturation on Solution of Magnesia by —. (Andriik)..... 140

Juices; Influence of Specific Heat and Viscosity on Working of —. (Classen)..... 820

Juices; Obtaining German Yeast from —. (P) Bramsch..... 736

Kjeldahl's Method for Determination of —. (Woy)..... 395

Liquors; Disappearance of Alkalinity during Evaporation. (Andriik)..... 140

Liquors; Influence of Alkalinity on —. (Zscheje)..... 53

Machinery in Cuba. (T.R.)..... 1161

Manufacture; French —. (Horsiu-Déon)..... 1007

Manufacture in French Colonies; Allowance for Waste in —. (T.R.)..... 78

Micro-Organisms in Manufacture of Beetroot —. (Schöne) 733

Milk; Detection of — in Milk. (Riegler)..... 285

Obtaining — in Crystals. (P) Claessen..... 489

Production in Germany during 1900—1. (T.R.)..... 957

Production of Russia for 1900—1. (T.R.)..... 1047

Products; Acidity and Alkalinity of —. (Stanko)..... 821

Products; Analysis of Waste —. (Andriik and others)..... 374

Products; Boiling and Crystallising — by Grosse's Process. (Carlson)..... 1126

Products; Mannose in Cane —. (Pellet)..... 754

Products; Nitrites in — and their Influence. (Andriik and Stanek)..... 1225

Products; Tables for Converting Quotients of Purity, &c., into Quotients of Impurity and Inorganic Quotients. (Sachs)..... 1225

Reaction; A New —. (Solimann)..... 753

Refining; Improvements in —, during 25 years. (Patterson)..... 1088

Refining of —, and Apparatus therefor: (P) Johnson. From the Cereal Sugar Company.... 824 (P) Robin-Langlois..... 55

Solutions; Action of Strontia on —. (Schöne and Tollens)..... 821

Solutions; Determining Acidity and Alkalinity in Coloured —. (Pellet)..... 488

Solutions Saturated with Lime; Action of Carbolic Acid on —. (Weisberg)..... 488

Solutions; Solubility of Lime in —: (Pellet)..... 821 (Pellet and Weisberg)..... 733

Solutions; Treatment of — for Precipitation. (P) Lillie..... 140

Statistics for 1900—1. (T.R.)..... 1047

Third-Jet, and Molasses; Composition of the Insoluble Matter of —. (Pellet)..... 53

Trade in — by Austria-Hungary. (T.R.)..... 521

Trade of Nagasaki during 1900. (T.R.)..... 957

Treating Waste Liquids from Manufacture of —. (P) FischeI..... 734

Ultramarine for Blueing —. (Herzfeld)..... 1007

Waste; Utilisation of Beet —. (T.R.)..... 775

Works; Sulphides in Bone-Black for —. (Stolle)..... 268

Sugars, Alkalinity of Raw —; Determination of. (Herzfeld) 510

Alterability of Stored Raw —. (Köhler)..... 1147

Arsenic in; Determination of —. (Newlands and Ling) 748

Beet- and Cane- — in Europe. (T.R.)..... 407

Cause of Rapid Deterioration of some —. (Prinsen-Geerligs)..... 1007

Dutch; Countervailing Duties on — in British India. (T.R.)..... 628

Dutch; Countervailing Duties on — in the United States. (T.R.)..... 406

Fermentation Experiments with various —. (Lindner)..... 141

From Cellulose. (Fenton)..... 757

Griess's Diaminobenzoic Acid for identifying —. (Schilling)..... 621

In Products of Hydrolysis of Wood. (Storer)..... 822

Influence of Salts on Rotatory Power of —. (de Kowalski and Tomartschenko)..... 623

New Derivatives of —. (van Ekenstein and Lobry de Bruyn)..... 291

Sulphammonium; Preparation and Properties of —. (Moissan)..... 362

Sulphate of Copper; Demand for — in Greece. (T.R.)..... 1039

Of Copper in Algeria. (T.R.)..... 1039

Sulphates, Metallic; Electrolytic Production of —. (P) Palas and Cotta..... 906

Sulphide Blacks; Research on —. (Sunderland)..... 243

Colour and its Leuco Compound; Manufacture of a —. (P) Ransford. From Cassella and Co. 1205

Colours; Dyeing and Printing with —. (P) Green and others..... 713

Colours; Printing with —. (P) Sansone and The Clayton Aniline Company..... 693

Dyestuffs; Analysis of —. (Meyenberg)..... 508

PAGE

Sulphide—cont.

Dyestuffs; Dyeing and Printing with —. (P) Abel. From the Actienges. für Anilin Fabrikation..... 577

Ores. See under Ores.

Sulphides co-existing with Hydrosulphides, &c.; Determination of —. (Gautier)..... 392

In Bone-Black for Sugar Works. (Stolle)..... 268

Metallic; Metallurgical Treatment of —. (P) Bulhier and others..... 481

Precipitation of Metallic — by Thiosulphate. (Donath) 619

Sulphinic Acids, Aromatic; Manufacture of —. (P) Imray. From the Basle Chemical Works..... 119

Sulphite Cellulose Liquors; Removal of Silica from —. (Lunge and Lohöfer)..... 1231

Cellulose Waste Liquors; Treatment and Utilisation of —. (P) Brookes. From Trippe..... 741

Sulphocyanides; Action of Reducing Gases on —. (Conroy and others)..... 320

As Bye-Product of Zinc Sulphide Manufacture. (P) Beringer..... 592

Manufacture of Cyanides from —. (P) Raschen and others..... 899

Sulphocyanogen and Pseudo — Production of. (Goldberg) 1103

Pseudo —, and Canarin. (Goldberg)..... 258

Research on —. (Goldberg)..... 798

Sulphonates, Diazo -, and Phenols or Amines; Action of Light on Compounds of —. (Seyewetz and Blanc)..... 1103

Sulphonations. (Crafts)..... 796

Sulphonic Acids; Alkylated Aminobenzene —. (Gnehm and Scheutz)..... 793

Separation of — by Distillation in Vacuo. (Krafft and Wilke)..... 113

Sulphur and India-rubber. (Springer)..... 592

At Taltal. (T.R.)..... 1039

Blue or Green; Wohler's; Formation of —. (Orlow)..... 943

Colours; Employment of a New Class of —. (Green)..... 576

Compounds from Waste Gases; Recovery of —. (P) Carey and others..... 474

Deposits in Japan. (T.R.)..... 300

Dioxide; Action of — on Aqueous Solutions of Red Prussiate of Potash. (Matuschek)..... 897

Dyestuffs; Dyeing with —. (P) Imray. From the Farb. vorm. Meister, Lucius und Brüning..... 41

Elimination of — from Sulphide Ores. (P) Gutensohn and Pries..... 723

Green Modification of; Reaction of Formation of the —. (Orlow)..... 943

In Acetylene and other Gases; Determination of —. (Eitner and Keppeler)..... 938

In Asphalts and Bituminous Chalks of Palestine. (Glschner)..... 885

In Benzol; New test for —. (Irwin)..... 410

In British Columbia. (T.R.)..... 1040

In Fuel; Determination of the Total —. (Dubois)..... 1241

In Iron and Steel; Determination of —. (Noyes and Helmer)..... 1143

In Japan. (T.R.)..... 1156

In Oils; Determination of —. (Jean)..... 1147

In Pig-Iron; Irregular Distribution of —. (Bolling)..... 126

In Sicily. (T.R.)..... 1157

In Wrought Iron and Steel; Determination of —. (Auchy)..... 620

Industry in Sicily:—

(Jungfleisch)..... 714

(T.R.)..... 166

Influence of Aluminium Salts in Determination of —. (Noailon)..... 984

Ore at Pernau, Russia. (T.R.)..... 1040

Production of — in New Zealand. (T.R.)..... 1258

Production of — in Spain in 1899. (T.R.)..... 301

Trioxide in Fuming Sulphuric Acid; Determination of —. (Rabe)..... 619

Trioxide; Investigation on —. (Schneck)..... 577

Trioxide; Production of —. (P) Meister, Lucius und Brüning..... 578

Sulphuretted Hydrogen. See under Hydrogen.

Sulphuric Acid and Copper Sulphate; Electrolysis of a Mixture of —. (Sand)..... 725

Anhydrous; Action of — on Potassium Persulphate. (Bach)..... 716

Apparatus for Concentrating:—

(P) Flanagan..... 1112

(P) Kessle;..... 807

(P) Krell..... 714

Apparatus for Manufacture of —. (P) Potot..... 393

Apparatus for Manufacture of — by Catalysis. (P) Actienges. vorm. Grillo and Schroeder..... 579

As a Typhoid Disinfectant. (Rideal)..... 1133

Containing Iron; Electrolysis of Dilute —. (Elbs)..... 48

Decomposition of Sodium Nitrate by —. (Volney)..... 896

Early Manufacture of —. (Gutmann)..... 5

In Brown-Coal Tar Purification; Chemical Function and Physical Significance of —. (Pauli)..... 32

In Japan. (T.R.)..... 299

Manufacture of — by the Catalytic Process. (P) Raynaud and Pierron..... 42

Manufacture of Concentrated —. (P) Zauner..... 717

Plant for — and Sulphur in Sicily. (T.R.)..... 1157

Preparation of Standard Solutions of —. (Meade)..... 392

Producing Gases for Manufacture of —. (P) Tangye..... 255



	PAGE		PAGE
Sulphuric—cont.		Tanning—cont.	
Production of —:—		Liquids; Determination of Tannin and Acids in —	
(P) Johnson	250	(Jean)	159
(P) Potat	280	Liquids; Manufacture of —. (P) Thompson and Blin ..	265
Seleniferous —. (Orlow)	619	Liquors; Purification of —. (P) Thompson and Blin ..	729
Selenium in; Detection of —. (Jouve)	619	Materials; Analysis of —. (Paessler)	486
Solution; Electrolytic Reduction of Substances. Diffi-		Materials; Application of Chromed Hide-powder in Analy-	
culty Reducible in —. (Tafel)	48	sis of —. (Paessler and Appellius)	1249
Water or Sulphur Trioxide in Fuming —; Determina-		Materials at Fiume in 1900. (T.R.)	956
tion of. (Rabe)	619	Materials at Hamburg in 1903. (T.R.)	771
Sulphuric Anhydride; Apparatus for Production of —. (P)		Materials; Determination of Tanning Matter in —	
Badische Anilin und Soda Fabrik	714	(Koerner)	286
Anhydride; Manufacture of —. By Contact Process. (P)		Materials in tussia. (T.R.)	953
Lurray. From the Farb. vorm. Meister, Lucius und		Materials; Influence of Water Used in Extracting —	
Brüning	1209	(Nihoul and Martinez)	1005
Anhydride; Production of —. (P) Badische Anilin und		Materials; Japanese —. (von Schroeder)	265
Soda Fabrik	360	Materials; Leather-Forming Value of Various —	
Sulphurous Acid; Purification of —. (P) Raynaud and		(Youl and Griffith)	426
Pierron	42	Micro-organisms and Antiseptics in —. (Jean)	265
Sulphuryl Chloride; Hydrate of —. (Bayer and Villiger).		New Material for	729
496		Plants in German East Africa. (T.R.)	520
Sulphuryl Fluoride; Preparation and Characteristics of —.		Rapid —. (P) Thirion. From Mindus	1006
(Moissan)	396	Sheep Skins with Wool on	5-3
Sumach Exports of Sicily. (T.R.)	1160	Solution for —. (P) Howorth. From Trant and others	
Sunflower Oil. (Jean)	908	Substances in some Tan-yard Liquors; Determination of	
Superphosphate; Absorption of —, by Arable Earth and		(Palmer)	138
Humus. (Dumont)	374	Use of Ercidin —. (Becker)	138
Basic; Preparation and Use of —. (Hughes)	325	Use of Sulphite Pulp Waste Liquors in —. (P) Jean ..	1037
Conversion of Acid — into Alkaline or Basic Superphos-		With Lactic Acid	536
phate. (P) Hughes	267	With Picric Acid. (Watenburger)	536
Manufacture of —. (P) Saxl and others	374	Tannoids; Research on the —. (Kunz-Krause)	1223
Superphosphates at Odessa, Russia. (T.R.)	1043	Tannol Resins; Researches on —. (Tschirch)	51
Preparation of —, for the Market. (Elschner)	267	Tan-yard Liquors; Determination of Tanning Substance in	
Water-soluble Phosphoric Acid in; Determination of —		(Palmer)	138
(von Zéll)	936	Tap, Glass —, with Universal Mercury Seal. (Göckel)	155
Suprarenal Glands; Products containing the Active Principle		Tar, Brown-Coal; Constituents of —. (Rosenthal)	885
of —. (P) Takamine	746	Brown-Coal; Use of Superheated Steam in Distillation of	
Sweden; Calcium Carbide Industry of —. (T.R.)	635	(Huth)	885
Duty on Gold and Platinum Salts in —. (T.R.)	515	Distillation; Treatment of Noxious Vapours from —	
Guano and Oil Trade of Gothenburg. (T.R.)	937	(Craven and Coleman)	200
Peat as a Substitute for Coal in —. (T.R.)	634	Drawback on —, in the United States. (T.R.)	1156
Wood-pulp in Gothenburg —. (T.R.)	958	Manufacture of —. (P) Rauch	352
Swedes; Sugar in —. (Collins)	536	Oil; Duty on —, in the United States. (T.R.)	759
Sweet Cassava; Hydrocyanic Acid in —. (Carmody)	502	Oils; Economical Saturation of Wood with —. (Sei-	
Sweetening Agents in Food; Detection of Artificial —		denschurn)	581
393		Products. (Class III.) .. 32, 80, 111, 165, 237, 295, 352, 399, 464,	
Switzerland; Monopoly Duties on Alcoholic Products. (T.R.)	629	536, 635, 700, 795, 854, 885, 977, 1038, 1156, 1200, 1258	
Syrups; Determination of Purity of —. (Arnauld)	755	Products at Lyons. (T.R.)	854
Real and Apparent Purity of —:—		Soot from; Manufacture of —. (P) Bente	728
(de Jongh)	488	Tariff Changes. 78, 162, 294, 397, 515, 628, 758, 848, 946, 1035, 1158	
(Pellet)	489	Modifications in Mexico. (T.R.)	1153
Regulating Supersaturation in Boiling of —, and		Of Australia. (T.R.)	1155
Apparatus therefor. (P) Cussen	1126	Valuations of Goods in British India. (T.R.)	163
Table for Degraes Baumé of — at Different Tem-		Tartar; Commercial Determination of —. (Quantin)	941
peratures. (Nové)	488	Tartaric Material Exported from Italy, 1899-1900. (T.R.)	169
		Tartrates in Odessa. (T.R.)	1262
T		Tautocinchonine; Preparation of —. (Langer)	560
Tacoma; Smelting Works at —. (T.R.)	859	Tea-seed Oil in India. (T.R.)	1043
Taka-diastrase and Reversed Ferment Action. (Hill)	736	-Sweepings for Caffeine Duty-Free in United States.	
Tallow; Duty on Vegetable —, in Italy. (T.R.)	950	(T.R.)	169
Imports of Bahia, Brazil. (T.R.)	1043	Theine in —. (Kochis)	58
Imports of the Straits Settlements. (T.R.)	1044	Tecomin; Characteristics of —. (Lée)	116
Of Sillingsia Sebifera. (Tortelli and Ruggeri)	261	Telluride Gold Ores of Cripple Creek and Kalgoorlie.	
Tangier; Chemical Imports of — for 1899. (T.R.)	631	(Rieckard)	45
Tank-Wagons; Regulations as to — in Germany. (T.R.) ..	393	Tellurides of Gold and Silver in the Kalgoorlie Region.	
Tanks for Acid or Alkaline Liquids. (Markfeldt)	986	(Carnot)	813
Manufacture of —. (P) Nobis and Wenzel	562	Tellurium; Effect on Marsh Test of Products containing —	
Tannase; Preparation of —:		(Berry)	322
(Fernbach)	137	In the Ores of the Hauraki Goldfields, New Zealand.	
(Poltevin)	137	(Allen)	901
Tanneries in Naples. (T.R.)	861	New Gravimetric Determination of —. (Gutbier)	1145
In the Province of Florence. (T.R.)	1260	Preparation of — in Large Quantities. (Matthey)	58
Tannery Refuse; Anthrax Traceable to —. (Russell) .. 405, 494		Temperature of Highly Heated Bodies; Determining and	
Refuse; Case under Rivers Pollution Act. (T.R.)	772	Controlling the —. (P) James. From the Bethlehem	
Tannin Determination; International Association Method of		Steel Co.	459, 460
(Procter)	104	Of Pottery and other Kilns; Means for Indicating. (P)	
Determination of —. (Sesti)	1031	Watkins	477
Estimation; Comparison of Methods for —. (Turnbull)		Temperatures; High; Production of — by Combustion of	
Estimation Results; Comparison of Volumetric Methods.		Aluminium. (Goldschmidt)	253
(Turnbull)	159	Measurement of High —, by the Spectroscope. (Hempel)	
-Gelatin; Manufacture of —. (P) Abel. From the		Of Substances Luminous or Incandescence on Heating;	
Actienges. für Anilin Fabrikation	276, 277	Apparatus for Determining —. (P) Wise. From	
Report on Methods in Use for Determination of —		Morse and others	343
(Procter)	1246	Terpene Compounds; Development of — in the Geranium.	
Use of —, in Purifying Residues containing Alkaloids.		(Charabot)	61
(Kippenberger)	74	In Basil Oil; New —. (van Komburgh)	744
Tanning. (Class XIV.)	52, 137, 263, 302, 373, 405, 486, 520, 593,	Series; Loss of Water, Haloid Acids, Ammonia, &c. in the	
642, 729, 771, 818, 860, 913, 956, 1005, 1045, 1124, 1160, 1223, 1290		(Semmler)	563
Experiment; Beam House	594	Series; Reduction in the —. (Semmler)	1135
Extracts; Absorptive Influence of Materials used in De-		Terjane, a New Tricyclic —. (Tschugaeff)	65
termination of Total Soluble Matter in —. (Searle) ..		Terpenes and Essential Oils. (Wallach)	64
Extracts containing Bisulphites; Effect of —, on		Terpenosins; Researches on —. (Tschirch)	51
Leather. (Gordon, Parker and Gansser)	1085	Terpinene Nitrosite; Reduction of —. (Wallach)	61
		Terpineol; Preparation of —. (Genvresse)	503
		Test for Arsenic; Discussion on Need of a Standard —	
		-Paper Sensitive to Several Chemicals Simultaneously.	
		(T) Bromhead. From the Chem. Fab. Helfenberg ..	748

	PAGE
Tetrachlorodialkylamino-m-oxybenzoylbenzoic Acids; New Derivatives of —. (Haller and Uabgrove)	980
Tetrahydrobrucine; Characteristics of. (Tafel and Naumann)	1233
Tetramethyldiaminophenyl-anthranol and -oxanthranol; Formation and Properties of —. (Haller and Guyot)	465
Texas; Mercury in —. (T.R.)	82
Petroleum; Quality of —. (Haller and Guyot)	237
Textiles. (Class V.)	33, 81, 119, 242, 358, 469, 573, 635, 709, 763, 804, 855, 890, 952, 982, 1108, 1206
Textile Dyeing in Philadelphia. (T.R.)	635
Textile Fabrics; Bleaching — and Apparatus therefor. (P) Hadfield	246
Fabrics; Colour Printing of —. (P) Hope	577
Fabrics; Cylinders for Use in Printing —. (P) Dejeu	360
Fabrics; Discharging of Dyed —. (P) Johnson. From The Badische Anilin and Soda Fab.	217
Fabrics; Drying — while Stretched. (P) Hain	469
Fabrics; Dyeing of —. (P) Schreiner	713
Fabrics; Filling or Weighting —. (P) Brothers	353
Fabrics; Manufacture of —. (P) Marty	39
Fabrics; Rendering — Non-Inflammable and Waterproof. (P) Baswitz	574
Fabrics; Shower-proofing of —. (Weber)	804
Fabrics; Waterproofing of —. (P) Baswitz	359
Fibres; Colouring Animal or Vegetable —. (P) Cumber and Chorley	472
Fibres from Cellulose; Apparatus for Production of —. (P) Topham	1207
Materials; Apparatus for Dyeing, &c. —. (P) Schirp	471
Materials; Apparatus for Testing —. (P) Grandage	703
Materials; Apparatus for Treating — with Liquids. (P) Heys. From Plantra	935
Materials; Cleaning, Degreasing, and Bleaching —. (P) Bourin and Aymeric	119
Materials; Drying of —. (Smith)	709
Materials; Manufacture of Lustreous Threads and Strips of —. (P) Inray. From Herberlein & Co.	710
Materials; Treatment of — with Fluids. (P) Weiss	463
Products; Bleaching of —. (P) Gebauer	892
Textiles, Finishing Materials for —. (Fürth)	212
Printing — with Indigo. (P) Wilcox. From The Badische Anilin and Soda Fabrik.	1111
See also under Piece Goods, Warps, Fabrics, and Fibres.	
Theobromine; Characteristics of —. (Vongerichten)	501
Theobromine; Properties of —. (Paul)	605
Thermometers at Higher Temperatures; Glass for —. (McClellan)	839
Thiocyanogen, Sulpho —. See under Sulphocyanogen.	
Thionine Dyestuffs. (Kehrmann and Schaposchnikoff)	116
Thiopyrine; Obtaining of —. (Michaelis)	1234
Thiosulphate in Photographic Films Destroyed by Potassium Permanganate. (Valenta)	608
Precipitation of Metallic Sulphides by —. (Donath)	619
Thiosulphates; Action of Hydrogen Peroxide on —. (Nahl)	76
Alkali; Interaction of — with Potassium Permanganate in Neutral Solutions. (Dobbin)	212
Co-existing with Polysulphides, &c.; Determination of —. (Gantier)	392
Thomas Slag. See under Slag.	
Thorium Hydride and Nitride. (Matignon and Delépine)	271
New Element Associated with —. (Baskerville)	1231
Thread from Cellulose Solutions; Manufacture of —. (P) Inray. From Brounet and others	1207
Threads and Fabrics; Production of Impermeable —. (P) Heys. From Sénéchal de la Grande	39
Manufacture of Artificial —. (P) Lehner	1206
Repetitions of Long Suites of Colours on —. (P) Heffmann	121
Thujene, a New Tricyclic Terpene. (Tschugaeff)	65
Thujylamine; Transformation of — into Thujene (Tschugaeff)	930
Thyme; Essences of —. (Jeancard and Satie)	1237
Oil; Examination of —. (Kebler)	756
1. Thymol. Displacement of Alkyls from Phenols by Nitration. (Larter)	745
Thymol; Manufacture of —. (Dinesman)	1019
Thymoquinone in Wild Bergamot Oil. (Brandel and Kremers)	744
Tiles; Composition for Manufacture of —. (P) Soège	532
Encaustic; Colouring or Decorating —. (P) Sinclair	727
Glass; Manufacture of —. (P) Inray. From the Opalite Tile Co.	364
Imported by Brazil. (T.R.)	1157
Manufacture of —. (P) Coiffier and others	477
Opal Glass Facing —. (P) Davis	477
Timber; Dyeing or Preserving —. (P) Pfister	900
Preservation of —. (Chanate)	43
See also under Wood.	
Tin Cuttings; Recovery of Copperas from —. (P) Gels-thorpe	483
Deposits in Alaska. (T.R.)	1260
Electrolytic Apparatus for Stripping — from Scrap. (P) Matthews and Davies	590
Extraction of — from Ores and Slags. (P) Brandenburg and Weyland	998
Flame Reaction of —. (Schmatolla)	748
In Fine Lead; Determination of —. (Liebschutz)	1028

Tin—cont.

	PAGE
In the Straits Settlements. (T.R.)	1041
Influence of — on the Quality of Steel or Iron	583
Influence of — on the Quality of Steel or Iron. (Zugger)	583
Influence of — upon Copper. (Stahl)	480
Obtainment of Pure — from Sheet-Iron Waste. (P) Bergsoe	363
Physico-Chemical Studies of —. (Cohen)	366
-Plate; Manufacture of —, and Apparatus therefor. (P) Inray. From Rogers and Beaver	129
-Plate, Printing of —, in Dead Colours. (P) Bayerthal. From Ewers	1208
Precipitation of — from Sulpho-Salts. (Ost and Klapproth)	1028
Production of — in Bolivia. (T.R.)	801
Recovery of — from "Hardhead" or "Sag". (P) Bradford	1217
Recovery of — from Tinned Iron. (P) Hemingway	368
Recovery of — from Waste. (P) Preto	368
Recovery of —, from Waste and Spelter Scrap. (P) Davis	363
Recovery of —, with Generation of Electric Energy. (P) Gould	817
Refining Raw —. (P) Bergsoe	368
Separation of — from Antimony, by Electrolysis. (Ost and Klapproth)	1023
Slags and Silicates; Lixiviation of —. (P) Brandeburg and Weyland	1216
The World's Supply of —, in 1900. (T.R.)	301
Volumetric Determination of —, by Stannous Chloride. (Zengills)	340
Tin foil and Bottle Caps; Manufacture of —. (Granja)	1191
Tinned Iron. See under Iron.	
Tinctures; Duty on —, in Japan. (T.R.)	294
Titanic Acid; Colorimetric Determination of —. (Brakes)	23
Oxide; Concentrates containing High Percentages of —. (P) Rossi and others	538
Titanium Salts; Application of —, for Leather Dyeing. (Lamb)	1111
Tobacco; Catalase and Enzyme of Cured —. (Low)	598
Free from Nicotine; Production of —. (P) Haase and Broeckmann	78
Leaf; Paraffins in —. (Thorpe and Holmes)	758
New Alkaloids of —. (Pictet and Rotschy)	501
Nicotine in; Determination of —. (Tóth)	942
Smoke; Chemistry of —. (Thoms)	626
Toluene; Electrolytic Oxidation of —. (Puls)	464
Sulphochlorides; Manufacture of —. (P) Thompson. From Geiler	504
Trinito; Reduction of —, with Hydrogen Sulphide. (Cohen and Dakin)	1254
Toluidine, m-; Azo-Compounds from —. (Samelson)	240
Para-; Oxidation of —. (Börstein)	701
Toning and Fixing Bath. (Liesegang)	153
-Baths for Gelatine-Chloride Prints. (Wilson)	834, 832
Tool-Steel. See under Steel.	
Torches; Gas-Lighting —. (P) Glover	698
Tornøe's Method of Determining Alcohol and Extract in Beer. (Ling and Pop)	755
Towers; Condensing —. (Clemmers)	1208
Guttman's Filling Material for Reaction and Absorption —. (Heintz)	862
Packing Material for Gay Lussac and other. (P) Gibson	897
Trade Marks; Chambers of Commerce Resolution on —. (T.R.)	951
Report ... 78, 162, 294, 397, 514, 628, 758, 818, 946, 1035, 1152, 1236	
Tragacanth; Presence of Cellulose in —. (Toiens)	740
Transport of Chemicals. (Musprat)	420
Trapa Natans, or Water-Nut; Composition of —. (Zega and Knez-Milojkovic)	270
Trass and Trass Mortar. (Burchartz)	252
Treasurer, Report of Honorary	662
Trees; Dyestuff-yielding — of Pemba. (T.R.)	763
Trentepohlia Jolithus; Erythritol in —. (Bamberger and Landsiedl)	77
Triazo Compounds. (Rupe and Majewski)	151
Tribenzal-d-sorbito. (van Ekenstein and Lobry de Bruyn)	291
Triboluminescence. (Tschugaeff)	845
Trichromatic Photography. See under Photography.	
Trinidad; Asphalt and Manjak in —. (T.R.)	1038
Trinitro-a-Naphthol OH:NO ₂ :NO ₂ :1.2.4.1'; Constitution of —. (Kehrmann and Misslin)	706
Trinitrobenzene; Reduction of — with Hydrogen Sulphide. (Cohen and Dakin)	1254
Trinitrotoluene; Reduction of — with Hydrogen Sulphide. (Cohen and Dakin)	1254
1.3.5'-Tri-oxylavone; Preparation of —. (St. v. Kostanecki and Steuermann)	375
Triphenylcarbinols; Etherification of — by Alcohol. (Fischer)	33
Triphenylchloromethane. (Gomberg)	114
Preparation of —. (Gomberg)	33
Triphenylmethane Colouring Matters; Production of —. (P) Johnson. From Boehringer and Soehne	358
Derivatives; Preparation of —. (Grimaux)	335



	PAGE		PAGE
Triphenylmethane—cont.		United States—cont.	
Dyestuffs; Absorption Spectra of Aqueous Solutions of — (Carnichel).....	114	Duty on Tar Oil or Carbolinum in — (T.R.).....	759
Dyestuffs; Blue — (Grimaux).....	355	Duty on Wolfram and Tungsten Ore in — (T.R.).....	759
Dyestuffs; Pink — (Grimaux).....	355	Earthenware and China at Portland, Oregon — (T.R.).....	857
Dyestuffs; Production of — (Grimaux and Lefevre).....	355	Electrolytic Refining in the — (Ulke).....	402, 727
Relation between Chem. Constitution of Dyestuffs from — and Absorption Spectra of their Aq. Solutions. (Lemoult).....	33	Fertiliser and Acid Plant at Atlanta, Ga. (T.R.).....	957
Triturating Apparatus. (P) Lake. From Werner and Pfeleiderer.....	789	Fuller's Earth Production of — (T.R.).....	81
Tropenas Process for Steel Castings. (T.R.).....	81	Glass, Glassware, and Earthenware in — (T.R.).....	1040
Tropidine; Conversion of — into Tropine. (Willstaetter).....	1135	Imports of Chemical Raw Materials. (T.R.).....	1156
Tropine; Detection of — (Vreven).....	285	Iron Ore Production in the — (T.R.).....	858
Group; Syntheses in the — (Willstaetter).....	1015	Leather Trade of the — (T.R.).....	302
Tropinone; Transformation of — into d-Cocaine. (Willstaetter and Bode).....	832	Linseed Oil in Portland, Oregon — (T.R.).....	830
Tung Oil; Attempts to Deodorise — (Ulzer).....	261	Magnesium Sulphate in the — (T.R.).....	950
Tungsten; Aluminium Alloys containing — (P) Berg.....	1217	Mercury Exports of San Francisco — (T.R.).....	859
And Aluminium; Alloys of — (Guillet).....	723	Metals Produced in the — (T.R.).....	760, 761
In Ores; Determination of — (Fritchie).....	840	Mineral and Metal Production of — (T.R.).....	79
Ore; Duty on — in the United States. (T.R.).....	759	Mineral Oil Industry of the — (T.R.).....	635
Ores in Colorado. (T.B.).....	519	Ores and Minerals Produced in the — (T.R.).....	759
Trioxide; Separation of — from Molybdenum Trioxide. (Buegenberg and Smith).....	69	Paint Industry of the — (T.R.).....	403
Tungstic Acid; Determination of —, and Separation from Silica. (Herting).....	392	Phosphate Production of the — (T.R.).....	1045
Quantitative Separation of — from Silicic Acid. (Wells and Metzger).....	749	Phosphate Rock Production of the — (T.R.).....	83
Turkey; Bitumen Production in — (T.R.).....	399	Pine Fibre Industry in Oregon. (T.R.).....	855
Cement Trade of Constantinople. (T.R.).....	1158	Platinum Prices in — (T.R.).....	1041
Chemical Trade of Sivas — (T.R.).....	630	Sheep-Dip Duty free in the — (T.R.).....	1048
Chrome, Coal, Silver-Lead and Antimony Mines in Salonica and Kossova — (T.R.).....	1259	Tea Sweepings for Caffeine Duty-Free in — (T.R.).....	169
Gall Crop at Baghdad — (T.R.).....	1045	Zinc Industry in the — (T.R.).....	518
Minerals of Diarbekir — (T.R.).....	859		
Sesame-seed at Baghdad — (T.R.).....	1043	Urals; Minerals in the — (T.R.).....	519
Soap in Van — (T.R.).....	860	Uranium; Electrolytic Determination of — (Kollock and Smith).....	1029
Turkey-Red Oil; Detection of Iron in —.....	503	Nitrate. (De Coninck).....	249
Turkey-Red Oils in the Woollen Industry. (Steinberg).....	470	Ore in Colorado. (T.R.).....	519
Turpentine; Bordeaux — (Tschirch and Bruening).....	276	Ores; Analysis of — (Fritchie).....	70
Trade Description of — in India. (T.R.).....	294	Preparation of — (Aloy).....	480
Tutu and Tutin; Characteristics of — (Easterfield and Aston).....	67	Quantitative Separation and Determination of — (Kern).....	1144
Tyres; Manufacture of Fabric for — (P) Radclyffe.....	111	Red; Preparation of — (Kohlschütter).....	262
U		V	
Uganda Aloes. (Tschirch and Klaveness).....	743	Vacuum Apparatus for Separating Salt from Solutions. (P) Vis.....	123
Ulexite (Boronatrocalcite); Synthesis of — (de Schulten).....	832	Pans; Construction of. (Greiner).....	1125
Ultramarine for Blueing Sugar. (Herzfeld).....	1007	Valerian Root; Pharmacopœia Tests of —.....	386
Unions; Dyeing of — with Diamine Dyestuffs. (Fearnsides).....	39	Valve for Gas, which Prevents Passage of Liquids. (Scholvien).....	748
United Alkali Co. versus St. Helens Corporation. (T.R.).....	765	Vanadium; Extraction and Uses of — (Proctor Smith).....	1183
United States; Beetroot Sugar Industry in the — (T.R.).....	406	In Slags and Cinders; Determination of — (Jouet).....	620
Beet Sugar in Los Angeles, in 1900. (T.R.).....	862	Iron; Properties of — (Baxeres).....	478
Boot and Shoe Industry of the — (T.R.).....	302	Ores; Analysis of — (Fritchie).....	70
Borax in Oregon — (T.R.).....	855	Vanilla; Formation of the Perfume of — (Lecomte).....	1236
Butter Substitutes in the — (T.R.).....	407	Planting in the Seychelles. (F.R.).....	1048
Cascara Sagrada in Oregon — (T.R.).....	864	Vanillin; Preparation of —, from Protocatechuic Aldehyde. (P) Sommer.....	1135
Cement at San Francisco — (T.R.).....	857	Vaporisers. (P) Firth and Jackson.....	697
Cement Imports of — (T.R.).....	1040	Vapour and Air; Apparatus for Burning — for Incandescence Lighting. (P) Leroux and Carmien.....	1101
Cement Imports of Portland, Oregon — (T.R.).....	857	At Desired Pressure; Production of —, and Apparatus therefor. (P) Steffen.....	562, 878
Cement Industry of the — (T.R.).....	766	Burners:—	
Cement (Portland) Industry in California — (T.R.).....	837	(P) Lecomte.....	32
Chemical and Metallurgical Industries of New York. (T.R.).....	858	(P) Thompson. From Braun.....	463
Chemical Imports of —, in 1900. (T.R.).....	81	Burners for Steam Generators. (P) Lake. From Kidder.....	975
Coal in Washington State — (T.R.).....	853	Burners; Hydrocarbon — (P) Hartel.....	32
Coke Manufacture in the — (T.R.).....	852	Burning Apparatus. (P) Kitson.....	1195
Consular Reports on Acetic Acid in the. (T.R.).....	297	Burning Apparatus and Systems. (P) Philipson and others.....	563
Copper Production of the — (T.R.).....	768	Vapours from Tar Distillation; Treatment of Noxious — (Craven and Coleman).....	200
Cotton Seed Products in the — (T.R.).....	403	Of Sugar and other Factories; Utilisation of — (P) Steffen.....	268
Countervailing Duties on Belgian and Russian Sugar in the — (T.R.).....	406	Varnish, Amber; Manufacture of — (P) Flather.....	372
Countervailing Duties on Dutch Sugars in the — (T.R.).....	406, 1261	Apparatus for Manufacture of — (P) Lake. From Worstall and Hackathorn.....	263
Customs Decision on Barium-coated Paper. (T.R.).....	1162	Chemical Process in the Manufacture of — (Heupel).....	818
Customs Decision on Carbonate of Baryta. (T.R.).....	1258	Manufacture of — by the Pressure Process. (Smith).....	1076
Customs Decision on Crude Colour and Unwrought Earth. (T.R.).....	1250	Resins; Examination of — (Lewkowitsch).....	372
Customs Decision on Glyceretannate. (T.R.).....	1045	Varnishes. (Class XIII.) 50, 83, 135, 262, 372, 729, 770, 818, 1005, 1045, 1122, 1160, 1222, 1260.....	687
Customs Decision on Herbs in Alcohol. (T.R.).....	1261	At Glasgow Exhibition.....	687
Customs Decision on Ichthyol. (T.R.).....	1262	Manufacture of — (P) Kronstein.....	1123
Customs Decision on Scammony Resin. (T.R.).....	1260	Production of Oil — (P) Winkelmann.....	729
Customs Decisions in the — (T.R.).....	79, 294, 515, 629, 848, 950, 1048, 1258	Vaselines; Tests for and Properties of Natural — (Hœhnel).....	909
Customs Regulations in the — (T.R.).....	397	Vats; Tar Coating for Distillery Fermentation — (Heinzelmann).....	56
Disinfection of Imported Hides in — (T.R.).....	956	Vegetaline; A Substitute for Margarine. (T.R.).....	862
Drawback on Tar and Pure Ammonia in the — (T.R.).....	1156	Venezuela; Balata Rubber in — (T.R.).....	771
Dutch Metal Free of Duty in — (T.R.).....	1041	Venice Turpentine. (Tschirch).....	51
Duty-Free Alcohol in — (T.R.).....	168	Vessels for Holding Liquids; Purification of —, and Apparatus therefor. (P) Hill.....	1230
Duty on Camphor Oil or Refuse in — (T.R.).....	759	For Inflammable Liquids; Non-Explosive —.....	293
		For Storing Inflammable Liquids. (Ernst).....	459

	PAGE
Victoria; Customs Decision in —. (T.R.)	1036, 1153
Victoria; Preserving Fresh Fruit in —. (T.R.)	862
Victorian Gold Jubilee Exhibition, Bendigo.	627
Vinegar Exempted from Duty in the Netherlands. (T.R.)	628, 759
Ferments; Biochemical Distinction between the two Chief —. (Bertrand and Sazerac)	826
Methyl Alcohol in. Detection of —. (Robine)	753
Vinegars; Manufacture of —, and Apparatus therefor. (P) Burbe	737
Viscosimeter; The Engler-Ragosine —. (Ragosine)	933
Visits to Works and Places of Local Interest	678
Vogel's Qualitative Test for Cobalt. (Treadwell)	390
Volcanic Products of the Solfatara (Naples). (T.R.)	856

W

Wal-del Oil. (T.R.)	641
Walnut Oil; Bulgarian —. (Petkow)	1122
Oil from Juglans Nigra, L. (Kebler)	727
Waring System of Magnetic Concentration; The —	1116
Warps; Apparatus for Dyeing and Treating —. (P) Heys. From Masseron and others	1110
Wash for Sheep and other Animals. (P) Roxburgh and Scott	1133
Washers for Gases. (P) Humfrey	1196
<i>See also under Gas.</i>	
Washing and Bleaching Compounds. (P) Bartelt	892
Washing-blue in Pomba. (T.R.)	770
Waste Carbonaceous Materials; Destructive Treatment of —. (P) Duff	272
Liquids from Sugar Manufacture; Treatment of —. (P) Fischel	734
Neutralisation of Acid —. (T.R.)	400
Products from Distilleries; Treatment of —. (P) Ferguson	144
Products of Mineral Oil Industry; Utilising —. (Ulzer)	112
Sulphite-Cellulose Liquors; Treatment and Utilisation of —. (P) Brookes. From Trippe	741
Watara Oil.	833
Water; Abraham and Marmier's System for Purification of —. (Krull)	271
Apparatus for Decanting —. (P) Gorianiuoff	314
Apparatus for Filtering and Purifying —. (P) Green	272
Apparatus for Filtering and Treating —. (P) Desrumaux and Norman	233
Apparatus for Purification of —. (P) Gathmann	1133
Apparatus for Softening and Purifying —: (P) Froitzheim and Schumacher	602
(P) Harris	925
(P) Koyl	925
(P) Pemberton	601
Apparatus for Taking Samples of —. (Röttger)	50
Apparatus for Use in Purification of —. (P) From Lacomme and Lauder	739
Brewing —; Influence of Chemical Composition of —. (Bousquet)	1226
Calcium and Magnesium in; Volumetric Determination of —. (Winkler)	507
Carbonic Acid in; Determination of —. (Ellms and Bezeke)	937
Drinking; Sterilisation of —: (Bergé)	601
(Hünermann and Deiter)	828
Electrolysis of — on the Large Scale. (Schmidt)	130
Elimination of Iron from —. (P) Teufer	602
Examination of Drinking — by Erdmann's Method. (Ferna)	381
Extraction of — from Substances. (P) Schwerin	726
Feed; Purification of —. (Aspinal)	828
For Ice Manufacture; Treatment of —. (P) Otto	147
For Steam Generators; Apparatus for Determining Amount of Chemicals for Softening —. (P) Erfmann	147
From Paper Mills; Recovering Water and Products from Waste —. (P) Faust	496
Germination in Distilled —. (Dehérain and Demoussy)	381
Glass as an Addition to Cement. (Bornträger)	477
In Fuming Sulphuric Acid; Determination of —. (Rabe)	619
Lead in Potable — (Cables)	145
Lille; Sterilisation of — by the Abraham and Marmier Process. (Krull)	381
Linde and Hess Process for Removal of Iron from —	145
Microchemical Detection of —. (Emich)	1142
Nitrates in; Detection and Determination of —. (Cazeneuve and Defournel)	838
-Nut (Tropa Natans); Composition of —. (Zega and Knez-Milojkovic)	276
Organic Matter in; Source of Error in Kubei-Tiemann Method for Determination of —. (Duyk)	750
Pollution of — by Waste Lye from Potash Works. (Rabner and Schmidtmann)	738
Purification. (Class XVII.)	59, 115, 271, 303, 381, 494, 601, 738, 775, 828, 863, 925, 1012, 1132, 1129

	PAGE
Water—cont.	
Purification of —:	
(P) Koyl	830
(P) Orchard and Fox	1230
(Schierholz)	271
(P) Weddell	601
Purification; Schumburg's Process of —. (Schüder)	828
Re-agents for Purifying —; Production of —. (P) Lake. From The Jewel Export Filter Co.	61
Softening of —. (P) Breyer	1013
Still for —. (P) Bessonoff	105
Uniformity in Bacterial Analysis of — Necessary. (Abba)	145
Waters, Apparatus for Purification of Dirty —. (P) Reinsch	495
Ferruginous; Purification and Rapid Filtration of —. (Kröhnke)	59
For Boiler Feed; Purification of —. (P) Harris	1094
Moorland; Researches on —. II. (Ackroyd)	494
Nitrates in; Determination of —. (Henriot)	619
Nitric and Nitrous Acid in Natural; Determination of —. (Winkler)	937
Of Sugar Factories in Russia; Purification of Waste —. (Slasski)	146
Oxygen in; Determination of —. (Rideal and Stewart)	841
Phosphates in Potable; Determination of —. (Woodman and Cayvan)	506
Purification of Waste —, and Recovery of Paper-Pulp. (Schmidt)	382
Reaction of Sodium <i>p</i> -Benzene-sulphonate on Iron Cyanate in Contaminated —. (Causse)	145
Sulphurous Mineral; Determination of Sulphides, &c., in —. (Gautier)	392
<i>See also under Effluents.</i>	
Waterproof Coating for Metal, Stone, etc. (P) Zimmer	719
Substance, and Manufacture thereof. (P) Stocker and Zander	727
Waterproofing Compositions. (P) Newman	892
Of Materials. (P) Kronstein	460
Textile Fabrics. (Weber)	804
Wax; Acid and Saponification Values of —. (Eichhorn)	74
Hull's Method for Determining Acid Value of —, Modified. (Eichhorn)	74
Imports of Sicily. (T.R.)	1166
Japan; Variations in Composition of —. (Ahrens and Het)	909
Montan; Characteristics of —. (von Boyen)	1221
Vegetable —	817
Vegetable —, in Japan. (T.R.)	1159
Waxes; Characteristics of Certain —. (Greshoff and Sack)	817
Elimination and Determination of Water in —. (Davis)	941
Optical Examination of —. (Marpmann)	509
Refining of —. (P) Crichton and Joselin	371
Weight in Chemical and Physical Reactions; Change of —. (Heydweiller)	76
Welding Process; Automatic Tapping Arrangement for the Thermite —. (Goldschmidt)	1214
Wellpark Brewery; Visit to —	678
Welsbach Light; Theory of the —. (Nernst and Bose)	791
Welsbach's Osmium Incandescence Lamp. (Scholz)	348
West Indies; Insecticides used in the —. (T.R.)	521
Portland Cement in the —. (T.R.)	953
Weston Cadmium Cell; Irregularities in the —. (Jaeger)	999
Wetherill Process of Magnetic Separation. (Ingalls)	478
Wheat Embryos; Saccharifying Action of —, and their Employment. (Lindet)	377
Germ; Saccharifying Action of —. (Lindet)	490
-Malt; Manufacture of —. (Rudo'ph)	141
Whey; Separation of —, from Milk. (P) Székely and Kovács	380
Whisky Distilleries; Composition and Disposal of Waste Liquids of —. (Hendrick)	450
White Lead; Conversion of —, into Oil Paste. (P) Bischof	372
Manufacture of —. (Hitchcock)	135
Production of —, by New Process. (P) Brundstone	591
Wine, Alum in —; Detection of. (Lopresti)	158
Citric Acid in —; Determination of. (Spica)	1030
Influence of Composition of —, on the "Tourné" Ferment. (Laborde)	921
Must; Concentration of —. (Dugast)	922
New Law as to —, in Germany. (T.K.)	862
Organism of Alcoholic Fermentation in the Manufacture of —. (Seifert)	1010
Orseille in —; Detection of. (Truchon)	284
Orseille, <i>Phytolacca</i> , &c., in; Detection of —. (Bellier)	284
Plastering of —. (Carles)	1130
Saccharin in —; Detection of. (Wirthle)	72, 1646
Salicylic Acid in; Detection and Determination of —. (Ferreira Da Silva)	396
Sweet Raisin; Constituents of —. (Schneegans)	1227
Vinasses and Wine Spoilt by Sickness; Utilisation of — as Manure. (Garrigou)	914
Wines. (Class XVII.)	55, 86, 141, 288, 376, 489, 597, 644, 734, 774, 824, 862, 916, 1008, 1127, 1226, 1261
Acidity of —. (Kayser and Barba)	922
American; Composition of —. (Bigelow)	57
Artificial —, in Germany. (T.R.)	774
Indicator for Determining Total Acidity of —. (Künzau)	941
Invertase in White —. (Pallot and Miction)	491



PAGE	PAGE
Wines—cont.	Wort—cont.
Raisin: Composition and Examination of — (Schneegans).....	Means for Pumping and Rousing — (P) Overbeck.....
599	737
Rapidly Ageing —, and Apparatus therefor. (P) Ivison.....	Production of High or Low-Fermenting — (P) Eckhardt.....
923	727
Salicylic Acid in —; Cause of Error in Detecting. (Peller).....	158, 284
Salicylic Acid in —; Sensitiveness of Various Methods of Detecting — (da Silva).....	938
Secondary Fermentation of Sparkling — (Manceau).....	539
Wire, Coated; Manufacture of — (P) Parker.....	729
Wöhler's Sulphur; Formation of — (Orlow).....	943
Wolfgram in Queensland. (T.R.).....	1159
Ore; Duty on — in the United States. (T.R.).....	759
Wood and Wood Refuse; Charring —, and Apparatus therefor. (P) von Heidenstam.....	112
Apparatus for Impregnating — with Fluids. (P) Lebioda.....	909
Artificial: Production of — (P) Helbing.....	491
Colouring — (Class VI.).....	893, 1111, 1208
Distillation of — (Bühler).....	885
Dry Distillation of Fir — (Irminger).....	111
Fireproofing and Preserving — (P) Feyerabend.....	1212
Fireproofing and Ret-proofing — (P) Lebioda.....	126
Fireproofing of — (P) Lake. From The American Wood Fireproofing Co.....	126
For Paper-making; Increased Cost of —, and Process for Utilising Cheaper Woods. (Bühler).....	147
Impregnating — with Solutions. (P) Youlten.....	810
Impregnation of — (P) Franse and Boddies.....	365
-Oil; Attempts to Deodorise Chinese — (Ulzer).....	261
-Oil, Chinese; Oxidising of — (P) Kronstein.....	485
-Oil; Composition of a — (Frays).....	237
Panama —; Presence of Saccharose in. (Meillere).....	267
Paper Materials from —, and Treatment of the Waste Waters. (Gottstein).....	495
Polished or Lacquered; Removing Brilliance of — (P) Buyten.....	373
Preservation of — (P) Allison. From Lawrence.....	992
(P) Lake. From Guissani.....	991
-Pulp. See under Pulp.	
Saturation of — with Tar Oils. (Seidenschnur).....	581, 718
Substitute for — (P) Lake. From The United States Chemic Wood Co.....	374
Sugars in Products of Hydrolysis of — (Storer).....	822
Treatment of — for Preserving, &c. (P) Higgins.....	365
See also under Timber.	
Wool. (Class V.).....	33, 81, 119, 242, 358, 469, 573, 709, 804, 855, 890, 952, 982, 1108, 1206
Action of Caustic Soda on — (Washburn).....	1206
Action of Diazo Compounds on — (Brandt).....	711
Action of Nitrozo Acid on — (Lidow).....	469
And Silk Union Fabrics; Dyeing of — (Brown).....	226
Apparatus for Treatment of — (P) Maertens.....	119
Behaviour of Azo Dye-stuffs from β -Naphthol and α -Naphthylamine Sulphonic Acids towards — (von Georgievics and Sprünzer).....	34
Cleaning — with Volatile Solvents. (P) Maertens.....	119
Dyeing — Black by means of Iron Nitrosulphide. (Prud'homme).....	575
Dyeing of — with Blue Colours from Azo Dye-stuffs. (P) Abel. From The Actieenges. für Amulfabrikation.....	893
Dyeing; Theory of — (Brandt).....	242
Dyeing — with Anilin Black. (P) Behlmann.....	577
Effect of Artificial Manuring on — (T.R.).....	495
Extraction of Fatty Matters from. (P) Abel. From Délainage Vervicots et Cie.....	591
Fast Brown Dyes on —; Production of. (Rumpf).....	890
Fibre: Obtaining Blue to Black Fast Dyes on — (P) Inray. From The Farb. vorm. Meister, Lucius und Brüning.....	472
Formation of "Ice Colours" upon — (Reisz).....	243
Mordanting — (P) Abel. From The Actieenges. für Anilin Fab.....	471
Potash from Sheep's — (T.R.).....	952
Producing Blue Shades Fast to Light on — (P) Newton. From The Farb. vorm. F. Bayer and Co.....	1110
Recovering Solvent from Compounds obtained in Dyeing — (P) Erben.....	359
Removal of Fat from — (P) Boulé. From Wislicki.....	119
Removing of Fat from —, and Apparatus therefor. (P) From Délainage Vervicots Peltzer and Co.....	891
Rendering — Incapable of Absorbing Dye-stuffs. (P) Inray. From The Farb. vorm. Meister, Lucius und Brüning.....	1110
Smelting of Sulphur Dioxide; Deodorising — (P) Briggs and Priestley.....	359
Wools; Cleaning, Decreaming, and Bleaching — (P) Bourin Aymeris.....	119
Woollen Goods; Discharge Effects on Indigo-Dyed — (P) Johnson. From The Badische Anilin and Soda Fab.....	121
Industry; Soaps and Turkey Red Oils in the — (Steinberg).....	470
Tissues, Stains and Unevenness in Dyed: Causes of — (Robrecht).....	39
Wort, Hopped; Production of a Concentrated — (P).....	144
Means for Converting — into Beer and Ale. (P) Allison. From Selz and Guttrum.....	1012
Xanthine Homologues; Manufacture of — (P) Johnson From Boehringer und Soehne.....	833
Xanthorhammin; Sugar Constituents of — (Votoczek and Fric).....	76
Xanthorrhoea Resin in Germany. (T.R.).....	1260
Xylidines; Nitro and Bromo-Derivatives of the — (Noelting, Braun and Thesmar).....	797
X	
Y	
Yarns. (Class V.).....	38, 81, 119, 242, 358, 469, 573, 709, 804, 855, 890, 952, 982, 1108, 1206
Yarn; Apparatus for Dyeing and Treating — (P) Hartley.....	1109, 1109
Apparatus for Dyeing, Mercerising, &c. — (P) Morgan and Menzies.....	472
Apparatus for Mercerising — (P) Shuman.....	574
Apparatus for Mercerising, Scouring, &c. (P) Crompton and Horrocks.....	985
Apparatus for Printing and Treating — (P) Hallensleben.....	892
Apparatus for Treating Cops of Spun — (P) Major and Wood.....	121
Machine for Treating Silvers of — with Liquids. (P) a Brassard.....	892
Machines for Testing — (Smith).....	38
Stretching and Mercerising Cotton — (P) Kopp and Usnell.....	469
Treatment of — (Coventry) (P).....	1109
Yarns; Apparatus for Bleaching &c. — (P) Brandwood.....	472
Apparatus for Dyeing or Drying — (P) Thompson. From Mallinson.....	577
Boiling and Dyeing —, and Apparatus therefor. (P) Schüle.....	892
Dyeing of —, and Apparatus therefor. (P) Schüle.....	577
Machines for Dyeing — (P) Hussong.....	247
Yeast; A Conjugating — (Barker).....	918
Action of Reagents upon the Activity of — (Bokorny).....	824
Agglutination of — (Barendrecht).....	1129
Antiseptic and Aseptic Action of Various Substances on — (Wehmer).....	597
Artificial Preparation of — without Lactic Acid Fermentation. (P) Bücheler.....	1128
As a Means of Detecting Communication with Subterranean Waters. (Miquel).....	844
Auto-fermentation and Liquefaction of Pressed — (Harden and Rowland).....	1228
Auto-fermentation of — (Kutscher).....	490
Bakers'; Manufacture of — (P) Hutschek.....	144
Bakers'; Utilising Brewers' Yeast and Treatment for Making — (P) Sarnighusen.....	1131
Beer; Detection of —, in Pressed Yeast: (Herzfeld).....	919
(Küttner and Ulrich).....	919, 1010
(Langfurth).....	1010
Beer Yeast in Pressed; Bau's Method for Detection of — (Langfurth).....	843
Buchner's Expressed Extract of — (Wroblewski).....	1009
Cells and Yeast Enzymes; Resistance towards Injurious Agents of — (Bokorny).....	598
"Chinese" —, and the so-called Amylomyces. (Wehmer).....	377
Chinese; Mucor Cambodia: A New Mould Fungus. (Chrzaszcz).....	757
Distinction between Distillery —, and Low-Fermentation Beer Yeast. (Lintner).....	1010
-Enclosing Amoebæ of a Slime Fungus. (Henneberg).....	491
Extract from; Preparation of —, without Auto-Fermentation. (P) Aubry and others.....	737
Extraction of Protoplasm of — (van Laer).....	397
From Grain Distilleries as a Food Stuff. (Rohn).....	58
German; Obtainment of — (P) Bramsch.....	600, 766
Glycozen in —; Appearance and Disappearance of. (Meissner).....	55
Grain —, and Bottom Fermentation Beer Yeast; Differentiation of. (Lintner).....	1128
Increase of Efficiency of Bottom Fermentation — (Krause).....	1128
Influence of Butyric Acid upon — (Wehmer).....	268
Injured to Hydrofluoric Acid; Employment of — (Verdière).....	1227

	PAGE
Yeast—cont.	
Invertase of —. (Salkowski).....	489
Lactic Acidification of the Seed —. (Frede).....	825
Maltose; Synthetic Action of —. (Emmerling).....	377
Nitrogenous Nutrition of —. (Thomas).....	918
Nutrition of —. III. (Stern).....	600
Oxidising Enzymes of —. (Grüss).....	824
Oxydase Reactions of —. (Grüss).....	919
Pressed —, and Alcohol; Production of. (P) Barbet.....	270
Pressed; Production of —. (P) Sauer.....	92C
Pressed; Utilisation of —. (P) Valentine.....	736
Substitute for Meat Extract prepared from —. (Lebbin).....	825
Supply of Pure —, for Top-Fermentation. (Schönfeld).....	480
Treatment of —. (P).....	1131
Use of —, in Preparing Spirit from Molasses. (Verbiese).....	378
Use of Lactic Acid in Manufacture of —. (Bücheler).....	376
Zymase from Sterilised —. (Buchner).....	55
Yeasts, Bottom Brewery; Preparation of —. (Jacquemin).....	825, 918
Determination of Starch in Mixed Pressed —. (Lange).....	393
Fermentation Experiments with —. (Lindner).....	141
Moulds; Enzyme in —, a Means of Differentiation.....	142
Sporulation of —. (Guilliermond).....	734
Ylang-ylang Oil; Isoeugenol a Constituent of —.....	825, 1237
Yucatan; Free Imports into —. (T.R.).....	1036
Yttrium Earths; Separation of the —. (Meyer and Marckwald).....	62

Z

	PAGE
Zinc—cont.	
Cleaning and Coating Iron or Steel with —. (P).....	484
Cowper-Coles.....	484
Coating Metal Articles with —. (P) Szirmay and von Kollerich.....	1003
Determination of —, by Iodine Solution. (Knaps).....	935
Dust; Action of — upon Fatty Acids. (Hébert).....	513
Electro-Production of —. (Kershaw).....	403
Electrolysis of —. (P) From Société des Piles Electriques.....	484
Extraction of —:.....	
(Belloc).....	255
(Swan).....	666
Extraction of —, and Apparatus therefor. (P) Bate and Zicart.....	724
Extraction of — from Waste Products. (P) Kellner.....	367
In Spathe Ores; Estimation of —. (Flath).....	935
Industry in the United States. (T.R.).....	518
-Lead Sulphide Ores and Tailings; Treatment of —. (P) Twynam.....	905
Oleate; Preparation of —. (Naylor).....	498
Ores. <i>See under Ores.</i>	
Prices of — since 1885. (T.R.).....	1041
Production in Austria. (T.R.).....	1259
Production of — in Spain in 1899. (T.R.).....	301
Quantitative Determination of —. (Herz).....	392
Separation of — from Lead in Solution. (P) Davis.....	47
Separation of — from Nickel and Cobalt. (Treadwell).....	392
Sulphide and By-Product; Manufacture of —. (P) Beringer.....	592
Theory of the Method for Removing Lead from Crude —. (Heyn).....	128
Treatment of Slags and By-Products containing —. (P) Kirkpatrick-Picard.....	1219
Volumetric and Gravimetric Determination of —. (Cohn).....	1243
Volumetric Determination of —. (Walker).....	535
-White; Treating Ores for Production of —. (P) Middleton and others.....	911
-White; Use of — in Place of White Lead. (Livache).....	728
Zinciferous Precipitates Obtained by Cyanide Process; Determination of the —. (Fulton and Crawford).....	749
Zymase, Buchner's —; Enzyme Theory versus Plasma Theory. (Windisch).....	56
Buchner's; Remarks on Paper by Macfadyen, Morris, and Rowland on —. (Buchner).....	55
Exhibiting the Action of —. (Albert).....	269
From Sterilised Yeast. (Buchner).....	55
Research on —. (Buchner).....	598



TABLE OF ERRATA.

Month.	Page.	Column.	Line.	Description.
1901. February	146	1	16 from top	<i>For "1899" read "1898," and insert before 1,148, the year "1830."</i>
March	255	2	First equation	<i>For "Co₂" in both cases, read "CO₂."</i>
April	356	2	38 from top	<i>For "igniting" read "diazotising."</i>
May	425	1	32 from bottom	<i>For "no" read "not."</i>
"	433	2	17 from top	<i>For "Oakbark" read "Oakbark tannage."</i>
"	437	2	26 from top	<i>For "sulphate" read "sulphide."</i>
"	437	2	20 from bottom	<i>For "averagely" read "on the average."</i>
"	438	1	30 from top	<i>For "aqueous" read "aqueous."</i>
"	445	2	30 from top	<i>After "Ceylon" insert "graphite."</i>
July	727	1	Middle	<i>In title, after "Elect. Rev." insert "(U.S.)."</i>
"	727	1	23 from bottom	<i>Before "Engineer" insert "Electr. World and."</i>
September	902	1	27 from bottom	<i>For "palæzoie" read "palæozoic."</i>
"	910	1	Table, col. 5, line 11 of figures.	<i>For "99.4" read "99.0." Also in col. 1, for "Linseed III. after three weeks' exposure" read "Linseed II. after three weeks' exposure."</i>
"	910	2	First table, second heading.	<i>For "Thermomter" read "Thermometer."</i>
"	941	2	Line 10 above second table.	<i>For "strength of acids" read "strengths of acid."</i>
October	1037	2	Table, line 14 under "Exports."	<i>For "Silver in ore, silver, and lead," read "Silver in silver and lead ores."</i>
"	1013	2	18, 10, and 4 from bottom, and next page.	<i>For "ground nut" read "earth nut."</i>
"	1014	1 and 2		
December	1237	1	7 from bottom	<i>After "In addition to" insert "other derivatives of."</i>
"	1237	1	6 from bottom	<i>For "finds that" read "prepared."</i>
"	1237	1	5 and 4 from bottom	<i>Delete "is also present."</i>



LIST OF PAPERS READ BEFORE SECTIONS OF THE SOCIETY DURING THE YEAR 1901.

N.B.—The words within () indicate the Journal in which the Paper is printed and the Section before which it was read.

	PAGE		PAGE
Abney, Sir W. de W. The Photography of Colour. (Nov. Liverpool).....	1060	Guttmann, O., The Early Manufacture of Sulphuric and Nitric Acids. (Jan. London).....	5
Adams, A. The Heat Producing Power of Fuel. (Oct. Nottingham).....	972, 1084	Hendrick, J. The Composition and Disposal of Burnt Ale and other Waste Liquids of Whisky Distilleries. (May. Scottish).....	450
Archbutt, L. Rosin Grease. (Dec. Nottingham).....	1193	Heslop, O. See Conroy, J. T.	
And Jackson, P. G. The Determination of Minute Quantities of Arsenic in Coke. (May. Nottingham).....	448	Homfray, I. See Ramsay, W.	1071
Bedson, P. Phillips. The History of the Artificial Production of Indigo. (March. Newcastle).....	209	Hughes, J. Basic Superphosphate: Its Preparation and Use as a Manure. (April. London).....	325
Berry, A. E. The Effect on the Marsh Test of some Commercial Products containing Selenium and Tellurium. (April. London).....	322	Irwin, W. A New Test for Sulphur in Benzol for Use in Gas Works. (May. Manchester).....	440
Bradburn, J. A. The Production of Soda by the Ammonia Process. (May. New York).....	442	Jackson, P. G. See Archbutt, L.	
Brakes, J. Colorimetric Determination of Titanic Acid. (Jan. New York).....	23	Jackson, W., and Rich, E. M. The Constitution of Glass. (June. Nottingham).....	555
Brown, R. B. The Dyeing of Wool and Silk Union Fabrics. (March. Yorkshire).....	226	Jenks, B. L. See R. F. Wood Smith.	
And McCrae, J. The Solution Theory of Dyeing. (Nov. Yorkshire).....	1092	Jones, G. C. A Danger Incidental to Gas-Firing in Small Gasworks. (June. London).....	535
Burgess, H. E., and Child, J. F. The Lemon Oil Industry. (Dec. London).....	1176	Klein, O. H., and Peckham, S. F. Additional Notes on Cement Testing. (June. New York).....	539
Carulla, F. J. R. The Valuation of Gas Liquor. (Jan. Nottingham).....	23	Kniifen, F. Powder Explosion at Indian Head, Maryland. (Feb. New York).....	102
Child, J. F. See Burgess, H. E.		Kremers, E. The Analysis of Oils containing Carvone. (Jan. New York).....	16
Clafin, A. A. Lactic Acid in the Manufacture of Leather. (March. New York).....	210	Lachmann, A. The Improvement of Instruction in Technical Chemistry. (June. New York).....	546
Coleman, W. H. See Craven, J.		Lane, N. J. Proportions of Liquid Fatty Acids in Some Fats and Oils, and their Iodine Values. (Nov. New York).....	1083
Collins, S. J. Sugar in Swedes. Part I.—Analytical Methods. (June. Newcastle).....	536	Levinstein, H. Notes on Indigo. (April. Manchester).....	332
Conroy, J. T. The Rate of Dissolution of Iron in Hydrochloric Acid. (April. Liverpool).....	316	Levinstein, I. Patent Law. (Jan. Manchester).....	13
And others. The Action of Reducing Gases on Sulphocyanides. (April. Liverpool).....	320	The Report of Sir Edward Fry's Committee on Patent Law. (Nov. Manchester).....	1082
Cooke, A. W. An Analysis of the Leeds Gas Liquor. (March. Yorkshire).....	225	Lunge, G. Du Pont's Nitrometer. (Feb. Newcastle).....	100
Craven, J., and Coleman, W. H. The Treatment of Noxious Vapours from Tar Distillation. (March. Manchester).....	200	Matthews, J. Merritt. The Synthesis of Indigo. (June. New York).....	551
Cullen, W. Notes on the So-called "Heat Test" for Explosives. (Jan. London).....	8	Moody, H. R. See S. Auchmuty Tucker.....	971
Davies, H. E. The Decomposition of Chlorides by Ignition with Organic Matter. (Feb. Liverpool).....	98	Murphy, A. J. Arsenical Beer and Malt. (April. Yorkshire).....	340
Dobbin, L. The Interaction of Potassium Permanganate and Alkali Thiosulphates in Neutral Solutions. (March. Scottish).....	212	Muspratt, M. The Transport of Chemicals. (May. Liverpool).....	420
The Solubility of Barium Sulphate in Solution of Sodium Thiosulphate. (March. Scottish).....	218	Myers, H. C. The Sugar Beet in Alkali Soil. (May. New York).....	445
Fitzgerald, F. A. J. Graphite Produced by the Acheson Process. (May. New York).....	443	Newton, W. A New System for the Manufacture of Borax and Nitrates. (April. London).....	324
Flower, G. W. Analysis of a Lime for Tanners' Purposes. (March. Yorkshire).....	224	Norris, G. L. The Determination of Manganese in Ferro-Manganese and Nickel in Steel. (June. New York).....	551
Frew, W. The Endowment of Technical Research: An Object Lesson. (March. Scottish).....	219	Parker, J. Gordon, and Gansser, A. The Effect of Tanning Extracts containing Bisulphites on Leather. (Nov. Nottingham).....	1085
The Valuation of Barleys for Brewing and Distilling. (March. Scottish).....	221	Patterson, T. L. Improvements in Sugar Refining during the last Twenty-five Years. (Nov. Scottish).....	1088
Gansser, A. See Parker, J. Gordon.		Peckham, S. F. See Klein, O. H.	
Gibb, A. The Determination of Arsenic and Antimony in Cupreous Materials. (March. Liverpool).....	184	Perkin, E. Mollwo. Action of Caustic Potash and Soda on Stannous Sulphide. (May. London).....	425
Granja, R. Tinfoil and Bottle Caps Manufacture. (Dec. New York).....	1191	A Simple Method for Obtaining a Saturated Aqueous Solution of Sulphuretted Hydrogen, or a Constant Supply of the Gas. (May. London).....	438
Gray, G. Watson. Determination of Calcium in High-Grade Ferro-Silicon. (June. Newcastle).....	538	Popplewell, J. M. Rapid Method for the Determination of Prussian Blue in Spent Oxide. (March. Yorkshire).....	225
Griffith, R. W. See Youl, J.	426	Procter, H. E. International Association Method of Tannin Determination. (Feb. Nottingham).....	104
Grossmann, J. Novelty in Patents according to German Patent Law. (Nov. Manchester).....	1078	Ramsay, W., and Homfray, I. Colorimetric Method for Determining Oxygen Dissolved in Water. (Nov. London).....	1071
Guthrie, A. The Solubility of Lime in Water at Different Temperatures. (March. Yorkshire).....	223	Rhodin, J. G. A. Production of Soluble Potash Salts from Potassium Felspar (Orthoclase). (May. Manchester).....	439
		Rich, E. M. See Jackson, W.	555
		Richardson, C. Uniformity in Technical Analysis. (April. New York).....	334



	PAGE		PAGE
Richardson, C., and Wallace, E. C. Petroleum from the Beaumont, Texas, Field. (July. New York).....	690	Trotman, S. R. Presence of Arsenic in Beer. (March. Nottingham).....	208
Shenton, J. Porter. See Thomson, W.		Tucker, S. Auchmuty and Moody, H. R. Production of Ethylene from Inorganic Sources. (Oct. New York).....	971
Shores, J. H. See Conroy, J. T.		Tucker, S. Auchmuty and Moody, H. R. The Reduction of Alumina by Calcium Carbide. (Oct. New York)....	970
Smith, A. J. Manufacture of Varnish by the Pressure Process. (Nov. London).....	1076	Van Gelder, A. P. Notes on Nitric Acid and Mixed Acid Analysis. (April. New York).....	339
Smith, H. The Action of Light on Coloured Brass Lacquers. (Dec. Newcastle).....	1189	Volney, C. H. The Manufacture of Nitric Acid. Part I. (June. New York).....	544
Smith, H. Procter. Vanadium; its Extraction and Uses. (Dec. Manchester).....	1183	The Manufacture of Nitric Acid. Part II. (Dec. New York).....	1189
Smith, Watson. A New Glyceride; Glycerol Phthalate. (Nov. London).....	1075	Wallace, E. C. See Richardson, C.	
Swan, J. W. Electro-Chemical Industry. (July. Presidential Address).....	663	Wood Smith, R. F., and Jenks, R. L. Arsenic in Coal and Coke. (May. London).....	437
Thomson, W., and Shenton, J. Porter. The Detection of Arsenic in Beers, Brewing Materials, and Food. (Mar. Manchester).....	204	Youl, J., and Griffith, R. W. The Relative Leather-forming Value of the Different Tanning Materials, their Speed of Tanning and Weight-giving, with Notes on the Quality. (May. London).....	426

LIST OF NEW BOOKS.

	PAGE		PAGE
A Dictionary of Dyes, Mordants and other Compounds; Use in Dyeing and Calico Printing. (Rawson, Gardner and Laycock).....	1152	Key to the Classification of the Patent Specifications of Germany, Austria, Denmark and Norway, in the Library of the Patent Office.....	945
A Hundred Years of Gas Enterprise. (Newbigging).....	397	Les Nouveautés Chimiques pour 1901. (Poulenc).....	758
A Manual of Laboratory Physics. (Tory and Pitcher).....	946	Manufacture of Paint. (Crickshank Smith).....	849
Alcoholic Beverages: The Production and Consumption of Alcoholic Beverages in Various Countries from 1885 to 1899.....	1035	Memoranda of the Origin, Plan, and Results of the Field and other Experiments conducted on the Farm and in the Laboratory of the late Sir J. B. Laves at Rothamsted. (Gilbert).....	1035
Arsenic. (Wanklyn).....	397	Merck's Annual Report on the Year 1910. (Boehm).....	627
Ausgewählte Methoden der Analytischen Chemie. (Classes).....	293	Microbes et Distillerie. (Lévy).....	73
Blowpipe Analysis. (Landbauer. Authorised English Edition by J. Taylor).....	343	Notes on Essential Oils, with Special Reference to their Use, Composition, Chemistry and Analysis. (Idris).....	1151
Capillaranalyse. (Goppelsroeder).....	753	Papermakers' Pocket-Book. (Beveridge).....	847
Chemie des Matières Colorantes Organiques. (Nietzki and others).....	514	Pharmacopœdia. A Commentary on the British Pharmacopœia, 1898. (White and Humphrey).....	1152
Chemisch-Technisches Repertorium. (Jacobsen).....	162, 514, 946, 1256	Practical Dictionary of Electrical Engineering and Chemistry. (Heyne).....	623
Commercial Organic Analysis. (Allen. Revised and Edited by T. Merritt Matthews).....	293	Prospecting for Gold. (Rankin).....	1256
Condensation. (Weiss).....	1151	Qualitative Chemical Analysis, Organic and Inorganic. (F. Mollwo Perkin).....	162
Dictionary of Chemicals and Raw Products Used in the Manufacture of Paints, Colours, Varnishes and Allied Preparations. (Hurst).....	397	Researches on Cellulose, 1895-1900. (Cross and Bevan).....	847
Die Arzneimittel-Synthese auf Grundlage der Beziehungen zwischen Chemischem Aufbau und Wirkung. (Fränkel).....	78	Select Methods in Food Analysis. (Lefmann and Beam).....	753
Die Brennstoffe Deutschlands und der übrigen Länder der Erde, und die Kohlenmoth. (Fischer).....	1255	Smokeless Powder, Nitrocellulose, and Theory of the Cellulose Molecule. (Bernadou).....	1035
Die Chemische Industrie auf der Internationalen Weltausstellung zu Paris, 1900. (Witt).....	1035	Subject List of Works on Chemistry and Chemical Technology in the Library of the Patent Office.....	945
Die Normalelemente und ihre Anwendung in der Elektrischen Messtechnik. (Jaeger).....	1255	List of Works on certain Chemical Industries in the Library of the Patent Office.....	1256
Die Physikalischen und Chemischen Methoden der Quantitativen Bestimmung Organischer Verbindungen. (Vaubel).....	1152	Tables of Colour and Solubility of Simple Salts. (Hill).....	162
Die Schokoladenfabrikation. (Zipperer).....	293	The Chemical Essays of Charles William Scheele. (M'Intosh).....	946
Ferments and Their Actions. (Oppenheimer. Translated by C. A. Mitchell).....	1255	Chemistry of Illuminating Gas. (Humphrys).....	1034
Fortsschritte der Theerfarbenfabrikation und Verwandter Industriezweige. (Friedlaender).....	513	Extra Pharmacopœia. (Martindale) and (Westcott).....	627
Handbook of Industrial Organic Chemistry. (Sadtler).....	78	Gas Engineer's Pocket Book. (O'Connor).....	1034
On Petroleum. (Thomson and Redwood).....	848	Laboratory Companion to Fats and Oils Industries. (Lewkowitsch).....	1255
Indikatoren der Acidimetrie und Alkalimetrie. (Glaser).....	514	Manufacture of Alum, and the Sulphates and other Salts of Alumina and Iron: their Uses and Applications. (Geschwind). (Translated from the French by C. Salter).....	874
Introduction to the Study of Chemical Philosophy. (Tilden).....	1256	Mineral Industry: Its Statistics, Technology, and Trade in the United States and other Countries to the End of 1900. (Rothwell and Struthers).....	945
Jahrbuch der Chemie. (Meyer).....	1152	Newer Remedies. (Coblentz).....	78
Der Elektrochemie. (Nernst and Borchers) VI. Jahrgang	1034	Twentieth Century Inventions: A Forecast. (Sutherland)...	946
		Zur Geschichte der Entstehung und Entwicklung der Chemischen Industrien in der Schweiz. (Lunge).....	945



INDEX OF ABSTRACTS OF ENGLISH PATENTS ACCORDING TO NUMBER OF PATENT.

No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1899.				
7282		Limb, C. M. J.	Metallic Carbides and Derivatives	463
16,811	Dymond	Cruz-Pasqual de Bonanza and others	Extraction and Treatment of Fibres	38
17,165		Thornton and Rothwell	Photographic Films	68
18,322		Cameron, Commin, and Martin	Apparatus for Delivering Sewage to Filters or Land	60
20,907		Badoil	Sleeping Flax, and Apparatus therefor	38
22,186		Hellriegel, C.	Material resembling Celluloid	62
22,425		Atkins, G. J.	Manufacture of Acetylene, &c.	31
22,549		Gostling, J. C., and others	Cement	125
22,862		Johnson, C. M.	Destroying Disease Germs	60
23,059		Fulton and Gillard	Photographic Printing Surfaces	388
23,123	Johnson	Badische Anilin und Soda Fab.	Indigo Leuco Compounds, &c.	35
23,123A	Johnson	Badische Anilin und Soda Fab.	Indigo Leuco Compounds, &c.	35
23,134		Robin-Langlois, J.	Refining Sugar	55
23,209		Liversedge, A. J.	Refuse Destructors	60
23,404		Naeff, P.	Treating Liquids with Gases; and Apparatus	28
23,432		Kieny, A. L.	Acetylene Gas Generators	31
23,476		Duffton and Gardner	Lamps for Colour Matching	237
23,539		Dyson and Gaskell	Saponaceous Products from Petroleum, &c.	262
23,572		Echndel, H. H.	Manufacture of Gas	30
23,598		McNeil, J. and C.	Concentrating and Crystallising Liquids	55
23,603		Ward, W. J.	Material for Wrappers and Bags	62
23,637	Newton	Farb. vorm. F. Bayer and Co.	Anthraquinone Dyestuffs	36
23,657	Ransford	Cassella and Co.	Indazol, and Brown Dyestuffs therefrom	36
23,808		Haase and Broeckmann	Tobacco free from Nicotine	73
33,874		Toby and Borch	Non-explosive Mixtures of Calcium Carbide	32
23,978		Helbing and Passmore	Solidification of Mineral Oils	50
23,979		Helbing and Passmore	Solidification of Mineral Oils	50
24,055		Springhorn, E.	Artificial Fuel	30
24,059		Bein, W.	Carrying off Gases from Electrolytic Apparatus	49
24,096		Snell, C. S.	Burners for Incandescence Lighting	32
24,188		Ecob, J. R.	Mercerising Apparatus	359
24,375		Huson, T.	Chemical Chimney Cleansers	30
24,383		Chandler and others	Gas-Scrubbers	30
24,455	Imray	Farb. vorm. Meister, Lucius und Brüning.	Dyeing with Sulphur Dyestuffs	41
24,496		Moseley, O. G.	Coating Iron and Steel Wire, &c.	46
24,502		Thomson, R.	Heating Gas	360
24,668		Punnett, H. M. and Son	Electro-deposition of Metals	50
24,680		Adler, G. W.	Tawing of Skins	53
24,801		Möller, J. J.	Preserving Foodstuffs	53
24,816		Crépele-Fontaine, C.	Rectifying and Distilling Apparatus	143
21,954	Imray	Farb. vorm. Meister, Lucius und Brüning.	Blue Mordant Anthraquinone Dyestuffs	37
24,960		Lucknow, C. jun.	Electrodes	49
25,009	Boult	Perrier, A.	Gas-producing Apparatus	30
25,077		Boessneck, F.	Acetic Acid	123
25,084		Williams, H. C.	Treating and Preserving Casks, &c.	143
25,139		Sievert, P. T.	Sheet Glass	124
25,228		Heywood, J.	Extracting Oil from Waste	50
25,288	Johnson	Badische Anilin und Soda Fab.	Black Colouring Matters, &c.	35
25,297	Edwards	Krauschwitzer Tionwaarenfab. vorm. Rohrmann.	Acetic Acid of High Percentage	42
25,329		von Bühler, E.	Pasteurising and Sterilising Milk, &c.	58
25,359		Duncan and The New Sunlight Incandescent Co.	Incandescence Bodies	32
25,418		Hatschek, M. P.	Bakers' Yeast	144
25,427		Rünler, T.	Anti-Incrustant for Boilers	105
25,434	Imray	Farb. vorm. Meister, Lucius und Brüning.	Celluloid in Films, &c.	62
25,484		Gürber, A.	Condensed Milk	58
25,511	Willcox	Badische Anilin und Soda Fab.	Red Azo Colouring Matter, &c.	35
25,618	Shillito	Geigy and Co.	Dyeing with Azo Colouring Matters	41
25,640		Vis.	Vacuum Separating Apparatus	123
25,734		Timofeff, P.	Artificial Stone and Cement	125
25,739		Froyck, A.	Pressing or Moulding Glass	124
25,754	Ransford	Cassella and Co.	Brown Colouring Matters	37
1900.				
23		Edmundson, J. W.	Acetylene Gas Producers	31
48		Hobson, H. A.	Concentrated Hopped Wort	144
51		Göhler, M.	Gas Producing Apparatus	351
194		Lancaster, E. W.	Purifying Acetylene Gas	463
214		Girard, A. C.	Explosives	155
225		Solon, M. F.	Glazed Bricks	126
236		Armstrong, Whitworth and Co. and Orde, E. L.	Apparatus for Supplying Liquid Fuel to Burners	109
253		Davis, G. E. and A. R.	Separating Lead from Zinc in Solutions	47
278	Dymond	The Westlake Co.	Furnaces for Powdered Fuel	349
279		Rauch, J.	Manufacture of Tar	352
333		Czerny and Schlimp	Kilns for Ceramic Ware	252
356		Feigson, A. A.	Treating Distillery Waste	144
379		Hoffmann, O.	Suites of Colours upon Threads	121
408		Beveridge, J.	Retorts for Distilling Shale, &c.	112



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
410	.. ..	Duff, E. J.	Gas Producers.....	110
483	.. ..	Ellershausen, F.	Treatment of Complex Ores.....	47
509	.. ..	Major and Wood.....	Apparatus for Treating Cops.....	121
526	Johnson	Boehringer, C. F., und Soehne	Manufacture of Xanthine.....	833
530	Newton	Farb. vorm. F. Bayer and Co.....	Chlorocarbonic Acid Ethers, &c.....	151
550	.. ..	Smith and others.....	Bacterial Treatment of Effluents, &c.....	61
552	.. ..	Gobbe, E.	Furnaces for Lime, &c.....	105
611	.. ..	Guimaraes, J. F.....	Intense Lighting Apparatus.....	237
618	Johnson	Chem. Fab. vorm. Goldenberg and Co.....	Materials with Platinum Surfaces for Contact Operations.....	250
710	.. ..	Davis, G. E. & A. R.	Treatment of Sulphide Ores.....	47
791	.. ..	Schürholz, H.	Artificial Stones.....	253
817	.. ..	Tangye, A. W.	Roasting Sulphide Ores.....	256
873	.. ..	Baudelot, L. G.....	Aluminium Alloys.....	47
874	.. ..	Baudelot, L. G.....	Composite Articles of Cast Aluminium, &c.....	47
877	Hatmaker	Just, J. A.	Bennet Ferment.....	59
889	Johnson	Badische Anilin und Soda Fab.....	Indigo Paste.....	116
890	Johnson	Badische Anilin und Soda Fab.....	Black Colouring Matter.....	35
901	Johnson	Badische Anilin und Soda Fab.....	Solid Hydrosulphites.....	43
985	.. ..	Bechi, G. de, and others.....	Treating Complex Zinc Ores.....	47
996	Thompson	Wright, L. T.	Rotary Stirrers for Roasting Furnaces.....	258
1004	.. ..	Reynolds, A.	Crucibles and Crucible Furnaces.....	47
1014	.. ..	Warren, J. W.	Clarifying Hydrocarbon Oils.....	352
1094	Imray	Farb. vorm. Meister, Lucius und Brüning.....	Hydrogenised Oxylbenzylamine and Hydrogenised Benzylamine Bases, &c.....	152
1122	.. ..	Rhodin.....	Device for Detecting Explosive Gases.....	31
1166	.. ..	Erfmann, F. R. K.....	Apparatus for Determining Condition of Water for Steam Generators.....	147
1221	Imray	Rogers and Beaver.....	Tin Plate Manufacture.....	129
1227	Johnson	Badische Anilin und Soda Fab.....	Yellow Azo Colouring Matters.....	36
1228	.. ..	Barbet, E. A.	Alcohol and Pressed Yeast.....	270
1293	Stuillito	Geigy and Co.....	Indigo in Easily Reducible Form.....	37
1323	.. ..	Bale, F.	Matches and Striking Compositions.....	155
1336	.. ..	Chicken and Smith.....	Purifying Acetylene Gas.....	110
1387	Johnson	Badische Anilin und Soda Fab.....	Colouring Matters.....	36
1457	.. ..	Barnes, W.	Electrolytic Apparatus.....	49
1497	.. ..	Ohlsson, O.	Centrifugal Separating Apparatus.....	344
1530	.. ..	Vickers and Rumsey.....	Photo-Printing and Developing Apparatus.....	68
1609	.. ..	Reid, W. F., and others.....	Coverings for Drawing Rolls used in Spinning.....	148
1736	.. ..	Macconel.....	Mercerising Apparatus.....	39
1743	.. ..	Glen, W. J.	Refuse Destructors.....	60
1760	Imray	Farb. vorm. Meister, Lucius und Brüning.....	Transformation Products of Coal-Tar Colours.....	117
1761	Imray	Farb. vorm. Meister, Lucius und Brüning.....	Blue-Violet Dyestuffs.....	37
1763	Imray	Bronner and others.....	Cuprammonia Solution.....	119
1791	.. ..	Stapp, D. W.	Burning Unconsumed Products of Combustion.....	30
1804	.. ..	Steffen, C.	Utilising Vapours of Sugar Factories.....	268
1809	.. ..	Clowse, G. A.	Manufacture and Treatment of Leather.....	139
1810	.. ..	Baker, R. C.	Hardening Compounds for Metals.....	256
1814	.. ..	Bourdil, F. F.....	Antiseptic Preparations.....	147
1820	Abel	Actienges. für Anilin Fab.....	Orange-Yellow Acridine Dyestuffs.....	37
1828	.. ..	Lefelmann, F. W.....	Acid-proof Vessels, &c.....	233
1888	.. ..	Beneke, G.	Factories for Explosives.....	279
1915	.. ..	Candenberg, C. A. C.....	Composition for Paving Roads.....	126
1959	Boult	Fleischer, E.	Water-Gas.....	110
1977	Ransford	Cassella and Co.....	Fast Dyeings with Dyestuffs Containing Sulphur.....	247
2070	.. ..	Bourin and Aymerie.....	Cleansing Wool, &c.....	119
2089	.. ..	Davis, G. E.: A. R.	Treatment of Sulphide Ores.....	129
2094	.. ..	Lyncker and Mohr.....	Indicating Presence of Fire-damp, &c.....	30
2146	.. ..	Dewrance and Paul.....	Desulphurisation of H ₂ S.....	110
2151	.. ..	Kirkpatrick-Picard, H. F.....	Treating Complex Sulphide Ores.....	130
2159	.. ..	Morrison, E.	Apparatus for Electro-plating Pins, &c.....	134
2193	.. ..	Stolaroff, W. W.....	Black Acid-proof Cotton Dye.....	240
2292	.. ..	Von Heidenstam.....	Charring Wood, Refuse, &c.....	112
2360	Abel	Délaingage Verviétois et Cie.....	Extracting Fatty Matters from Wool, &c.....	591
2372	.. ..	Merry, A. and Noble.....	Manufacture of Soap.....	728
2409	.. ..	Kent, H. A.	Electrolytic Electrodes and Resistances.....	260
2489	Imray	McLean, J. B.	Enriching Coal-Gas.....	351
2472	Lake	Rein, B.	Hydrocarbon Vapour Generators.....	350
2479	.. ..	Thompson and Blin.....	Tanning Liquids.....	266
2531	Abel	Actienges. für Anilinfab.....	Black Colouring Matter.....	38
2647	.. ..	Killon, H. B.	Apparatus for Discharge of Sewage.....	61
2656	.. ..	Schott, G. A. J.....	Pumping Apparatus for Slips and Glazes.....	364
2,663	.. ..	Gibbons.....	Furnaces, and Bricks therefor.....	344
2,683	Newton	Farb. vorm F. Bayer and Co.....	Azo Dyestuffs, Red and Violet.....	117
2,689	Johnson	Badische Anilin Fab.....	Discharging Indigo-Dyed Silk Goods.....	41
2,709	.. ..	Leroy, P.	Gas Generators.....	235
2,772	Imray	Farb. vorm. Meister, Lucius und Brüning.....	Violet-Black Azo Dyestuff.....	240
2,783	Johnson	Deutsche Gold und Silber-Scheide Anstalt.....	Electrical Arc Furnaces.....	376
2,784	Johnson	Badische Anilin und Soda Fab.....	Red Azo Colouring Matter, &c.....	240
2,834	.. ..	Hilliard, J. B.	Apparatus for Pumping Air or Gases.....	343
2,835	.. ..	Forbes, Sir C. S.....	Acetylene Gas Generators.....	236
2,888	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,888A	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,888B	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,888C	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,888D	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,888E	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,888F	.. ..	Naef, P.	Manufacture of Gas and Bye-Products.....	235
2,917	.. ..	Naef, P.	Coke, Gas, and Bye-Products.....	349
2,917A	.. ..	Naef, P.	Coke, Gas, and Bye-Products.....	349
2,917B	.. ..	Naef, P.	Coke, Gas, and Bye-Products.....	349
2,917C	.. ..	Naef, P.	Coke, Gas, and Bye-Products.....	349
2,917D	.. ..	Naef, P.	Coke, Gas, and Bye-Products.....	349
2,961	.. ..	Nordtmeier, H.....	Filtering Medium.....	27



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
2972	Boulton	The Fossilitch Leather Co.	Artificial Leather	373
2991	..	Otto, M.	Treating Matter for Ice Manufacture	147
2994	..	Kugel, M.	Electrolytic Deposition of Metals	290
3036	..	Springborn, E.	Precipitation of Sewage	272
3075	..	Woodhead and Thompson	Treatment of Silk Waste	358
3080	..	Simpson and Woods	Evaporating Apparatus	233
3094	..	Spencer, W.	Kilns for Limestone, &c.	344
3192	..	De Castro and Schlomann	Electric Batteries	133
3208	Ransford	Cassella and Co.	Brown Dyestuffs	118
3217	..	L. Weil	Saponine from Horse Chestnuts	608
3262	Lake	American Wood Fireproofing Co.	Fireproofing Wood, &c.	126
3266	..	Davidson, S. C.	Apparatus for Effecting more Complete Combustion in Furnaces	234
3275	..	Bock, J.	Transforming Crystallisable Liquors into Large Lumps	250
3288	Johnson	Badische Anilin und Soda Fab.	Discharging Dyed Textile Fabrics	247
3323	..	Radcliffe, D. E.	Fabric for Incandescence Mantles, &c.	111
3363	..	Magnir, P., and others	Saponifying Fatty Substances, &c.	261
3421	..	James, A.	Precipitating Gold and Silver	129
3429	..	Harrison, R.	Combustible Gases from Peat, &c.	697
3462	..	Armstrong, J.	Treating Zinc Ores	367
3522	..	Sudre and Thierry	Treatment of Distillers' Residues	379
3524	Thompson	Becker, H.	Anodes in Electrolytic Apparatus	133
3531	..	Wiszniewska and Strzelecki.	Welding Aluminium and its Alloys	369
3584	..	Briggs, J. W.	Utilising Waste Heat from Burning Kilns	126
3605	..	Plagwitz and Freund.	Protective Paint for Photo Plates, &c.	154
3611	..	Storey and McCulla	Plates of Glass, &c., which will Adhere to Cement	126
3615	Newton	Fabr. vorm. F. Bayer and Co.	Azo Dyestuffs, &c.	117
3631	..	Duff, E. J.	Gas Producers	110
3668	..	Worsley and Lancashire.	Treating Complex Ores	367
3673	Newton	Fabr. vorm. F. Bayer and Co.	Trisazo Colouring Matters	118
3716	..	Von Graeve and Reinecken	Oxidising Agents for Converting Hydrocarbons into Fats or Fatty Acids	261
3736	Mills	Lumière et fils	Matt-Surfaced Emulsions	278
3745	..	Messer, A.	Acetylene Gas Generator	110
3748	..	Scott, E. G.	Vacuum Evaporators	105
3762	..	De Mare and Frémy.	Steatite as Insulating Material	133
3807	..	Brown, E. W.	Paper and Ink for Copying Purposes	272
3817	Johnson	Actien Maschinenbau-Anstalt	Apparatus for Preparing Extracts	144
3866	..	A. W. Lawton	Common Salt in a Pure State	717
3918	..	Woodcock and Harper	Extracting Sodium Nitrate from "Caliche"	363
3975	Bloxam	Panzl and Troetscher	Protective Linings for Tubes, &c.	27
3976	..	Dejey, J. A.	Zinc Cylinders for Printing Textiles	360
3987	..	Scott, E. G.	Treatment of Ammonia Liquors	352
4114	..	Denaeyer, A.	Artificial Stone	125
4115	Imray	Fabr. vorm. Meister, Lucius und Brünig.	Alizarin Products for Direct Dyeing	247
4134	..	Tully, C. B.	Enriching Illuminating Gas	110
4173	..	Cameron, D., and others	Apparatus for Treatment and Disposal of Sewage	381
4175	Johnson	Boehringer und Soehne	Amines from Corresponding Nitro-Compounds	118
4219	..	Metcalf, S.	Anti-Incrustant for Boilers	105
4272	..	Potut, J.	Apparatus for Manufacturing Sulphuric Acid	363
4303	Imray	Bronnert, E., and others	Manufacture of Thread from Cellulose Solutions	1207
4309	..	Keyes, F. E.	Fire-proof Wood-Pulp	62
4326	..	Zühl, E.	Celluloid-like Substance	603
4389	..	Appert, L.	Rolling Glass, and Apparatus therefor	252
4407	..	Stevenson, G.	Acetylene Gas Generator and Storage	351
4448	..	Clarkson, T., and others	Vapour Generator and Burner	349
4449	..	Clarkson, T., and others	Vapour Generator and Burner	349
4506	..	Crichton and Joselin.	Refining Oils, Fats, and Waxes	371
4534	Johnson	Badische Anilin und Soda Fab.	Printing on Raw Silk, &c.	360
4556	Thompson	Haravodine, V.	Solidification of Crystalline Bodies	382
4560	..	Hecking, M.	Mixing and Drying Apparatus	344
4593	..	Borland, W. D.	Nitro-Explosives	279
4615	..	Schaal, E. and M.	Substitute for Gum Copal, and Amber	263
4641	..	Pantgwyn, W. F. R.	Gas for Regenerative Furnaces	350
4676	..	Otto, M.	Product of Solution of Ozone in Petroleum	112
4677	Ransford	Cassella and Co.	Blue Monazo Dyes	241
4689	..	Higgins, H.	Treatment of Wood	365
4712	..	Hargreaves, J.	Iron Oxides and Metallic Chlorides	364
4736	..	Arzt, A. H.	Gas for Lighting and Heating	235
4786	..	Morelle, C. T.	Acetylene Gas Generators	236
4792	..	Green, A. G. and others	Intermediate Products for Colouring Matters	118
4803	..	Fessenden, R. A.	Electric Incandescence Lamps	352
4847	..	Fowler (Welcome and Co.)	Solid Portable Fuel	461
4877	..	Wittmann, J. F.	Treatment of Fermentation Gas	736
4896	..	Twynam, T.	Direct Production of Iron and Steel	369
4930	..	Rosenthal, S. A.	Detecting Firedamp in Collieries	350
4961	..	Weidner, R.	Nickel Alloy	369
4982	..	Hoffmann, F.	Compressed Gas for Lighting and Heating	564
4986	..	Bouthillier, V. M.	Adhesive Compound	266
5016	..	Holland and Laurie	Porous Diaphragms	370
5040	Johnson	Badische Anilin und Soda Fab.	Aromatic Compounds for Colouring Matters	240
5047	Wetter	Actien. für Theer und Erdöl-Ind.	Obtaining Hydrocarbons contained in Coal Tar, and Recovering Certain By-Products	796
5057	..	Spence and Shearer	Sodium and Potassium Chromites and Bichromates	475
5066	..	Hadfield, H.	Bleaching Textile Fabrics	246
5122	Abel	Actienges. für Anilin Fab.	Bromo-Compounds (Tannin-Gelatin)	276
5123	Abel	Actienges. für Anilin. Fab.	Iodo-Compounds (Tannin-Gelatin)	277
5125	..	Prested, H. G.	Apparatus for Indicating Dangerous Gases	350
5261	..	House and Lancaster	Drying, Curing, and Sterilising Hops	492
5317	..	Stewart, J. K.	Gas Furnaces and their Air Compressors	234
5319	..	Emmerson, G. W., and Ward, J.	Furnace for Calcium Carbide, &c.	344
5366	..	Knöfler, O.	Incandescence Media for Gas-Lighting	463
5409	..	Jackson and Hunt.	Treating Piece Goods	120
5459	Johnson	Badische Anilin und Soda Fab.	Anthracene Derivatives and Colouring Matters	241
5502	..	Gwynne and Sargeant	Aërating Slimes	368



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
5518		Classen, H.	Obtaining Sugar in Crystals	489
5569	Thompson	Sperry, E. A.	Storage Batteries	492
5607		Green, G.	Apparatus for Filtering and Purifying Water	272
5644		Spence	Soda Alum Manufacture	250
5647		Cowper-Coles, S. O.	Coating Iron or Steel with Zinc	484
5659		Wright, W.	Improved Setting for Cements	478
5673		Ellis and Holt	Apparatus for Dipping Ceramic Ware, &c.	476
5763	Lake	Farb. vorm. A. Leouhardt and Co.	Phenylglycinecarboxylic Acid, &c.	277
5787		Robbé, H. de V.	Apparatus for Dissolving Sugar	481
5808		Künstner, J.	Carbonate of Soda Crystals	363
5817		Erfurt, M.	Boiling Frothing Liquids	591
5817		Javal, E. A.	Acetylene Gas Generator	351
5916		Schaffstädt, H.	Cooling Apparatus	105
5922		Lessing and Rheinfeld.	Burning Cement, &c., and Apparatus therefor	253
5981	Zimmermann	Chem. Fabrik vorm. Schering	Antiseptics	382
5989	Thompson	Karsten, W.	Incandescence Mantles	351
5995	Lake	Wachtel and Co.	Artificial Stone	478
6036	Shillito	Geigy and Co.	Homologues of α -Isatine-anilide and Indigo	357
6053	Johnson	Badische Anilin und Soda Fab.	Blue Colouring Matter	357
6170		Firth and Jackson	Carburetting Apparatus	697
6184		Hauslich, S. H.	Carburetting Apparatus	462
6238	Thompson	Terranova Industrie.	Cement	478
6254		Spence, B. D., F. M., and H.	Aluminous Compounds	364
6288		Watkin, H.	Indicating the Temperature in Kilns	477
6312		Cohn and Geisenberger	Soda and Chlorine Production by Electrolysis	726
6313		Notley and Frost	Lamps for Burning Oil or Spirit	464
6376		Furnival, S. B.	Clay or Filter Presses for China, &c.	364
6400		Warren, G.	Manufacture of Cement, &c.	582
6482		Zeiller, R.	Furnace for Press Glass	477
6523		Armitage, H. R.	Dyeing and Bleaching Fabrics	471
6554		Essner and Laurans	Melting Furnace	480
6563		Naef, P.	Furnaces, with Means for Recovering By-Products	463
6628	Newton	Farb. vorm. F. Bayer and Co.	Neutral Esters of Acetylphenylglycine- <i>o</i> -carboxylic Acid	277
6629		Riley, F. G.	Filtering Apparatus	344
6701		O. C. Strecker	Metals or Alloys for Lithographic Purposes	727
6733		Wohl and Kollrepp	Desaccharifying Saccharine Solutions	376
6745	Johnson	Heraus, W. C.	Uniting Aluminium to other Metals	587
6831	Jensen and Son	M. Krause	Purified and Bleached Peat Fibre	602
6839		Brothers, W.	Filling Textile Fabrics	358
6841	Ransford	Cassella and Co.	Preparing and Dyeing Furs	360
6857		Purves, W. T., and others	Carburetting Apparatus	462
6860		Richardson, C. G.	Incandescence Gas Lighting	586
6865		Sunderland and Marshall	Acetylene Gas Generator	351
6921	Lake	Souvero and Co.	Continuous Gas Muffle Kilns	581
6922		Dormoy, A.	Enamelling Metal, Mechanically	384
6924		Naef, P.	Smelting Ores, &c., and Distilling Fuel, &c.	386
6926		Régle, L. M.	Glass-Melting Pots	252
6931		J. Fischel	Treating Waste Sugar Liquids	734
6972		Prampolini, V.	Elastic Gum or Rubber Substitute	373
7026		Borgesio, P.	Obtaining Pure Tin from Waste	368
7028		Kellner, C.	Extracting Zinc from Waste	367
7074	Abel	Actienges. für Anilin Fab.	Black Colouring Matter	241
7075	Abel	Actienges. für Anilin Fab.	Black Colouring Matter	241
7076	Abel	Actienges. für Anilin Fab.	Black Colouring Matter	241
7080	Boult	Audouin, A.	Gas Condensing or Purifying Apparatus	350
7096		Grünberg, A.	Artificial Stone	365
7199	Thompson	Gfeller, E.	Saccharin Manufacture	386
7201	Thompson	Braun, F. W.	Vapour Burners	463
7210		Welsbach, C. A. von	Osmium Filaments	286
7211		Welsbach	Vacuum Osmium Lamps	32
7214		Hongxer	Sliver Cans for Dyeing Liquids and Gases	41
7240		Weddell, E. G.	Purification of Greasy Water	601
7261	Imray	Farb. vorm. Meister, Lucius und Brüning.	Blue Sulphurised Dyestuff	467
7272		Baker, H.	Connections for Carbon Electrodes	370
7290		Gorainoff, A.	Decanting and Settling Apparatus	344
7291	Newton	Farb. vorm. F. Bayer and Co.	Anthraquinone Dyestuffs	357
7292	Newton	Farb. vorm. F. Bayer and Co.	Blue Trisazo Dyestuffs	368
7332	Abel	Actienges. für Anilin Fab.	Black Colouring Matter	467
7333	Abel	Actienges. für Anilin Fab.	Black Colouring Matter	467
7383		Sharples, C.	Filtering Media	601
7388		Comber and Chorley	Colouring Textile Fibres	472
7397		Pemberton, W.	Apparatus for Treating Water	601
7477	Abel	Actienges. für Anilin Fab.	Black Colouring Matter	467
7591		Elliot, C.	Removal of Incrustation, &c., from Steam Boilers, &c.	878
7596	Thompson	Simonini, A.	Gas Igniters	236
7608		Rasch, E.	Electric Arc Light of Refractory Oxide Lamps	689
7680		Bernheim, E.	Apparatus for Mordanting, Dyeing, &c.	471
7686	Newton	Farb. vorm. F. Bayer and Co.	Dyeing with Amido-oxanthraquinone Sulphonic Acids	471
7692	Johnson	Chem. Fabrik Griesheim-Elektron	Nitronaphthalene Derivatives	358
7723	Symonds	Breakell and Hopwood	Vacuum Filters	562
7742		Southby, A. G., and others.	High Pressure Filter-Press	344
7751		Seagrave, G.	Acetylene Gas Generator	564
7768		Jungner, E. W.	Negative Accumulator Electrodes	482
7829	Imray	Farb. vorm. Meister, Lucius und Brüning.	Indigo Vat Dyeing	472
7842	Thompson	Füllner, E.	Apparatus for Separating Pulp Fibres from Waste Waters	608
7848		Renault and Cusson	Machines for Treating Pulverulent Materials	460
7850		Forbes, W. T.	Treating Hides and Skins	487
7854		Brearley, F. T.	Glass Annealing Furnaces	581
7859	Johnson	Comp. Française de l'Acetylene	Acetylene Gas Generator	564
7863		Lewes, V. B.	Gas Manufacture	350
7884	Pullon	Van Blarcom, E. C.	Filter for Sewage Treatment, &c.	562
7905		The Patent Agglomment Fuel Co., and others.	Artificial Fuel	350



No of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
7911	Feeny	The Abwärme Kraftmaschinen ges.	Pumps for Fluids of Low Boiling Point.	694
7934	..	Busch, M.	Incandescence Gas Burners	351
8090	..	Rattaire and Cottard	Soaps Soluble in Sea Water	372
8101	..	Fiedler, M.	Improvements in Explosives	837
8125	..	House and Lancaster	Apparatus for Fermenting, and Collecting the Gas	600
8135	..	Hemingway, H. W.	Solidifying Tin from Iron	368
8141	Hatmaker	Just, J. A.	Solidifying Mineral Oil Distillates	464
8184	Goedecke	Goedecke, C.	Blast Furnace for Smelting Fine Ore	255
8224	..	Goldie, T. I.	Structures for Bacterial Treatment of Sewage.	485
8229	Johnson	Kalle and Co.	Brown Colouring Matters	457
8230	Johnson	Hasslacher, F.	Mercerising Apparatus	359
8237	Imray	Farb. vorm. Meister, Lucius und Brüning.	Blue to Black-Blue Dyes, &c., on Wool Fibre	472
8267	..	Baswitz, C.	Rendering Textiles Non-Inflammable and Water-proof.	574
8305	..	Bramsch, F. R.	Purifying Molasses and Sugar Juices	736
8306	..	Bramsch, F. R.	German Yeast and Alcohol from Molasses, &c.	600
8363	Howorth	Harz and von Miller	Coating with Gold, Silver, &c.	587
8365	Imray	Norris, J. L.	A New Explosive.	1140
8415	..	Münsterberg, O.	Intense Heat for Limelight, &c.	351
8429	Boult	Poppe, O.	Artificial Leather	373
8434	..	Dannert, F.	Manufacture of Electric Incandescence Bodies.	977
8481	..	Talbot, B.	Iron and Steel Manufacture	369
8503	..	de Fanchoux d'Huny and McKenzie.	Anthracite Briquettes	697
8514	..	Société Alliance Industrielle.	Rendering Starchy Matter Soluble	492
8519	..	Novel, J.	Soldering Aluminium	47
8567	..	Hamel, H.	Apparatus for Vulcanising Caoutchouc	486
8635	..	St. C. Legge, J.	Inflammable Mixture for Incandescence Lighting	564
8654	..	Kopp and Uselli	Stretching and Mercerising Cotton Yarn	469
8691	..	Boenke, F.	Fireproof Artificial Stone Blocks	810
8763	..	McNeill, J. and C.	Evaporating Apparatus	460
8774	..	Reinsch, H.	Apparatus for Purifying Waters	495
8799	..	Duquesnoy, J.	Artificial Silk	469
8801	..	Hyatt, W. H.	Aluminium and its Alloys	724
8820	..	Blundstone, E. R.	White Lead Manufacture.	591
8873	Imray	Farb. vorm. Meister, Lucius und Brüning.	Brown Dyestuff for Cotton	468
8874	Abel	Actienenges. für Anilin Fab.	Mordanting Wool	471
8905	..	D'Altoft, L. B.	Manufacture of Gas	793
8942	..	Hooker, W.	Incandescence Gas-Burners	699
8987	Thompson	Johanssen, A.	Cement Substance for Shipbuilding	582
8993	..	Mohr, G. L.	Lacquer for Leather	487
9046	..	Bullier and The Soc. des Carb. Métalliques.	Treatment of Sulphide Ores, &c.	481
9048	..	Winkelmann, M.	Lacs from Hard Resin	729
9049	..	Sir W. G. Armstrong, Whitworth and Co. and Sir A. Noble.	Preventing Erosion of Guns	506
9081	Johnson	Badische Anilin und Soda Fab.	Colouring Matters of the Anthracene Series	707
9087	..	Plaissetty, A. M.	Non-Inflammable Nitrocellulose Compounds	709
9088	..	Plaissetty, A. M.	Incandescence Mantles	699
9157	..	Cochrane, B.	Coke Manufacture	462
9210	Thompson	Lavollay and Bourgoin.	Purification of Crude Spirit	600
9215	..	Marquardt, H.	Process and Apparatus for Preserving, Milk, &c.	924
9231	..	Bary, C. P.	Stannic Acid Manufacture	608
9260	Browne	Sanders, J. E.	Electric Light Carbons	236
9282	..	Hindman and Banyard.	Pigments and Paints	591
9283	..	Morel, L. A.	Manufacture of Gluten	738
9287	Johnson	Badische Anilin und Soda Fab.	Brown Colouring Matters	468
9334	..	Lancaster, E. W.	Protection of Calcium Carbide	463
9337	..	Ross, J. H.	Acetelene Gas Generator	564
9343	..	Vis, G. M.	Vacuum Evaporating Apparatus	250
9345	..	Foster, W. J.	Introducing Carbon, &c. into Blast Furnaces.	903
9346	..	Stassfurter Chem. Fab. vorm. Vorster and Gruneberg	Manufacture of Cyanides	717
9350	Johnson	Stassfurter Chem. Fab. vorm. Vorster and Gruneberg	Manufacture of Cyanides	717
9351	Johnson	Stassfurter Chem. Fab. vorm. Vorster and Gruneberg	Manufacture of Cyanides	717
9352	Johnson	Stassfurter Chem. Fab. vorm. Vorster and Gruneberg	Potassium Cyanate	717
9353	..	Zeigenbruch, L.	Pigments and Colouring Matters for Glass, &c.	477
9356	..	Duniewiczski, M.	Manufacture of Lump Sugar	823
9359	..	Richter, F.	Incandescence Oil Burners	565
9398	..	Gutensohn, A.	Producing Picric Acid	837
9451	..	Weeks, F. W.	Manifolding Paper	148
9493	..	Tritton and Beyer	Food Product	494
9505	..	Ross and Schneider	Mercerising Apparatus	709
9517	Johnsons and Willcox	Wildridge, G. J.	Manufacture of Paper	603
9563	Abel	Société des Piles Electriques	Electrolysing Zinc and other Salts	484
9587	Johnson	Kalle and Co.	Printing of Indigo, &c.	577
9609	..	Fischer, G., and others.	Carburetted Air Producer	564
9647	Abel	Société des Piles Electriques	Depolarising in Galvanic Batteries.	482
9649	..	Philips and Müller	Food for Animals	738
9710	..	Kirkpatrick-Picard, H. F.	Haloid Compounds of Cyanogen	717
9722	..	Brandwood, J.	Apparatus for Treating Yarns in Cop	472
9731	..	Cowper Coles, S. O.	Apparatus for Use in Electro-Deposition of Metals	1002
9735	..	Nielsen, E. A.	Incandescence Media	565
9796	..	Stewart-Wallace and Cowell	Treatment of Oils and Distillates	464
9802	..	Rosier, C. A.	Hydrocarbon Burners for Furnaces.	110
9819	..	Reeves, R. H.	Treating Sewage and Effluents.	601
9872	..	Maertens, E.	Separating Solvents from Oily Solutions	372
9906	..	Arnaud, A. L. and others	Manufacture of India-Rubber	373
9932	..	Tucker, A. E.	Artificial Fuel	340
9944	..	Drake, B. M., and The Nernst Electric Light Co.	Incandescence Electric Lamps	565
9991	..	G. Valentine	Utilisation of Pressed Yeast	736
10,012	..	Delattre, J.	Apparatus for Liberating Greasy Matters from Liquids.	371
10,017	..	Bettancy, W. and W. F.	Potters' Ovens	477



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
10,055	.. ..	Petolite Fuel Syndicate and Johnson ..	Material for Artificial Fuel	563
10,127	Imray	Farb. vorm. Meister, Lucius und Brünig.	Dyestuffs for Cotton, Fast to Alkali, &c.	468
10,196	Wetter	Haen, B. de	Chemically Pure Hydrochloric Acid	474
10,218	.. ..	Coiffier, H., and others	Bricks, Tiles, Pipes, &c.	477
10,267	.. ..	Duff, E. J.	Destruction of Waste Carbonaceous Matter	272
10,293	.. ..	Rudolph, C.	Black Colouring Matters, &c.	468
10,294	Abel	Actienges. für Anilin Fab.	Brown Azo Colouring Matters	467
10,316	Johnson	Badische Anilin und Soda Fab.	Colouring Matters of the Anthracene Series	708
10,317	.. ..	Carey, A., and others	Recovery of Sulphur Compounds	474
10,375	.. ..	Garassino, J.	Plates for Secondary Batteries	726
10,432	.. ..	Bower, G.	Apparatus for Mixing and Burning Gas and Air	697
10,438	Boult	Wislicki, F.	Treating Wool and other Fibres	119
10,466	.. ..	Macar, J. de	Explosives	617
10,500	.. ..	Grandage, H.	Apparatus for Testing Textiles	709
10,511	.. ..	Electrical Power Storage Co., and others	Plates for Secondary Batteries	482
10,514	.. ..	Bower, A. S.	Carburetting Apparatus	698
10,520	.. ..	Dickson, A. A.	Drying of Peat	793
10,556	.. ..	Lecomte, A.	Vapour Burners	32
10,580	Imray	Morani, F.	Electric Furnaces of Great Power	588
10,588	.. ..	Schniewind, F. W. C.	Carburetting Gas	31
10,708	.. ..	Thomas, V.	Filaments for Electric Lamps	700
10,705	.. ..	Betts, A. G.	Coating of Aluminium or its Alloys	1219
10,709	.. ..	Hope, C. H.	Colour-Printing Textile Fabrics	577
10,722	Thompson	Le Sueur, E. A.	Treating Air; For Obtaining a Gas or Liquid rich in Oxygen therefrom.	981
10,738	James	Bethlehem Steel Co.	Tool Steel	46
10,843	Abel	Actienges. für Anilin Fab.	Sulphurised Leuco Compound	573
10,844	Abel	Actienges. für Anilin Fab.	Black Disazo Dyestuffs	573
10,845	Zimmermann	Chem. Fabrik vorm. Schering	Antiseptic Compounds	608
10,865	.. ..	Sohege, P.	Composition for Tiles, &c.	582
10,899	.. ..	Rocca, E.	Refining Oils	485
10,912	.. ..	Parziale, T.	Manufacture of Soap	591
10,915	.. ..	Bate and Zicart	Extraction of Zinc	724
10,925	Thompson	Litzelmann and Tailfer	Decomposing Alkaline and other Amalgams	717
10,940	.. ..	Swinburne, J.	Heaters for Incandescent Electric Lamps	794
10,973	.. ..	Freeman, T. K.	Preservation of Milk	827
10,977	.. ..	Sinclair, D.	Decorating Brass and Porcelain Ware, &c.	727
11,035	Newton	Farb. vorm. F. Bayer and Co.	Colouring Matters of the Acridine Series	573
11,040	Imray	Farb. vorm. Meister, Lucius und Brünig.	Salicylate of 4-Dimethylamido-1-Phenyl-2,3-Dimethyl-5-Pyrazolone.	504
11,042	Abel	Actienges. für Anilin Fab.	Dyeing with Sulphide Dyestuffs	577
11,046	.. ..	Burmeister, E.	Treatment of Towns' Sewage and Waste	739
11,053	.. ..	Allworth, C.	Improved Soap	728
11,055	.. ..	Maertens, E.	Apparatus for Treating Wool, &c.	119
11,061	.. ..	Askham and Keevil	Crushing or Grinding Apparatus	694
11,077	.. ..	Crompton, W. H., and Horrocks, W.	Machines for Treatment of Yarn in Hank Form	985
11,085	.. ..	Zohrab, E. T.	Furnaces for Smelting, &c. Ores	587
11,091	.. ..	Gayley	Drying Air; and Apparatus therefor	27
11,108	.. ..	Beringer, E.	Zinc Sulphide for Pigments	592
11,128	Thompson	Rubenstein, J.	Incandescence Oil and Spirit Lamps	565
11,197	.. ..	Gauntlett and Lloyd	Printing upon Glass	718
11,217	.. ..	Heyl-Dia, G. E.	Covering Cables, &c., with Rubber, &c.	593
11,260	.. ..	Tribelhorn, A.	Accumulators and Electrodes therefor	588
11,287	Imray	The Opalite Tile Co.	Glass Tiles	364
11,301	.. ..	Gibb, A.	Melting or Smelting Furnaces	723
11,339	.. ..	Just, A.	Disinfectant Pocket Handkerchief	739
11,344	.. ..	Voelker, W. L.	Manufacture of Carbide Filaments for Incandescing Electric Lamps.	977
11,348	Imray	Farb. vorm. Meister, Lucius und Brünig.	Brown and Grey Dyestuffs for Wool	468
11,352	.. ..	Trier and Wilkinson	Preserving Hops, &c.	492
11,407	.. ..	Lancaster, E. W.	Sterilising and Lining Wooden Casks with Mineral Wax	826
11,426	.. ..	Goldzweig, A.	Purifying Fibrous Materials	119
11,502	.. ..	Fleurent, E. C. A.	Desiccating and Sterilising Flour, &c.	600
11,504	.. ..	Leroux, J. B., and Carmien, P. J.	Apparatus for Burning Mixtures of Air and Inflammable Vapour.	1101
11,506	.. ..	Prescher, H.	Gas Igniters	699
11,514	Nobis	Nobis and Wenzel	Tanks and Boiling Vessels, &c.	562
11,524	.. ..	von Mering	Food Preparations	738
11,526	.. ..	Ammundsen, J. S., and Rasmussen, E. A.	Coating Material for Linoleum	135
11,531	.. ..	Wurts, A. J., and others	Nernst Electric Lamps and Heaters	566
11,571	.. ..	Blumenberg, H., jun.	Electric Battery Compounds	726
11,602	.. ..	Martin, E.	Plates of Aluminium covered with Silver	724
11,603	.. ..	Martin, E.	Covering Steel or Iron Plates with Copper	905
11,622	.. ..	Calmette, L. C. A.	Process and Apparatus for the Manufacture of Glucose.	1127
11,639	.. ..	Schroeder and Diefenthal	Food from Brewers' Spent Grains	59
11,663	.. ..	Thomas and Bonavita	Hollow Cellulose Articles	741
11,664	.. ..	Thomas and Bonavita	Hollow Cellulose Articles	741
11,665	.. ..	Danayrouze, L.	Incandescence Oil Lamps	565
11,676	Thompson	Gfeller, E.	Toluene Sulphochlorides	504
11,678	.. ..	Adcock, S. B.	Cupric Oxide from Natural Sulphates or Carbonates	718
11,749	.. ..	Lederer, L.	Manufacture of Acetyl-Cellulose	741
11,751	.. ..	Zühl, E.	Celluloid	741
11,753	.. ..	Sellar, W. C.	Production of Silico-Fluorides	718
11,766	.. ..	Glover, J. G.	Gas Lighting Torches	698
11,799	.. ..	Moodie, R.	Cooling Apparatus	694
11,818	Abel	Bayerische Actienges. Heufeld	A Fungicide	495
11,852	.. ..	Meldrum Bros. and Orton	Kilns for Calcining Minerals	694
11,860	.. ..	Bärwinkel, M.	Linoleum Manufacture	50
11,912	.. ..	Craig, G. and Paterson, R. M.	Obtainment of Alkali Cyanides	808
11,922	Abel	Actienges. für Anilin Fab.	Amido-ammonium-azo Dyestuffs	708
11,953	.. ..	Atkins, G. J.	Process and Apparatus for Manufacture of Acetylene Gas.	883
12,020	Thompson	Mallinson, G.	Machines for Dyeing or Drying Yarns	577
12,027	.. ..	Koppelman, E.	Treating Filter- & Media	827
12,124	.. ..	Spence, F. M., and others	Treatment of Sewage Sludge	830



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
12,131	.. ..	Overbeck, O.	Appliance for Rousing Wort in Fermenting Vessels .	737
12,157	.. ..	Youtlen, W.	Impregnating Wood	810
12,160	.. ..	Thomas, V.	Filaments for Electric Incandescence Lamps.....	795
12,180	.. ..	Raschen, J., and others	Apparatus for Manufacture of Cyanides	809
12,182	.. ..	Schulthess, W.	Production of Calcium Hydrate	717
12,190	.. ..	Poster, J.	Evaporating Apparatus	562
12,231	Imray	Farb. vorm. Meister, Lucius und Brünig.	Rendering Cows' and Goats' Milk Digestible	601
12,268	.. ..	Guilbert, A.	Manufacture of Resinous Soap	818
12,313	Abel	Actienges. für Anilin Fab.	Photographic Prints	608
12,375	Abel	Actienges. für Anilin Fab.	Photographic Reducer	609
12,431	.. ..	Schwerin, G. B.	Extraction of Liquid from Mineral and other Substances.	726
12,459	.. ..	Eckardt, A.	Brewing Process	737
12,513	Lake	Wachtel and Co.	Artificial Sandstone	719
12,517	Johnson	Badische Anilin und Soda Fab.	Brown Sulphur Dyestuff, and Material therefor	708
12,523	.. ..	Holm, H.	Process and Apparatus for Carbonising Peat	793
12,525	.. ..	Petréano and others	Hydrocarbon Burner, without Solder	234
12,550	.. ..	à Brassard, H. F. A.	Machine for Treating Slivers of Fibre, &c.	892
12,619	.. ..	Brooke, R. G.	Apparatus for Purifying Fluids	694
12,621	.. ..	McDougall, I. S. and I.	Sheep-Dipping Preparations	495
12,647	.. ..	Giese, O.	Flash-Light Apparatus and Cartridges	237
12,668	.. ..	Dreher, C.	Manufacture of Paper	831
12,676	.. ..	Jensen, J.	Preservation of Eggs	738
12,686	.. ..	Danilevsky, A.	Utilisation of Fish for Food	738
12,789	.. ..	Atkins, W. G.	Filtering Apparatus	695
12,803	.. ..	Schmidt, H.	Kilns for Cement, &c.	582
12,804	Imray	Farb. vorm. Meister, Lucius und Brünig.	Black Azo Dyestuffs	708
12,805	.. ..	Steffen, C.	Producing Steam or Vapour at Desired Pressure	562
12,807	Haddan	Passburg, E.	Solidifying and Preserving Milk	827
12,819	Johnson	Badische Anilin und Soda Fab.	Azo Colouring Matters, &c.	708
12,823	.. ..	Saniter, F. L., and others	Open-Hearth Steel Furnaces	903
12,862	Lake	The Jewell Export Filter Co.	Reagents for Purifying Water	61
12,895	.. ..	Roth, C.	Artificial Manure	914
12,899	Newton	Farb. vorm. F. Bayer and Co.	Manufacture of Azo Colouring Matters	803
12,905	.. ..	Claude, E.	Apparatus for Manufacture of Liquid Air	1,018
12,949	.. ..	Bennett, J. W.	Appliances for Treating Ale, Beer, &c.	737
12,976	.. ..	Schule, R. F.	Dyeing Yarns, and Apparatus therefor	577
12,977	.. ..	Francken, P. E.	Electric (Constant) Battery	815
12,983	.. ..	Sprott, E. W.	Acetylene Generators	883
12,984	.. ..	Thuman, F.	Apparatus for Treating Liquor obtained from Washing, &c., of Carburetted Water Gas, &c.	882
13,027	.. ..	Ruttenau and Hahlo	Machine for Dipping and Dyeing Skins, &c.	713
13,050	.. ..	Talbot, B.	Open-Hearth Furnaces	903
13,084	.. ..	Marty	Textile Fabrics	39
13,113	.. ..	Wilkinson, J.	Production and Use of Vapourised Oil and Air	883
13,181	.. ..	Goldsmith, J. N., and others	Celluloid	741
13,145	.. ..	White, W. G., and E. A. A.	Compounds and Machines for Polychromatic Printing	714
13,201	.. ..	Linde, F.	Purification of Sweet Oils	591
13,205	.. ..	Gordes, H.	Gas Generators	697
13,289	.. ..	Fajole, E.	Acetylene Gas Generator	883
13,365	.. ..	Knopf, A. B., née Fuchshuber	Washing of Paper-making Materials and Recovery of Soap and Alkali.	926
13,289	.. ..	Hill, H.	Mantles for Incandescence Lighting	699
13,290	Imray	Hay, J. S.	Tool Steel	129
13,293	.. ..	Gutensohn and Price	Treating Sulphide Ores	723
13,299	.. ..	Smith, J. L., and others	Open-Hearth Steel Process	724
13,352	.. ..	Holzer, W., and Frith, W. F. L.	Process for Toughening, &c., Iron and Steel	1,218
13,361	.. ..	Riches, H. E., and others	Treating Hides, &c.	913
13,404	Boult	Molet, A.	Apparatus for Mixing Gases	882
13,467	.. ..	Mathieson-Thom and Oakes	Artificial Stone	719
13,468	Lake	Fab. Chem. præparate von Dr. E. Stäuer.	Production of Saponin	883
13,475	.. ..	Aubry, L.	Manufacture of a Food Extract from Yeast, &c.	924
13,491	.. ..	Güssow, G. E.	Artificial Stone Blocks	125
13,493	.. ..	Hargreaves, J.	Obtaining Metallic Chlorides and Oxides	808
13,566	.. ..	Fournier, E.	Disinfecting, and Apparatus therefor	147
13,644	.. ..	Lange, H.	Soldering Aluminium	369
13,653	.. ..	Greenway, A. G.	Purifying Molten Iron or Steel	908
13,658	.. ..	Graham, J.	Apparatus for Emptying Bacteria Beds, &c.	381
13,659	.. ..	Wulkan, H., and Straetz, H.	Preparation of Dry Starch from Grain	824
13,664	Johnson	Badische Anilin und Soda Fab.	Azo Colouring Matters, &c.	117
13,707	.. ..	Paucheur, J.	Combustible Briquette	30
13,749	.. ..	Naboulex, S. G.	Sterilising Apparatus	380
13,762	.. ..	Freyoldt, O.	Purifying Effluents; and Apparatus therefor	61
13,765	.. ..	Morison, D. B.	Evaporating Apparatus	694
13,814	Johnson	Deutsche Continental-Gas-Gesellschaft und Busch.	Gas and Coke Manufacture	697
13,815	.. ..	Atkins, G. J.	Manufacture of Chlorine	897
13,839	.. ..	Drake, B. M., and Nernst Elec. Light, Ltd.	Glow Bodies for Electrolytic Incandescent (Nernst) Lamps.	884
13,866	.. ..	Bell, E. D.	Preparation of Nuts	828
13,892	Feeny, V.	Allgemeine Elektrizitäts Gesellschaft ..	Heating Bodies for Exciting Electrical Incandescence Bodies.	237
13,896	.. ..	La Soc. H. Croizier et Cie	Artificial Stone Blocks	810
13,906	.. ..	Wilhelm, H.	Peptonised Preparation of Albumin	924
13,951	.. ..	Weiss, J.	Electric Muffles or Furnaces	697
13,952	Lake	Société Forderia Milanese d'Acciaio.	Manufacture of Steel	724
13,991	Mackenzie	Gesellschaft der Riga-r Eisengiesserei.	Pressing Plates for Hydraulic Oil-Presses	1,004
14,021	.. ..	Shearer, A.	Alkali Chromates and Bichromates	718
14,034	.. ..	Meissner, C.	Acetylene Gas Generators	31
14,047	.. ..	Griffin and Sons, and Ibbotson, F. H.	Receptacles for Holding small Quantities of Photographic Chemicals, &c.	932
14,050	.. ..	Briggs and Priestley	Deodorising Wool from Sulphur Dioxide	359
14,104	Langkner	Vogelsang, A.	Electrodes	49
14,121	Marks	General Electric Co.	Electric Light	287
14,124	Mills	International Chem. Co.	Alkaline-Earth Silicides, &c.	43



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
14,186	.. ..	Murphy, E. E.	Carbonating Apparatus.	59
14,188	.. ..	Hennings, C.	Acetylene Gas Apparatus.	698
14,174	.. ..	Jackson, C. L.	Bleaching Kiers.	712
14,213	Abel	Actienes. für Anilin Fab.	Manufacture of Organic Bromo-Compounds.	833
14,220	Ransford	Cassella and Co.	Production of Violet and Blue Dyestuffs.	893
14,229	Jöhnson	Badische Anilin und Soda Fab.	Discharge Effects on Indigo-Dyed Goods.	121
14,278	.. ..	Passow, H.	Production of First Class Cement.	992
14,283	Golby	Reichmann and Lagerqvist.	Mercerising Yarns.	469
14,286	.. ..	Ott, G.	Fusing Porcelain, &c.	581
14,291	.. ..	Graham, E. L.	Disintegration of Minerals or Ores. (Electric).	1221
14,353	Edison Ore Milling Syndicate.	Edison, T. A.	Process and Apparatus for Sampling, &c., Portland Cement, &c., in Bulk.	992
14,354	Edison Ore Milling Syndicate.	Edison, T. A.	Magnetic Separating Apparatus.	998
14,355	Edison Ore Milling Syndicate.	Edison, T. A.	Magnetic Separating Apparatus. (Gravity)	998
14,356	Edison, Ore Milling Syndicate.	Edison, T. A.	Briquetting Pulverised Material.	997
14,344	.. ..	E. Enzinger.	Filter-Presses and Material.	694
14,417	.. ..	Harris, A.	Apparatus for Softening or Purifying Water.	925
14,426	.. ..	Johnson, J. P.	Apparatus for Manufacture of Gas.	698
14,428	.. ..	Uhland, W. H.	Starch Manufacture.	916
14,462	.. ..	Wirth, E.	Purification of Anthracene.	464
14,463	.. ..	Schoop, P.	Apparatus for Electrolysis.	906
14,491	Clark	Blum, F.	Prophylactic, Immunifying, or Curative Substances.	746
14,503	.. ..	Talbot, B.	Bricks, &c., for Lining Metallurgical Furnaces.	900
14,518	.. ..	Schreiner, L.	Dyeing Textile Fabrics.	713
14,519	.. ..	Lich, M. L. H., and van der Werk, A.	Manufacture of Cocoa.	924
14,550	Lake	Testa, N.	Insulation of Electric Conductors.	258
14,553	Dymond	Zielenziger, S.	Incandescence Gas Lamps.	235
14,572	.. ..	Hall, C. M.	Obtainix Pure Alumina from Bauxite.	808
14,573	.. ..	Hall, C. M.	Manufacture of Alumina.	803
14,583	.. ..	Ziegler, H.	Explosive Printing Compositions.	933
14,625	.. ..	Edwards, A., and Nelson, E. M.	Drying Photographic Plates, &c.	932
14,627	.. ..	Hasselmann, F.	Producing Fuel from Moor Moss.	793
14,661	.. ..	McNamee, F.	Peat Fuel, &c.	882
14,673	.. ..	Joly, C.	Preservation of Air and Gases in Liquefied Condition.	695
14,722	.. ..	Horstmann, O.	Manufacture of Insulating Materials.	907
14,724	.. ..	Stauf, R.	Blood, Milk, &c., in form of Powder.	59
14,725	Lake	Oehler, K.	Manufacture of Disazo Colouring Matters.	803
14,727	.. ..	Riches, H. R., and others.	Removing Hair, &c., from Hides and Skins.	1124
14,751	.. ..	Brunschwyler and Parli.	Acetylene Gas Generator.	111
14,754	Mills	The Ampère Electro-Chemical Co.	Production of Camphor, Phyl Oxalate, &c.	67
14,778	.. ..	Croizier, A. H., and Thomine, A. E.	Manufacture of Artificial Stone.	810
14,780	.. ..	Andrew and Bellis.	Treating Low-Grade Steel.	369
14,788	.. ..	Enoch, C.	Manufacture of Non-Alcoholic Juices, &c.	924
14,840	Johnson	Badische Anilin und Soda Fab.	Manufacture of Disazo Colouring Matters.	803
14,831	Ransford	Cassella and Co.	Manufacture of Violet Dyestuffs.	889
14,845	.. ..	Yeadon, S. N., and Mason, W. D.	Apparatus for Revivifying Gas Lime.	798
14,876	.. ..	Gronwald, J. F. H.	Preventing Changes in Aromatic Alcoholic Liquors during Sterilisation.	827
14,879	Imray	Farb. vorm. Meister, Lucius und Brüning.	Rhodamine Sulphonic Acids.	709
14,892	.. ..	Luyten, L., and Blumer, E.	Purification of Anthracene.	796
14,976	.. ..	Johnstone, J. J.	Anti-Incrustant for Boilers.	233
14,983	.. ..	Twyman, T.	Treatment of Zinc-Lead Sulphide Ores.	905
15,002	.. ..	Ziegler, M.	Apparatus for Coking Peat.	793
15,018	Lake	Jørgensen	Fire-kindling Substances.	30
15,019	.. ..	Gould, E. H.	Recovery of Tin, and Simultaneous Generation of Electric Energy.	817
15,021	.. ..	Alexandroff, V.	Carbon Electrodes for Arc Lamps.	816
15,030	Woxam	Phlox-Glühlicht-Gesellschaft.	Manufacture of Incandescence Gas Mantles.	794
15,052	.. ..	Eunson, M.	Liquid-Fuel Furnaces and Muffle Ovens.	882
15,057	.. ..	Nahnsen, G. A.	Sheds for Explosive Materials.	155
15,087	.. ..	Maingard, L. A.	Artificial Fuel.	697
15,128	.. ..	Siemens Bros. Co., Ltd., and others.	Pumps for Liquid.	789
15,134	Wetter	Besemfelder, E.	Manufacture of Caustic Alkalis, &c.	987
15,166	.. ..	Kirkpatrick-Picard, H. F.	Treatment of Slags, &c. containing Zinc.	1219
15,171	.. ..	Murmann, E.	Manufacture of Alloy. (Al-Mg).	905
15,172	Newburn and Robson.	Chem. Fab. von Heyden.	Manufacture of Peptone.	827
15,185	Johnson	Badische Anilin und Soda Fab.	Manufacture of Blue Green Colouring Matters of Anthraquinone Series.	899
15,191	.. ..	Obermaier, J. O.	Dyeing Apparatus.	1207
15,233	.. ..	Thesen, J.	Extraction of Iodine, &c. from Sea-Weed.	608
15,241	.. ..	Hutchinson, R. H.	Lubricant for Fibres.	242
15,262	.. ..	Atkins, G. J.	Manufacture of Chlorine.	806
15,329	.. ..	Obermaier, J. O.	Apparatus for Subjecting Rovings, &c. to the Action of Fluids.	984
15,344	.. ..	Goreham, W. F.	Apparatus for the Separation of the Flour or Finer Particles of Cement, &c.	1115
15,352	.. ..	Rouse, T.	Manufacture of Concrete.	810
15,363	.. ..	Cooke, G., and Parr, J.	Electro Deposition of Metals upon Earthenware.	817
15,391	Newton	Farb. vorm. F. Bayer and Co.	Manufacture of Dyestuffs of Anthracene Series.	890
15,413	.. ..	Green, A. G., and others.	Dyeing Black with Sulphide Colours.	713
15,414	.. ..	Green, A. G., and others.	Calico Printing with Sulphide Colours.	713
15,432	.. ..	Gibb, A.	Manufacture of Portland Cement.	810
15,443	Tavernier	Belledin, V. E.	Sheets of Elastic Material.	266
15,455	.. ..	Kershaw, H. B.	Apparatus for Heating, Cooling, &c. Liquids or Gases.	878
15,459	Lake	Werner and Pfeleiderer.	Mixing, Kneading, and Triturating Machines.	789
15,470	Boult	Andreas, E.	Forming Metallic Electrode Plates.	1001
15,473	Boult	Andreas, E.	Forming of Electrodes.	816
15,476	.. ..	Dörr, C.	Artificial Fuel.	30
15,486	.. ..	Lishman, W. W. L., and others.	Kiers for Boiling, &c.	892
15,501	.. ..	Fletcher and others.	Burners for Gas used in Furnaces.	31
15,550	.. ..	Martini, A.	Gas-Igniting Devices.	884
15,589	.. ..	Weddell, G.	Manufacture of Table Salt.	828
15,598	.. ..	Ewan, T., and Pfeleger, J.	Manufacture of Alkaline Amides.	833



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900				
15,625	Defries, W., and Feeny, V. J.	Improved Steriliser	830
15,639	Kornfeld, F.	Alzarin Dyeing Processes	893
15,645	Kurz, F. K.	Apparatus for Carburetting Gas by Vapour of a Liquid.	883
15,646	Steffen, C.	Production of Vapour at Desired Pressure from Liquids Heated under Pressure.	875
15,649	Poppe, M.	Manufacture of Margarine, &c.	924
15,700	Macalpine, T.	Manufacture of Fuel	974
15,712	Jennings, W. E. A.	Governor and Enricher of Gas.	699
15,720	Bayer, A.	Purification of Sewage.	830
15,730	Tatham, E.	Material suitable for Use as a Cement and Insulator.	1001
15,759	Bartelt, F. L.	Compounds for Washing and Bleaching Vegetable Fibres.	892
15,813	Lazareff, P.	Generator for Manufacture of Combustible Gases from Hydrocarbon Liquids.	883
15,831	Tuckwell, J.	Imitation Marble.	552
15,868	Armstrong, W. G., Whitworth and Co., and Orde, E. L.	Separation of Fuel-Oil from Water	882
15,873	Hoepfner, C.	Manufacture of Alkali Salts and By-Products.	987
15,879	Armstrong, J.	Obtaining Volatile Metals.	905
15,920	British Thomson-Houston Co., Ltd.	Steinmetz, C. P.	Electric Furnaces (Pyro-electrolyte)	977
15,980	Lothammer, F. J.	Carburetted Air.	31
15,980	Schwartz, W.	Manufacture of Limestone.	810
15,960	Gabrielli, A.	Fireproof Coating for Walls	126
15,962	Collin, F. J.	Horizontal Coke Ovens.	882
15,971	Gordon, R. H.	Disinfectant or Deodoriser	61
15,986	Ward, W. J.	Manufacture of Waterproof Paper, &c.	831
16,004	Rawson, W. S., and Littlefield, R. D.	Manufacture of Refractory Bricks, &c.	992
16,010	Raphael and Elias.	Insulating and Packing Material	582
16,037	Adams, S. H.	Apparatus for Spraying Sewage on Filter Bed.	1013
16,060	Deycke, G.	Albumin and Meat Extract	59
16,077	Poetter, H.	Gas Generators.	883
16,104	Whittaker, C. J.	Preparation of Fuel Blocks, &c., from Sludge, &c., Sewage.	882
16,157	White, G.	Fuel Injectors.	350
16,199	Morris, E. W.	Diabetic Sugar-Free Milk	380
16,247	Ransford	Cassella and Co.	Manufacture of Blue Dyestuffs	889
16,253	Raynaud and Pierron.	Purification of Sulphurous Acid	42
16,254	Raynaud and Pierron.	Sulphuric Acid; by Catalytic Process.	42
16,277	Fuehrer, J.	Explosives.	68
16,293	Imray	Soc. Electro-Metallurgie Française	Electrodes for Electric Furnaces.	907
16,303	Lewis, J. A.	Manufacture of Artificial Fuel.	974
16,307	Seifarth, H.	Artificial Stone	365
16,312	Gebauer, F.	Bleaching Slivers, &c.	892
16,332	Heys	Sénéchal de la Grange.	Impermeable Threads and Fabrics.	39
16,371	Wenghöffer, L.	Manufacture of Picric Acid	932
16,409	Smyth, J. F.	Apparatus for Manufacturing Acetylene Gas.	975
16,494	Maddison, J. W., and Rhodes, Wm.	Melting Iron; and Materials employed therein.	1119
16,525	Posener, A. M., and Clerke, F. W.	Manufacture of Artificial Leather, Floor Coverings, &c.	913
16,526	Posener, A. M., and Clerke, F. W.	Manufacture of Artificial Leather, Floor Coverings, &c.	913
16,529	Mills	General Electro-Chemical Co.	Abrasive Material from Bauxite, &c.	78
16,534	Bühne, F. W.	Porous Metal Plates for Accumulators.	907
16,565	Willcox	Badische Anilin und Soda Fab.	Manufacture of Indigo.	803
16,596	Willcox	Badische Anilin und Soda Fab.	Manufacture of Intermediate Products and Indigo Colouring Matters.	889
16,581	Hamilton, A. O.	Compound for Removing Scale from Boilers.	878
16,598	Clark, T. E.	Acetylene Gas Generators.	883
16,601	Turner, W.	Hawking Machines for Indigo Dye Vats	247
16,617	Automatic Glass Blowing Patents Syndicate.	Colburn, H. J.	Machines for Blowing Glass.	125
16,623	Automatic Glass Blowing Patents Syndicate.	Bock, W. E.	Machines for Blowing Glass.	125
16,708	Bratt, H.	Preparation of Food from Gelatin.	828
16,716	Gulden, P.	Method of Extraction, Extraction of Dyeing Materials, &c.	38
16,734	Wenghöffer, L.	Treatment of Gluten, &c.	827
16,780	Howell, H.	High Pressure Accumulator for Incandescent Gas Lighting.	977
16,801	De Brito e Cunha, A. J.	Decomposition of Alkaline Salt Solutions. Process and Apparatus for the Electrolytic.	1121
16,844	Philp, H. R. A.	Preservative Paint for India-Rubber Tyres.	911
16,908	Ludwig, A.	Vessels for Reception of High-Pressure Gases.	878
16,921	Willcox	Badische Anilin und Soda Fab.	Manufacture of Amido-Naphthol-4-Sulpho Acid	889
16,934	Batley, W. H.	Artificial Fuel	462
16,960	Thorne, L.	Acetylene Generators, and Apparatus connected therewith.	1101
16,973	Naef, P.	Precipitation of Bicarbonate of Soda	1112
16,974	Naef, P.	Crystallising or Freezing; and Apparatus therefor	233
16,979	Fazan, J.	Acetylene Gas Generator.	31
16,980	Culmann, C. L.	Rosin Soap	591
16,988	Willcox	Badische Anilin und Soda Fab.	Manufacture of Blue Colouring Matters.	889
16,998	Bennett, W. H.	Apparatus for Generating and Burning Mineral Oil Gas.	1106
17,004	Bennett, W. H.	Apparatus for Generating and Burning Mineral Oil Gas.	1106
17,025	Predmerszky, J. and G.	Acetylene Gas Generator	111
17,027	Westman, G. M.	Treating Ores	367
17,034	Actienges. für Zink-Industrie	Apparatus for Making Sulphuric Acid by Catalysis	679
17,041	Crawford, J. A.	Smoke-Consuming Furnaces	1,049
17,048	F. Haerle	Metallised Paper	741
17,053	Naef, P.	Process and Apparatus for Heating Solids and Liquors for the Purpose of Decomposing, &c.	1,210
17,354	Naef, P.	Process and Apparatus for Treating Materials with Liquid and Gas.	1,195
17,071	Lester and Dean	Furnaces for Burning Refuse	147



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
17,119	Ludwig, A.	Artificial Production of Diamonds (Metallic Electrodes).	1034
17,120	Pilkington, W. W., and Ormandy, W. R.	Fire Bricks and Cement therefor	900
17,166	Bamberg, G.	Detergents and their Manufacture	1122
17,181	Bonal and Fietz	Liquid Fuel for Lighting and Heating	110
17,185	Simon, A.	Treating Ores and Minerals	368
17,190	Simon, A.	Apparatus for Producing Manganese, &c.	256
17,193	Sansone, A., and Clayton Aniline Co., Ltd.	Printing with Sulphide Colours	898
17,202	Besson, J. A.	Process and Apparatus for Continually Producing and Rectifying Chloral.	1139
17,243	Cowper-Coles, S., and Sterne, L.	Rendering Silver Surfaces Untarnishable	1003
17,253	Bauer, Imrie, and Co.	L. Cevaert-Naert	Artificial Leather	597
17,378	Hulme, F. A.	Manufacture of Soft Soap	910, 1005
17,378	Kronstein, A.	Manufacture of Varnishes and Products resembling Resins and Balsams.	1123
17,383	Mette, L.	Automatic Gas Igniters	1101
17,390	Ekker, M., and Krajcsics, J.	Metallic Alloys	47
17,416	Aikman, C. M.	Preparing Concentrated Foods	1132
17,427	Müller, F., and Rossbach, G.	Treating Rosin to obtain Rosin of Low Melting Point	1123
17,443	Stanley, J. C. W., and Cotton Seed Oil Syndicate.	Bleaching of Oils and Fats	1122
17,460	Jaubert, G. F.	Hydrates of Peroxides of Lime, &c.	42
17,461	Jaubert, G. F.	Compressed Peroxide of Sodium, &c.	43
17,466	Adolfsson, A. E.	Acetylene Gas Generator	31
17,472	Ivison, F.	Rapidly Ageing Wines and Spirits, and Apparatus therefor.	923
17,475	Steenstrup, C. A. R.	Substance Similar to India-Rubber	135
17,480	Laster, J. F.	Apparatus for Treating Hides and Fibres	53
17,485	Palas, H. J. U., and Cotta, F. A. J.	Making Copper Sulphate (Electrolytic)	906
17,490	Kuettner, B.	Manufacture of Secondary Battery Plates	1120
17,497	Barbe, E.	Manufacture of Vinegars, &c.	737
17,508	Bolland, J.	Dyeing Patterns on Fabrics	1110
17,527	Eriesson, C.	Indicating and Recording Carbon Dioxide in Products of Combustion.	110
17,537	Scott, J. J. C., and C. F. H.	Wash for Sheep, &c.	1193
17,569	Michalowsky, T.	Preparation of Nickel	1119
17,594	Presto, F. W.	Extracting Tin from Waste	368
17,611	Swinburne, J., and Ashcroft, E. A.	Treatment of Sulphide Ores	907
17,612	Swinburne, J., and Ashcroft, E. A.	Treatment of Sulphide Ores	907
17,674	Bail, F.	Apparatus for Consuming Smoke in Furnaces for the Destruction of Refuse.	1132
17,683	Wadsworth, F. L. O.	Prism Glass	125
17,687	Denayrouze, L.	Manufacture of Solidified Carburetted Spirits for Heating, &c.	976
17,701	Lake	Farb. Muhlheim vorm. Leonhardt.	Fixing of Dyeings on Vegetable Fibres	893
17,709	Heidemann, H., and Axdorfer, G.	Gas Burners for Heating Purposes	883
17,713	Kelsey, D. M.	Disinfectant Compound	61
17,734	Crossley, W. J., and Atkinson, J.	Apparatus for Purifying Gas from Gas Producers and Heating and Moistening the Air Supplied to the Producers.	1100
17,759	Lehner, F.	Artificial Horsehair	1109
17,762	Lane, H.	Manufacture of Gas for Lighting, &c., and Apparatus for Use therewith.	1101
17,764	Abel	Délaïnage Verviétois, Peltzer & Co.	Apparatus for Removing Fat from Wool	891
17,768	Flügge, A.	Manufacture of Nutritious Food from Seeds of Horse Chestnut.	1012
17,783	Stevenson, J.	Pigments and Dyes with Relation to Production of Designs, &c.	1208
17,873	Hallensleben, O.	Apparatus for Printing, &c., Yarn for Carpets, Plush, &c.	892
17,888	Marsh, W.	Manufacture of Carbonate of Magnesia	1113
17,912	Mills	The Bristol Co.	Air Pyrometers	28
17,924	Lillie, S. M.	Treatment of Sugar Solutions, &c.	140
17,928	Johnson, A. C.	Sulphuric Acid Manufacture	250
17,945	Deshler and McAllister	Electric Lamp Photometers	352
17,948	Zühl, F.	Manufacture of Celluloid	926
17,953	Stahlschmidt, F.	Production of Ferric Saccharate	1018
17,966	Kelsey, L. L.	Glue, and Products therefrom	267
17,993	Crossley, W. J., and Atkinson, J.	Apparatus for Purifying Heating Gas from Gas Producers, Blast Furnaces, or Coke Ovens.	1100
17,999	Coghlan, J. M.	Acetylene Gas Generating Apparatus	883
18,027	Saxl, H., and others	Superphosphates	374
18,028	Rondebush	Bradford, E. T.	Hot Blast Furnaces for Smelting Pyrite Ores	1117
18,035	Boult	Tissier, A.	Manufacture of a Mineral Catalytic Substance for Use as a Gas Condenser, &c.	1100
18,079	France, G. H.	Treating Fabrics with Liquids	1207
18,107	Abel	Actienges. für Anilin Fab.	Manufacture of Orange-Yellow Dyestuffs of the Acridine Series.	888
18,120	Sarg, E.	Moulding Material, for Steel Casting	46
18,152	Lenchs, G., and Lenchs, K.	Producing Clouded Glasses, &c.	990
18,166	Abel	Actienges. für Anilin Fab.	Dyeing Wool	893
18,181	Wolf, jun., and Co.	Treatment of Acetylene Gas	976
18,208	Theobald, W. & G.	Increasing Power of Gas-burners	32
18,218	Shearer, A.	Manufacture of Compounds of Chromic Acid	988
18,266	Harris, A.	Purification of Condensed Steam, &c., for Boiler Feed, &c.	1094
18,350	Lake	Fellner and Ziegler	Cement Kilns	810
18,352	Desrumaux, H. A.	Filtering Apparatus	233
18,353	Chauvin, E. L. H.	Acetylene Gas Generators	111
18,366	Willcox	Badische Anilin und Soda Fab.	Production of Azo Colouring Matters (Violet)	981
18,397	Gilmour, J. D.	Electrolytic Decomposition of Alkaline Chlorides; and Apparatus.	1220
18,425	Roe, J. P.	Puddling Iron	129
18,448	Newton	Farb. vorm. F. Bayer and Co.	Production of New Dyestuffs (Blue) of Triphenyl-methane Series.	981
18,449	Sievert, P. T.	Machines for Blowing Glass	124
18,474	Hartel, A. E.	Hydrocarbon Vapour Burners	82



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
18,502	.. ..	Walser and Cartier	Acetylene Gas Apparatus.....	111
18,533	Lake.....	Chem. Works, Bâle	Sulphur Dyes (Black, Blue, Brown) and Materials for use therein.	982
18,536	.. ..	Zühl, E.	India-Rubber and Gutta-Percha Substitutes	52
18,543	.. ..	Nixon, A.	Insulating Material.....	729
18,561	.. ..	Dillon, T. A.	Drying Peat, &c.	1099
18,621	.. ..	Holub and Dvoráček	Acetylene Gas Generator	351
18,624	Imray	Farb. vorm. Meister, Lucius und Brüning.	Manufacture of Brown and Black Dyestuff for Wool ..	890
18,645	.. ..	Parker, A.	Electric Furnaces. (Continuous Arc)	977
18,669	.. ..	Hitchley, J. W.	Apparatus for Heating, &c. Powdered Iron Salts (Production of Pigments), &c.	1222
18,674	.. ..	Beggs, D. C., and Fielding, W.	Apparatus for Generation of Acetylene Gas.....	976
18,680	.. ..	Zohrab, G. T.	Pulping, Mashing, and Moulding Peat, &c.	1689
18,698	.. ..	Friswell, R. J.	Manufacture of Refractory Materials for Building, &c.	992
18,708	.. ..	Grauang, A.	Filling Vessels with Liquefied Gases, and Apparatus therefor.	1018
18,726	Willcox.....	Badische Anilin und Soda Fab.	Manufacture of Derivatives of Aromatic Amines	981
18,756	.. ..	Levinstein, I., and others	Black Colouring Matters	1107
18,782	Lake.....	Weldon, L.	Leather Board from Pulp	382
18,786	Lake.....	Weldon, L.	Paper and Paper Board from Pulp.....	382
18,826	Abel.....	Actienges. für Anilin Fab.	Manufacture of Brown Colouring Matter Directly Dyeing Cotton.	889
18,827	Abel.....	Actienges. für Anilin Fab.	Manufacture of Brown Colouring Matter Directly Dyeing Cotton.	889
18,839	Boult.....	Exbrayat, A.	Coal Briquettes and Agglutinant	234
18,840	.. ..	Watson, G.	Refuse Destructors	1152
18,844	.. ..	Thomas, W. P.	Apparatus for Coating Steel, &c., Plates with Tin or other Metal.	1119
18,852	Willcox.....	Badische Anilin und Soda Fab.	Rendering Solid Hydrosulphites Stable upon Keeping	988
18,853	Johnson	Kalle & Co.	Production of Discharge Effects on Dyed Goods	985
18,860	.. ..	Rensing, C.	Hardening Calcereous Sandstones	125
18,864	.. ..	Seeman, R.	Apparatus for and Treatment of Copper Ores	1218
18,904	.. ..	Crawford and Turley	Thermo-Electric Batteries	260
18,913	.. ..	Thrupp, E. C.	Apparatus for Liquefying and Separating Oxygen from Air.	1018
18,920	.. ..	Gathmann, E.	Explosives.....	68
18,921	.. ..	Benedicks, G.	Electric Furnaces	370
18,923	.. ..	Benedicks, G.	Electric Furnaces	69
18,931	.. ..	Arndt, M.	Apparatus for Ascertaining, &c., the Composition of Furnace Gases.	1025
18,936	.. ..	Bell, E. D.	Utilisation of Waste Products for Food	1012
18,939	Newton.....	Farb. vorm. F. Bayer and Co.	Production of New Azo-Colouring Matters and Intermediate Products.	982
18,947	.. ..	Deike, A. H., and others	Acetylene Gas Generators	351
18,969	.. ..	Doremus, C. A.	Treating Cryolite	580
19,009	.. ..	Dunn, J.	Manufacture of Blacking for Foundry Purposes.....	1119
19,016	.. ..	Railsback, L. D.	Acetylene Gas Generator	111
19,029	.. ..	Schneider, C.	Electrolytic Oxidation of Solutions of Chromium Oxide Salts.	1221
19,039	Lake.....	Stahmer, R.	Production of Hydrocellulose	926
19,064	Haddan	Guy, B. A.	Apparatus for Producing Constant Mixture of Air and Vapour of Volatile Liquids.	976
19,061	.. ..	Sugg, W. T.	Incandescent Gas Burners.....	977
19,062	Newton.....	Farb. vorm. F. Bayer and Co.	Production of New Azo-Dyestuffs (Orange, Bluish-red) and Intermediate Products.	982
19,074	.. ..	Marston, R.	Manufacture and Use of Nitrogen and Nitrous Oxide from Atmospheric Air.	1209
19,087	.. ..	D'Humy, P. R. de F.	Manufacture of Fuel from Peat, &c.....	1197
19,125	Newton.....	Farb. vorm. F. Bayer and Co.	Production of New Derivatives of the Stilbene Series.	982
19,126	.. ..	Carroll, J. E.	Distilling and Treating Spirits	270
19,141	.. ..	Dietrich and Langer.....	Blood Preparations.....	145
19,143	.. ..	Stauber, E.	Coke Oven	1100
19,195	.. ..	Philippson, E., and others	Vapour Burning Apparatus and Systems	563
19,202	Ellis.....	Pertsch, F. A.	Manufacture of Substituted Amido-benzoic Acids and of Anthranilic Acid and Colouring matters therefrom.	1204
19,224	.. ..	Sommer, W.	Filter-Press.....	106
19,248	.. ..	Meikle, J.	Furnace for Oxidising Iron and Steel	904
19,250	.. ..	Hussong, J.	Yarn Dyeing Machines	247
19,254	.. ..	Pietet, R. P.	Method and Apparatus for the Separation of Gases from their Mixtures.	1194
19,264	.. ..	Cameron, D., and others.....	Sewage Works	1132
19,271	Imray	Farb. vorm. Meister, Lucius und Brüning.	Manufacture of Directly Dyeing Sulphurised Dyestuffs	982
19,273	.. ..	Barton, T., and McGhie, T. B.	Dezincing of Zinc Desilverised Lead.....	1219
19,304	.. ..	Nelson, D. M., and G. K.	Application of Spent Oxide as Fertiliser, &c.	495
19,316	Hatmaker	Hennig, C. T.	Alloy (Cu, Zn, Fe, Mn) and Process for making same.	998
19,322	.. ..	Brand, A.	Manufacture of Caustic Soda	897
19,326	.. ..	Alpe, Louise	Composition for use as Substitute for Borax	1219
19,337	.. ..	McDonald, D.	Acetylene Gas Generator	111
19,339	.. ..	von Fritz, A.	Anti-incrustant for Boilers	561
19,340	.. ..	Béchaux, L.	Fermentation Apparatus	270
19,377	.. ..	Crossley, W. J., and Atkinson, J.	Gas Producers.....	1197
19,392	.. ..	Müller, K.	Manufacture of Cement	992
19,393	.. ..	Arnold, R. J.	Apparatus for Electrically Treating Air, Gases, &c.	1120
19,398	.. ..	Watts, G. E., and Watts, C. J.	Machine for Agglomeration of Fuel, &c.....	974
19,400	James.....	The Bethlehem Steel Co.	Determining Temperature of Highly Heated Bodies .	459
19,401	James.....	The Bethlehem Steel Co.	Determining Temperature of Highly Heated Bodies .	460
19,406	.. ..	Fränkel and König.....	Rendering Sulphurised Hydrocarbons Soluble in Water.	277
19,432	Haddan	Wartenberg and Miller	Electric Light Carbons	111
19,515	.. ..	Lebiola, G. F.	Preparation for Rendering Wood Fireproof and Rot-proof.	126
19,535	.. ..	Winkler, H.	Incandescent Gas Burners	1101
19,574	.. ..	Hughes, J.	Converting Acid Superphosphate into Alkaline or Basic Superphosphate.	267
19,592	.. ..	Bradford, E. M.	Recovery of Tin from "Hardhead" or Slag.....	1217



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
19,597	.. ..	Bushman, E.	Composition for use as Plaster, &c.	1212
19,599	.. ..	Kuhn, R. P.	Formaldehyde Generators.	272
19,604	Wise	Morse, E. F., and others	Photometric Apparatus.	342
19,659	Abel	Szirmay, I., and von Kollerich, L.	Coating Metal Goods, &c., with Zinc	1003
19,667	.. ..	Actienges. für Anilin Fab.	Manufacture of Sulphurised Ureastuff (Reddish-violet) directly Dyeing Cotton.	182
19,668	Imray	Farb. vorm. Meister, Lucius und Brüning.	Rendering Wool Incapable of Absorbing Dyestuffs	1110
19,670	Newton	Farb. vorm. F. Bayer & Co.	Printing Cotton with Sulphur Dyestuffs.	1110
19,686	.. ..	Roussy de Sales and Guenouon	Secondary Batteries.	726
19,688	.. ..	Erben, W.	Recovering Solvent from Wool Degreasing.	359
19,689	Willcox	Badische Anilin and Soda Fab.	Production of Indigo Powder.	981
19,711	.. ..	Henderson, N. M., and others.	Purification of Paraffin.	978
19,734	.. ..	Garside and Saxon.	Anti-incrustant for Boilers.	28
19,773	.. ..	Curtis, C. H., and André, G. C.	Manufacture of Gunpowder.	1240
19,776	.. ..	Mallol, J.	Incandescent Gas Burners.	1199
19,806	.. ..	Morgan, F.	Hydro-Refiner for Oils.	371
19,831	.. ..	Valentiner, F.	Chromo Tanning or D.essing of Skins, &c.	1124
19,848	.. ..	Kitson, A.	Oil-Vaporising Apparatus.	1100
19,853	.. ..	Csáky, S., and others.	Acetelene Gas Generator.	883
19,859	.. ..	Meyer, G.	Incandescent Bodies for Lighting Purposes	1101
19,863	James	Roberts on, J. H., and others.	Coating Fibrous Material with Metal	260
19,871	.. ..	Hummel, J.	Heat-insulating Paint.	728
19,879	Johnson	Hoehringer und Sochue.	Reduction of Azo- and Nitro-Compounds	259
19,946	.. ..	Flessa, E.	Production of Coloured Malt.	736
20,023	.. ..	Depanzer and Pontini	Deodorising or Bleaching Agent.	728
20,034	.. ..	Arnold, R. J.	Obtainment of Disinfectant, &c., Preparations	1013
20,040	.. ..	Kitto, C. W., and Kitto, H.	Apparatus for Pulverising and Separating Mineral and other Substances.	1195
20,066	.. ..	Kitto, C. W., and Kitto, H.	Cleansing Wool and other Fibres	119
20,073	.. ..	Smith, G. G.	Purifying Acetylene and other Gases.	1102
20,133	.. ..	Bielef ldt, M.	Priming for Detonating and Percussion Caps	1240
20,136	.. ..	Morgan and Menzies.	Machines for Treating Hanks of Yarn	472
20,140	.. ..	Schübe, B. F.	Apparatus for Boiling, &c., Yarn.	892
20,142	Lake	Betts, A. G.	Coating Aluminium or its Alloys.	130
20,144	.. ..	Kaufmann, L.	Crystallisation of Salts.	123
20,150	.. ..	Hartley, C.	Apparatus for Dyeing and otherwise Treating Yarn in "Cheese" and other Compact Form.	1109
20,158	.. ..	Hartley, C.	Apparatus for Dyeing and otherwise Treating Yarn in Cop and other similar Compact Form.	1109
20,194	.. ..	Richards, G. H.	Compositions for use in Agriculture or Horticulture.. ..	1133
20,200	.. ..	Nobis, J. H., and Merry, A.	Electrolytic Cells.	1121
20,205	.. ..	Desrumaux and Norman	Apparatus for Filtering and Treating Liquids	233
20,210	.. ..	Kitson, A.	Vapour-Burning Apparatus.	1198
20,229	.. ..	Shepherd, H.	Acetylene Gas Generators.	351
20,271	.. ..	Vis, G. N.	Purification of Brine.	897
20,276	Imray	Farb. vorm. Meister, Lucius und Brüning.	Manufacture of Orange-Yellow to Red Mordant Dyestuffs.	992
20,277	Imray	Oesterr. Gasglühl und Elec. Gesell.	Means for Supporting the Osmium Filaments of Electric Incandescent Lamps.	884
20,332	.. ..	Coventry, W.	Treating Yarn in the Form of Cops, &c.	1109
20,346	.. ..	Callender, W. M.	Manufacture of Paper.	831
20,353	.. ..	Kasper, M.	Apparatus for Cooling or Aerating Liquids, and for Purifying Gases.	1094
20,369	.. ..	Thiersant, H. de, and Coulson, W.	Acetylene Gas Generators.	976
20,461	.. ..	Lehner, F.	Manufacture of Artificial Filaments, &c.	1206
20,513	.. ..	Simon, A.	Manufacture of (Electrolytic) Iron.	1221
20,523	.. ..	Häckel, W., and others.	Improved Liquid Paste.	141
20,564	.. ..	Baswitz, C.	Waterproofing Textile Fabrics.	359
20,567	.. ..	Hill, H.	Apparatus for Purifying Casks, &c.	1230
20,595	.. ..	Burrows, A. B.	Apparatus connected with Revolving Swift Hank Dyeing Machines.	1109
20,639	.. ..	Dinkelberg, W.	Artificial Stone.	562
20,656	.. ..	Berliner and Herbert.	Sterilising Beer in Transport Casks.	144
20,719	Willcox	Badische Anilin und Soda Fab.	Production of Anthracene Colouring Matters	1205
20,723	.. ..	Zühl, E.	Celluloid-like Products.	273
20,725	Lake	Worstell and Hackathorn	Oil Varnish.	263
20,799	.. ..	Kändler, R.	Manufacture of Safety Explosive.	1240
20,800	.. ..	Kändler, R.	Manufacture of Primer for Producing Ignition by Electricity.	1140
20,801	Imray	Bronnert, E., and others.	Manufacture of Cellulose Solution.	1231
20,819	.. ..	Hobson, H. A.	Production of Beer.	1131
20,864	Imray	Basle Chem. Works.	Aromatic Sulphinic Acids.	110
20,893	.. ..	Holm, H.	Carbonisation of Peat.	1197
20,947	.. ..	Gustafsson, K. G.	Acetylene Gas Generators.	236
20,948	.. ..	Parker, G. E.	Coated Wire.	729
20,960	.. ..	Edison, T. A.	Storage Batteries.	253
20,992	.. ..	Schrader, R.	Molasses Fodder.	489
21,063	.. ..	Raynes, A.	Coloured Marking Inks, for Marking Linen, &c., and Vessel for Holding same.	1108
21,065	.. ..	Wöhler, L.	Detonators.	388
21,068	.. ..	Bonnet, J.	Manufacture of Explosive Substances.	1024
21,130	Newton	Farb. vorm. F. Bayer and Co.	Producing on Wool Blue Shades Fast to Light.	1110
21,148	Mills	Société des Enduits Archambault	Treating Carboys, Casks, &c.	252
21,149	.. ..	Meurant, J.	Precipitation of Metals and Alloys.	370
21,153	.. ..	Marks, G. C.	Treatment of Yeast.	1131
21,195	.. ..	Laird, D.	Assay-Furnace.	255
21,214	.. ..	de Vulitch, D., and D'Orlowsky, J.	Process and Apparatus for Production of Calcium Carbide.	1198
21,213	Justice	The International Acheson Graphite Co.	Graphitising Electrodes, &c.	258
21,222	.. ..	Schmolka, H.	Apparatus for Purifying Paper Pulp, &c.	496
21,283	.. ..	Bethmann, G.	Dyeing Wool, &c., with Aniline Black.	577
21,310	Ransford	Cassella and Co.	Manufacture of a Sulphide Colour (Blue) and its Leuco Compound.	1205
21,345	.. ..	Mach, L.	Aluminium Alloy.	257
21,355	.. ..	Debel, H.	Mash Tuns for Preparation of Beer Wort.	1131
21,365	Ellis	Société Chim. des Usines du Rhône	Manufacture of Sulphonated Aldehydes and Bluish-Green Colouring Matters therefrom.	1205



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
21,376	..	Kessler, J. L.	Apparatus for Concentration of Sulphuric Acid	807
21,397	..	Simons, F.	Mercerising Cotton	242
21,416	..	Muller, T. N.	Open-Hearth Steel	587
21,467	..	Edson, E. R.	Gelatin Manufacture, and Apparatus therefor	140
21,469	Haddan	Edson, E. R.	Apparatus for Extracting Gelatin and Oil	261
21,494	..	Fischer, F., and Kiefer, L.	Apparatus for Saturating Liquids with Gases	1094
21,496	..	Friswell, R. F., and The British Uralite Co., Ltd.	Manufacture of Refractory Materials	1115
21,533	..	Matthews and Davies.	Electrolytical Apparatus	590
21,552	Boult	Goldschmid, E.	Production of Steel	1218
21,553	..	Gerhardt, F.	Binding Substances for Colouring Matters, &c.	372
21,557	..	Meslans, M.	Electrolytic Production of Fluorine	259
21,571	..	Alliott, J. B., and Paton, J. McC. C.	Apparatus for Evaporating or Concentrating <i>in vacuo</i>	1194
21,622	Eoult	New Process Lighting Co.	Caloric Engine for Supplying Air or other Combustion Supporter to Gas Burners.	1101
21,626	..	Neisse, J. H. G., and Boll, J. H.	Production of Margarine	1229
21,627	..	Ciepek, N.	Explosive Compounds	1240
21,731	Imray	Farb. vorm. Meister, Lucius und Brüning.	Manufacture of Indigo	981
21,733	..	Thwaite, B. H.	Charging Motor Engines Worked by Blast-Furnace Gases, and Apparatus therefor.	1197
21,734	..	Bessonoff, S.	Improved Still	105
21,757	..	Faust, A.	Recovering Pulp and Water from Paper Works Waste.	496
21,804	..	Claremont, E. A.	Manufacture of Electrical Insulating Materials	1220
21,819	Johnson	Deutsche Gold und Silber Schiede-Anstalt vormals Rössler.	Manufacture of Cyanamide and its Compounds	1139
21,820	Johnson	The Deutsche Gold und Silber Schiede-Anstalt vormals Rössler.	Manufacture of Alkali Cyanides	1113
21,821	Willcox	Badische Anilin und Soda Fab.	Manufacture of an Initial Material for the Production of Indigo.	1205
21,897	Newton	Farb. vorm. F. Bayer and Co.	Manufacture of Anthracene Dyestuffs	1205
21,898	Newton	Farb. vorm. F. Bayer and Co.	Manufacture of Dyestuffs containing Sulphur	1205
21,911	..	Sjöö, A., and Tornell, V.	Cleansing in Perforation Industries	1131
21,912	Boult	Hromadnik, C.	Vessels for Treatment of Liquids	233
21,914	Boult	Hromadnik, C.	Vessels for Treatment of Liquids	233
22,129	..	Gossweiler, K.	Process and Apparatus for Vaporising Spirit, &c.	1100
22,201	..	Smith, T. J.	Treating Bromide Photographic Prints	609
22,388	..	Bleichrode, J.	Manufacture of Pellets for Automatically Igniting Gas.	977
22,389	..	Duke, J. F.	Extraction of Gold from Sea-Water, &c.	1218
22,402	Willcox	Badische Anilin und Soda Fab.	Printing Textile Materials with Indigo	1111
22,406	..	Greenwood, J.	Decomposition of Alkaline Salts by Electrolysis; and Apparatus.	1220
22,408	Justice	Talbot, B.	Manufacture of Iron	1118
22,456	Abel	Actienges. für Anilin Fab.	Violet Colouring Matters belonging to the Diphenyl- α -naphthylmethane Series.	1108
22,458	..	Poppe, M.	Manufacture of Butter	1132
22,470	Berend	Schauher, J. R.	Incandescence Mantles for Gas Lighting	1199
22,482	..	Craig, G., and Paterson, R. M.	Apparatus for Obtaining Alkali Cyanides	809
22,488	..	Reim, C.	Production of Dry Alkali Silicate	808
22,491	..	Carpenter, C.	Incandescence Gas-Burners	236
22,581	..	Desrumaux, H.	Filtering Apparatus	233
22,584	..	Keller, C. A.	Electric Furnace with Two Bed-Plates	879
22,592	..	Müller, A.	Dealcoholising Fermented Beverages	609
22,596	..	Meurer, N.	Colouring Glass	477
22,599	..	Just, A., and Falk, E.	Incandescence Bodies for Electric Glow Lamps	1199
22,606	..	Müller, T.	Consolidating the Active Material of Accumulators	259
22,643	..	Humphrey, C.	Producer Gas Burners for Steam or other Boilers	1198
22,644	..	Humphrey, C.	Washers for Producer or other Gases	1198
22,694	..	de Lery, J. B.	Incandescent Lighting and Manufacture of Burners, &c. therefor.	884
22,698	..	Frasch, H. A.	Extracting and Reducing Metals by Electrolysis	370
22,699	..	Frasch, H. A.	Recovering Metals from Ores	907
22,767	..	Lavollay and Bourgoin.	Purifying and Decolorising Saccharine Solutions	489
22,777	..	Forsbach and Clerc.	Crucible Smelting Furnace	481
22,826	..	Stevenson, J. L.	Open-Hearth Steel	480
22,827	..	Stevenson, J. L.	Blast Furnaces; and Casting Metal therefrom	481
22,828	..	Stevenson, J. L.	Open-Hearth Tilting Furnaces	481
22,867	..	Hudnall, M. S., and Calvert, H.	Manufacture of Lubricant	910
22,905	..	Pellerin, A.	Manufacture of Margarine	1223
22,954	..	Stanley, J. C. W.	Treatment of Cotton-Seed Hulls	710
23,040	..	Krause and Beddies.	Impregnating Wood, &c.	365
23,046	..	Société des Usines Fond. d'Aluminium.	Uniting Aluminium and Steel or Iron	369
23,051	..	Markel, K. E., and Crosfield, J. J.	Apparatus for Separating Solid Matters from Liquids	1094
23,052	..	Gibson, J. M.	Packing Material for Gay Lussac and Glover Towers.	897
23,157	..	Topham, C. F.	Apparatus for Production of Textile Fibres, &c. from Solutions of Cellulose, &c.	1207
23,222	Thompson	Zielenziger, S.	Incandescent Gas Lamps	884
23,231	..	The British Oil and Cake Mills, and A. G. Wass.	Manufacture of Printing Ink	1005
23,237	..	Sims and Davis.	Treating and Drying Peat	462
23,244	..	Kaufmann, L.	Rapid Crystallisation	250
23,245	Howorth	Titel and Wolde.	Purifying the Air of Rooms	381
23,250	..	Wezel, J.	Substitute for Animal Glue	374
23,252	Justice	International Smokeless Powder and Dynamite Co.	Smokeless Powder	388
23,315	..	Wright, A., and others.	Electrolytic Meters	49
23,316	..	Wright, A., and others.	Electrolytic Meters	49
23,388	Willcox	Badische Anilin und Soda Fabrik.	Conversion of Indigo Leuco Compounds into Indigo and its application.	1205
23,400	..	Mather, W.	Bleaching Apparatus, &c.	359
23,401	..	Mather, W.	Bleaching and Dyeing	360
23,403	..	Huth, G.	Flux for Brazing	369
23,415	..	..	..	..
23,415A	..	Naef, P.	Manufacture of Gas, Coke, &c.	27
23,415B	..	..	..	..
23,415C	..	..	..	..



No of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1900.				
23,477	Boult.....	Pohlé and Croasdale	Reduction of Refractory Ores.....	368
23,574	.. ..	Stein, E. H.	Iron Shaft-Furnace for Burning Cement, &c.	1115
23,603	Boult.....	Ralfi and others	Substitute for Gutta-Percha	263
23,605	Portable Gas Fountain Syn- dicate, Ltd.....	Thovert, J.	Incandescent Gas Burners	1199
23,660	.. ..	Seligsohn, M.	Treatment of Ores	587
23,662	Boult.....	Turk, D., and others.....	Production of High-caloric Gases from Low-caloric Fuel Material.....	1197
23,668	.. ..	Schirp, P.	Apparatus for Dyeing, &c., Textiles	471
23,678	Thompson	Gebrueder Flick	Manufacture of Nitrites	364
23,687	Johnson	Boehringer and Soehne.....	Triphenylmethane Colouring Matters	358
23,701	.. ..	Rosenberg, A.	Self-igniting Incandescent Gas Lights	1199
23,722	Lake	The National Packing Co.	Fibrous Compositions	273
23,781	.. ..	Engels, E. W.	Carbonic Oxide	350
23,789	.. ..	Palmer, H., and Calderwood, W.	Candles for Spring Lamps	910
23,803	.. ..	Jasset and Cinqualbre	Depositing Metals on Metals	369
23,804	.. ..	Klumpp, A.	Manufacture of Soap	818
23,850	Brooks.....	The Incandescent Gas Light Co.	Apparatus for Incandescence Gas-lighting	493
23,858	Haddan	Ramage, A. S.	Iron Oxide Pigment from Ferrous Liquors	910
23,859	Haddan	Ramage, A. S.	Obtaining Ferro-Ferric Oxide	809
23,879	.. ..	von dem Borne und von Debschütz	Manufacture of Ceramic Ware	252
23,890	.. ..	Peust and Apel	Insulating Compounds	365
23,893	.. ..	R. Hengstenberg	Preservation of Food Products.....	738
23,903	.. ..	Voelker, A.	Electrical Glass Furnace	476
25,112	.. ..	Fox, W., and Kingscote, T. H.	Filters and Separators for Liquids	344
25,494	.. ..	Siemens Bros. and others	Gutta-Percha Manufacture.....	51
1901.				
228	.. ..	Rigamonti, C., and Tagliani	Kiers for Bleaching Textiles	577
249	.. ..	Billing, F.	Manufacture of Paper	926
276	.. ..	Vis, G. N.	Purification of Brine	1210
284	.. ..	Frasch, H. A.	Manufacture of Nickel Salt	580
357	Urquhart	Kubin, O. F.	Acetylene Lamps	794
377	.. ..	Meyer, A.	Mashing and Fermenting Vessels	1223
393	Newton	National Electrolytic Co.	Electrolysis, and Apparatus therefor	482
458	.. ..	Davis, A. J.	Opal Glass Facing Tiles	477
478	.. ..	Kautny and Lotz	Acetylene Gas Generators	463
497	.. ..	Orchard, B., and Fox, C. E.	Purification, &c., of Water.....	1230
508	.. ..	Strandh, A.	Disinfectant Compound	1230
536	.. ..	Joseph, L.	Manufacture of Waterproof Paper, &c.	1231
630	Cheesbrough.....	von Giese.....	Rendering Paper Temporarily Transparent.....	603
647	.. ..	Sauer, A.	Condensed Milk similar to Human Milk	330
694	.. ..	Hartleb, K.	Cultures of Bacteroids of Micro-organisms.....	374
738	.. ..	Hoult, K.	Fire Extinguishing Substances	809
755	.. ..	Székely and Kovács.....	Separating Casein and Whey from Milk	330
827	.. ..	Kohl, G.	Incandescence Bodies	699
913	Newton	Farb. vorm. F. Bayer and Co.	Production on Fibre of Shades Fast against Washing.....	1207
952	.. ..	Davis, S.	Stripping Tinned and Spelter Scrap	368
984	.. ..	Curtis, C. H., and others.....	Explosives	1240
993	.. ..	Schniewind, F. W. C.	Regenerative Coke-Ovens	462
1001	.. ..	Neureuther, C. F.	Regenerative Retort-Heating Furnace	462
1081	.. ..	König, E.	Softening Jute Fibres, &c.	892
1082	.. ..	Schultz, H.	Device for Maintaining Temperature, &c., of Liquids and Gases.....	788
1153	Boult.....	The A. Koller Maschinenfabrik	Drying Apparatus.....	694
1163	.. ..	Buyten, H.	Removing Brilliancy of Polished Surfaces.....	373
1283	.. ..	Martin, M.	Acetylene Gas Generator	564
1285	Abel.....	Actienges. für Anilin Fab.	Dyeing (Sulphur Dyestuffs)	1208
1366	.. ..	Hoz, A.	Colours for Chemical Printing	985
1374	.. ..	Hahn, P.	Drying Textile Fabrics.....	469
1375	.. ..	Grunauer, G.	Treatment of Cast Iron.....	903
1379	.. ..	Joselin and Crichton	Obtaining Blown Oil	485
1385	Imray.....	Farb. vorm. Meister, Lucius und Brüning.....	Manufacture of Sulphuric Anhydride by Contact Process.....	1209
1386	.. ..	Kronstein, A.	Oxidising Chinese Wood Oil, &c.	485
1459	.. ..	Wagner and Lorenz	Glass Mirrors with Colour Decorations.....	477
1467	.. ..	Takamine, J.	Glandular Extractive Products	746
1479	Lake	Wachtel and Co.	Slaked Lime	582
1482	Imray.....	Donaldson, W. J., and others.....	Apparatus for Burning Pulverised Fuel.....	882
1491	.. ..	Sudre and Thierry.....	Treating Oxides of Metals, &c.	477
1585	.. ..	Nielsen, L. C.	Burners for Oil Lamps having Incandescing Mantles.....	1199
1701	.. ..	Hoch, C.	Drying Apparatus for Enamelled Leather.....	487
1703	.. ..	Bennett and Fowler.....	Appliances for Producing Perfect Combustion of Gas.....	699
1758	Lake.....	Betts, A. G.	Refining Lead.....	724
1777	.. ..	Schmidt, O.	Apparatus for Purifying Effluents	381
1890	.. ..	Froitzheim and Schurzacher.....	Apparatus for Treating Water	602
1893	Lake	United States Chemico Wood Co.	Substitute for Wood, Bone, &c.	374
1918	.. ..	Laughlin, A.	Gas-Producers	462
2005	Thompson.....	Wasmuth, A.	Strengthening Incandescence Bodies	566
2009	Thompson.....	Gebrüder Flick	Soluble Indigo Paste	472
2010	.. ..	Wedge, U.	Raising Chemical Compounds to a Higher Oxide.....	626
2011	.. ..	Burwell, A. W.	Oleaginous Compounds or Oils	371
2026	.. ..	Sudre and Thierry.....	Treatment of Distillers' Residues	492
2039	.. ..	Paramore, E. C.	Method and Apparatus for Generating &c., Chlorine Gas Electrically.....	1002
2116	Imray.....	International Acheson Graphite Co.	Graphite Manufacture.....	462
2182	.. ..	J. Müller.....	Dyeing Gloves, &c.	713
2253	.. ..	J. B. Bernadou	Smokeless Explosives	617
2282	.. ..	Gelsthorpe, C. and F.	Recovering Copperas from Waste	483
2283	.. ..	Weiss, R.	Treating Textile Materials with Fluids	469
2339	.. ..	Bachrach, D.	Nitrocellulose and Similar Compounds	741
2384	.. ..	Scheuffgen, R.	Apparatus for Preventing Explosion by Ignition in Vessels containing Explosive Fluids.....	974
2490	.. ..	Edison, T. A.	Storage Batteries.....	589
2504	.. ..	Jaubert, G. F.	Alkaline Earth Oxides. Dioxides	474
2508	.. ..	Niemann, C.	Incandescent Gas and Vapour Lamps	794
2509	.. ..	Rudolph, A.	Carbureting Apparatus.....	462



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1901.				
2550	..	Schrader, J. C.	Machines for Mixing Explosive Compounds.	389
2677	..	Crosby, A. A.	Crucibles for Treatment of Ores.	587
2679	..	Kronstein, A.	Rendering Materials Waterproof, &c.	480
2690	..	Crötte, F.	Preserving Beer.	492
2706	..	Gossweiler, K.	Acetylene Generator with Automatic Supply of Carbide.	1102
2835	..	Hermite and Cooper.	Thermo-Electric Couples.	482
2842	..	Flather, G. W.	Amber Varnish.	372
2847	..	Baptistine-Blanc-Raynaud	Soap for Use in Sea Water.	919
2899	..	Wirth, E.	Manufacture of Nitro Derivative of Carbazole from Nitrocarbazole.	890
2912	..	Kahn, A., and Heberlein, M.	Artificial Fuel.	1099
2944	..	Händler and Reeves	Acetylene Gas Generator and Burner.	564
3009	..	Totten, E. M.	Solder for Aluminium.	481
3344	..	Pape and Henneberg	Crushing and Lixiviating Ores, &c.	587
3062	Marks and Clerk.	Falkenstein, G. S. and C. F.	Artificial Leather.	731
3192	..	Jurie, P.	Electric Furnaces.	697
3194	..	Newlands, B. E. R.	Drying Malt and Alimentary Matters.	736
3215	Jensen	Heine, G.	Method and Apparatus for Treating Peat.	1099
3292	Bromhead	Möller and Pfeiffer.	Solid Blocks of Cement from Slush.	582
3513	Thompson	Société Mangano Electrique pour la Purif. des Eaux.	Purifying Beverages by Manganates and Electricity.	494
3592	..	Behrens, J. G.	Chemically Pure Acetic Acid.	474
3416	..	Erny, E.	Construction of Zinc Electrodes for Use in Electric Batteries.	1001
3470	..	Powter, N. B.	Soap containing Free Rosin.	485
3518	..	Taylor, F., and others.	Bleaching Appliances.	712
3533	..	Flanagan, G. A.	Apparatus for Concentrating Sulphuric Acid.	1112
3598	..	Shuman, F.	Mercerising Apparatus.	574
3532	..	Rossi, A. J., and others.	Concentrates containing High Percentages of Titanic Oxide.	588
3586	..	Darby, J. H.	Apparatus for the Manufacture of Coke.	1197
3590	..	Schrader, F.	Apparatus for Making Molasses Fodder.	601
3750	..	Meyenberg, J.	Substitute for Mother's Milk.	691
3861	Imray	Heberlein and Co.	Lustrous Coloured Threads and Strips.	710
3893	..	Brunn, A.	Smoke-Consuming Furnaces.	462
3922	..	Herborn, H.	Treating Tar Oils for the Production of Preservative Oils.	1103
4023	..	Schön, L.	Stoppers for Receptacles for Volatile Inflammable Liquids.	695
4039	..	Clancy and Marsland.	Treatment of Sulphide Ores.	481
4123	Lake	National Package Co.	Fibrous Compositions.	603
4199	..	A. Classen	Converting Cellulose into Sugar.	784
4202	..	Marx, F.	Manufacture of Artificial Stone.	810
4316	..	Kessler, J. L.	Hardening Plaster and Fixing Colours thereon.	719
4323	..	Besemfelder, E. R.	Manufacture of Cyanogen Compounds from Gas Mixtures containing Ammonia.	1210
4359	..	Borntraeger, H., and others.	Manufacture of Fodder from Peat.	828
4393	Edwards	Krauschwitzer Thonwaarenfabrik	Distilling and Evaporating Apparatus.	480
4507	Imray	Basle Chem. Works.	A New Silver Paraneleim.	504
4509	..	Pickard and Evans	Composition for Filling Accumulator Cells.	482
4522	..	Pintsch, J.	Gas for Power Purposes.	699
4696	..	Rony, A.	Briquettes from Comminuted Ore, &c.	723
4790	..	Domergue, P. E.	Apparatus for Regulating Density of Liquids.	695
4834	..	Pickering, J., and Macgregor, P.	Continuous Subsiders for Sugar Juice, &c.	915
4834	..	Kennedy, J. E.	Testing Leather, &c. for Porosity.	731
4954	..	Cook and Heusner.	Acetylene Gas Machines and Regulators.	554
5017	..	Heidel, G.	Electric Batteries.	807
5149	..	Dannert, F.	Mixing Oxygen with Lighting, &c. Gas either previously formed or Generated simultaneously as Carburetted Air.	976
5168	Imray	Soc. Chem. Ind. Basle	Manufacture of Indophenolthiosulphonates, &c.	803
5204	Bromhead	Waterman, C. H.	Apparatus for Enamelling Refractory Materials.	581
5231	..	Skoglund, J. V.	Explosives.	617
5232	..	Heinemann, W.	Recovering Bye-Products from Coke-kiln Gases.	564
5239	Wheatley	The Clyde Chem. Co., Sydney.	Extraction of Chromium Oxide.	718
5264	..	Scott, R. W.	Explosive Charges for Guns.	617
5329	Lake	Rein, B.	Apparatus for Burning Liquid Fuel.	563
5336	..	Stocker and Zander	Insulating and Steam-Packing Substance.	727
5346	..	Lathbury and Spackman	Apparatus for Calcining Cement.	682
5352	..	Schultze, K.	Incandescence Bodies.	566
5515	..	Shumau, F.	Extinguishing Fires in Vessels containing Inflammable Liquids.	626
5559	Sloan	Martin, W. H.	Evaporating Apparatus.	694
5596	..	Atkins, G. J.	Obtaining Chlorine by Electrolysis of Chlorides of Metals.	815
5661	..	Atkins, G. J.	Manufacture of Chlorine and Treatment of Ores.	808
5689	..	Danner, S., and Kubelka, G.	Purification of Lighting and Heating Gas.	854
5757	..	Hayes, A.	Gas and Vapour Burners.	1198
5877	..	Reynolds, A.	Converter Treatment of Metals, &c.	587
5888	..	Blackmore, H. S.	Disinfecting, Sterilising, &c., and Apparatus therefor.	739
5948	..	Creeke, R. W. B.	Apparatus for Washing and Cleansing Gas.	1198
6058	..	Zimmer, C. L. V.	Waterproof Protective Coating.	719
6121	..	Teufer, B.	Eliminating Iron from Water, &c.	602
6217	..	Breyer, F.	Process for Softening Water.	1013
6241	..	Koslosky, I.	Composition for Protecting Iron Constructions from Fire.	582
6262	..	Fuerstenheim, F.	Incandescence Gas-Burners.	565
6272	..	Koppers, H.	Treating Gas Liquors.	579
6344	..	Bond, G. R., and others.	Acetylene Gas Generators.	698
6371	..	Mészáros, A.	Preserving Organic Bodies.	601
6417	..	von Bühler, E., and Bernstein, A.	Manufacture of Butter.	827
6537	Reitmayer	Volmar, J.	Saccharin.	746
6556	..	Day, A. A.	Apparatus for Aërating and Feeding Coal Powder.	881
6391	Heys	Schmitt, J.	Dyeing Cotton Slubbings, &c.	713
6655	Wheatley	Société Générale des Aciers fins.	Manufacture of Steel.	724
6638	..	Garrett and Cromwell	Gas Producers.	696
6726	Allison	Bronson, A. A.	Gas Manufacture.	698



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1901.				
6735	.. ..	Sasse, F.	Apparatus for Purifying Gas.....	564
6801	.. ..	Parker, F. W.	Cooling or Condensing Fluids.....	694
6815	James	Hall, W. A.	Casein Glue.....	597
6959	.. ..	Paulitschky, C. and others	Manufacture of Rubber Substitutes	812
7014	Bromhead	Chem. Fabrik Helfenberg	Test Paper Sensitive to several Chemical Substances at the same Time.	748
7081	.. ..	Schougaard and Evans.	Artificial Stone.....	719
7150	.. ..	Bourne, A. O.	Vulcanising Rubber Materials.....	912
7188	.. ..	Beck, C. W.	Acetylene Gas Lamps, or Generators.....	794
7234	.. ..	Watson, S. G.	Generators for Acetylene Gas.....	794
7236	.. ..	Kullak, F. C.	Media for Preserving Food.....	1229
7242	.. ..	Ramage, A. S.	Production of Oils for Use in Making of Paints and Varnishes.	1005
7286	.. ..	Sharpe, J., and Code, R. G.	Acetylene Gas Apparatus.....	1102
7299	.. ..	White, H. A.	Baking Carbonated Beverages.....	827
7316	Lake	Hewitt and Coe.....	An Alloy, and Production thereof.....	724
7324	Thompson	Dodge H. P.	Treatment of Lime.....	717
7388	.. ..	Hahn, P. D., and Lenz, Otto	Deodorising, &c., Sewage, &c.....	1013
7480	Lake	Weldon, K.	Mercerising Apparatus.....	709
7534	Boult	The Honneus Sulphide Co.	Converting Refractory Ore.....	724
7560	.. ..	Haagen, A.	Colouring Matters.....	738
7620	Marks	Société Anon. Forcee	Preserving Butter and Fats.....	738
7625	Wetter	Elektricitäts. Actienges. vorm. Schuckert and Co.	Hardening Colophony, &c.....	729
7634	.. ..	Fuchs, L.	Sugar Refining Apparatus.....	1008
7719	Wetter	Actienges. für Theer-und-Erdöl Industrie.	Rendering Phenols Soluble in Water.....	739
7806	Lake	Lacomme and Lauder.....	Apparatus for Purification of Water.....	739
7959	.. ..	E. Rushe	Increasing Efficiency of Electric Lamps.....	700
7986	Thompson	A. Wozé	Upward-flow Pulp Strainers.....	741
7996	.. ..	Cox, H.	Boiling Pan, &c.....	878
7999	.. ..	Zanner, A.	Concentrated Sulphuric Acid.....	717
8072	.. ..	Zühl, E.	Celluloid-like Substance.....	741
8088	Brookes	Trippe, W.	Utilising Sulphite-Cellulose Waste Liquors.....	741
8097	.. ..	Wheatley, R. B.	Metallic Alloys.....	725
8129	.. ..	Schill, C. H., and Primrose, W. G.	Manufacture of Gas.....	739
8153	Johnson	Pittsburg Reduction Co.	Purification of Aluminium.....	1139
8165	Newton	Farb. vorm. F. Bayer and Co.	Production of New Pharmaceutical Compounds.....	724
8175	.. ..	E. Herter	Casting and Refining Metals.....	726
8230	Johnson	The Atmospheric Products Co.	Nitrogen Compounds from Atmospheric Nitrogen.....	794
8275	Boult	Soc. Lumière Boule	Incandescent or Bunsen Gas Burners.....	719
8282	.. ..	F. Boas	Building Materials.....	1119
8333	.. ..	Elbers, A. D.	Treating Molten Blast Furnace Slag.....	737
8363	Imray	Joshua Bros., Proprietary	Maturing Spirits.....	794
8372	Haddan	Adams and Westlake Co.	Acetylene Generators.....	908
8376	.. ..	Brandenburg, H., and Weyland, A.	Extracting Tin from Ores and Slags.....	738
8505	.. ..	Cook, E. G.	Humanising Cows' Milk.....	815
8593	.. ..	Kloth, G. F. W., and others	Accumulators.....	1133
8643	.. ..	Martin, A. H., and others	Preparation of Paper, Paper Board, &c., for Embossing, &c.....	794
8817	Boult	Soc. Lumière Boule.	Incandescent, High Pressure Gas Lighting Plant.....	890
8881	.. ..	Johnson, C. J.	Apparatus for Manufacturing Gas.....	725
8904	Lake	Simonds, W. E.	Alloys, and Production thereof.....	924
8937	Wise	Bache-Wiig, B.	Preservation of Eggs, &c.....	725
8995	.. ..	Bente, A.	Soot from Tar.....	731
9025	Howorth.....	Trant, L. B., and others	Tanning.....	924
9091	.. ..	Heyen, A.	Preparation of Meat Extract.....	725
9124	.. ..	Mather, W. S.	Crucibles.....	880
9183	Bloxam	Dillan, E.	Treating Liquids with Ozone.....	729
9211	Lake	Hungerford, O. T.	Insulating Compounds.....	884
9222	.. ..	Fischer, J.	Incandescent Gas Burners.....	796
9259	.. ..	Fallnicht, R.	Production of Solidified Naphtha.....	998
9263	.. ..	Elmqvist, H.	Casting of Metal.....	904
9555	.. ..	Clancy, J. C., and Marsland, L. W.	Extraction of Metals from Sulphide Ores.....	797
9514	.. ..	Storer and McAlley.....	Treatment of Distillery Refuse.....	830
9589	.. ..	Pollak, A., and Esser, C.	Treatment of Peat Turf for Manufacture of Paper.....	1102
9664	.. ..	Schmitt, F.	Apparatus for Generating and Storing Acetylene Gas.....	817
9676	Brit. Aluminium Co., Ltd.	Cowles, A. H.	Apparatus for Electric Smelting.....	810
9730	.. ..	Beny, F. A., and Heinrigs, J.	Apparatus for Slaking Lime.....	820
9773	.. ..	Carstairs, J.	Production of Fish Guano.....	882
9822	.. ..	Koppers, H.	Coke Ovens.....	1005
9828	.. ..	Ammundsen, S.	Production of Substitute for Boiled Linseed Oil.....	1229
9898	.. ..	Fryklind, K. E.	Preserving Eggs.....	908
9903	Brit. Aluminium Co., Ltd.	Cowles, A. H.	Electrolytically obtaining Volatile Elements from Ores.....	818
9969	Boult	Wacker, C.	Extracting Oil from Fish.....	1133
9982	.. ..	Gathmann, L.	Liquid (Impure Water) Purifying Apparatus.....	1140
9984	.. ..	Blomén, J. E.	Manufacture of High Explosives and Celluloid Compounds.....	1222
10,007	.. ..	Oesterheld, A.	Manufacture of Fabric, &c. (Leather and Rubber Substitute) from Fibre, and an Adhesive.....	976
10,023	.. ..	Rey, J. A., and J. M. B.	Apparatus for Burning Hydrocarbons.....	1212
10,024	.. ..	Breitmayer, L.	Apparatus for Extracting the Naphthalene in Gases.....	913
10,084	.. ..	Boivie, S. E.	Artificial Stone.....	831
10,152	Allison	Scott Leather Machine Co.	Treating and Colouring Hides, &c.....	803
10,183	.. ..	Busch, C.	Apparatus for Generating Acetylene Gas.....	827
10,213	.. ..	Zühl, E.	Manufacture of Celluloid-like Material.....	810
10,277	Lake	Oehler, K.	Manufacture of Disazo Colouring Matters.....	827
10,287	.. ..	von Schlichtegroll, C. F.	Rectifying Spirit.....	810
10,297	.. ..	von Forell, C.	Manufacture of Portland Cement.....	1118
10,303	.. ..	Michael, O.	Crucible Furnace.....	796
10,332	.. ..	Snowden, E.	Stills for Gas Works, &c.....	882
10,336	.. ..	Koppers, H.	Heating of By-Product-Saving Coke-Ovens.....	882
10,337	.. ..	Koppers, H.	Coke Ovens to be worked With or without Saving of By-Products.....	575
10,365	Lake.....	Kidder, W. P.	Vapour Burners for Motor Steam Generators.....	900
10,448	.. ..	Lebioba, G. F.	Apparatus for Impregnating Wood.....	



No. of Patent.	Agent.	Inventor.	Short Title.	Page for Abstract.
1901				
10,461	Johnson	Cereal Sugar Co.	Apparatus for Refining Sugar.....	824
10,505	.. ..	Edison, T. A.	Storage Batteries (Alkaline).....	1002
10,524	Page	Grenier Art Co.	Photographic Fabrics, and Process for Preparing same	1020
10,549	.. ..	Billing, C.	Antiseptic or Detergent	1133
10,632	.. ..	Timm, F. C. W.	Manufacture of Oxygen Gas	1018
10,725	Wise	Klinger, R.	Acetylene Gas Generators	794
10,833	Thompson	Chem. Fab. Opladen vorm. Gebr. Flick.	Reduction of Indigo	802
10,844	.. ..	Siepen, W.	Lime Kilns.....	1115
10,883	.. ..	Steffen, C.	Extraction of Sugar from Lime Scum, &c.....	916
10,902	Day	Coleman International Coppering Co. ...	Antifouling Coating for Metal Structures	925
10,963	Day	Coleman International Coppering Co. ...	Antifouling Coating for Metal Structures	925
10,974	Justice	Castner Electric Alkali Co.	Carbon Electrodes for Electrolytic Cells	1002
10,976	Justice	Castner Electric Alkali Co.	Oscillating Electrolytic Cells	907
10,977	.. ..	Woolley, H. S.	Furnaces.....	788
10,983	.. ..	Wassel, E. D.	Manufacture of Wrought Iron.....	903
11,022	.. ..	Rahtjen, A.	Preparing Monobrom-Indigo, Dibrom-Indigo, Mono-chlor-Indigo, Dichlor-Indigo, &c.	1205
11,045	.. ..	Pfister, J.	Dyeing or Preserving Timber.....	900
11,052	.. ..	Arndt, M.	Pyrometers	788
11,085	.. ..	Budzinski, S. L.	Acetylene Lamps.....	976
11,218	.. ..	von Heydebrand, F. G., und der Lasa	Artificial Fuel	793
11,238	Edwards	Oxlyn-Werke, Actienges.	Preparing Rubber Coated Materials	804
11,353	.. ..	Koyle, C. H.	Apparatus for Softening and Purifying Water	925
11,354	.. ..	Koyle, C. H.	Purification of Water.....	830
11,359	.. ..	Aloy, L.	Manufacture of Dyeing Compositions.....	893
11,400	Edwards	Kent, W.	Smokeless Gunpowders.....	932
11,419	Cotton Seed Co., Ltd.	Stanley, J. C. W.	Bleaching of Oleaginous Matter.....	910
11,429	Lake.....	Powter, N. B.	Apparatus for Separating Liquids of Different Density	788
11,442	.. ..	Duryea, C. B.	Manufacture of Thin Boiling or Modified Starch....	1127
11,466	.. ..	Jaubert, G. F.	Preparation of Oxygen Gas.....	931
11,529	.. ..	Boehm, W.	Manufacture of Electric Lighting, Heating, and Resistance Bodies.	1199
11,687	.. ..	Schramm, O.	Process for Hardening Iron	903
11,715	.. ..	Lorenc, C.	Production of Mortar, Treatment of Stone, and Construction of Masonry Work therewith.	992
11,745	Bayerthal Ewers, Fr.	Ewers, Fr.....	Printing Tinplate in Dull Colours.....	1208
11,832	.. ..	Dietrich, R.	Production of Highly Carburised Steel	1118
11,856	.. ..	Raphael, M.	Treatment of Asbestos for Rendering it Waterproof and Increasing its Fire-resisting Qualities.	1212
11,858	Boult	Masse, C., and others	Treatment of Ramie, China Grass, &c.....	985
11,903	.. ..	Seifert, C. M.	Gas Burners for Heating Purposes	975
11,919	.. ..	Teisler, E.	Preventing Escape of Silicon Fluoride in the Decomposition of Phosphates.	1007
11,927	Lake.....	Guisarni, T.	Preservation of Wood	991
11,933	.. ..	Blackmore, H. S.	Reduction of Metals and Production of Alloys of the Same.	1118
11,944	.. ..	Miller, J. C.	Process for Sterilising, &c., Milk, &c.....	924
12,017	.. ..	Stein, L., and Storr, W.	Uniting Pieces of Glass, &c.	900
12,073	.. ..	Sborowitz, S.	Imitation Marble.....	992
12,066	.. ..	Kaufman, L.	Concentration of Heavy Lyes, &c.	987
12,147	.. ..	Griffiths, W.	Uniting or Welding Metals.....	905
12,174	.. ..	Newman, G. F.	Compositions for Rendering Garments Waterproof...	892
12,181	Lake.....	Berrigan, J. J.	Centrifugal Apparatus for Separating Solids from Liquids.	1095
12,241	.. ..	Boehm, W.	Manufacture of Electric Illuminating Bodies.....	884
12,274	.. ..	Middleton, W. B., and others.....	Treatment of Zinc for Production of Zinc White....	911
12,349	.. ..	Ferraris, E.	Treatment of Mixed Ore, for Separation of Metals....	1117
12,372	.. ..	Bez, P., and Bez, E.	Tanning Hides and Skins	1124
12,521	.. ..	Law, G. F.	(Acetylene) Gas Burners for Use with Incandescence Mantles.	884
12,558	.. ..	Classen, A.	Converting Wood, &c., into Sugar	1008
12,617	.. ..	Da Silva, A. A.	Explosives	1240
12,697	Bloxam	Gebrüder Sulzer	Manufacture of Non-Alcoholic Beer	1011
12,767	.. ..	Osenbrück, A.	Ammonia Absorption Process for Working Cooling, &c., Machines.	974
12,858	.. ..	Van der Made, P. R.	Process and Apparatus for Carburetting Air with Carburetted Hydrogen.	976
12,906	Allison	Selg, Otto, and others	Converting Wort into Beer and Ale.....	1012
12,933	.. ..	Garrison, J. M.	Separating Molten Glass from Impurities	1114
12,940	.. ..	McClurg, W. J.	Gas Generators	975
12,985	Johnson	Boehringer und Söhne, C. F.	Manufacture of Diacetyldiamidouracil	931
13,032	.. ..	Irvine, H. A.	Reduction of Ores or Compounds	908
13,042	.. ..	Cothias, A. F.	Crucible for Casting Alloys, &c., under Pressure	997
13,128	.. ..	Sabroe, T. T., and Hansen, H. J. T. ...	Apparatus for Equalising Temperature of Fluids (Milk, &c.)	1194
13,133	.. ..	Helbing, E.	Production of Artificial Wood	991
13,204	.. ..	Mitchell, G.	Extraction of Gutta-Percha from Leaves.....	912
13,300	.. ..	Nodon, A.	Electrode Plates of Secondary Batteries	1120
13,365	.. ..	Steinweg, C. E.	Separating Matrices	908
13,367	.. ..	Winter, R., and Pappenheim, V.	Electric Furnaces for Dental and other Purposes...	1120
13,379	.. ..	Taddei, G.	Process for Obtaining (part Electrolytic) Aluminium and other Metals.	1121
13,398	.. ..	Davis, J. W.	Machines for Re-carburising Iron or Steel.....	1118
13,408	.. ..	Waite, C. N.	Manufacture of Purified Lactic Acid from Crude Solutions.	931
13,579	Thompson	Simonini, A.	Devices for Automatic Gas Lighting	1198
13,620	.. ..	Maxim, H.	Smokeless Powder Charges for Guns	1141
13,675	.. ..	Greenwood, J., and Greenwood, J., jun.	Manufacture of Fuel	975
13,694	.. ..	Guttman, O.	Condensing Apparatus used in the Manufacture of Nitric Acid, &c.	987
13,745	.. ..	Dinesman, M.	Paracymene-3-Sulphonic Acid. Manufacture of its Salts and of Thymol.	1019
13,788	.. ..	Préardien, J. E.	Apparatus for Purifying Gas	1101
13,790	.. ..	Blériot, L.	Acetylene Generators for Lamps, &c.	1102
13,867	.. ..	Ruthenburg, M.	Apparatus for Agglomerating Communitud Ores, &c., and for Reducing Metal therefrom.	1218



No. of Patent.	Agent.	Inventor	Short Title.	Page for Abstract.
1901.				
13,894	Haddan	Desurmont, F.	Apparatus for Dyeing Slivers, &c., from Combing Machines.	985
14,085	Sefton-Jones.....	Feder, S., and van der Bücken, J.	Apparatus for Making Carpet Cleaning Soap	1122
14,090	Lake	Hiorth, F.	Drying Fibrous Material. Pulp, Yarn, &c., and Apparatus therefor.	1095
14,100	.. ..	Taylor, M.	Gas Producers	975
14,183	.. ..	Taylor, M.	Gas Producers	975
14,250	.. ..	Zehnpfund, K.	Bunsen or like Burners for Lighting, &c.	975
14,411	.. ..	Sander, W. N.	Manufacture of Filaments, &c., for Incandescent Electric Lamps and Heaters.	1199
14,453	Heyes	Plantru, E.	Apparatus for Treating Textile Materials with Liquids	985
14,507	.. ..	Froehling, H.	Extracting Alkaloids, &c., from Vegetable Substances	1019
14,513	.. ..	Karfunkelstein, C.	Carburetting Apparatus	1100
14,525	Mackenzie	Robin Hood Power Co.	Improvements in Explosives	1141
14,619	Heys	Masseron, A., and others	Apparatus for Dyeing, &c. Warps	1110
14,946	.. ..	Haas, M.	Electrolytic Apparatus (Bleaching Liquor).....	1120
14,967	Lake.....	Betts, A. G.	Apparatus for Refining Metals by Electrolysis	1121
15,078	.. ..	Beck, A.	Preparations for Protecting Barrels of Fire-arms from Rust, &c.	1240
15,139	.. ..	Walker, M. S.	Bunsen Gas Burners	1101
15,316	Allison	Lawrence, C. S.	Wood Preserving	992
15,402	.. ..	Feyerabendt, G.	Preserving, &c., Wood.....	1212
15,447	.. ..	Schutz, J. M., and Hawley, C. G.	Coffee Compound, and Process for Producing same.....	1012
15,468	.. ..	Wilton, G.	Treatment or Utilization of Sulphuretted Hydrogen, and other By-Products from Alkali, &c.	1112
15,511	.. ..	Joly, C. and Richardson, E. J.	Liquefaction of Air and other Aeriform Fluids.....	1095
15,527	Imray	Basle Chemical Works	Manufacture of Phthalic Acid and Benzoic Acids....	1139
15,603	.. ..	Rismuller, L.	Bleaching Whale and Seal Oils	1005
15,646	.. ..	Duff, E. J.	Gas Producers	975
15,673	.. ..	Haucke, H.	Paper for the Photographic Copying of Line Drawings, &c.	1140
15,706	Urquhart	Weiler-ter-Meer	Reducing Nitro, Azoxy-, Azo, and Hydrazo-Compounds.	1108
15,811	.. ..	Gallagher, G. S.	Consuming Smoke and Gaseous Products of Combustion in Furnaces.	1099
15,831	.. ..	Ferraris, E.	Zinc or other Distillation Furnaces	997
16,134	.. ..	Mason, J. W.	Purifying Hydrocarbon Oils, and rendering them non-explosive.	1100
16,162	.. ..	Kemp, C. M., and Denny, G. H.	Bunsen Burners	1198
16,327	Lake	Jebson, P.	Treatment of Peat.....	1197
16,356	.. ..	Ficht, P. A., and Heurtey, R. M. J.	Gas Generators.....	1197
16,640	.. ..	Hertwig, O., and Liebaug, E.	Artificial Marble, &c.....	1212
16,864	.. ..	Sorensen, C. P.	Preparing Aluminium for Soldering	1119
16,874	.. ..	Marctear, J.	Electrolytic Apparatus for Production of Chlorine and Alkali.	1121
16,876	Bloxam.....	Chem, Fabrik Brugg, A. G.	Manufacture of Greenish-Black Sulphurised Dyestuffs for Cotton.	1205
17,171	.. ..	Cornell, E. B., and Alderson, W. C.	Process and Apparatus for Making a Fixed Gas for Lighting, &c.	1197
17,510	.. ..	Schniewind, F. W. C.	Apparatus for the Manufacture of Gas	1197
17,566	.. ..	Belin, G.	Apparatus for Generating Acetylene.....	1198
17,639	.. ..	Crean, F. C.	Manufacture of Iron or Iron Alloys.....	1218
17,729	.. ..	Hoffmann, B.	Flour, Bread, &c. (Medicinal)	1229
17,852	.. ..	Pierce, S. F.	Heat-producing Devices for Smelting in Electric Furnaces.	1221
17,863	.. ..	Chailly, F.	Manufacture of Fuel Briquettes, &c.	1197
18,014	.. ..	Rapopot, J.	Manufacture of Enamelled Articles	1211
18,513	.. ..	Ruppert, O.	Manufacture of Illuminating Gas and Coke and Apparatus therefor.	1198
18,560	.. ..	Kornfeld, A., and Zirner, J. H.	Means for Exterminating Moths, and Production of same.	1230
18,808	.. ..	Paulitschky, C.	Manufacture of Artificial Sponges.....	1224
19,150	.. ..	Mactear, J.	Extraction of Metals, &c., from Alluvial Deposits.....	1217
19,237	.. ..	Füllner, E.	Separating Mechanical Admixtures from Liquids, and Apparatus therefor.	1194
19,247	Ihle, G.	Bunsen Burners for Incandescent Lighting.....	1199
19,286	Oelbermann, E.	Candles, &c., for Christmas Tree Illuminations.....	1200
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1895. Adamson, G. P., 233, Reeder Street, Easton, Pa., U.S.A., Manufacturing Chemist.
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1890. Bentz, Ernest, 5, Demesne Road, Whalley Range, Manchester, Lecturer on Dyeing.
1897. Berg, Julius, Elsaesischer Petroleum Gesellschaft, Waburg, Elsass, Germany, Oil Refinery Manager.
1884. Beringer, J. J., Basset Road, Camborne, Cornwall, Metallurgist.
1893. Berk, Fred. W., 1, Fenchurch Avenue, London, E.C., Chemical Manufacturer.
1900. Birmingham, Jno., jun., California Powder Works, 2572, California Street, San Francisco, Cal., U.S.A., Powder Works Superintendent.
1889. Bernard, Jas., jun., Casal das Rolas, Olivares, Listou, Chemical Works Manager.
- O.M. Bernays, J., 96, Newgate Street, London, E.C., Civil Engineer.
1900. Berolzheimer, D. D., 317, South 18th Street, Philadelphia, Pa., U.S.A., Chemist.
1897. Berry, Albert E., c/o Boake, Roberts, and Co., Chemical Works, Stratford, E., Works Manager.
1883. Berry, E. E., Casa Balestra, Bordighera, Italy, Technical Chemist.
1889. Berry, G. F., Atlas Chemical Works, West Ferry Road, Millwall, E., Chemical Works Manager.
1898. Berwick, D. C., 62, Trinity Road, West Bromwich, Electro-Metallurgist.
1900. Best, Alf. W., Cia. do Assucar de Moçambique, Zambesi River, Chinde, East Africa, Sugar Planter.
1898. Best, Dr. Otto, 16, Mastick Terrace, Alameda, Cal., U.S.A., Chemist.
1886. Best, Dr. T. T., Hardshaw Brook Chemical Works, St. Helens, Lancashire, Technical Chemist.
- O.M. Bevan, E. J., 4, New Court, Lincoln's Inn, London, W.C., Public Analyst and Consulting Chemist.
1900. Bevan, Jno. W., Risedale, St. James' Crescent, Swansea, Manager of Metallurgical Works.
- O.M. Beveridge, J., 159, Brookley Road, London, S.E., Pulp and Paper Manufacturer.
1900. Bevington, Col. S. B., 42, St. Thomas Street, Southwark, S.E., Leather Dresser.
1897. Bevington, Richard G., Metallurgist.
1893. Bhaduri, Prof. K., Canning College, Lucknow, India, Professor of Chemistry.
1898. Bhattacharyya, Haripada, Foundry and Shell Factory, Cossipore, Calcutta, India, Chemist.
1896. Bibby, John, c/o J. Bibby & Sons, Formby Street, Liverpool, Student.
- O.M. Bickerdike, W. E., Bryer's Croft, Wilpshire, near Blackburn, Manufacturing Chemist.
1895. Bicknell, G. Arthur, 839, East Madison Avenue, Cleveland, Ohio, U.S.A., Analytical Chemist.
1884. Biggart, J. Wm., 29, Cathcart Street, Greenock, N.B., Analytical Chemist.
1891. Biggart, Wm. L., Public Analyst.
- O.M. Biggs, B., 110, Cannon Street, London, E.C., Chemical Merchant.
1883. Bihn, G. F., Pennsylvania Salt Manufacturing Co., Philadelphia, U.S.A., Chemical Manufacturer.
- O.M. Billing, H. S., 11, Devon Terrace, Ford Park, Plymouth, Analytical and Managing Chemist.
1896. Billings, Edgar F., 404, Atlantic Avenue, Boston, Mass., U.S.A., Manufacturing Chemist.
1896. Billington, Chas., jun., Studleigh, Longport, Staffordshire, Metallurgist.
- O.M. Bindschedler, Dr. R., Villa Flora, Basle, Switzerland, Colour Manufacturer.
1898. Binney, Harold, Bank of Commerce Building, 31, Nassau Street, New York, Patent Lawyer.
- O.M. Binney, H. A., Rainhill, near Liverpool, Glass Manufacturer.
1897. Birchmore, Dr. W. H., 341, Adelphi Street, Brooklyn, N.Y., U.S.A.
1896. Bird, Arthur W., 10, Norfolk Square, London, W., Works Engineer.
1898. Bird, Frank W., Vinegar Works, Cambridge, Vinegar Brewer.
1897. Bird, Fred. C. J., 52, Cambridge Gardens, Notting Hill, W., Chemist.
1888. Bird, Henry, Bencoolen, Bude, North Cornwall, Metallurgist.
1896. Bird, Jno. B., Minver House, Bateman Street, Cambridge, Manure Manufacturer.
1885. Bird, R., Ellerslie, Roath, Cardiff, Tar Distiller.
1895. Bird, Wm. R., 12, Gordon Road, New Swindon, Wilts, Analytical Chemist.
1885. Birley, R. K., Chas. Macintosh & Co., Cambridge Street, Manchester, India-rubber Manufacturer.
1884. Bischof, Gustav, 9, Hythe Road, Willesden Junction, N.W., Technical Chemist.
1895. Bischoff, Dr. Ernst, 227, East 19th Street, New York, U.S.A., Chemist.
1883. Bishop, A. Conway, Three Mills Lane, Bromley-by-Bow, London, E., Manufacturing Chemist.
1884. Bishop, Fred, c/o Burmah Oil Co., Rangoon, Burmah, Technical Chemist.
- O.M. Bishop, G. A., Gartverrie Fireclay Works, Glenboig, N.B., Mining Engineer.
1894. Blackmore, H. S., 206, South Ninth Avenue, Mount Vernon, N.Y., U.S.A., Chemist (Pure Aluminium and Chemical Company).
1899. Blackwell, G. G., 44-47, The Albany, Liverpool, Mineral and Metal Merchant.
1896. Blagden, Victor, 50-51, Lime Street, London, E.C., Chemical Merchant.
1883. Blagden, W. G., 4, Fenchurch Avenue, London, E.C., Chemical Merchant.
1897. Blair, Andrew A., 406, Locust Street, Philadelphia, Pa., U.S.A., Analytical Chemist.
1884. Blake, Jas., Thames Sugar Refinery, Silvertown, London, E., Sugar Refinery Manager.
1890. Blakey, A. J., Dudbridge Mills, Stroud, Gloucestershire, Dyer.
1891. Blass, Edw., Essen (Ruhr), Germany, Civil Engineer.
1893. Blears, John, c/o Langworthy Bros. and Co., Lim., Greengate Mills, Salford, Dyer and Calico Printer.
- O.M. Bles, A. J. S., 32, Chorlton Street, Manchester, Chemical Merchant.
1889. Bloede, Victor G., Station D., Baltimore, Md., U.S.A., Manufacturing Chemist.
1891. Bloomer, Fred. J., 15, Broderick Road, Tooting, S.W., Technical Chemist and Nickel Works Manager.
1886. Blount, Bertram, Chemical Laboratory, Broadway, Westminster, S.W., Analytical Chemist.
1888. Bloxam, A. G., Birkbeck Bank Chambers, Chancery Lane, W.C., Analytical Chemist.
1890. Bloxam, W. Popplewell, Laboratories of the Royal Colleges of Physicians and Surgeons, Victoria Embankment, London, W.C.



1886. Blundstone, E. R., 14, Great Smith Street, Westminster, S.W., and (Journals) Heathfield, Hampton Hill, Middlesex, Consulting and Analytical Chemist.
- O.M. Blyton, J.,
O.M. Boake, A., Warton Road, Stratford, E., Manufacturing Chemist.
1888. Boake, Edmund J., Aberffraw, Nursery Road, Loughton, Essex, Manufacturing Chemist.
1885. Board, J. T., Distillery, Cheese Lane, Bristol, Distiller.
1899. Boehm, Fred., 16, Jewry Street, London, E.C., Chemical Agent and Merchant.
1900. Böhm, Dr. L. K., 320, Broadway, New York City, U.S.A., Expert in Patent Law.
1895. Böhm, Jos. A., c/o Actien Gesellschaft für Chemische Industrie, Rheinau bei Mannheim, Germany, Manager.
1898. Bogert, Marston T., Department of Organic Chemistry, Columbia University, New York, U.S.A., Instructor in Organic Chemistry.
1901. Bolton, E. Richards, South Shore Works, Gateshead-on-Tyne, Manufacturing Chemist.
1892. Bookman, Dr. S., 9, East 62nd Street, New York, U.S.A., Chemist.
1888. Boor, Leonard G., 1 and 2, Artillery Lane, London, E.C., Chemical Merchant.
1896. Boot, John C., Klatten, Java, Netherlands Indies, Chemist.
1884. Booth, Geo., Irk Vale Dyeworks, Middleton, near Manchester, Yarn Dyer.
1894. Booth, Robt., 110, Cannon Street, London, E.C., Engineer.
1891. Boothby, Chas., Woolnough, Vicarage Road, Lea Bridge Road, London, E., Analytical Chemist.
1897. Borland, C. R., Oakland, Bergen Co., N.J., U.S.A., Chemist (Powder Works).
- O.M. Borland, W. D., Beacon Lodge, Green Street Green, near Dartford, Kent, Explosives Chemist.
1900. Boseley, L. K., c/o J. Keiller and Son, Ltd., Tay Wharf, Silvertown, E., Analytical Chemist.
1898. Boss, Julian St. L., 45, Lupus Street, St. George's Square, London, S.W., Engineer.
- O.M. Bothamley, C. H., Otterwood, Beaconsfield Road, Weston-super-Mare, Somerset, County Director of Technical Instruction.
1890. Bott, Dr. Wm. N., The Vicarage, Sleaford, Lincolnshire, Science Lecturer.
1884. Böttinger, Dr. H. T., Elberfeld, Germany; and (subs.) c/o The Bayer Co., Ltd., 19, St. Dunstan's Hill, E.C., Colour Manufacturer.
- O.M. Bottle, Alex., 4, Godwyne Road, Dover, Pharmaceutical Chemist.
- O.M. Boulton, H. E., 64, Cannon Street, London, E.C., Chemical Manufacturer.
1890. Boulton, James, Crayford Mills, Stratford, E., Manufacturing Chemist.
- O.M. Boulton, S. B., 64, Cannon Street, London, E.C., Chemical Manufacturer.
1883. Boulton, T. S., 14, Freegrove Road, Caledonian Road, N., Manager.
1900. Bourcoud, Agustin E., Gijon, Spain, Civil Engineer.
1884. Bow, R. H., 7, South Gray Street, Edinburgh, Civil Engineer.
1885. Bowen, S. B., Brickfield Chemical Works, Llanelly, South Wales, Chemical Manufacturer.
1899. Bowen, W., Woodend Road, Erdington, Birmingham, Chemist.
1888. Bower, Frank, Truman's Brewery, Spitalfields, E., Analytical Chemist.
1897. Bowar, Wm. H., 29th Street and Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemical Manufacturer.
1892. Bowes, Harry, 53, Moss Bank, Higher Crumpsall, Manchester, Analytical Chemist.
1889. Bowing, Jno., Fuel Works, Tilbury, Essex, Consulting Chemist.
1883. Bowley, Jos. John, Wellington Works, Battersea Bridge, London, S.W., Chemical Manufacturer.
1899. Bowley, J. Plunkett, 1, Wellington Road, Battersea, S.W., Varnish Manufacturer.
1883. Bowman, Dr. F. H., Mayfield, Knutsford, Cheshire, Chemical Manufacturer.
1894. Bowman, Jas. H., Canada Chemical Manufacturing Co., London, Ont., Canada, Professor of Chemistry.
1884. Bowman, R., Bowman and Co., Ltd., Victoria Chemical Works, Widnes, Chemical Manufacturer.
1896. Bowman, Walker, 538, West 14th Street, New York City, U.S.A., Chemist.
1899. Bowtell, Norman E., 13, Hollow Way, Runcorn, Cheshire, Works Chemist.
1893. Boyce, Frank, c/o Goodall, Backhouse, and Co., White Horse Street, Leeds, Technical Chemist.
1884. Boyd, Pythagoras, 6, Union Street, North Adams, Mass., U.S.A., Print Works Superintendent.
- O.M. Boyd, W.,
Technical Chemist.
1899. Boyes, Herb. J., 9, Rua Episcopal, Sao Paulo, Brazil, Chemist.
1899. Brackett, E. R., 116, Haverhill Street, Lawrence, Mass., U.S.A., Chemist (International Paper Co.).
1885. Bradburn, J. A., 401, Lowell Avenue, Syracuse, N.Y., U.S.A., Chemical Engineer.
1883. Bradbury, A., Queen Buildings, 11, Dale Street, Liverpool, Chemical Broker.
1898. Bradford, Ernest, Ohio State University, Columbus, Ohio, U.S.A., Metallurgical Chemist.
1895. Bradford, Henry, c/o W. H. Gorringe, Woodcote, Chichester, Analytical Chemist.
1894. Bradley, Edw. F., The Star Brush Co., Ltd., Eden Grove, Holloway, N., Engineer.
1896. Bragg, Everett B., 489, Sibley Street, Cleveland, Ohio, U.S.A., Manufacturing Chemist.
1891. Braithwaite, Isaac, Kendal, Westmoreland, Drysalter.
1897. Braithwaite, Jno. O., Hilika, Warren Road, Chingford, Essex, Pharmaceutical Research Chemist.
1897. Brakes, Jas., c/o Chateaugay Ore and Iron Co., Lyon Mountain, N.Y., U.S.A., Analytical Chemist.
- O.M. Bramham, W., 115, Bow Road, London, E., Chemical Engineer.
- O.M. Bramwell, Major E., Felsberg, Hoylake, Cheshire, Chemical Manufacturer.
1883. Bramwell, Sir F., Bart., F.R.S., 5, Great George Street, Westminster, London, S.W., Civil Engineer.
- O.M. Bramwell, G. H., Cowley Hill, St. Helens, Lancashire, Alkali Manufacturer.
1900. Brandwood, John, 175, Walsbaw Road, Bury, Lancashire, Dyeworks Manager.
- O.M. Branson, F. W., Wynneholme, Far Headingley, Leeds, Pharmaceutical Chemist.
1888. Breffitt, Wm., Glasshoughton, Castleford, Yorks, Glass Manufacturer.
1900. Breneman, Harry C., 320, Manhattan Avenue, New York City, U.S.A., Chemical Student.
1888. Bressey, Edw., 209, Romford Road, Stratford, E., Gold and Silver Refiner.
1900. Brewis, E. Theodore, 7, Cowper Street, Finsbury, E.C., Chemist.
1894. Brycer, Theodor, 105, Main Street, Peoria, Ill., U.S.A., Chemist (American Glucose Co.).
1885. Briant, L., 24, Holborn Viaduct, London, E.C., Analytical Chemist.
1899. Bridge, Geo. E., 123, Old Christchurch Road, Bournemouth, Chemist and Druggist.
1890. Brierley, J. T., 249, Bolton Road, Chorley, Lancashire, Analytical Chemist.
1894. Briggs, J. Burnett, Vauxhall Soap Works, 6, Blackstock Street, Liverpool, Soap Manufacturer.
1893. Briggs, J. F., Brooklyn, Wimbledon Park Road, Wandsworth, S.W., Sugar Works Chemist.
1885. Briggs, T. Lynton, P.O. Box 533, Ridgewood, N.J., U.S.A., Technical Chemist.
1886. Briggs, W., 4, Erskine Terrace, Dundee, Manufacturing Chemist.
1890. Brindley, G. F., c/o Niagara Electro-Chemical Co., Niagara Falls, N.Y., U.S.A., Chemical Engineer.
1894. Bristed, John, Eton House, Margate, Manager.



1886. Bristow, G. W., Worcester House, 35, Eastcheap, London, E.C., Chemical Manager.
1887. Broadbent, H., c/o Goodall, Backhouse, & Co., Sovereign Street, Leeds, Chemist.
1896. Broadhurst, W. Homer, 294, Lafayette Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1889. Brock, Arthur, Messrs. C. T. Brock & Co., South Norwood, S.E., Firework Manufacturer.
- O.M. Brock, J., Gwern-Tyno, Colwyn Bay, North Wales, Chairman of United Alkali Co., Ltd.
1896. Brooke, C. B., jun., Colne House, Brantham, near Manningtree, Xylonite Manufacturer.
1900. Broome, F. J., 36-37, Mincing Lane, London, E.C., Chemist.
1884. Brookes, E. A., c/o Thos. Boyd & Co., Levenshulme Printworks, near Manchester, Analytical Chemist.
1895. Brookman, Fred. W., 176, Ramsay Street, Rochdale, Manure Works Manager.
1893. Broome, F. J., Leaholme, near Matlock Bath, Derbyshire, Assayer.
1901. Broome, Jos., 38, West 35th Street, Bayonne, N.J., U.S.A., Chemical Engineer.
1893. Brothers, H. E., Highfield House, Goldenhill, Stoke-on-Trent, Analyst.
- O.M. Brotherton, E. A., Commercial Buildings, Leeds, Ammonia Distiller.
1884. Brown, Prof. A. Crum, F.R.S., 8, Belgrave Crescent, Edinburgh, Professor of Chemistry.
1891. Brown, Cæsar R., Anglo-Continental Guano Works, Victoria Docks, E., Works Foreman.
- O.M. Brown, D., 93, Abbey Hill, Edinburgh, Chemical Manufacturer.
- O.M. Brown, D., Donaghmore, Tyrone, Ireland, Soap Manufacturer.
1890. Brown, Edw. Hilton, Tannin Extract Works, Zelonie-Dol Station, Moscow-Kazan Railway, Russia, Analytical Chemist.
- O.M. Brown, F. W., 56, Grange Park, Ealing, Science Tutor.
1894. Brown, G. E., 8, Palace Terrace, Palace Gates Road, Wood Green, N., Chemist.
- O.M. Brown, H., Cannon Brewery, Watford, Herts, Brewing Chemist.
1899. Brown, Dr. Henry C., The Chemical Works, King's Lynn, Chemical Manufacturer.
- O.M. Brown, Dr. Horace T., F.R.S., 52, Nevers Square, Kensington, S.W., Brewing Chemist.
- O.M. Brown, Dr. J. Campbell, 8, Abercromby Square, Liverpool, Professor of Chemistry.
1891. Brown, J. Henry, Minas d'Aljustrel Alemtejo, Portugal, Technical Chemist.
1899. Brown, Lucius P., 32-36, Cole Building, Nashville, Tenn., U.S.A., Analytical Chemist.
1892. Brown, Reginald B., 3, Alexandra Terrace, Headingley, Leeds, Dyer's Chemist.
1889. Brown, Robt., The Firs, Hartford, Northwich, Engineer.
1890. Brown, R. J., Technical School, Stockport, Principal.
- O.M. Brown, T., The Chemical Works, King's Lynn, Chemical Manufacturer.
- O.M. Brown, Walter, c/o Jas. H. Dennis and Co., Ltd., Widnes, Technical Chemist.
1900. Brown, Walter B., c/o Nelson, Morris, and Co., U.S. Yards, Chicago, Ill., U.S.A., Chemist.
1897. Brown, Wm., The Firs, Urmston, near Manchester, Engineer.
1899. Brown, Wm. J., Linksview Villa, Leven, Fife, N.B., Chemist.
- O.M. Browning, W., Broad Oak, Accrington, Calico Printer.
1890. Bruce, Jas., Vauxhall Distillery, Liverpool, Distiller.
1900. Bruce, Wm. T., c/o Hugh Wallace and Co., Ltd., 5, Fenchurch Street, London, E.C., Director.
1892. Bruckmann, G. T., 192, 18th Street, Brooklyn, N.Y., U.S.A., Chemical Engineer.
- O.M. Brunner, H., Holly Mount, Tarbock Road, Huyton, near Liverpool, Chemical Manufacturer.
1894. Brunner, H. Bertram, Winnington Park, Northwich, Chemist and Electrician.
1887. Brunner, J. F. L., 23, Wetherby Gardens, London, S.W., Chemical Manufacturer.
- O.M. Brunner, Sir J. T., Bart., M.P., Druid's Cross, Wavertree, Liverpool, Chemical Manufacturer.
1894. Brunton, J. Dixon, Wire Mill, Musselburgh, N.B., Wire Manufacturer.
1901. Bryan, A. Heugh, c/o Indianapolis Rubber Co., Indianapolis, Ind., U.S.A., Chemist.
1890. Bryce, John Annan, Messrs. Wallace Bros., 8, Austin Friars, London, E.C., Merchant.
1894. Bryce, Thos., Tharsis Mines, Huelva, Spain, Chemist.
1887. Bryce-Smith, N. J., Oakfield, Barrow, Whalley, near Blackburn, Calico Printer.
1897. Bryson, Jas., Pumpherton Oil Works, Midcalder, N.B., Oil Works Manager.
1892. Buchanan, D. G., Mount Vernon House, Glasgow, Analyst.
1888. Buchanan, Jas., jun., Caledonia Foundry, Brasenose Road, Liverpool, Engineer.
1897. Bucher, John E., Rhode Island College of Agriculture, Kingston, R.I., U.S.A., Assistant Professor.
1897. Buck, Chas. A., 521, Locust Street, South Bethlehem, Pa., U.S.A., Chief Chemist (Bethlehem Iron Co.).
1897. Bucknill, Jno. A. S., 3, Crown Office Row, Temple, E.C., Barrister-at-Law.
- O.M. Buddon, E. R., 28, Church Row, Hampstead, N.W., Consulting Chemist.
1900. Bull, Benjamin S., 21, Lambard Terrace, Ashburnham Road, Greenwich, S.E., Technical Chemist.
1892. Bull, Johannes C., Erith, Kent, Chemical Engineer.
- O.M. Bullock, J. L., 3, Hanover Street, Hanover Square, London, W., Manufacturing Chemist.
1899. Bult, Herbert J., 18, Billiter Street, London, E.C., Chemist.
- O.M. Bumby, H., Coltness Ironworks, Newmains, N.B., Ironworks Manager.
- O.M. Bunker, H. E., 1, Deanley Terrace, St. Mary's Road, Newton Heath, Manchester, Technical Chemist.
1894. Bunting, W. Lightfoot, Quarry Hill, Accrington, Calico Printer.
1893. Burbridge, Jas., India-rubber Mills, Tottenham, N., India-rubber Manufacturer.
1886. Burdekin, G., jun., Park Villa, Prescot Road, St. Helens, Chemical Works Manager.
1896. Burford, Samuel F., The Firs, Kirby Muxloe, near Leicester, Analytical Chemist.
1898. Burge, Chas. H., Government Laboratory, Clement's Inn Passage, Strand, W.C., Analyst.
1889. Bürger, Dr. J., 1, Birch Avenue, Talbot Road, Old Trafford, Manchester, Technical Chemist.
1889. Burgess, Geo., Hale Road, Ditton, Widnes, Chemist.
1897. Burgess, G. E., Thornbank, Ellesmere Park, Eccles, Manchester, Dyer.
1894. Burgess, Herb. E., The London Essence Co., George Street, Camberwell Green, S.E., Chemist.
1889. Burgess, Wm. T., 46, Portland Road, Holland Park, London, W., Analytical Chemist.
- O.M. Burghardt, Dr. C. A., Fern Cottage, Alderley Edge, Cheshire, Consulting Chemist.
1899. Burkhardt, Dr. A., Luiseplatz, Pforzheim, Germaany, Chemist.
1897. Burland, Lt.-Col. Jeffrey H., 824, Sherbrooke Street, Montreal, Canada, Paper and Card Manufacturer.
1896. Burland, Richard O., Bishopgate, Wigan, Manufacturing Chemist.
1900. Burleigh, Wm. F., c/o West Bergen Steelworks, Jersey City, N.J., U.S.A., Technical Chemist.
1897. Burls, Frank B., 20, Wellesbourne Grove, Stratford-on-Avon, Chemist.
1898. Burls, Herbert T., 206, Lewisham High Street, St. John's, S.E., Mechanical Engineer.
- O.M. Burnard, R., Plymouth Chemical Works, Plymouth, Chemical Manufacturer.
1891. Burnet, Henry K., North Brook Vitriol Works, Bradford, Yorks, Vitriol Maker.
1897. Burnet, Jno. Jas., 18, University Avenue, Glasgow, Architect.
1893. Burnham, J. C., 6, Brownhill Gardens, Catford, S.E., Analytical Chemist.



1900. Burnside, Chas. F., c/o International Smokeless Powder Co., South Amboy, N.J., U.S.A., Chemist.
1890. Burn-Murdoch, J. V., Neuck, Larbert, N.B., Assayer.
1900. Burr, Edmund C., 1722, Vallejo Street, San Francisco, Cal., U.S.A., Manufacturer.
1900. Burr, E. Willard, Alvarado, Alameda Co., Cal., U.S.A., Sugar Manufacturer.
- O.M. Burrell, B. A., 5, Mount Preston, Leeds, Analytical Chemist.
1897. Burrell, Loomis, Little Falls, Herkimer Co., N.Y., U.S.A., Manufacturer.
1892. Burrough, Horace, jun., c/o Burrough Bros. Manufacturing Co., Baltimore, Md., U.S.A., Technical Chemist.
1888. Burrows, Edw., Belle Vue Road, Low Fell, Gateshead-on-Tyne, Alkali Works Manager.
1889. Burton, Wm., Clifton Junction, near Manchester, Potter's Chemist.
1899. Burt, Stratford, 840, Halsey Street, Brooklyn, N.Y., U.S.A., Analytical Chemist.
1897. Burwell, A. W., 208, Superior Street, Cleveland, Ohio, U.S.A., Consulting Chemist.
1899. Bury, Ernest, Wharton Hall, Little Hulton, Bolton-le-Moors, Analytical Chemist.
1885. Bury, J. H., Church Chemical Works, near Acerington, Chemical Manufacturer.
1898. Busch, Dr. Albert, 2, Blücherstrasse, Brunswick, Germany, Chemist.
- O.M. Bush, Baron W. de, c/o W. J. Bush and Co., Ltd., Ash Grove, Hackney, E., Chemical Manufacturer.
1897. Bush, J. M., 7, Hyde Park Street, London, W., Manufacturing Chemist.
1897. Butler, David B., 41, Old Queen Street, Westminster, S.W., Cement Expert.
1890. Butler, Paul, Lowell, Mass., U.S.A., Ammunition Manufacturer.
1885. Butler, Samuel, Compton, Wolverhampton, Brewer.
1886. Butler, W. W., Southfield, Norfolk Road, Edgbaston, Birmingham, Brewer.
- O.M. Butterfield, J. C., 79, Endlesham Road, Balham, S.W., Analytical Chemist.
1892. Butterfield, W. J. A., Overdale, Bletchingley, Surrey, Analytical Chemist.
1883. Butt, E. N., 77, Hamilton Terrace, Maida Vale, W., Pharmaceutical Chemist.
1897. Butters, Charles, 20, Bishopsgate Street Within, London, E.C., Metallurgist.
1900. Butterworth, Elwell R., c/o Reversible Collar Co., 111, Putnam Avenue, Cambridge, Mass., U.S.A., Chemist.
1930. Butterworth, Jas., P.O. Box 54, Newark, N.J., U.S.A., Manufacturing Chemist.
1892. Buttfield, Horace V., 13, Wellington Road, Bush Hill Park, Enfield, N., Chemical Demonstrator.
- O.M. Byard, A. G., c/o Burt, Boulton, and Heywood, Apartado 8, Bilbao, Spain, Technical Chemist.
1899. Byrnes, Eugene A., U.S. Patent Office, Washington, D.C., U.S.A., Examiner in Electro-Chemistry.
1893. Byrom, T. H., Laboratory, Wigan Coal and Iron Co., Wigan, Analytical Chemist.
1887. Bythway, M., 44, Lloyd Street, Albert Street, Manchester, Drysalter.
1896. Cairns, F. Irvan, Anaconda, Montana, U.S.A., Metallurgist.
1897. Cairns, Wm., 5, Carlton Place, Glasgow, Plumber.
1891. Caldecott, Arthur, Metallurgist.
1897. Calder, W. A. S., The Hollies, South Road, Smethwick, Chemical Manufacturer.
- O.M. Calderwood, J., Gowanlea, Spencer Park, Wandsworth, S.W.; and Price's Patent Candle Co., Battersea, Candle Manufacturer.
1900. Caldwell, Thos. O., Virginia City, Montana, U.S.A., Assayer and Chemist.
1888. Caldwell, Wm., Murray Street, Paisley, N.B., Drysalter.
1891. Calkin, Wm. S., Spring Forge, Pa., U.S.A., Paper Pulp Works Chemist.
1899. Calvert, Sidney, State University, Columbia, Mo., U.S.A., Professor of Chemistry.
1895. Cambier, Jacob, 910, Spruce Street, Pueblo, Colo., U.S.A., Chemist.
1894. Cameron, Alex., Kronthal im Taunus, Germany, Chemical Engineer.
1891. Cameron, Jas., 36, Mersey Lane South, Rock Ferry, near Birkenhead, Chemist.
1888. Cameron, Peter, Bath Bridge Colour Works, Bristol, Colour Works Manager.
- O.M. Cammack, J., 51, Denton's Green Lane, St. Helens, Technical Chemist.
1886. Campbell, Andrew, c/o Burmah Oil Co., Ltd., Rangoon, Burmah, Analytical Chemist.
- O.M. Campbell, Archibald, 1, Anson Street, Rugeley, Staffordshire, Technical Chemist.
1899. Campbell, J. Eunyce, 11, Woodland Street, Cheetham Hill, Manchester, Chemical Engineer.
1886. Campbell, John, 75, Hudson Street, New York City, U.S.A., Dye Manufacturer.
1897. Canfield, F. D. jun., c/o National Sugar Refining Co., New York Refinery, Long Island City, N.Y., U.S.A., Sugar Refiner.
1893. Cannon, J. C., c/o Forbes, Abbott, and Lennard, Kingston Wharf, near Brighton, Analyst.
- O.M. Cannon, M., Chemical Works, Wickersley Road, Lavender Hill, S.W., Vinegar Works Manager.
1891. Canziani, Enrico, 3, Palace Green, Kensington, W., Civil Engineer.
1891. Carden, Albert J., Lea Valley Distillery, Warton Road, Stratford, E., Distiller.
1893. Carey, Arthur, Grange Cottage, Gateacre, near Liverpool, Chemist.
- O.M. Carey, E., 20, Alexandra Drive, Sefton Park, Liverpool, Chemical Manufacturer.
- O.M. Carlile, T., 23, West Nile Street, Glasgow, Chemical Manufacturer.
1895. Carlsson, Hugo, c/o Dominion Iron and Steel Co., Sydney, B.C., Canada, Analytical Chemist.
1893. Carmichael, Dr. H., 12, Pearl Street, Boston, Mass., U.S.A., Analytical Chemist.
1896. Carmichael, Herbert, Bureau of Mines, Victoria, British Columbia, Public Analyst and Assayer.
1884. Carmody, Prof. Patrick, Government Laboratory, Port of Spain, Trinidad, Analytical Chemist.
1897. Carnell, Wm. C., 3232, Wabash Avenue, Chicago, Ill., U.S.A., Chemist.
1899. Carney, Jas. A., Beardstown, Ills., U.S.A., Division Master Mechanic, C. B. & Q. Railroad.
- O.M. Caro, Dr. H., Mannheim, Germany, Technical Chemist.
1900. Carp, B. M. A., Seragi Sugar Estate, Pekalongan, Java, N.E.I., Manager.
1893. Carpenter, C. C., South Metropolitan Gas Co., 709A, Old Kent Road, London, S.E., Civil Engineer.
1900. Carpenter, Frank B., Crenshaw Building, Richmond, Va., U.S.A., Chemist.
1900. Carpenter, Harry B., c/o Lister's Agricultural Chemical Works, Newark, N.J., U.S.A.
- O.M. Carpenter, R. F., Prestwich, Greencroft Gardens West Hampstead, N.W., Alkali Works Inspector.
1885. Carruthers, J. G., Burnbrae House, Milngavie, N.B., Dyeworks Manager.

C

1884. Cabot, Godfrey L., 82, Water Street, Boston, Mass., U.S.A., Chemist.
1889. Cadett, Jas., Ashtead, Surrey, Photographic Dry Plate Maker.
1901. Cady, Wm. H., 13, North Water Street, Philadelphia, Pa., U.S.A., Colour Chemist.
1891. Caines, G. S. A., 7, Rochester Terrace, Camden Road, London, N.W., Analytical Chemist.
1900. Cairns, And., Thistle Rubber Mills, Commerce Street, Glasgow, Manager.



- O.M. Carteighe, M., 180, New Bond Street, London, W.,
Pharmaceutical Chemist.
1895. Carter, Stewart F., Windsor Printworks, North,
Adams, Mass., U.S.A., Technical Chemist.
1886. Carter, W. C., 19, Short Strand, Belfast, Ireland
Analytical Chemist.
1889. Carulla, F. J. E., 84, Rose Hill Street, Derby, Che-
mical Manufacturer.
1894. Case, W. T., 7, Cedar Street, New York, U.S.A.,
Chemist.
1900. Cates, Wm. A., Lynmouth, Vicarage Road, Leyton, E.,
Chemist.
1900. Cathcart, Dr. Wm. R., c/o Schaefer Alkaloid Works,
Maywood, N.J., U.S.A., Chemist.
1895. Catlin, Chas. A., 133, Hope Street, Providence, R.I.
U.S.A., Chemist (Rumford Chemical Works).
1900. Catt, Arthur E., The Tannery, Lingfield, Surrey,
Tanner.
1896. Caven, Robt. M., University College, Nottingham,
Lecturer in Chemistry.
- O.M. Cawley, G., 29, Great George Street, Westminster,
S.W., Chemical Engineer.
- O.M. Cawley, J., 278, Passaic Street, Newark, N.J., U.S.A.,
Analytical Chemist.
1897. Cawley, Thos. A., British Gelatin Works, Luton,
Beds., Gelatin Manufacturer.
1900. Cayvan, Llewellyn L., 294, West Monroe Street,
Chicago, Ills., U.S.A., Chemist.
1891. Chadwick, Walter M., 24, West 3rd Street, Bayonne,
N.J., U.S.A., Chemical Works Manager.
1897. Challen, Matthew B., School of Mines, Daylesford,
Victoria, Australia, Assayer.
- O.M. Chaloner, G., 30, Weston Park, Crouch End, N.,
Chemical Lecturer.
1894. Chaloner, G. W., 26, Eagle Wharf Road, Hoxton, N.,
Chemical Manager.
- O.M. Chance, A. M., Chemical Works, Oldbury, near Bir-
mingham, Chemical Manufacturer.
1883. Chance, J. F., New University Club, St. James'
Street, London, S.W., Chemical Manufacturer.
- O.M. Chandler, Dr. C. F., Columbia University, Depart-
ment of Chemistry, Havemeyer Hall, New York,
U.S.A., Professor of Chemistry.
1900. Chandler, Prof. W. H., Lehigh University, South Beth-
lehem, Pa., U.S.A., Professor of Chemistry.
1893. Chaplin, Dr. Edw. M., 60, Westgate, Wakefield,
Yorks, Analytical Chemist.
1890. Chapman, Alf. C., East India Chambers, 23, Leaden-
hall Street, E.C., Analytical Chemist.
- O.M. Chapman, S., 36, Mark Lane, E.C., Chemical
Manufacturer.
1894. Charlier, A. C. J., Sussex House, Hill Street, Glasgow,
General Manager and Chemist.
1900. Chase, March F., c/o Mineral Point Zinc Co., Mineral
Point, Wis., U.S.A., Chemist.
1889. Chase, R. L., Arnold Printworks, North Adams,
Mass., U.S.A., Printworks Chemist.
1894. Chatard, Dr. T. M., 1714, Rhode Island Avenue,
Washington, D.C., U.S.A., Chemical Engineer.
1900. Chattaway, Wm., Apothecaries' Hall, London, E.C.,
Consulting Chemist.
1898. Chattock, Herbert E., 23, Apsley Road, Clifton,
Bristol, Oilcake Manufacturer.
1894. Cheney, J. P., c/o Cheney Bros., South Manchester,
Conn., U.S.A., Silk Manufacturer's Chemist.
1900. Chevassus, Philip, Melrose, Catford Hill, S.E., Che-
mical Student.
1885. Cheyne, A. M., c/o Messrs. Burgoyne, 16, Coleman St.,
E.C., Analytical Chemist.
1899. Child, Josiah F., The London Essence Co., George
Street, Camberwell Green, S.E., Technical Chemist.
1893. Cholerton, A. F., Beech Leigh, 'Narboro' Road,
Leicester, Manufacturing Chemist.
1890. Chorley, Jno. C., Lodge Lane, Bewsey, Warrington,
Analytical Chemist.
- O.M. Christie, J., Levenfield, Alexandria, N.B., Dyer and
Printer.
1898. Christison, Geo., Cremona, Kelvinside North, Glas-
gow, Engineer.
1883. Christy, Thos., The Manor House, Wallington,
Surrey; and 4, 10, and 12, Old Swan Lane, London,
E.C.; Chemical Botanist.
- O.M. Chrystal, W. J., Shawfield Works Rutherglen, near
Glasgow, Chemical Manufacturer.
- O.M. Church, Professor A. H., F.R.S., Shelsley, Kew,
Surrey, Professor of Chemistry in the Royal
Academy.
1890. Church, Elihu D., jun., 65, Wall Street, New York
City, U.S.A., Soda Manufacturer.
1896. Claffin, Alan, Littleton, Mass., U.S.A., Manufacturing
Chemist.
1900. Clamer, Guillian H., 46, Richmond Street, Philade-
phia, Pa., U.S.A., Chemist.
1885. Clanahan, H. C., 88, King Street, Manchester,
Chemical Merchant.
1891. Clapp, Ralph R., c/o Standard Ammonia Co., Ltd.,
Iceiland Wharf, Old Ford, E., Ammonia Works
Manager.
1889. Clapperton, J., jun., c/o British Aluminium Co., Ltd.,
Larne Harbour, Co. Antrim, Ireland, Analytical
Chemist.
1896. Clark, Donald, Bairnsdale, Victoria, Australia,
Director of School of Mines.
- O.M. Clark, Dr. J., 138, Bath Street, Glasgow, Analytical
Chemist.
1900. Clark, Jno., 34, Fitzjohn's Avenue, Hampstead, N.W.,
Manufacturing Chemist.
1891. Clarke, Goddard, Fairlawn, 157, Peckham Rye, S.E.,
Drysalter.
1898. Clarke, J. F. Wyllie, Messrs. J. and R. Tennent,
Wellpark Brewery, Glasgow, Brewery Proprietor.
1897. Clarke, Wm. B., Edison-Swan Electric Works,
Ponders End, N., Electro-Chemist.
1898. Clarkson, Thos., Usine du Meglin, Buxière-les-
Mines, Allier, France, Chemist.
- O.M. Claudet, A. C., 6, Coleman Street, E.C.; and
(Journals) 9, Daleham Gardens, Hampstead, N.W.,
Metallurgist.
- O.M. Claudet, F. G., 6, Coleman Street, E.C.; and
(Journals) Ennismore, Willesden Lane, N.W.;
Assayer and Metallurgist.
1889. Claus, Wm. H., c/o Claus and Ree, Clayton, Man-
chester, Manufacturing Chemist.
- O.M. Clayton, E. G., Chemical Laboratory, 32, Holborn
Viaduct, London, E.C., Analytical Chemist.
1895. Clayton, Dr. G. C., Maldon Lodge, Wavertree, Liver-
pool.
1899. Clayton, Harold, 17, Woodville Road, Chorley, Lan-
cashire, Colourist and Chemist.
1891. Clayton, J. W., Bentfield, Hunt's Cross, Liverpool,
Pharmaceutical Chemist.
1894. Clayton, Robt. H., 12, Park Avenue, Southport,
and (Journals), 37, George Street, Cheetham Hill,
Manchester, Chemist.
1893. Clemen, J. H., The Bracken, Newquay, Cornwall.
1886. Clemenishaw, E., Alkali Works, Oldbury, near Bir-
mingham, Technical Chemist.
1883. Clemons, G. H., Cudbear Street, Hunslet Road,
Leeds, Dyeware Manufacturer.
1896. Clennell, J. E., c/o V. Marcenaro and Co., La Union,
Salvador, Central America, Analytical Chemist.
1899. Clergue, Francis H., Sault Ste. Marie, Ontario,
Canada, Chemical Manufacturer.
1884. Clerk, Dugald, 18, Southampton Buildings, Chancery
Lane, W.C., Engineer.
1899. Cleveland, D. B., Struthers, Ohio, U.S.A., Chemist.
1884. Cliff, Stephen, Wortley, near Leeds, Firebrick Maker.
1900. Clifford, Wm., Glenhurst, Avondale Road, Riches
Street, Wolverhampton, Sewage Works Manager.
1885. Clifton, C. D., Royal Oak Brewery, Stockport,
Brewer.
1896. Clinch, Jno. W., Eartfield House, Douglas, Isle of
Man, Brewer.
- O.M. Cloud, T. C., Wallaroo Smelting Works, Wallaroo,
South Australia, Metallurgist and Manager.
- O.M. Clowes, Dr. F., 18, Bedford Court Mansions, Bedford
Square, W.C.; and 40, Craven Street, Strand,
W.C.; Chief Chemist (L.C.C.).



1886. Clowes, G. A., Needham Market, Suffolk, Brewer and Maltster.
1891. Clutton, J. H., Goring Villas, Burry Port, R.S.O., Carmarthenshire, Assayer.
1900. Clymer, Wm. R., 2012, Detroit Street, Cleveland, Ohio, U.S.A., Chemist.
1899. Coates, Chas. E., jun., Louisiana State University, Baton Rouge, La., U.S.A., Professor of Chemistry.
1888. Coats, Jno. T., 105, Broughton Street, Edinburgh, Manufacturing Chemist.
1893. Cobb, Jno. W., Farnley Ironworks, near Leeds, Technical Assistant to Managing Director.
1894. Coblentz, Dr. Virgil, College of Pharmacy, 115, West 68th Street, New York, U.S.A., Chemical Lecturer.
1899. Cochran, Alfred, 559, Madison Street, Brooklyn, N.Y., U.S.A., Chemist.
1898. Cochrane, A. Lynde, 55, Kilby Street, Boston, Mass., U.S.A., Clerk (Cochrane Chemical Co.).
1895. Cochrane, Jno., Watford Bridge, New Mills, via Stockport, Calico Printer.
1901. Cockburn, John A., Ardeer, Stevenston, Ayrshire, Analytical Chemist.
1887. Coghill, P. de G., Borax Works, Old Swan, Liverpool, Technical Chemist.
1884. Cogswell, W. B., Syracuse, New York, U.S.A., Chemical Engineer.
1899. Cohen, Dr. Hermann, 4, Lütticherstrasse, Köln a/Rhein, Germany, Organic Chemist.
- O.M. Cohen, Dr. J., Yorkshire College, Leeds, Analytical Chemist.
1900. Cohen, R. Waley, 11, Hyde Park Terrace, London, W., Chemist.
1897. Cohn, Alfred J., c/o Merck and Co., 13-19, University Place, New York, U.S.A., Chemist.
1891. Colby, Albert L., c/o Bethlehem Steel Co., South Bethlehem, Pa., U.S.A., Metallurgical Engineer.
1899. Colby, E. A., Baker Platinum Works, Newark, N.J., U.S.A., Metallurgical Chemist.
- O.M. Colby, W. H., Carreg-wen, Aberystwith, Wales.
1895. Colchester, G. H., Burwell, near Cambridge, Manure Manufacturer.
1893. Colefax, Dr. Arthur, (Journals) 26, Ashgrove, Bradford, Yorks; and (notices and subs.) 4, Brick Court, Temple, E.C.; Barrister-at-Law.
1899. Coleman, Gurney F., 4244, Cook Avenue, St. Louis, Mo., U.S.A., Chemist and Paint Merchant.
1885. Coleman, Jas. B., 40, Whitehead Grove, Chelsea, S.W., Analytical Chemist.
1893. Coleman, W. H., 303, Ashton New Road, Clayton, Manchester, Tar Works Chemist.
- O.M. Collens, E., Vinegar Works, Stourport, Worcestershire, Vinegar Works Manager.
1887. Collett, J. M., Guy's Cliff, Wotton, Gloucester, Chemical Manufacturer.
1893. Collin, Dr. C. A., Ferguslie Threadworks, Paisley, N.B., Textile Chemist.
1898. Collingridge, Frank, Glen Roy, Heathfield Park, Willesden Lane, N.W., Chemist.
1895. Collins, H. S., c/o Davy, Hill and Son, Yates, and Hicks, 64, Park Street, Southwark, S.E., Analytical Chemist.
1883. Collins, J. H., 14-15, Broad Street Avenue, London, E.C., Technical Chemist.
1899. Collins, S. Hoare, Durham College of Science, Newcastle-on-Tyne, Agricultural Chemist.
1888. Collins, W. Hepworth, 26, Coupland Street, Oxford Road, Manchester, Analytical Chemist.
1899. Collis, Walter T., Swinford House, Stourbridge, Worcestershire, Chemist.
1891. Colman, Dr. H. G., 23, Stirling Road, Edgbaston, Birmingham, Analytical Chemist.
1887. Colquhoun, D., Maulesbank, Carnoustie, N.B., Chemical Works Manager.
1892. Colquhoun, Lewis, c/o Nobel's Explosives Co., Ltd., Perranporth, R.S.O., Cornwall, Analytical Chemist.
1894. Colquhoun, W., 6, Grove Road, Wrexham, North Wales, Engineer.
1900. Comey, Arthur M., 54, Concord Avenue, Cambridge, Mass., U.S.A., Technical Chemist.
1899. Conant, Francis M., Mathieson Alkali Works, Niagara Falls, N.Y., U.S.A., Chemical Engineer.
1883. Connor, C. C., 4, Queen's Elms, Belfast, Ireland, Chemist.
1900. Conolly, David A., c/o Mountain Copper Co., Keswick, Shasta Co., Cal., U.S.A., Chemist.
1891. Conradson, Pontus H., Galena Oilworks, Franklin, Pa., U.S.A., Analytical Chemist.
1889. Conroy, Dr. Jas. T., 13, Howard Drive, Cressington, Liverpool, Chemist.
1887. Constable, W. H., Australian Alum Works, Runcorn, Analytical Chemist.
1891. Coode, J. Charles, 19, Freeland Road, Ealing, W., Civil Engineer.
- O.M. Cook, H. J., The Firs, Woodford Green, Essex, Soap Manufacturer.
1888. Cook, Jno. J., Atlas Foundry, St. Helens, Lancashire, Ironfounder.
1899. Cook, R. Anderson, New Brunswick, N.J., U.S.A., Chemist.
1898. Cook, Thos. Alex., East London Soap Works, Bow, E. Soapmaker.
1899. Cook, Walter G., 9, Hendon Lane, Finchley, N., Analytical Chemist.
1894. Cook, Wm. Martyn, 142, Highbury New Park, London, N., Analytical Chemist.
1891. Cooke, Arthur W., c/o Brotherton and Co., Holmes Street, Dewsbury Road, Leeds, Analytical Chemist.
- O.M. Cookson, N. T., Newcastle-on-Tyne, White Lead Manufacturer.
1891. Cooper, Harry J., Drinagh, Wexford, Ireland, Cement Manufacturer.
1891. Cooper, Walter J., c/o South Wales Cement Co., Penarth, Cardiff, Cement Works Manager.
1897. Cooper, Wm. R., Carisbrooke, Upper Tulse Hill, S.W., Electrical Engineer.
1890. Corcoran, Bryan, 31, Mark Lane, London, E.C., Chemical Engineer.
1887. Cordner-James, J. H., Finsbury House, Blomfield Street, London, E.C., Mining Engineer.
1899. Cornelison, Dr. Robt. W., Bloomfield, N.J., U.S.A., Consulting Chemist.
1887. Cornett, Jas. P., Ford Paper Works, Hylton, near Sunderland, Paper Maker.
1889. Corrie, David, c/o Nobel's Explosives Co., Ltd., Polmont Station, N.B., Technical Chemist.
1898. Cosby, C. D., Radford House, Home Park Road, Saltash, Cornwall, Mining Engineer.
1894. Coste, J. H., 40, Craven Street, W.C.; and (Journals) 206, Amburst Road, Hackney, E., Analytical Chemist.
1883. Cotterill, Thos., The Poplars, West Bromwich, Chemical Agent.
1891. Cotton, W. F., Hollywood Roebuck, Co. Dublin, Gas Works Manager.
1898. Coupe-Annable, H. W., Keadby, Doncaster, Chemical Assistant.
1894. Court, Heywood, 67, Surrey Street, Sheffield, Analytical Chemist.
1898. Courtney, Samuel, 37, The Mount, Belfast, Ireland, Manager.
1894. Cousins, W. J., 11 and 12, Southampton Buildings, Chancery Lane, W.C., Consulting Chemist and Director.
1893. Cowan, W. J., 12, Park Avenue, Wood Green, N., Fine Colour Manufacturer.
1894. Coward, Percy, Sewage Disposal Works, Deighton, Huddersfield, Chemist.
1897. Cowburn, Arthur W., Fernroyd, St. Margaret's Road, Bowdon, Cheshire, Chemical Merchant and Analytical Chemist.
1894. Cowburn, W. H., Fernroyd, St. Margaret's Road, Bowdon, Cheshire, Chemical Merchant.
1891. Cownley, A. J., 13, Fenchurch Avenue, London, E.C., Analytical Chemist.
1891. Cowper-Coles, Sherard Osborn, Grosvenor Mansions, Victoria Street, Westminster, S.W., Metallurgical Engineer.



1884. Craig, G., 9, Hampden Terrace, Mount Florida, Glasgow, Technical Chemist.
1895. Craig, Thos. J., c/o Messrs. Peter Spence and Sons, Manchester Alum Works, Manchester, Chemist.
1886. Crane, Wm., 397, Staniforth Road, Sheffield, Analytical Chemist.
1898. Cranfield, Wm., 5, Second Avenue, Halifax, Yorks, Teacher of Chemistry.
1899. Craven, Chas. E., Hawthorne Cottage, White Cote Hill, Bramley, near Leeds, Dyer.
1899. Craven, Jas., The Netherlands, Broughton Park, Manchester, Chemist.
1891. Craven, Jno., jun., 6, Halliwell Lane, Cheetham Hill, Manchester, Chemist.
1885. Craw, John, 15, Cadogan Street, Glasgow, Drysalter.
1896. Crawford, Alex., 113, Fenchurch Street, London, E.C., Chemical Merchant.
- O.M. Crawford, D., Langdale's Chemical Manure Co., Lim., St. Laurence, Newcastle-on-Tyne, Manager.
1884. Crawford, D., 12, Abbey Grove, Eccles, Manchester, Dyer and Printer.
1897. Crawford, Walter W., Imperial Chambers, 91, Pitt Street, Sydney, N.S.W., Mechanical Engineer.
1890. Crawshaw, E., 25, Tollington Park, London, N., Dye Merchant.
1900. Crayen, Dr. Gustav, 446, West 23rd Street, New York City, U.S.A.
1895. Cremer, John H., 24, Superior Street, Cleveland, Ohio, U.S.A., Chemist and Metallurgist.
- O.M. Cresswell, C. G., Ermyngarth, Ashtead, Surrey; and 9, Bridge Street, Westminster, S.W., Chemist.
1886. Crichton, Donald G. (Journals), Nundle, via Tamworth, New South Wales; (subs.) Logan Bank, Cupar, Fife, N.B., Analytical Chemist.
1898. Crichton, Jas., Raeburn, Stonebridge Park, Willesden, N.W., Merchant.
1890. Cripser, Wm. R., Cossipore Chemical Works, Cossipore, Calcutta, India, Manufacturing Chemist.
1899. Crombie, Jos. A., 1105, Metropolitan Avenue, Brooklyn, N.Y., U.S.A., Essential Oils Manufacturer.
1898. Crompton, Benj. F., Church Street, Adlington, Lancashire, Printworks Manager.
1885. Crompton, Percy R., Elton Paper Mills, near Bury, Lancashire, Paper Maker.
1889. Cronquist, Prof. A., Werner, 5, Malmtorgsgatan, Stockholm, Sweden, Consulting Chemist.
- O.M. Crookes, Sir Wm., F.R.S., 7, Kensington Park Gardens, Notting Hill, London, W., Analytical Chemist.
1899. Crosbie, Adolphe, Walsall Street Chemical Works, Wolverhampton, Chemical and Colour Manufacturer.
1896. Crosby, Thos., Briton Ferry Steelworks, Briton Ferry, Glamorganshire, Metallurgist.
- O.M. Crosfield, A. L., 46, Bidston Road, Oxtou, Birkenhead, Analytical Chemist and Assayer.
1896. Crosfield, George R., Walton Lea, Warrington, Soap Manufacturer.
1884. Cross, C. F., 4, New Court, Lincoln's Inn, London, W.C., Analytical Chemist.
1900. Crosskey, Alex., N., c/o Alloys Syndicate Ltd., New Dock, Llanelly, South Wales, Chemist.
1894. Crossley, Dr. Arthur W., Chemical Laboratory, St. Thomas' Hospital, London, S.E., Organic Chemist.
1900. Crossley, Frank, Duchy Bank, Seedley Road, Pendleton, Manchester, Analytical Chemist.
1892. Crossman, Tom, Albion Brewery, Coldhurst Street, Oldham, Brewing Chemist.
1884. Crow, Dr. J. K., Tressillian, Ulundi Road, Blackheath, S.E., Technical Chemist.
1894. Crow, Henry W., 94, Romford Road, Stratford, E., Tar Distiller.
- O.M. Crowder, W., Eden Vale, 177, Lower Adiscombe Road, East Croydon, Chemist and Assayer.
1893. Crowther, Edw., Woodland Dyeworks, Headingley, Leeds, Dyer.
1883. Crowther, Horace W., 21, Beeches Road, West Bromwich, Technical Chemist.
1899. Crowther, J., Municipal Technical School, Swansea, Metallurgist.
1884. Crowther, W. M., Field House, Gomersal, near Leeds, Manufacturing Chemist.
1884. Crumie, W. D., 146, Washington Street, East Orange, N.J., U.S.A., Analytical Chemist.
1892. Cullen, Wm., Bronte Villa, Gravesend, Kent, Chemist.
1897. Culmann, Dr. Julius, 843, Front Avenue, Buffalo, N.Y., U.S.A., Chemist and Colourist.
1883. Cuming, James, jun., Chemical Works, Yarraville, Melbourne, Australia, Manure Manufacturer.
1897. Cunliffe, Albert J., Kern Mill Printworks, Whittle-le-Woods, Lancashire, Calico Printer.
1884. Cunliffe, E. T., The Parsonage, Handforth, near Manchester.
1893. Cunningham, Edw., 79, Kilby Street, Boston, Mass., U.S.A., Chemical Engineer.
- O.M. Curphey, W. S., Borva, Lenzie, N.B., Alkali Works Inspector.
- O.M. Curry, W. A., Giltbrook Chemical Works, Aysworth, Notts, Manager.
1898. Curtis, Marvin, 123, California Street, San Francisco, Cal., U.S.A., Wine Merchant.
1884. Cuthbertson, Sir J. N., 29, Bath Street, Glasgow, Chemical Broker.
1899. Cutler, Fred F., 17, Spruce Street, New York, U.S.A., Publisher.

D

- O.M. Dacie, J. C., Soap Works, Putney, London, S.W., Soap Manufacturer.
1897. Dains, Hebert H., Vizianagram Cantonment, Madras Presidency, India, Analytical Chemist.
1897. Dakin, Henry D., 9, Beech Grove Terrace, Leeds, Assistant Analyst.
1887. Dale, Jas., The Towers, Wallington, Surrey, Copper-smith.
1897. Dancer, Wm., 466, Chester Road, Old Trafford, Manchester, Analytical Chemist.
1884. Daniell, Louis C., (Journals) Royal Standard Brewery, Tamworth, New South Wales; and (subs.) c/o W. T. Allen & Co., 132, Queen Victoria Street, London, E.C., Brewer.
1885. Darby, J. H., Pen-y-Garth, near Wrexham, Iron-master.
1901. Darke, Jesse M., Steel Foundry, General Electric Co. Lynn, Mass., U.S.A., Chemist.
1894. Darling, G. A., 59, Cornwall Road, Bayswater, W., Metallurgical Chemist.
- O.M. Darling, W. H., 126, Oxford Street, Manchester, Analytical Chemist.
1887. Davenport, Dr. B. F., 161, Tremont Street, Boston, Mass., U.S.A., Consulting, Sanitary, and Toxicological Chemist.
1900. Davidson, Alex., jun., 1, Almond Bank Terrace, East Merchiston, Edinburgh, Analytical Chemist.
1899. Davidson, Charles, 37, Heriot Street, Pollokshields, Glasgow, Analytical Chemist.
1883. Davidson, J. E., 40, Percy Gardens, Tynemouth, Chemical Manufacturer.
1891. Davidson, Richard, 44, High Street, Dundee, Oil Merchant's Clerk.
- O.M. Davidson, R. Holden, c/o United Alkali Co., Ltd., Golding Davis Works, Widnes, Works Manager.
1897. Davies, Charles T., 405, Elm Street, Reading, Pa., U.S.A., Chemist.
1889. Davies, G. W., 8, Spring Hill, Stockport, Chemical Lecturer.
1898. Davies, Herbert E., The Laboratory, 28, Chapel Street, Liverpool, Analytical Chemist.
1893. Davies, Leyshon, Kames, Kyles of Bute, by Greenock, N.B., Gunpowder Mills Manager.
1896. Davies, Llewellyn J., Bute Chambers, Bute Road, Cardiff, Analytical and Consulting Chemist.
1886. Davies, M. Lloyd, North American Chemical Co., Bay City, Mich., U.S.A., Alkali Works Manager.



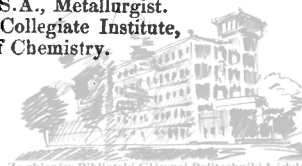
1897. Davies, Saml. H., c/o H. S. Rowntree and Co., Cocoa Works, York, Research Chemist.
- O.M. Davis, A. R., Derby Lodge, Wellington Road, Heaton Chapel, Stockport, Analytical Chemist.
1900. Davis, Arthur C., Saxon Portland Cement Co., Cambridge, Cement Maker.
1885. Davis, Chas., 15, Goldsmith Avenue, Manor Park, Essex, Analytical Chemist.
1893. Davis, Fred., 51, Imperial Buildings, Ludgate Circus, E.C., Analytical and Consulting Chemist.
- O.M. Davis, George E., Sandilands, Knutsford, Cheshire, Chemical Engineer.
1893. Davis, G. Keville, Sandilands, Knutsford, Cheshire, Chemical Engineer.
1893. Davis, Herbert J., 65, Wall Street, New York, U.S.A., Merchant.
- O.M. Davis, H. W., Government Laboratory, Clement's Inn Passage, Strand, W.C., Analytical Chemist.
- O.M. Davis, T. Sebastian, 199, South Lambeth Road, London, S.E., Vinegar Works Chemist.
1897. Davis, Wm. A., Central Technical College, South Kensington, Chemist.
1893. Davis, W. Walley, Virginia Iron Coal and Coke Co., Bristol, Tenn., U.S.A., Analytical Chemist.
1900. Daw, Fred W., Eureka Place, Ebbw Vale, Mon., Metallurgical Chemist.
- O.M. Dawson, C. A., 40, Russell Road, Sefton Park, Liverpool, Technical Chemist.
1896. Dawson, Geo., Reddish Chemical Works, near Stockport, Technical Chemist.
1894. Dawson, Jas., 27, St. Vincent Place, Glasgow; and (Journals) Eglinton Dyewood Mills, Alloa, N.B., Drysalter.
1886. Dawson, W. Haywood, British Alizarin Co., Limited, Silvertown, Victoria Dock, E.; and (Journals) 187, Eglinton Road, Woolwich, S.E., Technical Chemist.
- O.M. Deacon, H. W., 8, Ullet Road, Liverpool, Alkali Manufacturer.
1896. Deakin, E. C., Ryecroft House, Belmont, near Bolton, Dyer.
- O.M. Deakin, H. T., Dewhurst House, Egerton, near Bolton, Dyer.
1899. Deane, Leopold M., Davington House, Faversham, Kent, Analytical Chemist.
1892. Deaville, B., Hyson Green Works, Nottingham, Manufacturing Chemist.
1899. De Castro, J. Paul, Ford House, Redruth, Cornwall, Principal (Redruth School of Mines).
1893. De Clerck, Maurice, Heule-lez-Courtrai, Belgium.
1884. Deering, W. H., Chemical Department, Royal Arsenal, Woolwich, S.E., Analytical Chemist.
1900. Deerr, Noel, Albion, Demerara, B.G., Analytical Chemist.
1893. Delahaye, Philibert, 65, Rue de Provence, Paris, Gas Engineer.
1899. Delano, Warren, jun., 1, Broadway, New York, U.S.A., Mine Operator.
1896. De Lessing, G. C., 147, East 81st Street, New York, U.S.A., Manufacturing Chemist.
1898. Deming, Edw. D., 143, Federal Street, Boston, Mass., U.S.A., Editor of "The Leather Manufacturer."
1883. Dempsey, Geo. C., 165, Market Street, Lowell, Mass., U.S.A., Chemist.
1899. Denham, Wm. S., 9, Holyrood Crescent, Glasgow, Chemist.
1891. Denison, Joseph R., 1, Park View Terrace, Manningham, Bradford, Analytical Chemist.
1897. Dennis, John, Brixwold, Bonnyrigg, Midlothian, Contractor.
1898. Dent, Dr. Frankland, 93, Holly Avenue, Newcastle-on-Tyne, Consulting Chemist.
1901. Devas, Ernest W., 274, Upper Brook Street, Manchester, Technical Chemist.
1890. De Velling, F. W., Higher Grade Board School, The Boulevard, Hull, Head Master and Science Lecturer.
1898. Dewar, Alex. H., Russian Steam Oil Mills, 32, Kourlandsky Street, St. Petersburg, Chemist.
- O.M. Dewar, Prof. J., F.R.S., Royal Institution, Albemarle Street, W. (for Journals); and 1, Scroope Terrace, Cambridge, Professor of Chemistry and Physics.
1891. Dewar, Jno. A., M.P., Murrayshall, Perth, N.B., Distiller.
1889. Dewey, Fred. P., 702, 9th Street Northwest, Washington, D.C., U.S.A., Metallurgist.
1899. Dewez, Eugène, jun., Herve, Belgium, Tanner.
1891. De Wilde, Prof. P., 339, Avenue Louise, Brussels, Belgium, Professor of Chemistry.
1886. Dey, Preo Lall, 4, Beadon Street, Calcutta, Manufacturing Chemist.
- O.M. Dibdin, W. J., Edinburgh Mansions, Howick Place, S.W.; and (Journals) Mayfield, Grange Road, Sutton, Surrey; Analytical Chemist.
- O.M. Dick, A., 110, Cannon Street, London, E.C., Chemical Engineer.
1896. Dick, F. Burnett, 8, Disraeli Gardens, Putney, S.W., Chemist.
1897. Dick, Jno., 14, Bay Street, Toronto, Ont., Canada, Manufacturer.
1898. Dickenson, Frank, 48, Bignor Street, Cheetham Hill, Manchester.
1896. Dickenson, F. M., c/o Broxon Hill Proprietary Co., 3, Great Winchester Street, E.C., Secretary.
1893. Dickerson, E. N., 15, Wall Street, New York, U.S.A., Lawyer.
- O.M. Dickinson, A. J., Neptune Tar and Chemical Works, Deptford, S.E.; and (Journals) 4, Shardeloes Road, New Cross, S.E., Tar Distiller.
1887. Dickson, Jno., 54, Brown Street, Broomielaw, Glasgow, Oil Merchant.
1898. Dickson, Samuel, 2, Broadway, Westminster, S.W., Analytical Chemist.
1899. Dieckmann, Dr. Otto, 1182, Harrison Avenue, Cincinnati, Ohio, U.S.A., Chemist.
1894. Diestel, Wm., 77, William Street, New York, U.S.A., Dyestuff Importer.
1898. Dillon, Wm., 7, Laurel Place, Armley, Leeds, Oil, Colour, and Varnish Manufacturer.
- O.M. Divers, Dr. E., F.R.S., 9, Rugby Mansions, Addison Bridge, Kensington, W., Professor of Chemistry.
1899. Dixon, Fred. W., P.O. Box 390, Providence, R.I., U.S.A., Dyer.
1888. Dixon, Prof. Harold B., F.R.S., Owens College, Manchester, Professor of Chemistry.
1885. Dixon, Jos., Spring Grove, near Sheffield, Paper Maker.
1884. Dixon, Wm., 102, Spring Street, Bury, Lancashire, Science Master.
1892. Dobb, Thos., Audrey Cottage, Union Road, Sharrow, Sheffield, Pharmaceutical Chemist.
- O.M. Dobbie, Dr. J. J., University College of North Wales, Bangor, Professor of Chemistry.
- O.M. Dobbin, Dr. L., Chemical Laboratory, University, Edinburgh, Professor of Chemistry.
1890. Dodd, A. J., River View, Belvedere, Kent, Oil Refiner.
1892. Dodd, Archelaus, 135, Coleman Street, Whitmoreheans, Wolverhampton, Electro-Chemical Foreman.
1889. Dodd, W. R., Oak Dene, Bush Hill Park, Enfield, N., Chemical Works Manager.
1900. Dodge, Dr. Francis D., c/o Dodge and Olcott, 137, Water Street, Brooklyn, N.Y., U.S.A., Chemist.
1897. Doerflinger, Wm. F., 85, Lafayette Avenue, Brooklyn, N.Y., U.S.A., Research Chemist.
1897. Dohme, Dr. Alf. R. L., Messrs. Sharp and Dohme, Baltimore, Md., U.S.A., Manufacturing Chemist.
1885. Doidge, H., 112, Loop Street, Pietermaritzburg, Natal.
1897. Dolge, Carl B., Westport, Conn., U.S.A., Manufacturer of Instruments and Antiseptics.
1886. Domeier, A., Thriffwood, Silverdale, Sydenham, S.E., Chemical Merchant.
1884. Donald, Jas., 5, Queen's Terrace, Glasgow, Manufacturing Chemist.
1890. Donald, Samuel, Corporation Gasworks, Dundee, Analytical Chemist.



- O.M. Donald, W., Saltcoats, N.B., Analytical Chemist.
 1900. Donald, Wm., Ridgefield Park, Bergen Co., N.J., U.S.A., Assayer and Chemist.
 1886. Doolittle, Orrin S., 445, Oley Street, Reading, Pa., U.S.A., Chemist, Philadelphia and Reading Railroad.
 1890. Dore, Jas., Copper Works, High Street, Bromley-by-Bow, E., Distiller's Engineer.
 1896. Doremus, Dr. Chas. A., 59, West 51st Street, New York, U.S.A., Professor of Chemistry.
 O.M. Dott, D. B., c/o J. F. Macfarlan & Co., 93, Abbey Hill, Edinburgh, Analytical Chemist.
 O.M. Dougall, A., 271, Beverley Road, Hull, Gas Engineer.
 1883. Dougall, Archibald, Gasworks, Kidderminster, Gas Engineer.
 1897. Douglas, Geo., Heather Bank, Bingley, Yorks, Dyer.
 1894. Douglas, London M., Baltic Wharf, Putney, S.W., Chemical Manufacturer.
 1884. Douglas, William, Diamond Plantation, Demerara, British Guiana, Chemical Engineer.
 1900. Doulton, H. Lewis, Lambeth Pottery, London, S.E., Potter.
 1900. Dow, Allan W., 2016, Hillyer Place, Washington, D.C., U.S.A., Chemist (District Engineer's Dept.).
 1898. Dow, Herbert H., Midland, Mich., U.S.A., Manufacturing Chemist.
 1897. Dowling, Walford R., Chemist.
 1885. Dowson, J. Emerson, 39, Old Queen Street, Westminster, S.W., Civil Engineer.
 1885. Drake, Chas. A., Three Mills Distillery, Bromley-by-Bow, E., Brewer.
 1886. Dreaper, W. P., Clifton Villa, Coggeshall Road, Braintree, Essex, Technical Chemist.
 O.M. Drew, D., Lower House Printworks, near Burnley, Calico Printer.
 1896. Drewsen, Dr. Viggo B., c/o F. Barbuch & Co., 308, Temple Court Building, New York City, U.S.A., Wood Pulp and Paper Expert.
 O.M. Dreyfus, Dr. C., Clayton Aniline Co., Limited, Clayton, Manchester, Dye Manufacturer.
 1893. Dreyfus, S., Clayton Aniline Co., Ltd., Clayton, Manchester, Chemist.
 1899. Dreyfus, Dr. Wm., c/o The West Disinfecting Co., 208, E. 52nd Street, New York, U.S.A., Chemist.
 1898. Driessen, Dr. P. A., Leyden, Holland, Colour Chemist.
 O.M. Driffield, V. C., Appleton, Widnes, Chemical Engineer.
 1899. Drobegg, G., 81, Maiden Lane, New York City, U.S.A., Superintending Chemist.
 1887. Drown, Prof. T. M., The Lehigh University, South Bethlehem, Pa., U.S.A., Professor of Analytical Chemistry.
 1889. Drummond, Hon. G. A., Montreal, Canada.
 1898. Drummond, Isaac W., 436, West 22nd Street, New York City, U.S.A., Chemist.
 1899. Ducas, B. P., 13-15, Coenties Slip, New York, U.S.A., Chemical and Dyestuff Importer.
 1897. Duckham, Alex., The Red House, Blackbeath, S.E., Works Chemist.
 1899. Dudderidge, Frank R., 55, Northumberland Street, Newcastle-on-Tyne, Teacher of Chemistry.
 1890. Dudley, Dr. C. B., 1219, 12th Avenue, Altoona, Pa., U.S.A., Analytical Chemist.
 1887. Dudley, Prof. W. L., Vanderbilt University, Nashville, Tenn., U.S.A., Professor of Chemistry.
 1899. Duff, Wm. S., Woodland View, Cleveland Road, South Woodford, Essex, Manufacturing Chemist.
 O.M. Duggan, T. R., Sunnybank, Vanbrugh Hill, Blackheath, S.E., Analytical Chemist.
 1898. Duguid, Jas., 46, Sotheby Road, Highbury, N., Journalist.
 1858. Duisberg, Dr. Carl, The Bayer Co., Ltd., (Journals), Elberfeld, Germany, (Subscriptions), 19, St. Dunstan's Hill, E.C., Chemist.
 1888. Dukes, T. William, Merchant.
 1889. Duncan, Arthur W., 42, Trevelyan Street, Eccles, Manchester, Analytical Chemist.
 O.M. Duncan, J., 9, Mincing Lane, London, E.C., Sugar Refiner.
 1898. Dunham, Edw. K., 338, East 26th Street, New York City, U.S.A., Professor of Bacteriology and Hygiene.
 1889. Dunlop, Robt., Orepuki, Southland, New Zealand, Oil Works Manager.
 1892. Dunn, Fred., 193, Collins Street, Melbourne, Victoria, Analytical Chemist.
 O.M. Dunn, J., 53, Brown Street, Manchester, Chemical Manufacturer.
 1890. Dann, John, Morgan Academy, Dundee, Science Teacher.
 O.M. Dunn, Dr. J. T., Northern Polytechnic, Holloway Road, London, N., Headmaster.
 O.M. Dunn, F., 53, Brown Street, Manchester, Chemical Merchant.
 1893. Dunn, W. H., jun., c/o Messrs. Reckitt and Sons, Lim., Hull, Analyst.
 O.M. Dupré, Dr. A., F.R.S., Edinburgh Mansions, Howick Place, S.W., Consulting Chemist.
 1897. Durant, H. T., Butter's Salvador Mines, Ltd., Sta. Rosa, La Union, Salvador, C. A., Chemist.
 1900. Durbrow, Wm., c/o Mountain Copper Co., Keswick, Shasta Co., Cal., U.S.A., Chemist.
 1897. Durkee, Frank W., Tuft's College, Mass., U.S.A., Assistant Professor of Chemistry.
 1899. Duryea, Chester B., 34, Gramercy Park, New York City, U.S.A., Starch Manufacturer.
 1891. Duttson, W. H., Southwood, Silverdale, Sydenham, S.E., Merchant.
 1899. Du Vivier, Ernest H., 441, West 21st Street, New York City, U.S.A., Chemist.
 1891. Dvorkovitch, Dr. P., 6, Willow Bridge Road, Canonbury, N., Technical Chemist.
 O.M. Dyer, Dr. B., 17, Great Tower Street, London, E.C., Analytical and Consulting Chemist.
 O.M. Dyson, C. E., Flint, North Wales.
 1892. Dyson, Septimus, 8, Belmont Avenue, Harrogate, Manufacturing Chemist.

E

1895. Earle, Vavasour, Franks Hall, near Dartford, Kent, Merchant.
 1899. Earnshaw, Edward H., 22nd and Filbert Streets, Philadelphia, Pa., U.S.A., Chemist (Gas Improvement Co.).
 O.M. Earp, W. R., Halton Road, Runcorn, Cheshire, Chemical Manufacturer.
 1884. Eastick, C. E., Martineau's Refinery, King Edward Street, Mile End New Town, Sugar Works Manager.
 O.M. Eastick, J. J., Millaquin Refinery, Bundaberg, Queensland, Sugar Works Manager.
 1890. Eastlake, A. W., Caenwood House, Grove Road, Clapham Park, S.W., Petroleum Works Manager.
 1891. Eastwick, Jos. H., 2216, North 51st Street, Philadelphia, Pa., U.S.A., Chemist.
 1885. Eastwood, Edw., c/o Lever Brothers, Ltd., Port Sunlight, Birkenhead, Soapmaker.
 1898. Eavenson, Alban, 2013 Vine Street, Philadelphia, Pa., U.S.A., Soap Works Chemist.
 1892. Eddy, Harrison P., Sewage Purification Works, Worcester, Mass., U.S.A., Superintendent.
 1894. Ede, Henry E., 251, School Road, Crookes, Sheffield, Analytical Chemist.
 1885. Edge, Anthony, Readville, Mass., U.S.A., Chemist.
 1900. Ederley, Daniel W., Chilton Manufacturing Co., College Point, Long Island, N.Y., U.S.A., Chemist.
 1893. Edwards, Henry W., Mountain Copper Co., Iron Mountain, Shasta Co., Cal., U.S.A., Metallurgist.
 1885. Ehrenfeld, Prof. Chas. H., York Collegiate Institute, York, Pa., U.S.A., Professor of Chemistry.



1896. Ehrhardt, Ernest F., Badische Anilin und Soda Fabrik, Ludwigshafen a/Rhein, Germany, Research Chemist.
1895. Ekenberg, Dr. M., Gothenburg, Sweden, Technical Chemist.
- O.M. Ekman, C. D., Paper Mills, Northfleet, Kent, Technical Chemist.
1885. Elborough, T., 59, Mark Lane, London, E.C., Manure Manufacturer.
1900. Elliot, Harry T., Elliot's Buildings, Falkirk, N.B., Chemical Student.
1892. Elliot, John, Free Library, Wolverhampton, Librarian.
1884. Elliott, Dr. A. H., Consolidated Gas Co., 4, Irving Place, New York, U.S.A., Analytical Chemist.
1896. Elliott, Dr. J. F., c/o Grimwade and Co., 82, Bishopsgate Street, E.C.; and (Journals), O'Connell Street, Sydney, N.S.W., Manufacturing Chemist.
1891. Ellis, Alex., Victoria Terrace, South Shields, Pharmaceutical Chemist.
1885. Ellis, C. J., 13, West Scotland Street, Kinning Park, Glasgow, Technical Chemist.
1893. Ellis, F. Victor, 21, Castle Street, Edinburgh, Analytical Chemist.
1894. Ellis, G. Beloe, 56, Chancery Lane, W.C., Patent Agent.
- O.M. Ellis, H., 112, Regent Road, Leicester, Chemical Merchant.
1891. Ellis, Prof. W. Hodgson, 74, St. Alban Street, Toronto, Canada, Professor of Applied Chemistry.
1891. Ellison, Henry, Flatt Lane, Cleckheaton, Yorks, Manufacturing Chemist.
- O.M. Elmore, A. S., Oak Lawn, Blackheath, S.E., Electro-Metallurgist.
1885. Elworthy, H. S., 239, Dashwood House, New Broad Street, E.C., Sugar Works Chemist.
1899. Emery, E. G., 677, Avenue C., Bayonne, N.J., U.S.A., Chemist.
- O.M. Endemann, Dr. H., 23, William Street, New York City, U.S.A., Analytical Chemist.
1897. Enequist, Erik W., North 8th and Roebing Streets, Brooklyn, N.Y., U.S.A., Chemist.
1894. Enequist, John, 556, Greene Avenue, Brooklyn, N.Y., U.S.A., Chemical Engineer.
1899. Engledue, Col. W. J., Petersham Place, Byfleet, Surrey, Colonel (late) Royal Engineers.
1895. English, Frank H., Manchester Road, Hapton, Lancashire, Analytical Chemist.
1899. Enright, Bernard, 330, East 4th Street, South Bethlehem, Pa., U.S.A., Analytical Chemist.
1886. Ermen, F., jun., Nassau Mills, Patricroft, Manchester, Dyer and Bleacher.
1885. Ernst, Adolf, Oberlangenberg, Schlesien, Germany, Chemist.
1888. Erskine, J. K., Analytical Chemist.
1897. Escher, Paul, c/o The Acker Process Co., Niagara Falls, N.Y., U.S.A., Chemist.
1884. Esilman, A., 25, Roe Lane, Southport, Lancashire, Analytical Chemist.
- O.M. Estcourt, C., 20, Albert Square, Manchester, Consulting Chemist.
1883. Evans, Enoch, 181, Herbert Road, Small Heath, Birmingham, Accountant.
1898. Evans, Ernest D., The Western Tanning Co., Bedminster, Bristol, Tanner.
1900. Evans, J. Eric, Casilla 250, San José, Costa Rica, C.A., Chemist and Assayer.
1883. Evans, Sir John, K.C.B., F.R.S., Nash Mills, Hemel Hempstead, Herts, Paper Maker.
1889. Evans, R. E., 3, Glencoe, Stratford-on-Avon, Brewing Chemist.
1893. Evans, S. Lavington, Sittingbourne, Kent, Tanner.
1896. Evans, Dr. Thos., University of Cincinnati, Ohio, U.S.A., Instructor in Technical Chemistry.
1898. Evans, Wm. Perceval, Christ's College, Christchurch, New Zealand, Science Master.
- O.M. Evershed, F., Atlas Works, Hackney Wick, London, E., Colour Chemist.
1894. Ewan, Dr. Thos., 30, Lansdowne Crescent, Kelvinbridge, Glasgow, Chemist (Aluminium Co.).
1896. Ewen, Eric D., c/o West Indian Tobacco Co., Ltd., Port of Spain, Trinidad, B.W.I., Chemist.
1900. Eyssen, Lorenz, Guatemala, C.A., Coffee and Ramie Planter.
1892. Exley, Arthur, 13, Woodbine Terrace, Headingley, Leeds, Tanner.

F

1898. Fade, Louis, c/o Roessler and Hasslacher Chemical Co., Perth Amboy, N.J., U.S.A., Chemist and Director.
- O.M. Fahlberg, Dr. C., Saccharin Fabrik, Salbke-Westerhüsen a/Elbe, Germany, Manufacturing Chemist.
- O.M. Fairley, T., 17, East Parade, Leeds, Analytical Chemist.
- O.M. Fairlie, H. C., Camelon Chemical Works, Falkirk, N.B., Chemical Manufacturer.
1894. Fairweather, Wallace, 62, St. Vincent Street, Glasgow, Patent Agent.
1898. Falding, F. J., Aldrich Court, 45, Broadway, New York, U.S.A., Chemical Engineer.
1891. Fallon, J. H. M., 61, Birdhurst Rise, South Croydon, Fertiliser Expert.
1897. Farmer, John E., Beddington Farm, near Croydon, Assistant Manager (Sewage Works).
- O.M. Farrant, N., c/o J. Nicholson and Sons, Chemical Works, Hunslet, Leeds, Analytical and Metallurgical Chemist.
1897. Farrell, Frank, 82, Deodar Road, Putney, S.W., Analytical Chemist.
- O.M. Farries, T., 16, Coleman Street, London, E.C., Manufacturing Chemist.
- O.M. Farrington, T., 5, Summerhill Terrace, Cork, Ireland, Chemical Engineer.
1900. Faulenbach, C., 118, Portland Street, Manchester, Chemist and Merchant.
- O.M. Faulkner, F., The Laboratory, Bath Row, Birmingham, Consulting Brewer's Chemist.
1891. Fawcett, Jas. H., Federal Metal Agency, Ltd., 1, Leadenhall Street, London, E.C., Metallurgist.
1884. Fawsitt, C. A., Atlas Chemical Works, East Nelson Street, Glasgow, Chemical Manufacturer.
1900. Fehrlin, H. C., Fink and Fehrlin Chemical Co., Milwaukee, Wis., U.S.A.
1892. Feld, Walther, Chemische Fabrik, Linz a/Rhein, Germany, Chemical Works Director.
1897. Felix, Dr. Lorenz, 86, Heidenkampsweg, Hamburg, Germany, Technical Chemist.
1899. Ferguson Geo., Gleniffer Soap Works, Paisley, N.B., Soap Manufacturer.
1900. Ferguson, Geo. A., College of Pharmacy, 115, West 68th Street, New York City, U.S.A., Professor of Analytical Chemistry.
1896. Ferguson, J. Hart, Loch Katrine Distillery, Camlachie, Glasgow, Distillery Manager.
- O.M. Ferguson, Prof. J., The University, Glasgow, Professor of Chemistry.
1892. Ferguson, Wm. B., 3, Plowden Buildings, Temple, E.C., Barrister-at-Law.
1883. Ferguson, H., Prince Regent's Wharf, Victoria Docks, E., Technical Chemist.
1893. Fiebing, John H., 644, 28th Street, Milwaukee, Wis., U.S.A., Leather Trade Chemist.
1885. Field, E. W., Cloud House, Sandiacre, near Nottingham, Brewer.
1887. Field, S. S., 1, Bell Rock Villas, Mycenæ Road, Westcombe Park, S.E., Manufacturing Chemist.
1891. Field, Wm. Eddington, 65, Sutherland Road, Armadale, Melbourne, Victoria, Analytical Chemist.
1886. Fielding, A., George Street, Salford, Manchester, Drysalter.
1897. Fielding, Frank E., Cons. Cal. and Virginia Mining Co., Virginia City, Nevada, U.S.A., Assayer and Chemist.
1884. Filcock, P., Cumberland House, Cumberland Street, Macclesfield, Analytical Chemist.



1900. Fillis, Frank, Fairlight, Rhoose, near Cardiff, Cement Works Chemist.
1899. Fingland, Jno. J., Minas de Aznalcollar, Prov. de Sevilla, Spain, Analytical Chemist.
1892. Finlay, Kirkman, c/o Milne & Co., 123, Bishopsgate Street, London, E.C., East India Merchant.
1899. Finley, Norval H., 6638, Deary Street, Sta. A., Pittsburg, Pa., U.S.A., Chemist.
1900. Fisher, Henry, 108, East 70th Street, New York City, U.S.A., Teacher of Chemistry.
- O.M. Fisher, W. W., 5, St. Margaret's Road, Oxford, Chemical Lecturer.
1895. Fison, Jno., Messrs. Jas. Fison and Sons, Thetford, Norfolk, Chemical Manufacturer.
- O.M. Fitzbrown, G., Ditton Copper Works, Widnes, Metallurgist.
1897. Fitzgerald, Francis A. J., c/o International Acheson Graphite Co., Niagara Falls, N.Y., U.S.A., Chemical Engineer.
1900. Fitz-Randolph, Raymond B., Hoagland Laboratory, Henry and Pacific Streets, Brooklyn, N.Y., U.S.A., Bacteriologist and Chemist.
1896. Flammer, E., Heilbronn a/N., Würtemberg, Manufacturing Chemist.
1892. Flanagan, Chas. A., 54, Gorse Street, Stretford, Manchester, Manufacturing Chemist.
1896. Fleisher, Saml., 25th and Hamilton Streets, Philadelphia, Pa., U.S.A., Woollen Manufacturer.
1892. Fleming, J. Arnold, 136, Glebe Street, Glasgow, Potter.
1898. Fleming, Wm. P., 17, Prince's Road, Jamalpur, E.I.R., Bengal, India, Analytical Chemist.
- O.M. Fletcher, A. E., Coombe Lea, Dorking, Surrey, Ex-Chief Inspector Alkali, &c. Works.
1895. Fletcher, Eli, Park House, Aked's Road, Halifax, Yorks, Master Dyer.
1893. Fletcher, E. Morley, 73, Victoria Road, Headingley, Leeds, Alkali Works Inspector.
- O.M. Fletcher, F. W., Beauchamp Lodge, Enfield, Manufacturing Chemist.
1891. Fletcher, R. Jaques, North Geelong, Victoria, Manufacturing Chemist.
1892. Flintoff, R. J., Haxby, Crumpsall Lane, Manchester, Chemist.
1885. Flower, Major Lamorock (Lee Conservancy Board), 12, Finsbury Circus, E.C., Sanitary Engineer.
1899. Focht, Louis, State Board of Assessors, Trenton, N.J., U.S.A., Civil Engineer.
1890. Foden, Alfred, 19, Lancaster Avenue, Sefton Park, Liverpool, Metallurgical Chemist.
1900. Foersterling, Dr. H., c/o The Roessler and Haslach Chemical Co., Perth Amboy, N.J., U.S.A., Chemist.
1900. Fogetty, Lucien, c/o And. Jergens and Co., Spring Grove Avenue, Cincinnati, Ohio, U.S.A., Chemist.
1895. Fogg, Chas. A., 39, Park Road, Bolton-le-Moors, Lecturer in Chemistry.
1901. Folsom, Herbert A., 5, Brighton Street, Providence, R.I., U.S.A., Textile Chemist.
1900. Forbes, Eli, Lancaster Mills, Clinton, Mass., U.S.A., Chemist.
1895. Forbes, Paul R., 614, Years Building, Boston, Mass., U.S.A., Chemist and Assayer.
1893. Ford, J. B., jun., Michigan Alkali Co., Wyandotte, Mich., U.S.A., Secretary and Treasurer.
1894. Ford, Jno. Humphrey, Holyrood Glass Works, Edinburgh, Flint Glass Manufacturer.
1889. Ford, Jno. S., Abbey Brewery, Edinburgh, Analyst.
1899. Forel, Geo., 6, Am Roseneck, Strasburg, Alsace, Chemist.
1898. Forgie, Jas. T., Viewfield, Bothwell, N.B., Civil and Mining Engineer.
1885. Formoy, J. Arthur, Chestham, Grange Road, Sutton, Surrey, Oil Expert.
1898. Forrester, J. Kerr, 97, Jeffcott Street, Melbourne, Victoria, Australia, Manufacturing Chemist.
1890. Forrester, Albert, Ranipettai, North Arcot, Madras, India, Chemist and Distiller.
1890. Forrester, A. M., Port Dundas Chemical Works, 20, Canal Bank, Glasgow, Analytical Chemist.
1899. Forster, Dr. Martin O., Royal College of Science, South Kensington, S.W., Demonstrator of Chemistry.
1884. Forster, Ralph C., c/o Messrs. Bessler, Waechter, & Co., 18 and 19, Fenchurch Street, E.C., Chemical Merchant.
1889. Fort, Jas., 16, Adelphi Bank Chambers, South John Street, Liverpool, Chemical Merchant.
1884. Forth, Henry, Meadowcroft, Marple, near Stockport, Drysalter.
1898. Foster, Dr. Arthur M., Canal Glue and Size Works, Verney Road, London, S.E., Chemist.
1895. Foster, Jas., 11, St. Andrew's Drive, Pollokshields, Glasgow, Engineer.
- O.M. Foster, R. Le Neve, Harrytown Hall, Bredbury, near Stockport, Manufacturing Chemist.
1888. Foster, Wm., Esholt House, Chapeltown, Leeds, Manufacturing Chemist.
1884. Foulis, Wm., 2, Montgomerie Quadrant, Kelvinside, Glasgow, Gas Engineer.
1901. Fowle, Arthur, F., c/o Cia. Industrial Jabonera de la Laguna, Gomez Palacio, Durango, Mexico, Chemical Engineer.
1891. Fowler, Gilbert J., Broad Oak, Urmston, near Manchester, Superintendent and Chemist (Manchester Corporation Sewage Works).
1898. Fowler, Theo. V., P.O. Box 168, Buffalo, N.Y., U.S.A., Chemical Works Manager.
1896. Fox, A. Stanley, 23, South Road, Faversham, Kent, Chemist (Cotton Powder Co., Ltd.).
1898. Fox, Jno., 76, Butler Street, Oldham Road, Manchester, Analyst.
1888. Fox, J. Wesley, 115, Lower Thames Street, London, E.C., Salt Merchant.
- O.M. Fox, T., jun., Tonedale, Wellington, Somerset, Wool Manufacturer.
- O.M. France, G. T., Friar's Goose Works, Gateshead-on-Tyne, Alkali Works Manager.
- O.M. France, H. C. D., Avondale, Salford Friars, near Evesham, Chemical Engineer.
1899. Franchot, Stanislaus P., Niagara Falls, N.Y., U.S.A., Manufacturing Chemist.
1885. Francis, E., Ivy Bank, Park Valley, Nottingham, Chemical Lecturer.
- O.M. Francis, E. G., c/o Manbré Saccharine Co., Hammersmith, W., Glucose Works Manager.
- O.M. Francis, G. B., 38, Southwark Street, London, S.E., Wholesale Druggist.
- O.M. Francis, W. H., 38, Southwark Street, London, S.E., Wholesale Druggist.
1894. Frank, Jerome W., 29, Broadway, New York, U.S.A., Chemist.
1889. Frankel, Dr. L. K., 103, North Front Street, Philadelphia, Pa., U.S.A., Chemical Demonstrator.
1886. Frankenburg, Isidor, Greengate Rubber Works, Salford, Manchester, India-rubber Manufacturer.
1895. Frankforter, Dr. G. B., University of Minnesota, Minneapolis, Minn., U.S.A., Professor of Chemistry.
- O.M. Frankland, Prof. P. F., F.R.S., The University, Birmingham, Professor of Chemistry.
- O.M. Frankland, H., Streonshalh House, The Crescent, Lintorpe, Middlesbrough, Analytical Chemist.
1900. Frasch, Herman, 681, Euclid Avenue, Cleveland, Ohio, U.S.A., Oil Refiner.
1891. Fraser, Leslie McG., 98, Commercial Road East, London, E., Mechanical Engineer.
1886. Fraser, W. J., 98, Commercial Road East, London, E., Mechanical Engineer.
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1885. Freear, H. M., Hardwick Road, Woburn Sands, Beds., Analytical Chemist.
1897. Freestone, Jos. T., Fenestrella, Egerton Park, Rock Ferry, Cheshire, Manufacturing Chemist.
1899. French, Alf., 67, Mayton Street, Holloway, N., Dispenser.
1899. French, H. Hutchins, Florenceville, Grove Road, Sutton, Surrey, Produce Broker.
1900. French, Thos., 1, Kelvinside Terrace West, Glasgow, Chemist.



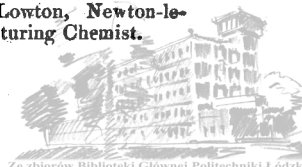
1898. French, Wm., 135, Walmersley Road, Bury, Lancashire, Science Teacher.
1888. Frew, Dr. Wm., Laboratory, Wellpark Brewery, Glasgow, Brewing Chemist.
1898. Frick, O. O'D., c/o Sanitary Block and Tile Pavement Co., Ltd., Briton Ferry, South Wales, Manager.
1886. Fries, Dr. Harold H., 92, Reade Street, New York, U.S.A., Chemical Manufacturer.
- O.M. Friswell, R. J., Bound Reed, Hingham, Kent, Colour Manufacturer.
1898. Frith, J. Mason, Sunnyside, Norman Road, Runcorn, Lime Burner.
1899. Fritzsche, Carl, c/o Schimmel and Co., 7, Berliner Strasse, Leipzig, Germany, Manufacturer of Essential Oils.
1890. Frost, Dr. Howard V., 3953, Drescel Boulevard, Chicago, Ill., U.S.A., Professor of Chemistry.
1884. Frost, Joe, Mold Green, Huddersfield, Manufacturing Chemist.
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1899. Fry, Henry E., Suffolk House, Cannon Street, London, E.C., Metallurgist.
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1894. Fuerst, Dr. Alex. F., c/o Wood Street Smelting Works, 30, Wood Street, London, E.C., Chemist.
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1894. Fuller, Chas. J. P., L. and Y. Railway Works, Horwich, near Bolton, Analytical Chemist.
1899. Fuller, Robt. F., Neston Park, Corsham, Wilts, Rubber Manufacturer.
1899. Fuller, W. M., (Journals) Bryn Tigid, Gold Tops, Newport, Mon.; and (subscription) c/o Morris & Griffin, Lim., Maindee, Newport, Mon., Chemical Manufacturer.
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1893. Gardiner, H. J., 22, Chatham Place, Hackney, N.E., Chemical Manufacturer.
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1900. Garrigues, Wm. E., 1123, Broadway, New York City, U.S.A., Chemical Engineer.
1899. Garroway, Wm., Netherfield, Duke Street, Glasgow, Chemical Manufacturer.
1898. Garry, H. Stanley, St. John Street, Mansfield, Notts, Manure Works Manager.
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1886. Gascoyne, Dr. W. J., 36, South Holliday Street, Baltimore, Md., U.S.A., Analytical Chemist.
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- O.M. Gibbs, W. P., c/o Dominion Pulp Co., Ltd., Chatham, New Brunswick, Canada, Analytical Chemist.
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1898. Gies, Wm. J., College of Physicians and Surgeons, 437, W. 59th Street, New York City, U.S.A., Instructor in Physical Chemistry.
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1897. Gilbody, Dr. Alex. W., Owens College, Manchester, Research Chemist.

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1890. Gajjar, T. K., Techno-chemical Laboratory, Girgaum, Bombay, India, Consulting Chemist.
- O.M. Galbraith, Wm., Rose Lea, Beeston, Leeds, Technical Chemist.
1898. Galewsky, Dr. Paul, c/o L. Cassella and Co., Mainkur, bei Frankfurt a/Main, Germany, Colour Chemist.
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1897. Galletty, J. C., 101, Armadale Street, Dennistoun, Glasgow, Assistant to Professor of Metallurgy.
1901. Gallup, W. Arthur, Arnold Printworks, North Adams, Mass., U.S.A., Printer.
1891. Galt, Hugh Allen, Columbia Chemical Co., Barberton, Ohio, U.S.A., Works Manager.
- O.M. Gamble, Sir David, Bart., Windlehurst, St. Helens, Chemical Manufacturer.
1887. Gamble, Jas. N., The Laboratory, Procter and Gamble Co., Ivorydale, Ohio, U.S.A., Soap Manufacturer and Oil Refiner.



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1884. Gilchrist, Peter S., Charlotte, N.C., U.S.A., Chemical Engineer.
1900. Gildersleeve, W. H., Flintstone Tannery, Flintstone, Ga., U.S.A., Chemist.
- O.M. Giles, W. B., The Grange, Leyton, E., Chemical Manufacturer.
1886. Gill, Dr. Aug. H., Massachusetts Institute of Technology, Boston, Mass., U.S.A., Assistant Professor of Gas Analysis.
1900. Gill, J. Arthur, Dalton Hall, Victoria Park, Manchester, Analyst.
1901. Gilles, Wm. T., Bradford Street, Bocking, near Braintree, Essex, Technical Chemist.
1888. Gillman, Gustave, A.M.I.C.E., Ferro-carril de Murcia á Granada, Aguilas, Prov. de Murcia, Spain, Civil Engineer.
1892. Gilmour, J. D., 190, Butterfiggins Road, Glasgow, Chemist.
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1900. Ginder, Wm. H., c/o American Sheet Steel Co., Vandergrift, Pa., U.S.A., Analytical Chemist.
1886. Girdwood, Dr. G. P., 111, University Street, Montreal, Canada, Professor of Chemistry.
- O.M. Gladstone, Dr. J. H., F.R.S., 17, Pembroke Square, London, W., Professor of Chemistry.
1886. Glaeser, F. A., Carpenter's Road, Stratford, E., Varnish Manufacturer.
1889. Glaser, Chas., 21, South Gay Street, Baltimore, Md., U.S.A., Analytical and Consulting Chemist.
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1901. Glegg, Robt., Marischal College, Aberdeen, Analytical Chemist.
1894. Glen, Chas., Glengowan Printworks, Caldercruix, N.B., Calico Printer.
1890. Glen, J., jun., Glengowan Printworks, Caldercruix, N.B., Calico Printer.
1900. Glendenning, Arthur, 31, Bright Street, Middlesbrough, Analytical Chemist.
1884. Glendinning, H., Mount House, The Hill, Sandbach, Cheshire, Technical Chemist.
1895. Glenn, Wm., Baltimore Chrome Works, 1348, Block Street, Baltimore, Md., U.S.A., Chrome Manufacturer.
1888. Gloag, Robt. F., Grove Hill, Middlesbrough, Secretary.
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1896. Glover, H., East Falls, Schuylkill, Philadelphia, Pa., U.S.A., Chemical Works Superintendent.
- O.M. Glover, John, 20, Holly Avenue, Newcastle-on-Tyne, Chemical Engineer.
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- O.M. Glover, W., Rio Tinto Mines, Huerva, Spain, Technical Chemist.
1896. Goetz, Isidore, c/o Rio Negro Mines, Ltd., 6, Suffolk Street, Pall Mall, London, S.W., Mine Manager.
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- O.M. Goldschmidt, Dr. S. A., 43—51, Sedgwick Street, Brooklyn, N.Y., U.S.A., Chemical Manufacturer.
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1895. Goldsmith, Byron B., 19, East 74th Street, New York, U.S.A., Vice-President (American Lead Pencil Co.).
1899. Goldsmith, Jno. N., British Xylonite Co., Ltd., Manningtree, Essex, Chemist.
1887. Goodall, Thos., Hendon Grange, Sunderland, Paper Manufacturer.
1900. Goodchild, Wm. H., Rosslyn, Haslemere Road, Crouch End, N., Chemical Student.
1898. Goode, J. Archibald, 16, Crampton Street, London, S.E., Analytical Chemist.
1899. Goodhue, Francis A., 32, India Street, Boston, Mass., U.S.A., Aniline Colour Importer.
1898. Goodrich, Chas. G., Akron, Ohio, U.S.A., Rubber Manufacturer.
1884. Goodwin, C. C., The White House, St. John's Road, Bowdon, Cheshire, Soapmaker.
1894. Goodwin, Dr. W. L., The School of Mining, Kingston, Canada, Professor of Chemistry.
- O.M. Goppelsroeder, Dr. F., Leimenstrasse 51, Basel, Switzerland, Professor of Chemistry.
1898. Gordon, Colin, Storer's Wharf, Cubitt Town, E., and (Journals) 8, College View, North Greenwich, E., Chemical Engineer.
1884. Gordon, J. G., Queen Anne's Mansions, Westminster, S.W., Steel Manufacturer.
1883. Gore, Dr. G., F.R.S., 20, Easy Row, Birmingham, Metallurgist.
1900. Gormly, Sam. J., P.O. Box 1041, Butte, Montana, U.S.A., Assayer.
1901. Gornall, Frank H., 256, Park Road, Crouch End, N., Chemist.
1891. Gorvin, Jno. C., English Crown Spelter Co., Ltd., Swansea, Works Manager.
- O.M. Gossage, F. H., Widnes, Alkali Manufacturer.
1897. Gossage, W. Winwood, Widnes, Lancashire, Soap Manufacturer.
1890. Goulding, Wm. Joshua, 25, Eden Quay, Dublin, Manure Manufacturer.
- O.M. Gow, R. J., Ivy Lea, Hough Green, near Widnes, Metallurgical Chemist.
- O.M. Gowland, W., 13, Russell Road, Kensington, W., Assayer and Metallurgist.
1886. Goyder, G. A., Ootalinka, Hawker's Road, Medindie, near Adelaide, South Australia, Chemist (Adelaide School of Mines).
1890. Grabfield, Dr. J. P., 1915, Indiana Avenue, Chicago, Ill., U.S.A., Chemist.
1900. Grabill, Clarence A., c/o Mountain Copper Co., Keswick, Shasta Co., Cal., U.S.A., Chemist.
1897. Graesser, Franz A., The Wrexham Lager Beer Co., Wapping Station, Liverpool, Manager.
1883. Graesser, K., Cefn, near Ruabon, North Wales; and Argoed Hall, Llangollen, North Wales, Manufacturing Chemist.
- O.M. Graham, Prof. C., The Reculvers, Hastings, Consulting Chemist.
- O.M. Graham, C. C., Highmoor, Bemhydding Road, Ilkley, Yorks, Technical Chemist.
1883. Grandage, H., Low Royd Dyeworks, Thornton Road, Bradford, Dyer.
1897. Granger, Dr. J. Darnell, 25, All Saints Street, Nottingham, Analytical Chemist.
1900. Granja, Rafael, c/o The Palen Co., Kingston, N.Y., U.S.A., Chemist.
1893. Gratama, Dr. W. D., Huize Kraayenburg, Ryswyk, Z.H., Holland, Professor of Chemical Technology.
1896. Graves, Geo. H., c/o General Chemical Co., Bridgeport, Conn., U.S.A., Manufacturing Chemist.
1896. Graves, Walter G., 555, Sibley Street, Cleveland, Ohio, U.S.A., Chemist.
1895. Gray, Elisha B., New Brighton, Richmond Co., N.Y., U.S.A., Oil Inspector and Chemist.
1884. Gray, G. Watson, 8, Inner Temple, Dale Street, Liverpool, Consulting Chemist and Assayer.
1886. Gray, Jno., 13, Queen's Road, Rock Ferry, near Birkenhead, Oil Works Chemist.
1896. Gray, Dr. Thos., Technical College, 204, George Street, Glasgow, Lecturer in Chemistry.
1891. Greaves, I. A. B., Morton, Gainsborough, Brewer.
1894. Greaves, Wm., Powell Duffryn Steam Coal Co., Aberaman, Aberdare, South Wales, Chemical Engineer and Chemist.
1894. Greeff, R. W., 20, Eastcheap, London, E.C., Chemical Agent.
1890. Green, Alfred H., Oaklands, Lowton, Newton-le-Willows, Lancashire, Manufacturing Chemist.



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1896. Green, Jno. Wilberforce, 36, Crystal Palace Park Road, Sydenham, S.E., Technical Chemist.
- O.M. Green, L., Lower Tovil, Maidstone, Paper Manufacturer.
1891. Green, Samuel, 28 and 29, St. Swithin's Lane, London, E.C., Chemical Auctioneer.
- O.M. Greenaway, A. J., Frognaal, Hampstead, N.W., Sub-Editor of Chemical Society's Journal.
1884. Greenhalgh, J. Herbert, Whitekirk, Green Mount, near Bury, Assistant Manager of Printworks.
- O.M. Greenhough, D. W., 5, Rood Lane, London, E.C., Chemical Broker.
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1897. Gref, Anthony, 40, Stone Street, New York, U.S.A., Patent Lawyer.
- O.M. Greville, H. L., Diersheim, Churchfields, Woodford, Essex, Gas Examiner.
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1890. Griffin, John R., 20-26, Sardinia Street, Lincoln's Inn Fields, W.C., Chemical Apparatus Maker.
1886. Griffin, Martin L., Mechanicville, Saratoga Co., N.Y., U.S.A., Analytical Chemist (and Consulting) (Fibre, Paper, Clays).
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1888. Gripper, Harold, Great Central Railway, Gorton, Manchester, Analytical Chemist.
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1896. Grosvenor, Wm. M., jun., P.O. Box 183, Englewood, N.J., U.S.A., Electro-Chemist.
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1900. Guitermann, Edw. W., Passaic, N.J., U.S.A., Chemist.
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1900. Günther, Chas. E., 9, Fenchurch Avenue, London, E.C., Merchant.
1894. Gurney, J. Clare, Fabrica Roma, La Union, Prov. de Murcia, Spain, Analytical Chemist.
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1898. Haddow, Geo., Nobel's Explosive Co., Ferranporth, R.S.O., Cornwall, Chemist.
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1884. Hadkinson, F., Pamphila Oil and Soap Works, Mitylene, Mediterranean, Oil Refiner and Soap Manufacturer.
- O.M. Hadkinson, R., Smyrna, Asia Minor, Oil Refiner.
1894. Hadley, Walter S., Millersdale, Sutton, St. Helens, Lancashire, Plate Glass Maker.
1899. Haenlein, Dr. Fried. H., Director der Deutschen Gerberschule, Freiberg in Sachsen, Leather Chemist.
1887. Haig, Robert, Mechanical Retorts Co., Limited, Murray Street, Paisley, N.B., Chemical Engineer.
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1896. Hall, Henry J., 51, Malmesbury Road, Bow, E., Coca Wine Purveyor.
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1900. Hall, Jos. J., c/o G. H. Hammond Co., Hammond, Ind., U.S.A., Chemist.
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1896. Hall, S. G., East London Soap Works, Bow E., Soap Maker.
1898. Hall, Wm. F., Red House, via Zwartkops, Cape Colony, South Africa, Cyanide Manager.



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1892. Hamaguchi, K., Hiro Mura, Arito Gori, Wakayama Ken, Japan, Soy Manufacturer.
1897. Hambly, Fred. J., Buckingham, Quebec, Canada, Chemist.
1895. Hamburger, Aron, 18 and 19, Great Windmill Street, London, W., Technical Chemist.
1887. Hamilton, Jas. C., Arncliffe, Arnside, via Carnforth, Chemical Works Manager.
1885. Hamilton, Oswald, Lancaster Cottage, Old Stratford, near Stony Stratford, Chemical Engineer.
1884. Hamilton, Robert, Glengarnock Chemical Co., Ltd., Glengarnock, N.B., Works Manager.
1892. Hamilton, Robt., Leeds Steelworks, Ltd., Leeds, Analytical Chemist.
- O.M. Hammill, M. J., The Gables, St. Helens, Alkali Manufacturer.
1898. Hammersley, W. Stanley, Longjumeau, S. et O., France, Tanner.
1892. Hammond, Geo. W., Yarmouthville, Maine, U.S.A., Paper Co.'s Agent.
- O.M. Hammond, J., Gas Works, Eastbourne, Sussex, Gas Manager.
1900. Hampton, F. T., Hill City, Tenn., U.S.A., Civil Engineer.
1900. Hancock, Walter C., 10, Upper Chadwell Street, Myddelton Square, E.C., Analytical Chemist.
1896. Hand, Daniel, 30, Mount Pleasant Avenue, Newark, N.J., U.S.A., Chemist.
1889. Handy, Jas. O., 325, Water Street, Pittsburg, Pa., U.S.A., Chemist.
1888. Hanks, Abbot A., 531, California Street, San Francisco, Cal., U.S.A., Assayer.
1901. Hanna, Charles E., 316, St. James' Street, Montreal, Canada, Secretary.
1899. Hanna, Dillinger C., 426 $\frac{1}{2}$, Parkside Avenue, Philadelphia, Pa., U.S.A., Chemist and Superintendent.
- O.M. Hanson, A. M., Abbey Printworks, Whalley, Blackburn, Print Works Chemist.
1891. Hanson, John, Highfield Villa, Belle Vue, Wakefield, Manufacturing Chemist.
1899. Hantke, Ernst, 646, Broadway, Milwaukee, Wis., U.S.A., Director of Brewers' School.
1894. Harden, Arthur, c/o British Institute of Preventive Medicine, Grosvenor Road, London, S.W., Lecturer in Chemistry.
1896. Hardman, Richard B., Fernhill Mills, Bury, Lancashire, Woollen Manufacturer.
1900. Hardwick, W. Roscoe, 13, Batavia Buildings, Hackins Hey, Liverpool, Chemist.
1897. Harger, Dr. Jno., 30, Jalland Street, Hull, Chemist.
1896. Hargreaves, Jas., May Villa, Peelhouse Lane, Widnes, Lancashire, Chemical Engineer.
- O.M. Hargreaves, Jno., Widnes, Alkali Manufacturer.
1898. Hargreaves, Luke, c/o Electrolytic Alkali Co., Ltd., Middlewich, Cheshire, Chemical Engineer.
- O.M. Harland, R. H., Plough Court, 37, Lombard Street, London, E.C., Consulting Chemist.
1893. Harlock, E. B., Newton Farm, Middlewich, Chemical Manufacturer.
1898. Harman, Edw. A., Elsinore, Gledholt, Huddersfield, Gas Engineer.
1890. Harmon, L. E., 46-54, Fulton Street (Drawer 255), Buffalo, N.Y., U.S.A., Analytical Chemist.
- O.M. Harrington, W. B., Leeview, Montenotte, Cork, Chemical Manufacturer.
1893. Harris, Arthur, Marsh Gate Works, Stratford, E., Soap Maker.
1885. Harris, Booth, jun., Hillside, Loughton, Essex, Soap Maker.
- O.M. Harris, D., Caroline Park, Edinburgh, Chemical Manufacturer.
1897. Harris, Fred. W., Sanitary Chambers, Chemical Department, Glasgow, Public Analyst.
1900. Harris, Dr. Harry B., 212, Jones Street W., Savannah, Ga., U.S.A., Chemist.
1896. Harris, H., Hall Mines Smelter, Nelson, British Columbia, Metallurgical Chemist.
1900. Harris, L. A., 28, Glengall Road, London, S.E., Chemist.
1896. Harris, Wm. T. A., Ideal Soapery, East Street, Brompton, Adelaide, South Australia, Soap Maker.
- O.M. Harrison, A., Thames Sugar Refinery, Silvertown, London, E., Sugar Works Chemist.
- O.M. Harrison, C., Hayle, Cornwall, Technical Chemist.
- O.M. Harrison, G. D., Netham Chemical Works, Bristol, Chemical Manufacturer.
1883. Harrison, G. H., Hagley, near Stourbridge, Firebrick Maker.
1884. Harrison, G. King, Hagley, near Stourbridge, Fire-clay Mine Owner.
- O.M. Harrison, J., Madore, Ballintemple, Cork, Chemical Engineer.
1887. Harrison, Jno., 35th and Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemical Manufacturer.
1892. Harrison, Prof. John B., c/o Harrison, Griffin, and Co., Bridgewater Place, Manchester, Government Analyst.
1898. Harrison, Wm. H., 13, Brunswick Street, Leeds, Analytical Chemist.
1896. Hart, Bertram, c/o Tennants and Co., Clayton, Manchester, Analyst.
1886. Hart, Bertram H., The Elms, Old Charlton, S.E., Analytical Chemist.
- O.M. Hart, Dr. E., Lafayette College, Easton, Pa., U.S.A., Professor of Chemistry.
1890. Hart, H. W., 13, Lynwood Villas, Darwen, Lancashire, Analytical Chemist.
1897. Hart, Wm. Beamont, Poste Restante, British Post Office, Constantinople, Consulting Chemist.
1888. Hartford, Jas., 3, Cedar Street, New York, U.S.A., Aniline Merchant.
1886. Hartley, Arthur, The Brewery, Emsworth, Hants, Brewer.
1883. Hartley, Joseph, 159, Hamilton Road, Longsight, Manchester, Technical Chemist.
1889. Hartley, R. Kent, Springwood House, Middleton Junction, near Manchester, Chemical Works Manager.
- O.M. Hartley, Prof. W. N., F.R.S., Royal College of Science, Dublin, Professor of Chemistry.
1897. Hartmann, Ernest E., c/o Onomea Sugar Co., Papaikou, Hawaii, Chemist.
1891. Hartog, Philip J., 6, Mauldeth Road West, Withington, Manchester, Analytical Chemist.
1892. Hartridge, Jas. Hills, Holmwood, Hendon, Manufacturing Chemist.
1899. Harvey, Chas., c/o J. Thompson and Co., 10, Gorce Piazzas, Liverpool, Manufacturing Chemist.
1892. Harvey, E. Feild, Omrac, St. John's, Newfoundland, Chemist.
1885. Harvey, Ernest W., 20, Malwood Road, Balham, S.W., A.R.S.M. Engineer.
1888. Harvey, H. C., Raglan House, Brooklands, near Manchester, Chemist.
1891. Harvey, Sidney, South-Eastern Laboratory, Canterbury, Analytical Chemist.
1899. Harvey, Thos. F., 84, Henry Road, West Bridgford, Nottingham, Analyst (Drug Co.).
1883. Harvey, T. H., Cattedown, Plymouth, Chemical Manufacturer.
1893. Harzer, C. A., 79 $\frac{1}{2}$, Gracechurch Street, London, E.C., Merchant.
- O.M. Hasenclever, R., Chemische Fabrik - Rhenania, Aachen, Prussia, Chemical Manufacturer.
1900. Haskell, J. Amory, Laffin and Rand Powder Co., 92, Cedar Street, New York City, U.S.A., President.
1900. Haslwanter, Chas., 904, Flushing Avenue, Brooklyn, N.Y., U.S.A., Analytical Chemist.



1897. Hasslacher, Jacob, P. O. Box 1999, New York, U.S.A., President of Roesler-Hasslacher Chemical Co.
1894. Hatfield, Jno. A., 89, Bridge Street, Wednesbury, Staffordshire, Analytical Chemist.
1891. Hätsehek, M., 41, Montserrat Road, Putney, S.W., Chemical Engineer.
1887. Hatton, Wm. P., c/o W. R. Hatton & Sons, Wormwood Scrubs, W., Starch Works Manager.
1899. Haus, Simon V., c/o Nepera Chemical Company, Nepera Park, N.Y., U.S.A., Photographic Chemist.
1900. Havens, Dr. Franke S., 30-32, Varick Street, New York City, U.S.A., Silk Conditioner.
1899. Hawdon, H. S., Hedworth Barium Works, East Jarrow-on-Tyne, Manager.
1895. Hawker, E. W., Adelaide Club, Adelaide, South Australia, Metallurgist.
1897. Hawkins, Ernest M., South Eastern Laboratory, Canterbury, Chemist.
- O.M. Hawkins, H., c/o American E.C. and Schultze Gunpowder Co., Ltd., Oakland, Bergen Co., N.J., U.S.A., Explosive Works Manager.
1893. Hawkins, J. Dawson, c/o Colo. Phila. Reduction Co., Colorado City, Col., U.S.A., Smelting Works Manager.
1887. Hawliczek, Josef, Yoredale, Alexandra Road, Waterloo, Liverpool, Technical Chemist.
1899. Haworth, Dr. Edw., 6, Stanley Villas, Runcorn, Cheshire, Chemist.
1895. Hay, Alex. B., Kelvindock Chemical Works, Maryhill, Glasgow, Manufacturing Chemist.
1898. Haycraft, Jos. H., St. Peter's, Adelaide, South Australia, Metallurgical Chemist.
1894. Haynes, David O., 396, Broadway, New York City, U.S.A., Proprietor of "Pharmaceutical Era."
1894. Heal, Carlton, c/o Northampton Tanning Co., St. James' End, Northampton, Chemical Student.
1899. Healey, Alfred E., Willesden Paper and Canvas Works, Willesden Junction, N.W., Managing Director.
1894. Heap, Isaac H., Turnhurst Hall, Chell, near Stoke-on-Trent, Pharmaceutical Chemist.
1890. Heape, Chas., 19, George Street, Manchester, Calico Printer.
1898. Heasman, Walter, Castle Brewery, Bridgnorth, Salop, Brewer.
- O.M. Heath, R. C., Myton Grange, near Warwick, Chemical Manufacturer.
1897. Heaton, John, 3, Belle Vue Park, Sunderland, Brewer and Chemist.
1895. Hebden, Jno. C., 64, Exchange Place, Providence, R.I., U.S.A., Works Manager and Chemist.
1889. Hecht, Jos., c/o McCormick Harvesting Machine Co., Chicago, Ills., U.S.A., Analytical Chemist.
1895. Hecker, Paul, 102, Fenchurch Street, London, E.C., Chemical Merchant.
1900. Heckman, J. Conrad, Seneca Street, Buffalo, N.Y., U.S.A., Chemist.
1889. Heckmann, C., 9, Görlitzerufer, Berlin, S.O., Germany, Chemical Apparatus Maker.
1885. Hedley, Armorer, Mayfield, Gosforth, Newcastle-on-Tyne, Soap Manufacturer.
1895. Hedley, Geo. H., Hedge Mill, Loudwater, Bucks, Chemical Manufacturer.
1883. Heerlein, Robert, Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A., Salt Works Chemist.
1893. Hefford, Geo., Technical Institute, Stafford, Chemical Instructor.
- O.M. Hehner, O., 11, Billiter Square, London, E.C., Analytical and Consulting Chemist.
1898. Heileman, W. H., Washington Agricultural College, Pullman, Wash., U.S.A., Chemist.
1887. Hellier, E. A., 90, Marlborough Avenue, Hull, Varnish Manufacturer.
1895. Hellon, Dr. R., 40, New Lowther Street, Whitehaven, Analytical and Consulting Chemist.
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1898. Hemingway, Frank C. R., Albyns, Forest Road, Walthamstow, Essex.
1883. Hemingway, H., Marsh Gate Lane, Stratford, E., Chemical Manufacturer.
1884. Hempleman, F. S., Wennington House, Wennington, Romford, Essex, Manure Manufacturer.
1900. Henderson, J. Brownlie, Government Analyst's Office, Brisbane, Queensland, Government Analyst.
1894. Henderson, Jos., 3, Derwent Street, Norton Road, Stockton-on-Tees, Metallurgical Chemist.
1894. Henderson, Norman M., Broxburn Lodge, Broxburn, N.B., Oil Works Manager.
1883. Henderson, Prof. G. G., The Technical College, George Street, Glasgow, Professor of Chemistry.
- O.M. Henderson, W. F., Moorfield, Claremont Gardens, Newcastle-on-Tyne.
1893. Hendrick, Jas., Marischal College, Aberdeen, Lecturer on Agricultural Chemistry.
1889. Henmin, Alphonse, National Tube Works, McKeesport, Pa., U.S.A., Metallurgical Chemist.
1885. Henshaw, Jno., Green Lane, Brook Street, Manchester, Soap Manufacturer.
1894. Henshaw, Sam., Staffordshire Chemical Company, Limited, Tunstall, Stoke-on-Trent, Chemical Works Manager.
1894. Hepburn, J. G., Priory Works, Dartford, Kent, Leather Manufacturer.
1887. Herf, O., Herf & Frerichs Chemical Co., St. Louis, Mo., U.S.A., Chemical Manufacturer.
1897. Heriot, James, 18, Dumbiedykes Road, Edinburgh, Mineral Water Manufacturer.
1894. Heriot, T. H. P., Usine Ste. Madeleine, San Fernando, Trinidad, B.W.I., Analytical Chemist.
- O.M. Herman, W. D., Holm Lea, Rainhill, Lancashire, Glass Works Chemist.
- O.M. Heron, J., 110, Fenchurch Street, London, E.C., Brewing Chemist.
1899. Herrick, Rufus F., 22, Herrick Street, Winchester, Mass., U.S.A., Chemist.
1887. Herriot, Wm. Scott, c/o Calico Printers' Association, 56, Mosley Street, Manchester, Chief Engineer.
- O.M. Herrmann, R. W., 59, Mark Lane, London, E.C., Chemical Merchant.
1891. Hersam, Ernest A., University of California, Berkeley, Cal., U.S.A., Assistant Professor of Metallurgy.
- O.M. Herschel, Prof. A. S., F.R.S., Observatory House, Slough, Bucks, Hon. Professor of Experimental Physics.
1898. Hersey, Milton L., 146, St. James' Street, Montreal, Canada, Consulting Chemist.
1895. Hesketh, Everard, Dartford Ironworks, Dartford, Kent, Civil Engineer.
1898. Heslop, Oliver, 55, Sandown Lane, Wavertree, Liverpool, Analytical Chemist.
1885. Hess, Dr. Adolph, Oil Works, Leeds, Chemical Manufacturer.
1891. Hetherington, Dr. Albert E., Ammonia Soda Works, Fleetwood, Lancashire, Analytical Chemist.
1894. Hewitt, A. H., The Green Island Cement Co., Lim., Hong Kong, China, Engineer.
- O.M. Hewitt, Dr. D. B., Oakleigh, Northwich, Cheshire, Alkali Manufacturer.
1899. Hewitt, Edw. R., 13, Burling Slip, New York, U.S.A., Glue Manufacturer.
1896. Hewitt, Dr. J. Theo., 65, Silverdale, Sydenham, S.E., Lecturer.
1897. Hewitt, T. Lacey, Beechfield, St. John's, Higher Broughton, Manchester, Analytical Chemist.
1890. Hewlett, John C., 40-42, Charlotte Street, Great Eastern Street, London, E.C., Manufacturing Chemist.
1893. Hey, Harry, 2, Ash Terrace, Savile Town, Dewsbury, Dyer.
1884. Heyden, Dr. F. von, Chemische Fabrik, Radebeul, bei Dresden, Germany, Salicylic Acid Manufacturer.
1894. Heyl-Dia, G. Edw., 236, Great Clowes Street, Higher Broughton, Manchester, Chemical and Electrical Engineer.
1884. Heys, W. E., 70, Market Street, Manchester, Engineer and Patent Agent.



1884. Heys, Z. J., Stonehouse, Barrhead, N.B., Calico Printer.
1883. Heywood, J. H., 231, Drake Street, Rochdale, Technical Chemist.
- O.M. Heywood, J. S., 7, Caledonian Road, King's Cross, London, N., Chemical Manufacturer.
1897. Hibbard, Paul L., Nebraska City, Neb., U.S.A., Starch Chemist.
- O.M. Hibbert, W., 101, Goldhurst Terrace, South Hampstead, N.W., Analytical Chemist.
1897. Hicks, Edwin F., 203, West 81st Street, New York City, U.S.A., Analytical Chemist.
1893. Hicks, Jas. A., c/o B. Redwood, 4, Bishopsgate Street Within, London, E.C., Analytical Chemist.
- O.M. Higgin, W. H., Hollywood, Lostock, near Bolton-le-Moors, Chemical Manufacturer.
1886. Higgins, C. L., Muspratt's Works, Widnes; and (Journals) 79, Bedford Street South, Liverpool, Manufacturing Chemist.
1897. Hill, George, Barton-on-Humber, Chemical Works Manager.
1897. Hill, Herbert M., University of Buffalo, N.Y., U.S.A., Professor of Chemistry and Toxicology.
- O.M. Hill, J. K., 13, Osborne Place, Copland Road, Govan, near Glasgow, Manufacturing Chemist.
1892. Hill, Sydney, c/o Blundell, Spence, and Co., Ltd., Hull, Analytical Chemist.
1898. Hill-Jones, Thos., 30, Bisham Gardens, Highgate, N., Manufacturing Chemist.
- O.M. Hills, C. H., Anglesea Copper Works, Low Walker, Newcastle-on-Tyne, Copper Smelter.
1894. Hills, Harold F., 147, Bow Road, London, E., Analytical Chemist.
1898. Hills, Thos. Herbert, Chemical Works, Deptford, S.E., Chemical Manufacturer.
- O.M. Hills, W., 225, Oxford Street, London, W., Pharmaceutical Chemist.
1893. Hilton, Edgar G., 37, Kourlandsky Street, St. Petersburg, Russia, Varnish and Paint Manufacturer.
1899. Hinchley, J. W., 29, Furnival Street, Holborn, London, E.C., Chemical Engineer.
- O.M. Hindle, J. H., 8, Cobham Street, Accrington, Dye-works Manager.
1883. Hinds, James, 127, Gosford Street, Coventry, Pharmaceutical Chemist.
1899. Hinks, Percy J., Tavern Street, Stowmarket, Chemist.
1891. Hinman, Bertrand C., 9, Worship Street, London, E.C., Metallurgical Chemist.
1892. Hinshelwood, Thos., Glasgow Oil and Paint Works, Glenpark Street, Glasgow, Oil Refiner.
1900. Hirsh, Jos. E., 1245, 85th Street, Brooklyn, N.Y., U.S.A., Chemist.
1895. Hirst, H. Reginald, Croft House, Batley, Yorks, Works Chemist.
1896. Hislop, Geo. R., Gas Work House, Craigielea, Paisley, N.B., Gas Engineer and Manager.
1900. Hobbs, Alex. F., Merrimack Manufacturing Co., Lowell, Mass., U.S.A., Printworks Superintendent.
1900. Hobbs, Dr. Perry L., Western Reserve Medical College, Cleveland, Ohio, U.S.A., Professor of Chemistry.
1894. Hodge, Andrew, 20, Hawthorn Grove, Heaton Moor, near Stockport, Printworks Chemist.
1890. Hodges, Harry B., Long Island Railroad Co., Long Island City, N.Y., U.S.A., Chemical Engineer.
- O.M. Hodgkin, J., 12, Dynevor Road, Richmond, Surrey, Chemical Manufacturer.
- O.M. Hodgkinson, Dr. W. R., 18, Glenluce Road, Blackheath, S.E. (Journals); and Royal Artillery College, Woolwich, S.E., Prof. of Chemistry.
- O.M. Hodgson, C., High House, Eppleby, Darlington, Metallurgical Chemist.
1897. Hodgson, Matthew, Leitrim Cottage, Wicklow, Ireland, Technical Chemist.
1890. Hodgson, Wm., 66, Deansgate, Manchester, Oil and Colour Broker.
1886. Hogben, W., c/o Fiberloid Co., Newburyport, Mass., U.S.A., Analytical Chemist.
1888. Hogg, Quintin, 61, Threadneedle Street, London, E.C.; and (Journals) Polytechnic, 309, Regent Street, W., Merchant.
- O.M. Hogg, T. W., c/o John Spencer & Sons, Newburn Steelworks, Newcastle-on-Tyne, Metallurgical Chemist.
1899. Holden, Archie Neill, 73, Albert Road, Southport, Manufacturing Chemist.
1887. Holden, G. H., Gildabrook, Edge Lane, Chorlton-cum-Hardy, Manchester, Manufacturing Chemist.
1885. Holgate, S. V., 29, Long Row, Nottingham, Pharmaceutical Chemist.
1885. Holgate, T. E., 173, Hollins Grove, Darwen, Lancashire, Metallurgist.
1884. Holgate, T., Rawson Avenue, Greenroyd, Halifax, Gas Engineer.
- O.M. Holland, Philip, 22, Taviton Street, Gordon Square, London, W.C., Analytical Chemist.
1892. Holland, Philip H., 958, Sherbrooke Street, Montreal, Canada, Merchant.
- O.M. Holliday, R. (Read Holliday & Sons), Huddersfield, Dye Manufacturer.
1898. Hollinger, M. J., Alma Portland Cement Co., Wellston, Ohio, U.S.A., Chemist.
1896. Hollings, J. Spencer, Brymbo, North Wales, Works Manager.
1900. Hollinshead, W. H., Vanderbilt University, Nashville, Tenn., U.S.A., Teacher of Chemistry.
1890. Holloman, Fred R., 43, Southern Road, Plaistow, E., Sugar Works Chemist.
1890. Holloway, G. T., 57 and 58, Chancery Lane, W.C., Analytical and Consulting Chemist.
1884. Holloway, Wm., Newlands, Middlesbro', Manufacturing Chemist.
1900. Holtway, Jno., 6, Highbury Grange, London, N., Mine Owner.
1883. Holmes, Ellwood, Wyncote, Jesmond Park East, Newcastle-on-Tyne, Colour Manufacturer.
- O.M. Holmes, F. G., Haydn Villa, St. George's Road, Waterloo, Liverpool, Technical Chemist.
1900. Holthouse, Harold B., 12, Melton Grove, West Bridgford, Nottingham, Chemist.
1892. Holton, E. C., Sherwin-Williams Co., 100, Canal Street, Cleveland, Ohio, U.S.A., Chemist.
1893. Holzapfel, Max., Quayside, Newcastle-on-Tyne, Manufacturer.
1893. Homfray, D., 6, Dartmouth Row, Greenwich, S.E., Analytical Chemist.
1890. Hooker, Benj., Pear Tree Court, Farringdon Road, London, E.C., Mechanical Engineer.
1899. Hooker, H. D., 341, Adelphi Street, Brooklyn, N.Y., U.S.A., Sanitary Engineer.
- O.M. Hooper, E. Grant, Government Laboratory, Clement's Inn Passage, Strand, W.C.; and (Journals) 16, Royal Avenue, Sloane Square, S.W., Analytical Chemist.
1889. Hooper, Ernest F., Wear Fuel Works, Hendon Dock, Sunderland, Technical Chemist.
1888. Hope, Jas., The Nickel Co., Kirkintilloch, N.B., Nickel Works Manager.
1892. Hopkins, Erastus, Lake Mary, Florida, U.S.A., Consulting Chemist.
1893. Hopkins, Gerald V., Nicholaston House, Penmaen, near Swansea; and (Journals) Silico, Rossland, Canada, Metallurgist.
1894. Hopkins, Herbert W., 13, Harrington Gardens, South Kensington, S.W., Metallurgist.
1891. Hopkinson, John, Marion Street, Lister Hills, Bradford, Yorks, Lubricant Manufacturer.
1898. Hopwood, Wm. H., Strines, near Stockport, Printworks Chemist.
1889. Horn, Wm., Lautaro Nitrate Co., Taltal, Chili, Technical Chemist.
1895. Horne, W. D., Yonkers, N.Y., U.S.A., Consulting Chemist.
1900. Horsfall, Jno., 4, Grange Avenue, Rawtenstall, Manchester, Analytical and Consulting Chemist.
1901. Horton, Edw., jun., 8, Orford Street, Chelsea, S.W., Student.



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1892. Hosie, G. H., 136, Cambridge Drive, Kelvinside, N., Glasgow, Technical Chemist.
1890. Hoskins, A. Percy, 25, Cromwell Road, Belfast, Analytical Chemist.
1899. Hoskins, Wm., Room 55, 81, South Clark Street, Chicago, Ills., U.S.A., Chemist.
1897. Hotson, Arthur E., 147, East 125th Street, New York City, U.S.A., Chemist.
1899. Houlder, Bertram E., 10, Ossulton Villas, Southall, Middlesex, Chemist.
1892. Houston, John, 26, Princess Street, Manchester, Drysalter.
1888. Houston, Robt. S., Hawkhead Road, Paisley, N.B., Analytical Chemist.
1891. Hovenden, Fred., Glenlea, Thurlow Park Road, West Dulwich, S.E.
- O.M. Howard, A. G., Burnt House, Chigwell, Essex, Chemical Manufacturer.
1900. Howard, Chas. D., Agricultural Experiment Station, Morgantown, W. Va., U.S.A., Chemist.
- O.M. Howard, D., Devon House, Buckhurst Hill, Essex, Chemical Manufacturer.
1887. Howard, D. L., City Mills, Stratford, London, E., Chemical Manufacturer.
1898. Howard, Henry, 175, Mountfort Street, Brookline, Mass., U.S.A., Chemical Engineer.
- O.M. Howard, W. D., City Mills, Stratford, London, E., Chemical Manufacturer.
1899. Howles, Fred., c/o McDougall Bros., Millwall Docks, London, E., Chemist.
1889. Howorth, F. Wise, c/o Lloyd Wise, 46, Lincoln's Inn Fields, W.C., Manufacturing Chemist.
1896. Hoyte, Percy S., Gas Works, Coxside, Plymouth, Gas Engineer.
1900. Hübner, Julius, 24, Delaunay's Road, Crumpsall, Manchester, Chemist and Colourist.
1898. Hudson, Albert, Northport Mining and Smelting Co., Northport, Wash., U.S.A., Assayer.
1899. Hudson, Dr. Edw. J., Cleveland Cliffs Iron Co., Gladstone, Mich., U.S.A., Chemist.
1896. Hudson, Jos., Rawden Lodge, Headingley, Leeds, Drysalter.
1897. Hudson, Thos., Isle of Cinder Oil and Grease Works, Leeds, Oil Manufacturer.
- O.M. Hughes, J., 79, Mark Lane, London, E.C., Agricultural Chemist.
1898. Hughes, Raymond M., Oxford, Butler Co., Ohio, U.S.A., Professor of Chemistry and Physics.
- O.M. Hughes, T., 31, Loudon Square, Cardiff, Analytical Chemist.
1900. Hulley, Geo. D., c/o J. Eavenson and Sons, 20th and Wood Streets, Philadelphia, Pa., U.S.A., Soapworks Chemist.
1893. Humphrey, Chas., Hilderstone, Hartford, Cheshire, Alkali Works Manager.
- O.M. Hummel, Prof. J. J., 152, Woodsley Road, Leeds, Prof. of Dyeing.
1896. Humphrey, H. A., West View, Winington, Northwich, Chemical Manager.
- O.M. Humphrys, N. H., Gasworks, Salisbury, Wilts, Gas Engineer.
1895. Hunicke, Dr. H. Aug., 3532, Victor Street, St. Louis, Mo., U.S.A., Prof. of Applied Chemistry.
1900. Hunt, Arthur V., 76, Cromwell Street, Stretford, Lancashire, Analytical Chemist.
- O.M. Hunt, Bertram, c/o C. D. Laing, 717, Taylor Street, San Francisco, Cal., U.S.A., Technical Chemist.
- O.M. Hunt, C., Gasworks, Windsor Street, Birmingham, Gas Engineer.
- O.M. Hunt, E., Wood Green, Wednesbury, Staffordshire, Chemical Manufacturer.
1897. Hunt, Edmund, 121, West George Street, Glasgow, Patent Agent.
1883. Hunt, J. S., Appleton, Widnes.
1895. Hunt, L. W., 29, Albert Road, Withington, Manchester, Paint and Colour Manufacturer.
- O.M. Hunt, W., Hampton House, Wednesbury, Staffordshire, Chemical Manufacturer.
1897. Hunter, Prof. A. G. Kidston, (subs.) c/o John Hunter, 18, Great Clyde Street, Glasgow; and (Journals) P.O. Box 164, Dunedin, N.Z., Prof. of Chemistry.
1893. Hunter, Prof. Matthew, Rangoon College, Rangoon, Burmah, Prof. of Chemistry.
1892. Hunter, Sidney H., 202, Bow Road, E., Mechanical Engineer.
- O.M. Huntington, Prof. A. K., King's College, Strand, London, W.C., Prof. of Metallurgy.
1897. Huntington, Dr. Harwood, The Buckingham, 2, East 50th Street, New York, U.S.A., Consulting Chemist.
1884. Hunzinger, A., Dinting Vale Printworks, Dinting, Derbyshire, Calico Printer.
1900. Hurd, Geo. E., 72, Michigan Avenue, Chicago, Ills., U.S.A., Food Products Manufacturer.
1894. Hurry, E. H., Bethlehem, Pa., U.S.A., Mechanical Engineer.
1884. Hurst, G. H., 22, Blackfriars Street, Salford, Manchester, Analytical Chemist.
- O.M. Huskisson, P. L., 77, Swinton Street, London, W.C., Chemical Manufacturer.
- O.M. Huson, C. W., 18, Batavia Buildings, Hackins Hey, Liverpool, Analytical Chemist.
1894. Hutcheson, Jno. F., 22, St. Enoch Square, Glasgow, Chemical Manufacturer.
- O.M. Hutchinson, C. C., 3, Harcourt Buildings, Temple, E.C., Barrister-at-Law and Chemical Engineer.
1900. Hutchinson, Edw. G., Gasworks, Pontefract Road, Barnsley, Yorks, Assistant at Gasworks.
- O.M. Hutchinson, T. J., Aden House, Manchester Road, Bury, Analytical and Consulting Chemist.
- O.M. Huxley, J. H., 15, Kenwood Park Road, Sharrcw, Sheffield, Metallurgical Chemist.
1897. Hyams, Geoffrey M., P.O. Box 5104, and 312, Sears Building, Boston, Mass., U.S.A., Mines Manager.
1897. Hyde, B. T. Babbitt, c/o B. T. Babbitt, 82, Washington Street, New York, U.S.A., Soap Manufacturer.
1899. Hyde, Fred. S., 215, Schermerhorn Street, Brooklyn, N.Y., U.S.A., Research Chemist.
1897. Hyde, Henry St. John, 210, East 18th Street, New York City, U.S.A.
1899. Hyde, Wm. Grantley, 20, Wincham Street, Clapham Common, S.W., Assayer.
1896. Hyndman, H. H. Francis, Physical Laboratory, Leyden, Holland, Analytical and Consulting Chemist.
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1898. Ibbotson, E. C., jun., c/o Dearne and Dove Steelworks, Worsbrough Dale, Barnsley, Metallurgist.
1900. Ichioka, Tajiro, Stevenston, Ayrshire, Doctor of Chemistry, Chemist (Imperial Japanese Navy).
1885. Idris, T. H. W., Pratt Street, Camden Town, N.W., Mineral Water Manufacturer.
1899. Imhoff, Dr. Paul, 18, Greenbank Road, Liverpool, Chemist.
1900. Imrie, John, 415, Shields Road, Pollokshields, Glasgow, Analytical Chemist.
1900. Ingalls, Walter R., 153, Milk Street, Boston, Mass., U.S.A., Mining Engineer and Metallurgist.
1839. Ingle, Dr. Harry, 15, John Street, Kirkealdy, Fifeshire, Organic Chemist.
1891. Ingle, Herbert, Yorkshire College, Leeds, Assistant Lecturer on Chemistry.
1884. Inglis, R. A., Culrain, Bothwell, N.B., Analytical Chemist.
1891. Innes, Murray, P.O. Box 156, Clifton, Arizona, U.S.A., Technical Chemist.
1888. Iriyè, Koremasa, China and Japan Trading Co., Kobé, Japan, Analytical Chemist.
- O.M. Irvine, R., Royston, Granton, Edinburgh, Chemical Manufacturer.



1884. Irving, J. M., 17A, Dickinson Street, Cooper Street, Manchester, Chemical Merchant.
 O.M. Irwin, W., 3, Wilton Polygon, Cheetham Hill, Manchester, Analytical Chemist.
 1893. Isaac, J. F. V., , Research Chemist.
 1888. Isaac, T. W. Player, Barton Court, Abingdon, Chairman of Waterworks Co.
 1896. Isaacs, Louis A., 110, Greencroft Gardens, West Hampstead, N.W., Manufacturer.
 O.M. Isler, Otto, 35-37, Dickinson Street, Manchester, Chemical Merchant.
 1900. Itner, Dr. Martin H., c/o Colgate and Co., Jersey City, N.J., U.S.A., Soap and Essential Oil Chemist.

J

1890. Jackman, E. J., 60, Belgrave Road, Ilford, Essex, Technical Chemist.
 1898. Jackson, Alf. Greville, 208, George Street, Brisbane, Queensland, Electrical Engineer.
 1900. Jackson, Dr. W. Hatchett, Radcliffe Library, University Museum, Oxford, Librarian and Science Tutor (Keble College).
 O.M. Jackson, Edward, Clovelly, Grove Avenue, Moseley, Birmingham, Alkali Works Inspector.
 1891. Jackson, F., Smedley Bridge Works, Cheetham, near Manchester, Chemical Apparatus Maker.
 1883. Jackson, Frederick, 14, Cross Street, Manchester, Laboratory Furnisher.
 1884. Jackson, G. B., 7, Brazenose Street, Albert Square, Manchester, Chemical Manufacturer.
 1886. Jackson, John, 98, Dobbie's Loan, Glasgow, Lubricant Manufacturer.
 O.M. Jackson, R. V., c/o Scotch and Irish Oxygen Co., Polmadie, Glasgow, Technical Chemist.
 1891. Jackson, Robt., 18, Harrington Street, Dublin, Analytical Chemist.
 1890. Jackson, Saml., c/o Messrs. Binny & Co., Madras, India, Analytical Chemist.
 1898. Jackson, Thos., Clayton Chemical Works, Clayton Manchester, Chemical Manufacturer.
 1886. Jackson, Walter, 24, Sydenham Avenue, Sefton Park, Liverpool, Metallurgical Chemist.
 1899. Jackson, W. E. Russell, Sunderland Brewery, Sunderland, Brewer.
 1893. Jackson, Rt. Hon. W. L., M.P., F.R.S., 27, Cadogan Square, S.W.; and (Journals) Allerton Hall, Chapel Allerton, near Leeds, Leather Manufacturer.
 1900. Jackson, Victor G., 167, Grove Lane, Denmark Hill, S.E., Chemist.
 1899. Jackson, W. Morton, c/o Manchester Oxygen Co., Ltd., Great Marlborough Street, Manchester, Manager.
 O.M. Jackson, W. P., Saxilby, near Lincoln, Chemical Works, Manager.
 1900. Jacoby, Areli H., c/o F. E. Atteaux and Co., 176, Purchase Street, Boston, Mass., U.S.A., Chemist.
 1897. Jacqué, Maurice, Fabrica de Dinamita, Galdacano, cerca Bilbao, Spain, Chemical Engineer.
 1900. Jäger, B. M., c/o Geo. Jäger and Sons, 77, Burlington Street, Liverpool, Chemist, Sugar Refinery.
 1886. Jago, Wm., Godrevy House, Wilbury Avenue, Hove, Sussex, Chemical Engineer.
 1889. James, Alf., 56, New Broad Street, London, E.C., Mining Engineer.
 1900. James, Edgar C., 202, Portway, West Ham, E., Chemist.
 1883. James, E. T., British Alizarin Co., Ltd., Silvertown, Victoria Docks, E., Secretary.
 1885. James, Dr. J. Wm., Aylmer House, Weston-super-Mare; and (Journals) 29, Redcliff Street, Bristol, Chemical Lecturer.
 1893. James, Lawrence S., 32, Hawley Street, Boston, Mass., U.S.A., Gas Inspector.
 1894. Jameson, A. H., Logan Manufacturing Co., Phoenixville, Pa., U.S.A., Chemist.
 1897. Jansen, Dr. Robt., 43, Plymouth Avenue, Longsight, Manchester, Technical Chemist.
 1890. Jantzen, Paul, 132, Fenchurch Street, London, E.C., Chemical Merchant.
 O.M. Japp, Dr. F. R., F.R.S., The University, Aberdeen, Professor of Chemistry.
 1890. Jarmain, Geo. S., Kirkheaton, near Huddersfield, Wool Extractor.
 O.M. Jarmay, G., Hartford Lodge, Hartford, Cheshire, Alkali Manufacturer.
 1894. Jarrett, H. T., 90, William Street, New York, U.S.A., Chemist.
 1884. Jarves, Deming, Michigan Carbon Works, Detroit, Mich., U.S.A., Manufacturing Chemist.
 1900. Jarvie, Hugh, Earnest Soap and Glycerin Works, Coatbridge, N.B., Chemist.
 1900. Jarvie, Jas., Monkland House, Kirkintilloch, N.B., Chemist.
 1894. Jarvis, Talbot McL., Castle Lodge, Bedford, Brewer.
 O.M. Jayne, Dr. H. W., 931, North Broad Street, Philadelphia, U.S.A., Manufacturing Chemist.
 1900. Jefferson, Jos., Empreza Industrial Portuguesa, Sto. Amaro, Lisbon, Metallurgist.
 O.M. Jekyll, J., Castle Moat House, Lincoln, Chemical Manufacturer.
 1892. Jenkin, W. A., 5, Bella Vista, Minas de Rio Tinto, Provincia de Huelva, Spain, Metallurgical Chemist.
 1894. Jenkins, John H. B., Laboratory, G.E.R. Works, Stratford, E., Analytical Chemist.
 1894. Jenks, Robt. L., Research Department, Imperial Institute, London, S.W., Chemist.
 O.M. Jenner, E., 209, Markhouse Road, Walthamstow, Essex, Chemical Manufacturer.
 1898. Jennings, Arthur S., 62, Barry Road, East Dulwich, S.E., Editor of "Oils, Colours, and Drysalteries."
 1899. Jennings, Thos., Brookfield, Cork, Ireland, Chemical Manufacturer.
 1899. Jerdan, Dr. David S., c/o J. and G. Cox, Ltd., Gorgie Mills, Edinburgh, Chemist (Gelatin Works).
 1899. Jessop, Louis V., 8, Rockmead Road, Victoria Park, N.E., Chemist.
 1896. Job, Robt., 638, North 6th Street, Reading, Pa., U.S.A., Analytical Chemist.
 1886. Johnson, A. E., 155, Lea Road, Wolverhampton, Analytical Chemist.
 1900. Johnson, Albert C., 320, East 25th Street, Baltimore, Md., U.S.A., Chemical Engineer.
 1893. Johnson, Chas. H., jr., Laboratory, Rubberine Works, Oatlands Mill, Leeds, Works Manager.
 1891. Johnson, Edmond E., Engineering Works, Carpenter's Road, Stratford, E., Chemical Engineer.
 1897. Johnson, Edward H., Cyanide Works Manager.
 1900. Johnson, F. Carter, National Acid Co., 714, Union Street, New Orleans, La., U.S.A., Chemical Engineer.
 O.M. Johnson, J. E., 40, Idmiston Road, Stratford, London, E., Manufacturing Chemist.
 1884. Johnson, J. Grove, 23, Cross Street, Finsbury, London, E.C., Assayer.
 1895. Johnson, Jesse F., c/o Hamilton Powder Co., Montreal, Canada, Chemical Engineer.
 1900. Johnson, Jno. E., 95, Liberty Street, New York City, U.S.A., Chemical Engineer.
 1900. Johnson, Jno. W. H., York House, Thornhill, Dewsbury, Yorks, Analytical Chemist.
 O.M. Johnson, S. H., Warren Hill House, Loughton, Essex, Chemical Engineer.
 1899. Johnson, S. H., jun., Engineering Works, Stratford, E., Chemical Engineer.
 O.M. Johnson, T. A., Field House, Winnington Park, Northwich, Cheshire.
 1900. Johnson, Thos. II., American Forcite Powder Manufacturing Co., Landing, N.J., U.S.A., Superintendent.
 1895. Johnston, Alex. R., 18, Percy Street, Ibrox, Glasgow, Analytical Chemist.



1894. Johnston, G. L., Kingswood Road, Sydenham Hill, S.E., Director (Bovril, Ltd.).
1889. Johnston, Thos., Nobel's Explosives Co., Ltd., 149, West George Street, Glasgow, Explosives Co.'s Manager.
1890. Johnston, Wm. A., The S. S. White Dental Manufacturing Co., Princess Bay, New York, U.S.A., Dental Enamel Manufacturer.
1894. Johnston, Wm. E. Lawson, 8, Park Crescent, London, W., Assistant Chemist (Bovril, Limited).
- O.M. Johnston, Wm. G., Chemical Works, Coatbridge Street, Port Dundas, Glasgow, Technical Chemist.
- O.M. Johnstone, Jas., Shawfield Works, Rutherglen, Glasgow, Technical Chemist.
- O.M. Johnstone, W. G., The Brewery, Newark-on-Trent, Chemist.
- O.M. Johnstoun - Coombes, Dr. W., Pilmuir, Falmouth, Analytical Chemist.
- O.M. Jones, Chapman, Royal College of Science, South Kensington, S.W., Senior Demonstrator in Chemistry.
1897. Jones, Chas. H., Minas de Rio Tinto, South Spain, Technical Chemist.
1899. Jones, Ernest W., 18, Upper Tooting Road, S.W., Chemist.
- O.M. Jones, E. W. T., 10, Victoria Street, Wolverhampton, Analytical Chemist.
1897. Jones, Fred. W., Barwick, near Ware, Herts, Explosives Works Manager and Chemist.
1896. Jones, G. Cecil, Basingstoke Ironworks, Basingstoke, Works, Chemist.
1900. Jones, Gordon, Pystill, Holywell, Flint., North Wales, Paper Manufacturer.
1898. Jones, Henry, Broughton Bridge Mills, Salford, Dyer and Finisher.
1893. Jones, Herbert. See Sefton-Jones, H.
1899. Jones, Llewellyn J. W., Omaha Smelting Works, Omaha, Neb., U.S.A., Metallurgist.
1898. Jones, Martin L., c/o Joregum G. M. Co., Oorgaum, Mysore Prov., India, Metallurgical Chemist.
1894. Jones, M. W., 8, Cavendish Place, Jesmond, Newcastle-upon-Tyne, Analytical Chemist.
1899. Jones, Thos. J., Anglo-Continental Guano Works, North Woolwich Road, E., Foreman.
1887. Jones, T. Tolley, 356, Little Collis Street, Melbourne, Victoria, Explosives Manufacturer.
- O.M. Jones, W. Norris, Lancashire Metal Works, Widnes, Technical Chemist.
1899. Joplin, Geo. C., 8, O'Connell Street, Sydney, N.S.W., Australia, Analyst.
1897. Jorissen, Dr. Wm. P., Koninklijk Inst. v. d. Marine, Willemsoord, Holland, Editor.
1892. Joseland, Walter H., Laboratory, Newport Lane, Burslem, Staffordshire, Analytical Chemist.
1900. Josephson, Edgar, 131, Amity Street, Brooklyn, N.Y., U.S.A.
1891. Joslin, Omar T., 215, East Fourth Street, Cincinnati, Ohio, U.S.A., Chemical Engineer.
1887. Joüet, Dr. C. H., Roselle, Union Co., N.J., U.S.A., Technical Chemist.
1889. Journand, Louis, 21, Grand Rue, Bourg-de-Péage, Drôme, France, Technical Chemist.
1888. Joy, Douglas G., Pine Wood, Beverley, Yorks, Oil Refiner.
1887. Jürgensen, Dr. Rolof, Karls-gasse 5, Prag-Zizkov, Austria, Chemist.
1900. Just, Jno. A., 109, West Kennedy Street, Syracuse, N.Y., U.S.A., Chemist.
- O.M. Justice, P. M., 55-56, Chancery Lane, London, W.C., Patent Agent.
1899. Karas, J., c/o Tim and Co., Troy, N.Y., U.S.A., Laundryman.
1892. Kaufmann, Dr. Herbert M., c/o Mutual Chemical Co., Jersey City, N.J., U.S.A., Chemist.
1885. Kawakita, Michitada, Imperial Engineering College, Tokio, Japan, Analytical Chemist.
- O.M. Kay, H. A., 71, Maida Vale, London, W.
1891. Kay, Dr. Percy, South-Western Polytechnic, Manresa Road, Chelsea, S.W., Analytical Chemist.
- O.M. Kay, W. E., Ashlands, Sale, Cheshire, Printworks Chemist.
- O.M. Kearns, H. W., Baxenden, near Accrington, Dyer.
1897. Kearns, Jno. S., Baxenden House, near Accrington, Chemist and Dyer.
1894. Kebler, Lyman F., 35, Poplar Street, Philadelphia, Pa., U.S.A., Analytical and Manufacturing Chemist.
1900. Keeble, Arthur J., Peterborough, Cement Manufacturer.
1886. Keiser, Prof. E. H., Washington University, St. Louis, Mo., U.S.A., Professor of Chemistry.
1900. Kelf, Henry C., c/o East India Distilleries, Nellikuppam, S. Arcot, Madras, India, Sugar Chemist.
1900. Kellner, Dr. Carl, Kellner Partington Paper Pulp Co., Hallein bei Salzburg, Austria, Paper Chemist.
1885. Kellner, Dr. Wm., 13, Victoria Road, Old Charlton, S.E., Chemist to War Department.
1901. Kelsey, D. McC. Stone, 192, Woodlawn Avenue, Saratoga Springs, N.Y., U.S.A., Manufacturing Chemist.
1898. Kemball, Chas. F., Ogdensburg, N.Y., U.S.A., Chemical Manufacturer.
1889. Kempson, John F., Pye Bridge Chemical Works, near Alfreton, Derbyshire, Chemical Manufacturer.
1891. Kenrick, Prof. Edgar B., St. John's College, Winnipeg, Manitoba, Canada, Professor of Chemistry.
1888. Kent, Wm. J., Holly Lodge, Hornsea, Yorks, Assayer and Chemical Engineer.
1889. Kenyon, Thos., The Shrubbery, Hilton Park, Prestwich, near Manchester, Manufacturing Chemist.
1900. Keppelmann, Alf. J., 308, Carpenter Street, Germantown, Pa., U.S.A., Chemical Merchant.
1888. Ker, Alan D., Millburn Chemical Works, Garngad Hill, Glasgow, Chemical Manufacturer.
1899. Kern, Walter P., 141, Milton Street, Brooklyn, N.Y., U.S.A., Chemist.
1894. Kerr, Jas., 42, Craiglea Drive, Morningside, Edinburgh, Works Chemist.
1890. Kerr, Saml. T., c/o Alex. Kerr Bros. & Co., Philadelphia, Pa., U.S.A., Salt Manufacturer.
1897. Kerr, Wm. M., c/o General Chemical Co., 608, Philadelphia Bourse, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1896. Kershaw, J. B. C., Faraday House, Charing Cross Road, W.C., Analytical Chemist.
1893. Kestner, Paul, 22, Boulevard Vauban, Lille, France, Chemist.
1898. Keswick, Wm., M.P., 3, Lombard Street, London, E.C., Merchant.
1900. Kewley, Jas., Arbory Road, Castletown, Isle of Man, Technical Chemist.
1890. Keys, W. H., Hall End Chemical Works, West Bromwich, Oil and Chemical Manufacturer.
1892. Kibble, W. Oakes, Sonora, Tuolumne Co., Cal., U.S.A., Chemical Engineer.
1896. Kier, Thos., Thornliebank, Glasgow, Chemist.
1900. Kilgore, Benj. W., Raleigh, N. Carolina, U.S.A., Chemist.
- O.M. Kinch, E., Royal Agricultural College, Cirencester, Professor of Chemistry.
- O.M. King, A. J., Ingersley Vale, Bollington, near Macclesfield, Bleacher and Finisher.
1883. King, C. M., Chemical Engineer.
1884. King, C. M., Campsie Alum Works, Leenoxtown, N.B., Alum Manufacturer.
1887. King, Sir James, Bart., 115, Wellington Street, Glasgow, Chemical Manufacturer.
- O.M. King, J. Falconer, 20, Chambers Street, Edinburgh, Consulting Chemist.

K

1898. Kahn, Julius, Hotel Majestic, 4, West 72nd Street, New York, U.S.A., Manufacturer of Rubber Goods.
1896. Kalbfleisch, Franklin H., 33-35, Burling Slip, New York, U.S.A., Chemical Manufacturer.
1884. Kalle, Dr. Wm., Biebrich-am-Rhein, Germany, Colour Manufacturer.



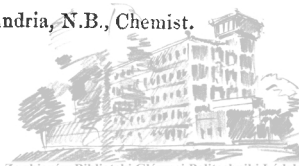
1897. King, Joshua, Clarewood, Camberley, Surrey, Indian Civil Service (retired).
1887. King, Robt., 115, Wellington Street, Glasgow, Chemical Manufacturer.
1895. King, Sidney J., 49, Arundel Square, Barnsbury, N., Colour and Dyestuff Traveller.
- O.M. King, Walter R., (Journals) Avalon, Trinity Avenue, Southend-on-Sea; and (Subscriptions) 47, Wilson Street, Finsbury, E.C., Chemical Manufacturer.
1839. King, Wm. R., Box 695, Summit, N.J., U.S.A., Mechanical Engineer.
1896. Kingdon, G. Holman, Ivy Lodge, Frogghall, Warrington, Technical Chemist, M.A., Oxon.
1899. Kingsford, Edw. A., 91, Petherton Road, Highbury, N., Manufacturing Chemist.
1883. Kingsford, T. P., Oswego, New York, U.S.A., Starch Manufacturer.
- O.M. Kingzett, C. T., Elmstead Knoll, Chislehurst, Kent, Technical Chemist.
1892. Kinnicut, Professor L. P., 77, Elm Street, Worcester, Mass., U.S.A., Professor of Chemistry (Worcester Polytechnic Institute).
1897. Kipping, Dr. F. Stanley, F.R.S., University College, Nottingham, Prof. of Chemistry.
1897. Kirkby, Wm., 14, Ducie Avenue, Oxford Road, Manchester, Chemist.
1898. Kirkland, Archd., High Street, Irvine, N.B., Baker.
1897. Kirkland, Robt., Viewfield, Newmains, N.B., Chemist.
1900. Kirkpatrick, Staffor F., c/o Mountain Copper Co., Keswick, Shasta Co., Cal., U.S.A., Assayer.
1887. Kitamura, Y. (Journals), c/o R. Fujihanaya, Yokoyamacho Sanchoe, Tokyo, Japan, Agricultural Chemist.
1883. Kitchen, Theo., (Journals) 28, Flinders Lane North, Melbourne, Australia; and (subs.) 35, Queen Victoria Street, E.C., Soap and Candle Manufacturer.
1891. Kitson, Sir James, Bart., M.P., Gledhow Hall; and (Journals) Monkbridge Iron and Steel Co., Ltd., Leeds, Iron and Steel Manufacturer.
1883. Kitto, B., 26, Lancaster Road, Finsbury Park, London, N., Analytical Chemist.
1900. Kittredge, H. G., 42, Linden Avenue, Dayton, Ohio, U.S.A., Chemist.
1900. Kleber, Dr. Clemens, Union Avenue, Clifton, N.J., U.S.A., Director (Fritzche Bros.' Laboratory).
1888. Kleemann, Dr. S., Farben Fabrik, Forcheim, Bavaria, Analytical Chemist.
1898. Klein, Otto H., Room 110, Stewart Building, 280, Broadway, New York, U.S.A., Consulting Engineer.
1889. Klipstein, A., 122, Pearl Street, New York, U.S.A., Chemical Manufacturer.
1891. Knaggs, Alfred B., Bradley Lane, Huddersfield, Technical Chemist in Dyeworks.
1900. Knapp, Rudolf R., 487, East Congress Street, Detroit, Mich., U.S.A., Chemist.
1901. Knecht, Carl E., 1615, Figueroa Street, Los Angeles, Cal., U.S.A., Chemist.
1892. Knecht, Dr. E., Station Road, Crumpsall, Manchester, Analytical Chemist.
1900. Kniffen, Fred., U.S. Naval Smokeless Powder Factory, Indian Head, Md., U.S.A., Chemist.
1887. Knight, A. H., 2, Gerald Road, Oxton, Cheshire, Assayer.
1884. Knight, Henry, 33, Faraday Street, Breck Road, Liverpool, Colour and Varnish Manufacturer.
- O.M. Knight, J. B., Silvertown Soapworks, Silvertown, London, E., Soap Manufacturer.
1894. Knight, Wm. A., Sexey's Trade School, Bruton, Somerset, Head Master.
1887. Knights, J. West, Public Laboratory, Tenison Road, Cambridge, Analytical Chemist.
1885. Knipfer, F., c/o R. Harper and Co., 352, Flinders Lane, Melbourne, Victoria, Starch Manufacturer.
1883. Knowles, Joshua, Stormer Hill, Tottington, near Bury, Calico Printer.
1886. Knox, E. W., Colonial Sugar Refining Co., Sydney, N.S.W.; and c/o Parbury Henty & Co., 20, Eastcheap, London, E.C., Sugar Manufacturer and Refiner.
1895. Koechl, Victor, 122, Hudson Street New York; (Journals) 47, Montgomery Place, Brooklyn, N.Y., U.S.A.; Dye Merchant.
1884. Kohn, Dr. Chas. A., University College, Liverpool, Chemical Demonstrator.
1896. Kohnstamm, E. H., 44, West Broadway, New York, U.S.A., Colour Maker and Importer.
1884. Kolb, J., Soc. Anon. des Manuf. de Produits Chimiques, Lille, France, Chemical Manufacturer.
1898. Koop, Eugene, 1, Leadenhall Street, London, E.C., Chemical Merchant.
- O.M. Kraftmeier, E., 54, Parliament Street, Westminster, S.W., Explosives Manufacturer.
1894. Krause, Dr. Albert H., 32, Wellington Avenue, Cleveland, Ohio, U.S.A., Chemist (Grasselli Chemical Co.).
- O.M. Krause, Dr. G., "Chemiker-Zeitung," Cöthen, Germany, Editor.
- O.M. Krause, O. H., c/o American Sugar Refining Co., Jersey City, N.J., U.S.A., Chemical Engineer.
1898. Krebs, H. J., Wilmington, Del., U.S.A., Manufacturing Chemist.
1900. Kremers, Dr. Edw., Madison, Wis., U.S.A., Professor (University of Wisconsin).
1899. Krick, Howard L., Sheridan Furnaces, Sheridan, Leb. Co., Pa., U.S.A., Analytical Chemist.
- O.M. Kühl, W. H., 73, Jägerstrasse, Berlin, Germany, Bookseller.
1900. Kunheim, Erieh, 32, Dorathenstrasse, Berlin, N.W., Germany, Chemist.
1885. Kupferberg, Dr. H., 303, Collyhurst Road, Manchester, Technical Chemist.
1896. Kuttroff, Adolf, 128, Duane Street, New York, U.S.A., Chemical Merchant.
1900. Kuttroff, Fred., 128, Duane Street, New York City, U.S.A., Merchant.
- O.M. Kynaston, J. W., 3, Oak Terrace, Beech Street, Liverpool, Chemical Engineer.
1898. Kynaston, Wm. C. R., 9, Harland Road, Higher Tranmere, Cheshire, Analyst.

L

1897. Labonde, Dr. Leon, Los Angeles, Cal., U.S.A., Consulting Chemical Engineer.
1890. Lacey, E. C., 10, Clarence Road, Croydon, Manufacturing Chemist.
- O.M. Lacey, T. S., Gas Light and Coke Company, Lupus Street, Pimlico, S.W., Gas Engineer.
1899. Lachman, Albert, California Wine Association, San Francisco, Cal., U.S.A., Wine Merchant.
1897. Ladd, Edwin F., Agricultural College, Fargo, North Dakota, U.S.A., Prof. of Chemistry.
1888. Lagerwall, Dr. Ivar, 3, Prince's Street, London, E.C.; and (Journals) Sunthorpe, Wallington, Surrey, Petroleum Manufacturer.
- O.M. Laidler, C. P., 20, Noble Terrace, Gateshead-on-Tyne, Analytical Chemist.
1894. Laing, Wm., 10-11, The Exchange, Bradford, Yorks, Oil Merchant.
- O.M. Lake, G., jun., 83, Primrose Lane, Glossop, Derbyshire, Analytical Chemist.
1900. Lamar, Wm. R., 840, Southern Boulevard, New York City, U.S.A., Chemist.
1898. Lamb, Morris C., Herold's Institute, Drummond Road, Bermondsey, S.E., Chemist.
1898. Lamb, Osborn R., 59, Carmine Street, New York, U.S.A.
1892. Lambert, Alan, Union Oil Mills, Ltd., 18, Bishops-gate Street Within, E.C., Oil Mills Director.
1900. Lambert, Walter S., 56, Leytonstone Road, Stratford, E., Analyst.
1899. Lamborn, Leebert Ll., 108, Fulton Street, New York City, U.S.A., Technical Chemist.
1895. Lancaster, Jno. C., 260, Alfreton Road, Nottingham, Engineering Works Manager.



1900. Lander, Geo. D., 1, Balmoral Road, Nottingham, Lecturer.
1895. Landin, John, 40, Drottninggatan, Stockholm, Sweden, Public Analyst.
1890. Lang, Jas. G., Balmoral Hotel, Victoria, British Columbia, Analytical Chemist.
1899. Lang, Dr. Wm. R., University of Toronto, Canada, Professor of Chemistry.
- O.M. Langdon, Dr. M. J., 16, Harriet Street, Stretford, Manchester, Analytical Chemist.
1890. Lange, Dr. Martin, Nieuwe Witsenkade 35, Amsterdam, Holland, Analytical Chemist.
1892. Langer, Dr. Carl, Ynyspenllwch, Clydach, R.S.O., Glamorganshire, Analytical Chemist.
1897. Langmuir, Arthur C., c/o Marx and Rawolle, 9, Van Brunt Street, Brooklyn, N.Y., U.S.A., Analytical Chemist.
1898. Langstaff, Wm., 34, Fowler Street, Cleveland, Ohio, U.S.A., Chemist.
1900. Lant, Herbert, c/o Chas. Stanley & Son, Ltd., Wath-on-Dearne, near Rotherham, Yorks, Chemist and Manager.
1884. Latham, Baldwin, 13, Victoria Street, Westminster, S.W., Civil Engineer.
1889. Latham, J. J., Mill House, Bold, Widnes, Chemical Works Manager.
- O.M. Lawrence, Jas., Repauno Chemical Works, Paulsboro', N.J., U.S.A., Assistant Manager.
- O.M. Laws J. P., 2, Aigburth Vale, Liverpool, S., Analytical Chemist.
1885. Lawson, Arthur J., Marsh Soapworks, Bristol, Soap Manufacturer.
1888. Lawson, Dr. T. A., 90, Boundary Road, London, N.W., Colour Chemist.
1900. Lawson, Wm., Alameda Sugar Co., Alvarado, Cal., U.S.A., Chemist.
1893. Lawton, Thos., Calthorpe House, Aldridge Road, Perry Bar, Birmingham, Chemical Works Manager.
1890. Laycock, Dr. W. F., 2, Park Street, Dewsbury, Analytical Chemist.
1898. Lean, Geo., 15, Park Terrace, Glasgow, Chemist.
1897. Leathart, Thos. H., Bracken Dene, Gateshead-on-Tyne, Lead Manufacturer.
- O.M. Leather, Dr. J. W., Dehra Dun, N.W.P., India, Agricultural Chemist, Government of India.
1897. Le Bosquet, Maurice, 328, East Eagle Street, East Boston, Mass., U.S.A., Technical Chemist.
1893. Le Boutillier, Clement, c/o Taylor Iron and Steel Co., High Bridge, N.J., U.S.A., Chemist.
1896. Lecomber, W. G., Moorland Villa, Brooklands, near Manchester, Engineer.
1896. Lederle, Dr. E. J., Health Department, New York City, U.S.A., Chief Chemist.
1892. Ledoff, Prof. A., Technological Institute, Kharkoff, Russia, Professor of Chemistry.
1895. Ledoux, Dr. Albert R., 99, John Street, New York City, U.S.A., Chemist.
1898. Lee, Jno. L., 44, Westby Street, Lytham, Lancashire, Dyer and Bleacher.
1889. Lee, J. W. Richmond, 70, St. Helens Gardens, North Kensington, W.; and (Journals) Villar, Onis, Prov. de Oviedo, Spain, Mining Engineer.
1885. Lee, S. Wright, 6-10, Whitechapel, Liverpool, Wholesale Druggist.
1891. Lee, Theo. H., (subsn.) Edgcumbe Villa, Clevedon, Somerset; and (Journals) St. John Del Rey Mine, Morro Velho, Villa Nova de Lima, Minas Geraes, Brazil; Analytical Chemist.
1899. Lee, Waldemar, Passaic, N.J., U.S.A., Chemist.
1886. Leeds, F. H., 26, East Bank, Stamford Hill, N., Analytical Chemist.
1889. Leese, Joseph, 3, Lord Street West, Southport.
1884. Leete, Jes., 19-25, Bermondsey Street, S.E., Lithographic Printer.
1901. Leibfried, Jno. E., Bethlehem, Pa., U.S.A., Analytical Chemist.
1888. Leigh, Cecil, Adderley Park Rolling Mills, Birmingham, Technical Chemist.
1894. Leitch, Jno. W., Milusbridge Chemical Works, near Huddersfield, Aniline Dye Manufacturer.
1898. Leman, Wm. T., c/o Paragon Refinery Co., Toledo, Ohio, U.S.A., Oilworks Manager.
1894. Leuders, A. W. H., c/o Glucose Sugar Refining Co., Davenport, Iowa, U.S.A., Technical Chemist.
1883. Lennard, F., 70, Gracechurch Street, E.C.; and (Journals) Merrow Croft, Merrow, Guildford, Chemical Manufacturer.
1884. Leonard, Wm. J., Hope Chemical Works, Hackney Wick, E., Naphtha Distiller.
1888. Lequin, E., 9, Rue Ste. Cécile, Paris, General Manager of Chemical Works (St. Gobain Co.).
1895. Lesinsky, Dr. Jos., 36, East 61st Street, New York, U.S.A., Manufacturing Chemist.
1894. Leslie, Hugh M., Marikuppam, Mysore State, South India, Chemical Engineer.
1899. Lesser, Wm., P.O. Box 162, Albany, N.Y., U.S.A., Manufacturing Chemist.
1900. Lessner, Chas. B., 331, Ivydale Road, London, S.E., Metallurgical Chemist.
1896. Lester, Isaac E., Lyndhurst, Coundon Road, Coventry, Steelworks Manager.
1892. Lester, J. H., Royal Exchange, Manchester, Analytical Chemist.
1899. Le Sueur, Henry R., Chemical Laboratory, St. Thomas' Hospital, London, S.E., Demonstrator.
1894. Lett, Stephen J., 25, Percy Street, Liverpool, and (Journals) Fort Young, N.E. Rhodesia, *via* Clinde and Kota Kota, Analytical Chemist.
1891. Lever, Jas. D., Thornton Hough, Cheshire, Soap Manufacturer.
1891. Lever, Wm. H., Thornton House, Thornton Hough, Cheshire, Soap Manufacturer.
1900. Levine, Edmund J., c/o The Fiberloid Co., 638, Broadway, New York City, U.S.A., Chemist.
1901. Levinstein, Dr. Herbert, Crumpsall Vale Chemical Works, Crumpsall, Manchester, Chemist.
- O.M. Levinstein, Ivan, 21, Minshull Street, Manchester, Colour Manufacturer.
1887. Lewes, Prof. Vivian B., Royal Naval College, Greenwich, S.E. Professor of Chemistry.
1898. Lewin, H. James, Royal Victoria Yard, Deptford, S.E., Assistant Inspector of Stores.
- O.M. Lewinton, B.,
1889. Lewis, A. E., 2, Mulgrave Street, Liverpool, Analytical Chemist.
1896. Lewis, Daniel C., c/o Millville Manufacturing Co., Millville, N.J., U.S.A., Dye and Bleach Works Chemist.
1900. Lewis, Ernest A., 310, Dudley Road, Birmingham, Chemist and Metallurgist (Muntz Metal Co.).
1900. Lewis, John, 57, East Dulwich Road, East Dulwich, S.E., Cashier (Paint Works).
1900. Lewis, Saml. J., 122, Newington Causeway, London, S.E., Pharmaceutical Chemist.
1889. Lewkowitsch, Dr. Julius, 71, Priory Road, West Hampstead, N.W., Consulting Chemist.
1901. Lichtenstein, Alf. S., Arnold Printworks, North Adams, Mass., U.S.A., Chemist.
- O.M. Lichtenstein, Theodore, Chemical Works, Silvertown, London, E., Manufacturing Chemist.
1892. Liddle, G. A., 313, Walmersley Road, Bury, Lancashire, Chemist, Dyewood Extract Works.
1885. Liddle, W. T., Woodville, Walmersley Road, Bury, Lancashire, Manager, Dyewood Extract Works.
- O.M. Liebmann, Dr. A., 61, Marsden Street, Manchester, Analytical Chemist.
1899. Liedbeck, P. F. Alarik, Stockholm, Sweden, Chemical Engineer.
- O.M. Lightfoot, T. E., 88, Arden Terrace, Accrington, Calico Printer's Chemist.
1898. Lilly, Josiah K., c/o Eli Lilly and Co., Indianapolis, Ind., U.S.A., Manufacturing Pharmacist.
1885. Lilly, Oliver M., The Croft, Spondon, Derby, Colour Manufacturer.
1897. Lindsay, Robt., Rosshead, Alexandria, N.B., Chemist.



1890. Ling, Arthur R., Laboratory, 2, St. Dunstan's Hill, E.C., and (Journals) 45, Lambton Road, Cottenham Park, Wimbledon, Analytical and Consulting Chemist.
1900. Linton, Jas. H., c/o Tenn. Coal, Iron, and R. R. Co., Ensley, Ala., U.S.A., Chemist.
1896. Lishman, Geo. P., Bunker Hill, Fence Houses, Co. Durham, Colliery Chemist.
1896. Littell, R. Ballantine, 50, South Walnut Street, E. Orange, N.J., U.S.A., Chemist.
1900. Little, Jno. G., 66, Albany Street, London, N.W., Assayer.
1889. Little, Wm. G., Blendon Grove, Bexley, Kent, Chemical Manufacturer.
- O.M. Littlejohn, J., Analytical Chemist.
1886. Liversedge, A. J., 41, Elms Road, Clapham Common, S.W., Mechanical Engineer.
- O.M. Liversidge, Prof. A., F.R.S., The University, Sydney, New South Wales, Professor of Chemistry.
1883. Livingston, W. J., London County Council, Spring Gardens, London, S.W., Analytical Chemist.
1899. Lloyd, Charles, 77, Bishopsgate Street Within, E.C., and (Journals) c/o Manager, Lake View Consols, Ltd., Boulder, Western Australia, Secretary.
1900. Lloyd, Fred. J., Muscovy House, Trinity Square, London, E.C., Analyst.
1900. Lloyd, Thos. H., 121, Kingsley Road, Prince's Park, Liverpool, Analyst.
1899. Lockwood, Alfred A., 48, East Street, Faversham, Kent, Metallurgist.
1899. Loder, Francis H., 9, St. John's Park, Blackheath, S.E., Director.
1884. Lodge, A. S., Newchurch, near Manchester, Technical Chemist.
1888. Lodge, Edw., 25, Cowcliffe Hill, Huddersfield, Teacher of Wool Dyeing.
1900. Loeb, Dr. Morris, New York University, University Heights, New York City, U.S.A., Professor of Chemistry.
1901. Loebell, Eugene, jun., 130, Dickenson Road, Rusholme, Manchester, Brewers' Chemist.
1891. Loewenthal, Dr. R., Sandweg 22, Frankfurt a/M., Germany, Textile Chemist and Lecturer on Dyeing.
1899. Logan, John, Moatfield House, Timperley, Cheshire, Indigo-Blue Dyer.
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1888. Lombard, Emile, 12-Rue Breteuil, Marseilles, France, Director of Pyrites Co.
1898. Longstaff, Jas. P., Chemical Department, University New Buildings, Edinburgh, Assistant.
1899. Loos, Hermann A., c/o Copper Corporation of Chile, Chañaral, Chile, Chemist.
1890. Lord, F. J., 4, Winmarleigh Street, Warrington Analytical Chemist.
1896. Lord, Jno. Lloyd, 5, Commercial Buildings, Love Clough, near Rawtenstall, Chemist and Manager.
1897. Lord, N. W., 338, West 8th Avenue, Columbus, Ohio, U.S.A., Professor of Metallurgy.
- O.M. Lorenz, H., 7 and 8, Idol Lane, London, E.C., Chemical Merchant.
- O.M. Lorimer, J., Britannia Row, Islington, N., Manufacturing Chemist.
- O.M. Lorrain, J. G., Norfolk House, Norfolk Street, Strand, London, W.C., Civil Engineer.
- O.M. Lott, F. E., The Laboratory, Bridge Chambers, Burton-on-Trent, Consulting Bridging Chemist.
1893. Loughton, J. P., Washington Chemical Works, co. Durham, Technical Chemist.
- O.M. Louis, D. A., 77, Shirland Gardens, London, W., Metallurgist and Mining Engineer.
1894. Louis, Prof. Henry, Durham College of Science, Newcastle-on-Tyne, Professor of Mining.
- O.M. Love, Dr. E. G., 80, East 55th Street, New York, U.S.A., Analytical Chemist.
1899. Love, Wm., 28, Royal Exchange Square, Glasgow, Managing Director (Broxburn Oil Co., Ltd.).
1895. Lovejoy, Frank W., Kodak Park, Rochester, N.Y., U.S.A., Chemical Engineer.
- O.M. Lovibond, J. W., Lake House, Salisbury, Tintometer Manufacturer.
- O.M. Lovibond, T. W., West Jesmond House, Newcastle-on-Tyne, Brewer.
1897. Low, Albert H., P.O. Drawer 1537, Denver, Colo., U.S.A., Metallurgical Chemist.
1900. Low, Prof. Wilson H., Cudahy Packing Co., South Omaha, Neb., U.S.A., Chemist.
1887. Lowe, C. W., Summerfield House, Reddish, near Stockport, Manufacturing Chemist.
1900. Lowe, Herbert G., c/o Fululah Paper Co., Fitchburg, Mass., U.S.A., Paper Manufacturer.
1892. Lowe, Jas. S., c/o T. & W. A. McLaren, 29, Queen Street, Edinburgh, Sugar Planter.
- O.M. Lowe, W. F., 9, Hough Green, Chester, Analytical Chemist.
1885. Lowson, J. G. F., Hollycot, Lasswade, N.B., Paper Maker.
1895. Lucas, Alf., Survey Department, Public Works Ministry, Cairo, Egypt, Analyst.
1892. Lucas, Bernard K., 3, Dyar Terrace, Winnington, Northwich, Alkali Works Manager.
- O.M. Lucas, R., Alwinenstrasse 11, Wiesbaden, Germany, Technical Chemist.
- O.M. Luck, A., Home Farm, Rusthall, Tunbridge Wells, Explosives Chemist.
- O.M. Luck, E., 68, Sumner Street, Southwark, S.E., Manufacturing Chemist.
1900. Lummus, Walter E., 62, Newhall Street, Lynn, Mass., U.S.A., Manager (Commonwealth Manufacturing Co.).
1888. Lund, Jas., 142, Hawthorne Street, Malden, Mass., U.S.A., Ammonia Works Manager.
1888. Lundholm, Carl O., Ardeer Factory, Stevenston, Ayrshire, Explosives Works Manager.
1898. Lundteigen, Andreas, Union City, Mich., U.S.A., Chemist.
- O.M. Lunge, Dr. G., Englisches Viertel, Hottingen, Zürich, Switzerland, Professor of Chemistry.
1894. Lungwitz, Dr. Emil E., 14, Belvedere Street, Brooklyn, N.Y., U.S.A., Chemist.
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1899. Lustig, Alf. L., Lexington Printworks, Canton, Mass., U.S.A., Printworks Superintendent.
1890. Luthy, Edmund O., P.O. Box 232, Cincinnati, Ohio, U.S.A., Distiller.
1884. Lüthy, Otto, 2336, Fairmount Avenue, Philadelphia, Pa., U.S.A., Analytical Chemist.
1895. Luxmoore, Dr. Chas. M., University Extension College, Reading, Lecturer on Chemistry.
1899. Luxton, Thos., 4, Cavendish Square, Margaret Street, Hull, Teacher of Chemistry.
1885. Lye, W. T., Leagrave Hall, near Luton, Beds, Straw Dyer.
1884. Lyle, James, Plaistow Wharf, North Woolwich Road, London, E., Sugar Refiner.
1885. Lyle, Jno., 21, Mincing Lane, London, E.C., Sugar Refiner.
1889. Lynn, Arthur H., 1, Manor Crescent, East Molesey, Chemical Works Manager.
1899. Lynn, R. Rankine, 7, Highburgh Terrace, Downahill, Glasgow, and (Journals) Plattenstrasse 19, Zurich, Switzerland, Chemical Engineer.
1899. Lynn, Vaughan G., c/o Messrs. Best and Co., Madras, India, Merchant.
1898. Lynne, Miss Daisie, c/o American Reduction Co., 1514, Second Avenue, Pittsburg, Pa., U.S.A., Chemist.
1898. Lyon, C. W., 244, West Somerset Street, Philadelphia, Pa., U.S.A., Oil Chemist and Manufacturer.
- O.M. Lyon, J. G., The Aire Tar Works, Knottingley, Yorks, Tar Distiller.
- O.M. Lyte, F. Maxwell, 60, Finborough Road, Redcliffe Square, London, S.W., Chemical Manufacturer.

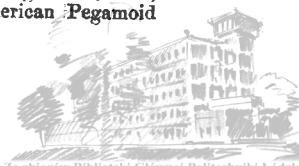
O.M. Lytle, A. M., 34, Victoria Street, Belfast, Ireland, Chemical Manufacturer.

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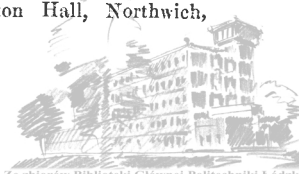
1898. Maass, Frank, P.O. Box 507, Paterson, N.J., U.S.A., Silk Dyer.
1887. Mabery, Prof. Chas. F., Case School of Applied Science, Cleveland, Ohio, U.S.A., Professor of Chemistry.
1894. Mabey, Fred O., 196, Amhurst Road, Hackney, N.E., Wine Merchant.
1891. Macadam, Herbert E., Milton House, Selsdon Road, Wanstead, E., Manure Works Manager.
- O.M. Macadam, Prof. W. Ivison, Surgeons' Hall, Edinburgh, Professor of Chemistry and Consulting Chemist.
1894. Macadam, Stevenson, jun., Surgeons' Hall, Edinburgh, Analytical Chemist.
- O.M. McAlister, R., Lawes' Chemical Manure Co., Limited, Barking Creek, Essex, Manure Works Manager.
1894. McAlley, Robt., Bankside, Falkirk, N.B., Paint Works Manager.
1891. Macallan, J., 3, Charlemont Terrace, Clontarf, Dublin, Analytical Chemist.
1892. Macara, Thos., jun., 6, West Bank Terrace, Hillhead, Glasgow, Chemical Student.
1889. McArthur, Jno., 196, Trinity Road, Wandsworth Common, S.W., Chemist.
1887. McArthur, J. B., Price's Patent Candle Co., Limited, Bromborough Pool, near Birkenhead, Oil Works Chemist.
1886. MacArthur, J. G., 98, Dobbie's Loan, Glasgow, Lubricant Manufacturer.
- O.M. McArthur, J. S., 45, Renfield Street, Glasgow, Consulting Chemist and Metallurgist.
1892. McArthur, Thos., 7, Temple Dale Street, Liverpool, Drysalter and Dyewood Extractor.
1892. McBretney, E. G., Pontefract Road, Castleford, Yorks, Glass Works Chemist.
1898. MacCallum, D. A., 10, Midlothian Drive, Shawland, Glasgow, Chemist.
- O.M. MacCallum, J. M., South Park, Paisley, N.B., Soap Manufacturer.
- O.M. McCalman, D., 18, Harbour Street, Irvine, N.B., Technical Chemist.
1894. McCann, Owen, 80, Studley Road, Forest Gate, Essex, Printing Ink Manufacturer.
1893. McCombie, C., 19, St. Dunstan's Hill, London, E.C., Drug and Chemical Merchant.
- O.M. McCowan, W., 6, Marlborough Mansions, West Hampstead, N.W., Brewer.
1897. McCrae, Dr. John, jun., Yorkshire College, Leeds, Chemical Demonstrator.
1898. McCreath, W. D., West Cornwall Creamery, Lelant, R.S.O., Cornwall, Analytical Chemist.
1884. McCulloch, J., Oakleigh, Rose Street, Garnet Hill, Glasgow, Chemical Works Manager.
1900. McCulloch, John, Glencoe, Lostock Gralam, Cheshire, Chemical Engineer.
- O.M. McDaniel, J. J., Bandon, Ireland, Distiller.
- O.M. Macdonald, A., 72, Great Clyde Street, Glasgow.
1897. Macdonald, G. W., c/o Curtis and Harvey, Ltd., Dartford, Kent, Explosives Chemist.
1894. McDonald, John, Distillery Offices, Fort William, N.B., Distiller.
- O.M. Macdonald, J. W., c/o Messrs. H. Tate & Sons, Love Lane, Liverpool, Analytical Chemist.
1899. Macdonald, S. Fremont, c/o Ashtabula Hide and Leather Co., Ashtabula, Ohio, U.S.A., Tanner.
- O.M. McDonald, T. M., Walllabo Estate, St. Vincent, West Indies, Sugar Chemist.
1888. McDougall, Arthur, Fallowfield House, Fallowfield, Manchester, Chemical Manufacturer.
1899. McDougall, Hugh, Mount Pleasant, Uddingston, N.B., Chemical Engineer.
1895. McDougall, Isaac, jun., High Bank, Didsbury, Manchester, Student.
1895. McDougall, Isaac S., High Bank, Didsbury, Manchester, Manufacturing Chemist.
1890. McDougall, J. T., Dunolly, Morden Road, Blackheath, S.E., Manufacturing Chemist.
1889. MacEwan, Peter, 37, Hornsey Lane Gardens, Highgate, N., Editor of "Chemist and Druggist."
1891. McEwen, Atholl F., 43, Gilmore Road, Lewisham, S.E., Analytical Chemist and Assayer.
- O.M. Macfarlane, J. A., Metallurgical Chemist.
- O.M. Macfarlane, R. F., Tharsis Copper Works, East Moors, Cardiff, Technical Chemist.
1884. Macfarlane, Thos., Inland Revenue Dept., Ottawa, Canada, Analyst to Dominion of Canada.
1803. Macfarlane, Walter, Kelvin, Hollies Drive, Wednesbury, Chemist and Metallurgist.
1894. McFarlane, Dr. Walter D., c/o Canada Paper Co., Windsor Mill, P.Q., Canada, Paper Manufacturer.
1890. McFarlane, W. W., 522, West 9th Street, Chester, Pa., U.S.A., Dyeworks Manager.
1900. McFie, Robt. A., The Nickel Co., Kirkintilloch, N.B., Chemist.
1893. McGhie, T. Burns, c/o Quirk, Barton, and Co., Normandy Wharf, Rotherhithe, S.E., Analytical Chemist and Assayer.
1891. McGill, Dr. J. T., Vanderbilt University, Nashville, Tenn., U.S.A., Adjunct Professor of Chemistry.
1899. MacGillivray, Wm. A., c/o Swansea Safety Fuse Co., Pipe House Wharf, Swansea, Analytical Chemist.
1887. McGlashan, John, Cawnpore Sugar Works, Cawnpore, India, Technical Chemist.
1884. McGowan, John, Ash House, Talke, near Stoke-upon-Trent, Colliery Manager.
1896. McIlhiney, Dr. Parker C., 145, East 23rd Street, New York City, U.S.A., Chemist.
1894. McIlwaine, Alf. W., Stoneferry, Hull, Oil Manufacturer.
- O.M. MacIndoe, G. D., Belfast, Christchurch, New Zealand, Chemical Works Manager.
1900. Mackay, Philip A., Mineral Point Zinc Co., Mineral Point, Wis., U.S.A., Superintendent of Acid Department.
1888. MacKean, Wm., Incandescent Gas Light Co., Ltd., 14, Falmer Street, Westminster, S.W., Technical Chemist.
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- O.M. McKechnie, D. M., 196, Lodge Lane, Liverpool, Copper Extractor.
1898. McKechnie, Robt., 56, Mosley Street, Manchester, Calico Printer.
1887. McKellar, W. G., c/o United Alkali Co., Ltd., Eglinton Works, Irvine, N.B., Technical Chemist.
1895. McKenna, Dr. Chas. F., 221, Pearl Street, New York City, U.S.A., Chemist.
1899. Mackenzie, Alex. H., 12, Hale Street, North Adams, Mass., U.S.A., Colour Mixer.
1891. Mackenzief, Dr. G. S., Sydney Smelting Works, Woolwich, N.S.W., Metallurgical Chemist.
1900. Mackenzie, John K., 1104, Rookery Building, Chicago, Ill., U.S.A., Mining Engineer.
1885. Mackenzie, T. E., 6, Cardonald Park Terrace, Cardonald, Renfrewshire, N.B., Technical Chemist.
1898. McKenzie, Thos., Dailuaine House, Carron, Morayshire, Distiller.
1884. Mackenzie, Dr. W. Cossar, Tewfikieh College of Agriculture, Ghizeh, Egypt, Analytical Chemist.
1893. McKerrow, C. A., 8, Exchange Street, Manchester, Analytical and Consulting Chemist.
1893. McKesson, John, 91, Fulton Street, New York City, U.S.A., Manufacturing Chemist.
1891. Mackey, W. McD., Victoria Chambers, Leeds, Analytical Chemist.
1898. McKillop, Fred. W., c/o Jos. Townsend, Ltd., Port Dundas, Glasgow, Chemical Works Manager.
1900. McKillop, George F., Broxburn Oilworks, Broxburn, N.B., Works Chemist.
1890. McKillop, Jno., 10, Adelphi Terrace, London, W.C., Metallurgist.



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1898. **McLaurin, Robt.**, Cassel Gold Extracting Co., Ruchill Road, Maryhill, Glasgow, Chemist.
1888. **MacLean, Alex. S.**, 31, Bank Street, Greenock, N.B., Soap Refiner.
- O.M. **McLellan, J. Y.**, 21, Onslow Square, Dennistoun, Glasgow, Chemical Manufacturer.
1892. **McLeod, Jas.**, Westhill, Cardross Road, Dumbarton, N.B., Analytical Chemist and Gas Examiner.
1896. **McMaster, Daniel**, McMurray's Royal Paper Works, Wandsworth, S.W., Paper Mill Manager.
1894. **Macmillan, Arch.**, 12, Hastings Street, Sunderland.
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- 1889 **McMurtrie, J. M.**, 21, Princes Street, Pollokshields, Glasgow, Brass Founder.
1900. **McMurtrie, Wm. T.**, 101, West 81st Street, New York, U.S.A., President of American Chemical Society.
1895. **McMurtry, G. C.**, Copper Smelting Works, Lithgow, N.S.W., Australia, Metallurgist.
1884. **Macnab, C.**, Lillyburn, Milton of Campsie, N.B., Calico Printer.
- O.M. **Macnab, W.**, Edinburgh Lodge, Howick Place, Victoria Street, S.W., Analytical Chemist.
- O.M. **Mactear, J.**, 28, Victoria Street, Westminster, S.W., Chemical Engineer.
1892. **McVie, Jas. P.**, Ravenscraig, Canning Street, Hebburn-on-Tyne, Analytical Chemist.
1894. **McVitie, Robt.**, 12, Greenhill Gardens, Edinburgh, Biscuit Manufacturer.
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1895. **Magnus, Isidor**, 52, Leadenhall Street, London, E.C., Chemical Merchant.
1885. **Mahon, R. W.**, 1778, Second Avenue, Pittsburg, Pa., U.S.A., Analytical Chemist.
1898. **Main, Wm.**, 299, Jefferson Avenue, Brooklyn, N.Y., U.S.A., Chemical Expert.
- O.M. **Major, J. Lewis**, Sulcoates, Hull, Tar Distiller and Chemical Manufacturer.
1886. **Mallinckrodt, Edw.**, Mallinckrodt Chemical Works, St. Louis, Missouri, U.S.A., Manufacturing Chemist.
1897. **Mallory, J. Halsey**, 409, Fitten Building, Atlanta, Ga., U.S.A., Assistant Chemist (The American Cotton Oil Co.).
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1893. **Mann, Harold H.**, Indian Tea Association, Royal Exchange Buildings, Calcutta, India. Research Chemist.
1899. **Mann, Jas. S.**, 521, Barking Road, Plaistow, Essex, Analyst.
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1900. **Manna, Haridas**, 4, Gulu Ostagur's Lane, Calcutta, India, Chemist and Doctor.
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1896. **Manoukian, Wahan**, Königsplatz 3A I, Breslau, Germany, Analytical Chemist.
1892. **Mansbridge, Wm.**, Colgate, near Horsham, Sussex, Chemist.
1893. **Marchlewski, Dr. L.**, Strzelecka, 9, Krakau, Austria.
1899. **Margetson, J. Charles**, Struan, Wexford Road, Wandsworth, S.W., India-Rubber Manufacturer.
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1886. **Markham, A. D.**, 71, Queen Street, Hull, Pharmaceutical Chemist.
1901. **Marsden, Dr. Fred**, 4, Swinton Grove, Manchester, S.E., Chemist.
- O.M. **Marsh, J. T.**, Ammonia Soda Works, Fleetwood, Lancashire, Chemist.
1883. **Marsh, W.**, Union Alkali Co., Soho Works, Manchester, Chemical Manufacturer.
1895. **Marshall, Arthur**, c/o Mrs. Griffiths, Farm Hill, Waltham Abbey, Essex, Chemist.
1891. **Marshall, Dr. Hugh**, Chemistry Department, The University, Edinburgh, Professor of Chemistry.
1895. **Marshall, Frank G.**, 4, Woodhouse Terrace, Bewick Road, Gateshead, Technical Chemist.
1894. **Marshall, Jas.**, St. Blane's, Paisley, N.B., Chemical Student.
1896. **Marshall, Percy S.**, Union Laboratory, Half Moon Street, Huddersfield, Assistant Chemist.
1887. **Marshall, Dr. T. Rymer**, c/o Stockham and Dawley, Clayoquot, Vancouver Island, Chemist.
1883. **Marshall, Wm.**, 149, Drake Street, Rochdale, Dyer.
1884. **Marshall, Wm.**, 35, Streathbourne Road, Balham, S.W., Analytical Chemist.
1894. **Martin, Alex. M.**, Douglas Villa, Coatbridge, N.B., and (Journals), Twechar Office, Kilsyth, N.B., Analytical Chemist.
1895. **Martin, Chas. H.**, 14, Aldred Street, Crescent, Salford, Oil and Soap Works Assistant Manager.
1885. **Martin, H.**, 67, High Street, Wellington, Somerset, Manure Works Manager.
- O.M. **Martin, N. H.**, Ravenswood, Low Fell, Gateshead-on-Tyne, Manufacturing Chemist.
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1899. **Martin, Wm. E.**, c/o Kynoch Ltd., Arklow, Co. Wicklow, Ireland, Chemist.
- O.M. **Martin, W. H.**, 183B, King's Road, Chelsea, London, S.W., Analytical Chemist.
1892. **Martindale, Wm.**, 19, Devonshire Street, Portland Place, W., Pharmaceutical Chemist.
1887. **Martineau, Sydney**, Northwood, Rydal Road, Streatham, S.W., Sugar Chemist.
1894. **Martyn, T. Graham**, 11, Stratton Terrace, Truro, Cornwall, Metallurgist.
- O.M. **Mason, J.**, Eynsham Hall, Witney, Oxon, Director of Pyrites Co.
1887. **Mason, J. Francis**, Eynsham Hall, Witney, Oxon.
1892. **Mason, Thos.**, Hyson Green Works, Nottingham, Manufacturing Chemist.
1884. **Mason, W. B.**, 117, Derby Street, Bolton-le-Moors, Pharmaceutical Chemist.
- O.M. **Masson, Prof. D. Orme**, University of Melbourne, Victoria, Australia, Professor of Chemistry.
1889. **Master, Ardesheer B.**, 679, Tardeo, Bombay, India, Chemical Manufacturer.
1893. **Mather, Colin**, Salford Iron Works, Manchester, Engineer.
- O.M. **Mather, J.**, Blydon Chemical Works, Blydon-on-Tyne, Manager.
1900. **Mather, Wm.**, c/o British Aluminium Co., Ltd., Larne Harbour, co. Antrim, Ireland, Chemist.
1896. **Mather, Wm., M.P.**, Salford Ironworks, Salford, Manchester, Chemical and Mechanical Engineer.
1890. **Matheson, W. J.**, 182-184, Front Street, New York, U.S.A., Chemical Merchant.
1900. **Mathews, Dr. J. A.**, 4, First Place, Brooklyn, N.Y., U.S.A., Chemist.
1898. **Mathewson, E. P.**, c/o Guggenheim's Sons, Antofagasta, Chile, U.S.A., Metallurgist.
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1896. **Matsui, G.**, c/o Japan Sugar Refinery Co., Onagigawa, Tokio, Japan, Chemical Engineer.
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1899. **Matthews, Dr. J. Merritt**, 634, Spruce Street, Philadelphia, Pa., U.S.A., Professor of Chemistry and Dyeing (Philadelphia Textile School).
1889. **Mawdsley, W. H.**, c/o Gold Mining Co., Ltd., Mount Morgan, Queensland, Chemist.
1894. **Maxwell, Jno.**, Solway Chemical Works, Sillith, Cumberland, Chemical Manure Manufacturer.
1897. **May, George H.**, Hohokus P.O., Bergen Co., N.J., U.S.A., Assistant Chemist (American Pegamoid Co.).



1884. Mayenfeld, Dr. E. von Salis. See under "Salis."
1896. Mayfield, A. S., Avenue House, Beverley Road, Hull, Analyst.
1892. Mayfield, H. B., Normanhurst, Mundy Street, Heanor, near Nottingham, Dyer.
1885. Mayhew, E. W. A., High Street, Freemantle, Western Australia, Manufacturing Chemist.
1900. Maywald, F. J., 1028, 72nd Street, Brooklyn, N.Y., U.S.A., Technical Chemist.
1892. Meacham, Chas. S., c/o Ohlsson's Cape Breweries, Ltd., Cape Town, South Africa, Brewer.
1898. Meeds, Alonzo D., 103, Boston Block, Minneapolis, Minn., U.S.A., City Gas Inspector and Chemist.
1896. Meggitt, Loxley, Laboratory, Sutton-in-Ashfield, Notts, Analytical Chemist.
1888. Meikle, Jno., 8, Melrose Street, Great Western Road, Glasgow, Journalist.
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1891. Meldrum, Jas. Jones, Atlantic Works, City Road, Manchester, Manufacturing Engineer.
1891. Mellen, E. D., 1590, Massachusetts Avenue, Cambridge, Mass., U.S.A., Treasurer (Curtis, Davis, and Co.)
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- O.M. Mellor, S., Magnesium Metal Co., Patricroft, Manchester, Metal Refiner.
1899. Mellors, Paul, Looksley House, Sherwood Rise, Nottingham, Mine Manager.
1884. Melville, D., P.O. Box No. 1, Woodmere, Wayne Co., Mich., U.S.A., Chemical Works Manager.
1900. Mende, Alex. P., 536, West 14th Street, New York-City, U.S.A., Manufacturing Chemist.
1893. Mensching, Dr. C., Crumpsall Vale Works, Blackley, near Manchester, Chemist.
- O.M. Menzies, R. C., Inveresk Mills, Musselburgh, N.B., Paper Maker.
1892. Mercer, C. A., 22, Streathbourne Road, Upper Tooting, S.W., Chemical Apparatus Maker.
1886. Mercer, J. B., 330, Lower Broughton Road, Manchester.
- O.M. Mercer, F. M., 34, Camomile Street, London, E.C., Manufacturing Chemist.
1890. Merck, E., Darmstadt, Germany, Manufacturing Chemist.
1896. Merck, Geo., cor. of University and Clinton Places, New York City, U.S.A., Chemical Manufacturer.
1887. Merrell, Geo., Lock Box 786, Cincinnati, Ohio, U.S.A., Manufacturing Chemist.
1899. Merrill, Frank H., Los Angeles Soap Co., Los Angeles, Cal., U.S.A., Factory Superintendent.
1897. Meslans, Prof. M., 59, Quai de la Baronnie, Ablon (Seine et Oise) France, Professor of Chemistry.
- O.M. Messel, Dr. R., 30, Ebury Street, S.W., Chemical Manufacturer.
1899. Metcalf, Howard F., Farr Alpaca Co., Holyoke, Mass., U.S.A.
1886. Metcalf, Jno., Moorfield, Altham, near Accrington, Tar Distiller.
1885. Metcalf, Wm., Aspin House, Oswaldtwistle, near Accrington, Tar Distiller.
1898. Metz, Herman A., P.O. Box 2178, New York, U.S.A. (Victor Koechl and Co., Dyestuffs and Chemicals).
1900. Newborne, Robt. G., c/o Kentucky Tobacco Product Co., Louisville, Ky., U.S.A., Chemist.
1883. Mewburn, J. C., 55 and 56, Chancery Lane, London, W.C., Patent Agent.
1898. Meyer, Dr. Franz, c/o Actien Gesellschaft für Zink-industrie vorm. W. Grills, Hamborn a/Rhein, Germany, Chemist and Manager.
1900. Meyer, Karl, 15, Fredericiagade, Copenhagen K., Denmark, Chemist.
1896. Miles, G. Wellington, 29, Central Street, Boston, Mass., U.S.A., Analytical Chemist.
1889. Milestone, W. C., Garratt Lane, Wandsworth, S.W., Chemical Works Manager.
1900. Miller, Hampton K., Lake City, Fla., U.S.A., Chemist (Florida A. & M. College).
1899. Millar, Jas. H., c/o P. J. Petersen and Co., P.O. Box 38, Cape Town, South Africa, Laboratory Manager.
1897. Millard, Edgar J., 40-42, Charlotte Street, London, E.C., Chemist and Manager.
1883. Miller, Dr. A. K., Kilvert's Buildings, Withy Grove, Manchester, Analytical Chemist.
1884. Miller, A. Russell, Cambuslang, near Glasgow, Printworks, Chemist.
1899. Miller, Chas. E., 6, Gibson Street, Hillhead, Glasgow, Chemist.
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1889. Miller, Geo., Wood Lane, Halewood, near Liverpool, Technical Chemist.
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1893. Miller, Dr. Harry E., 1015, Chestnut Street, Oakland, Cal., U.S.A., Analytical Chemist.
1883. Miller, Dr. H. von, Beatrixgasse 32, Wien III., Austria, Chemical Manufacturer.
1894. Miller, Dr. John A., 40-45, Lewis Block, Buffalo, N.Y., U.S.A., Consulting Chemist, State Analyst.
1897. Miller, Jas., Minas de Sao Bento, Santa Barbara de Matto Dentro, Minas Geraes, Brazil, Metallurgical Chemist.
1894. Miller, J. Carlile, 89, Rumford Street, Bridgeton, Glasgow, Manufacturing Chemist.
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1889. Miller, Jno. Poynter, Sandilands Chemical Works, Aberdeen, Technical Chemist.
1884. Miller, Dr. N. H. J., Harpenden, near St. Albans, Agricultural Chemist.
1899. Miller, P. Schuyler, Mount Prospect Laboratory, Flatbush Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1884. Miller, T. Paterson, The Cairns, Cambuslang, near Glasgow, Dyer and Printer.
1884. Miller, W. M., Caledonia Estate, Prov. Wellesley, Penang, S.S., Sugar Chemist.
1894. Mills, Chas., 188, Bedford Hill Road, Tooting Common, S.W., Chemist to Colour Works.
- O.M. Mills, Prof. E. J., F.R.S., 60, John Street, Glasgow, Professor of Chemistry.
- O.M. M'ner, E., Hartford Manor, Northwich, Alkali Manufacturer.
1887. Milnes, Edmund, Seedfield, Bury, Lancashire, Dyeing Extract Maker.
1895. Miner, Harlan S., c/o Welsbach Light Co., Gloucester City, N.J., U.S.A., Technical Chemist.
1889. Miniati, T., Penketh, near Warrington, Chemist.
1896. Misell, D., 65, 66, Basinghall Street, E.C., Commercial Traveller.
1895. Mitchell, Chas. A., c/o Beaufoy and Co., South Lambeth Road, S.W., Analyst.
1898. Mitchell, G. D. H., c/o S. S., White Dental Manufacturing Co., Prince's Bay, Staten Island, N.Y., U.S.A., Chemist.
1883. Mitchell, J. W., Wood Leigh, Clough Fold, near Manchester, Waste Bleacher.
- O.M. Mitting, E. K., 43, Highfield South, Rock Ferry, Cheshire, Technical Chemist.
1900. Mixner, Albert F., c/o Homeward Bound G. M. Co., Yalwal, via Nowra, N.S.W., Australia, Metallurgist.
1895. Moale, Dr. Philip R., 100, Merrimon Avenue, Asheville, N.C., U.S.A., Analytical Chemist.
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1891. Molineux, Roland, 6-8, Jersey Street, Newark, N.J., U.S.A., Colour Work Chemist and Manager.
1899. Mommers, Rich., Glucose Sugar Refining Co., Marshalltown, Pa., U.S.A., Chemist.
- O.M. Mond, Dr. L., F.R.S., 20, Avenue Road, Regent's Park, N.W.; and 64, Via Sistina, Rome, Alkali Manufacturer.
1891. Mond, Robt. L., Winnington Hall, Northwich, Chemist.



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1898. Moody, Herbert R., 159, West 105th Street, New York City, U.S.A., Science Instructor.
1884. Mook, Chas., 2, Kapellenstrasse, Eisenach, Germany, Alkali Works Director.
1883. Mooney, M., 118, Pembroke Road, Dublin, Chemical Manufacturer.
1898. Moore, Byron L., c/o N. W. Fertilising Co., 45th and Center Avenue, Chicago, Ill., U.S.A., Chemist.
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1892. Moore, Dr. Geo. D., 201, Salisbury Street, Worcester, Mass., U.S.A., Professor of Chemistry.
1899. Moore, Landon C., 85, Perkins Hall, Harvard University, Cambridge, Mass., U.S.A., Secretary.
1899. Moore, Quintin, jun., Dalmarnock Chemical Works, 89, Rumford Street, Glasgow, Works Manager.
1899. Moore, Russell, W., 47, Linden Place, Orange, N.J., U.S.A., Chemist (U.S. Appraiser's Office).
1885. Moore, R. T., 156, St. Vincent Street, Glasgow, Mining Engineer.
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1890. Mordle, F. Dare, 38, The Ropewalk, Nottingham, Starch Manufacturer.
1892. Morgan, Albert J., 439, West Street, New York City, U.S.A., Soap Manufacturer.
1890. Morgan, J. Jas., Rooth Street, Wood Green, Weynesbury, Assayer.
1898. Morgan, Thos. M., Longue Pointe, Hochelaga Co., Canada, Manufacturer.
1885. Morgans, Thos., 60, Queen Square, Bristol, Civil Engineer.
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1897. Morris, Harry, Avenue House, Doncaster, Chemical Merchant.
1890. Morris, Herbert N., Gorton Brook Chemical Works, Manchester, Technical Chemist.
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1890. Morrison, Geo. R., c/o E. Ryan & Co., Ltd., Pope's Quay, Cork, Analytical Chemist.
- O.M. Morton, T., 124, Southampton Row, Russell Square, London, W.C., Manufacturing Chemist.
1899. Morton, Dr. Hy., Stevens Institute of Technology, Hoboken, N.J., U.S.A., President.
1889. Morton, Jas., Dalquhurn Works, Renton, N.B., Dyeworks Manager.
1897. Morton, Jno., 50, North Road, St. Helens, Lancashire, Analytical Chemist.
1899. Morton, Thos. W., Kew College, Kew, Surrey, Headmaster.
1888. Mosenthal, Henry de, 220, Winchester House, Old Broad Street, E.C., Explosives Company Manager.
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1894. Moszczanski, J. von, Tartar Chemical Co., Ninth Street and Gowanus Avenue, Brooklyn, N.Y., U.S.A., Consulting Chemist.
1897. Motion, Jno., c/o Jno. Ellis & Co., Edgewater, N.J., U.S.A., Oil Refinery Chemist.
1887. Moul, Frank, Aldersgate Chemical Works, Southall, Technical Chemist.
1884. Moul, J., Underhill, Low Fell, Gateshead-on-Tyne, Secretary.
1890. Moulton, G. J., Rulow, Macclesfield, Chemical Manufacturer.
1898. Moulton, Prof. Chas. W., Vassar College, Poughkeepsie, N.Y., U.S.A., Professor of Chemistry.
1892. Mount, Edw., Oaklands, Aughton, near Ormskirk, Assistant Secretary (United Alkali Company).
- O.M. Muir, J. P., 233, Camden Road, London, N., Chemist.
1890. Muir, Jas. Stanley, Rota Anna Mines, Ltd., Kapnikbanya, Hungary, Chemist.
1896. Muir, Wm., 97, Church Street, Edmonton, Middlesex, Merchant.
1894. Muir-Smith, W., c/o A. B. Fleming & Co., Ltd., Caroline Park, Edinburgh, Oil Works Manager.
- O.M. Müller, Dr. H., F.R.S., 13, Park Square East, Regent's Park, London, N.W., Research Chemist.
1896. Mundy, Lionel, 27, Merton Road, Kensington, W., Importer of Unfermented Wines.
1887. Munroe, Prof. Chas. E., Columbian University, Washington, D.C., U.S.A., Professor of Chemistry and Dean.
1900. Munsell, Dr. Chas. E., c/o Devor and Reynolds Co., 110, Horatio Street, New York City, U.S.A., Colour Chemist.
1900. Munton, Fred. T., The Oak House, Winsford, Cheshire, A.R.S.M., Analytical Chemist.
1897. Murch, D. Wilshin, Church Road, Lostock Gralam, Cheshire, Chemist.
1886. Murdoch, H. R. M., 4, Nobel's Villas, Stevenston, Ayrshire, Explosives Chemist.
1899. Murphy, Albert J., The Laboratory, 11, Lyddon Terrace, Leeds, Brewer's Chemist.
1899. Murray, Jas. J., c/o Mountain Copper Co., Ltd., Iron Mountain, Shasta Co., Cal., U.S.A., Mining Engineer.
1896. Murray, Dr. Thos. S., 1, Nelson Street, Dundee, Professor of Chemistry.
1898. Murray, Rd., Laurel Bank, Potternewton Lane, Chapel Allerton, Leeds, Analyst.
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- O.M. Muter, Dr. J., Winchester House, Kennington Road, London, S.E., Chemical Lecturer.
1895. Muurling, T. J. R., P.O. Box 2660, New York City, U.S.A., Dyestuff Importer.
1897. Myers, Dr. Henry C., University of California, Berkeley, Cal., U.S.A., Professor of Chemistry.
1893. Myers, Dr. Jno. A., Room 125, Anderson Building, John Street, New York City, U.S.A., Chemist.
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1901. Nanabhai, Krishnalal, 8-10, Nepean Sea Road, Malabar Hill, Bombay, India, Technological Chemist.
1893. Napier, Jno. W., Gas Works, Carnoustie, N.B., Manager and Chemist.
1897. Nash, Leonard M., 281, Seven Sisters Road, Finsbury Park, N., Student of Chemistry.
1900. Nathan, Major Fred. L., R.A., Royal Gunpowder Factory, Waltham Abbey, Essex, Superintendent.
1898. Nation, Edmund C., 237, Smith Street, Peekskill, N.Y., U.S.A., Manager (Highlands Chemical Co.).
1892. Naylor, Wm., 16, Walton's Parade, Preston, Lancashire, Chief Inspector (Ribble Joint Committee).



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1899. Neale, Harry A., Brentwood, Clothorn Road, Didsbury, Manchester, Chemist.
1899. Neate, Percy J., 268, High Street, Rochester, Kent, Director of Cement Co.
1898. Neil, Jas. Millar, 129, Beverley Street, Toronto, Ont., Canada, Technical Chemist.
1890. Neill, Geo. D., Drumslea, Greenock, N.B., Sugar Refiner.
1898. Neilson, Alex. M., c/o T. Stanes and Co., Coimbatore, Madras, India, Analytical Chemist.
1889. Neilson, Thos., Silver Bell, Redrock, Arizona, U.S.A., Metallurgical Chemist.
1893. Nelson, Arthur J., c/o Clayton Aniline Co., Ltd., Clayton, Manchester, Chemist.
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1897. Nelson, H. W., 15, Hamilton Chambers, 17, St. John Street, Montreal, Canada, Manufacturer of Electrical Insulators.
1897. Nelson, Walter, Messrs. Geo. Nelson, Dale, & Co., Ltd., Enascote Mills, Warwick, Gelatin Manufacturer.
- O.M. Ness, T., Black Banks Chemical Works, Darlington, Tar Distiller.
1899. Neurath, Dr. F., 37, George Street, Cheetham Hill, near Manchester, Chemist.
- O.M. Newall, F. S., Washington, co. Durham, Chemical Manufacturer.
1889. Newberry, Spencer B., Sandusky Portland Cement Co., Sandusky, Ohio, U.S.A., Cement Works Manager.
1896. Newcomen, Thos., Chemical Works, Lydbrook, near Ross; Wood Distiller.
- O.M. Newlands, B. E. R., 2, St. Dunstan's Hill, London, E.C., Analytical and Consulting Chemist.
- O.M. Newlands, W. P. R., 232, Amesbury Avenue, Streatham Hill, S.W., Sugar Chemist.
1885. Newton, A. H., Pury Park, Stony Stratford, Artists' Colour Manufacturer.
- O.M. Newton, H. C., 4, Ornan Mansions, Haverstock Hill, N.W., Artists' Colour Manufacturer.
1884. Newton, Jno., Park Green, Macclesfield, Silk Dyer.
- O.M. Newton, Jno., Manor Works, Botherhithe New Road, London, S.E., Manure Manufacturer.
1900. Newton, Dr. Wm., 39, Mincing Lane, London, E.C., Chemist.
1884. Nichols, J. A., Stanley Mount, New Mills, near Stockport, Teacher of Science.
1888. Nichols, W. H., 45-47, Cedar Street, New York, U.S.A., Manufacturing Chemist.
1897. Nicholson, Harry, Smethurst Furnace, Penmaenpool, near Dolgelly, North Wales, Assayer.
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- O.M. Nicol, Dr. W. W. J., 15, Blacket Place, Edinburgh, Chemical Lecturer.
1900. Niehl, J. H., c/o General Chemical Co., Bayonne Works, Bayonne, N.J., U.S.A., Superintendent.
1898. Nightscales, Geo., 9, Tynemouth Street, Hull, Oil Merchant.
1899. Nihoul, Dr. Edw., Waremmes, Belgium, Professor of Leather Industries.
- O.M. Nimmo, J., Penshurst, Stanger Road, South Norwood, S.E., Analytical Chemist.
1885. Nishigawa, T., Ryuso Kaisha, Osaka, Japan, Director of Sulphuric Acid and Soda Works.
1898. Nishikawa, T., c/o Nippon, Seimikaisha, Onoda, Nagato, Japan, Chemist.
- O.M. Nolting, Dr. E., Ecole de Chimie, Mulhouse, Alsace, Germany, Professor of Chemistry.
- O.M. Norman, F. J., Lyndhurst, Higher Runcorn, Cheshire, Chemical Manufacturer.
1900. Norman, Geo. M., 249, Center Street, Bloomsburg, Pa., U.S.A., Chemist.
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1898. Norris, Albert P., 760, Massachusetts Avenue, Cambridgeport, Mass., U.S.A., Assistant Chemist.
1899. Norris, Geo. L., Standard Steel Works, Burnham, Mifflin Co., Pa., U.S.A., Chemist.
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1890. North, E. Gordon N., Bella Vista 14, Minas de Rio Tinto, Huelva, Spain, Technical Chemist.
- O.M. Northing, J., The Murrrough, Wicklow, Ireland, Technical Chemist.
- O.M. Norton, Dr. S. A., 363, East Town Street, Columbus, Ohio, U.S.A., Professor of Chemistry (Ohio State University).
1887. Norton, Dr. T. H., Kharput, Turkey in Asia, *via* Constantinople, Ph.D., Sc.D., U.S. Consul.
1899. Noyes, Henry, 17, Queen Street, Melbourne, Vic., Australia, Engineer.
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1900. O'Byrne, Leo C., 996, Washington Boulevard, Chicago, Ill., U.S.A., Chemist.
1897. Oddie, Jas., School of Mines, Ballarat, Australia, Chemical Lecturer.
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1884. Oehler, K., Offenbach-am-Main, Germany, Colour Manufacturer.
1888. Ogata, Saburo, Zohei Shikyoku, Okurasho, Tokyo, Japan, Assayer.
1896. Ogilvy, D. J., Gest Street; and C. H. and O. R. R., Cincinnati, Ohio, U.S.A., Manufacturing Chemist.
1898. Ogle, F. B., Royston Park, Pinner, Middlesex, Cyanide Manager.
1898. Olden, Chas., The Oaklands, Warley, Langley, Birmingham, Metallurgical Engineer.
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1893. Ormerod, Ernest, The Oaklands, Rochdale, Lancashire, Chemical Student.
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1900. Osbourne, Jno. P., 572, Alexandra Parade, Dennistoun, Glasgow, Analytical Chemist.
1896. Osmond, Jno. H., c/o Smith, Bell, & Co., Manila, Sugar Works and Technical Chemist.
1889. Östlere, Edward, Messrs. Barry, Ostlere, & Co., Kirkealdy, N.B., Linoleum Manufacturer.
1900. O'Shaughnessy, Francis R., Home Farm, Tyburn, Birmingham, Chemist.
1885. O'Shea, L. T., Firth College, Sheffield, Chemical Lecturer.
- O.M. O'Sullivan, C., F.R.S., 140, High Street, Burton-on-Trent, Brewer and Chemist.
1883. O'Sullivan, J., High Bank, Burton-on-Trent, Brewing Chemist.
1893. Oswell, Benj. L., 5, Balmoral Road, Burton-on-Trent, Brewer's Chemist.
1898. Oushkoff, John P., c/o P. K. Oushkoff & Co., Moscow, Russia, Chemical Manufacturer.
1887. Overtoun, Lord, 7, West George Street, Glasgow, Chemical Manufacturer.
1891. Owens, Caradoc, 88, Great Clowes Street, Lower Broughton, Manchester, Dyer's Manager.
- P**
- O.M. Packard, E., jun., Bramford, near Ipswich, Manure Manufacturer.
1899. Paessler, Dr. Joh., Vorstand der Deutschen Versuchsanstalt für Lederindustrie, Freiberg in Sachsen, Germany, Chemist.
- O.M. Page, F. J. M., 54, Sutherland Street, Pimlico, S.W., Chemical Lecturer.
1886. Pagés, Albert, 34, Boulevard Henri IV., Paris, Technical Chemist.
1892. Paine, Augustus G., 60, Times Building, New York, U.S.A., President of Paper Making Co.
- O.M. Paine, S., Devisdale, Bowdon; and (Journals), Otter Works, Manchester Pharmaceutical Chemist.
1887. Palmer, T. Chalkley, Box 19, Chester, Pa., U.S.A., Manufacturing Chemist.
1887. Palmer, Thos. C., 98, Commercial Road East, London, E., Engineer.
- O.M. Park, J., Millburn Chemical Works, Garngad Hill, Glasgow, Chemical Manager.
1888. Parker, Chas. E., Vine House, Penketh, Warrington, Tanner.
1894. Parker, Chas. E., 150, Alden Street, Orange, N.J., U.S.A., Chemist.
1898. Parker, Charles H., Manor House, Tettenhall, Wolverhampton, Chemist.
1894. Parker, Dr. J. Gordon, Herold's Institute, Drummond Road, Bermondsey, S.E., Head of Tanning School.
1891. Parker, Edw., Laburnum House, Rushford Park, Levenshulme, Manchester, Analytical Chemist.
1897. Parker, Matthew A., 13, Hamilton Crescent, Partick, Glasgow, Assistant to Professor of Chemistry.
- O.M. Parker, Thos., Manor House, Tettenhall, Wolverhampton, Electrical Engineer.
1894. Parker, Thos. J., Bayonne, N.J., U.S.A., Chemical Works Manager.
1898. Parker, W. W., Whitehouse Street Tannery, Bristol, Tanner.
1900. Parkes, Geo. A., Hayfield, Antrim, Ireland, Chemist.
1898. Parmelee, C. W., New York and Boston Dyewood Co., Green and West Streets, Brooklyn, N.Y., U.S.A., Chemist.
1898. Parrish, Saml., 10, Sholebroke Mount, Leeds, Teacher of Chemistry.
1896. Parry, John, E. V. Wharf, Newport, Mon., Analytical Chemist.
1899. Parsons, C. Chauncey, 43, Sedgwick Street, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
- O.M. Pass, A. C., Hawthornden, Clifton Down, Bristol, Lead Smelter.
1901. Pass, James, Syracuse, N.Y., U.S.A., Pottery Manufacturer.
1897. Patchett, Jas., Oakworth, Hadley, Wellington, Salop, Ironmaster.
1888. Paterson, Dr. Jas. H. R., 10, Millerfield Place, Edinburgh.
1884. Paterson, John, Belle Isle Place, Workington, Cumberland, Mechanical Engineer.
1887. Paton, J. M. C., Messrs. Manlove, Alliott & Co., Ltd., Nottingham, Mechanical Engineer.
1886. Paton, W. Grant, Greenbank Alkali Works, St. Helens, Lancashire, Alkali Works Manager.
- O.M. Patterson, G., c/o The Manbré Saccharine Co., Ltd., Hammersmith, W., Technical Chemist.
1893. Patterson, Harry J., College Park, Prince George's Co., Md., U.S.A., Agricultural Chemist.
- O.M. Patterson, T. L., Maybank, Finnart Street, Greenock, N.B., Sugar Works Manager.
1884. Pattinson, Dr. H. Salvin, 75 Side, Newcastle-on-Tyne, Analytical Chemist.
- O.M. Pattinson, J., 75, The Side, Newcastle-on-Tyne, Consulting Chemist.
- O.M. Pattison, J., 83, North Oswald Street, Glasgow, N.B., Chemical Merchant.
1889. Pattison, Percy J., 5, Kingsley Road, Forest Gate, E., Technical Chemist.
1894. Paul, Dr. Benjamin H., 13, Fenchurch Avenue, E.C.; and (Journals) Parkside, Kingston Vale, Putney, S.W., Consulting and Analytical Chemist.
1900. Paul, Dr. L. Gordon, 3, Market Street, Huddersfield, Consulting Chemist.
1891. Paul, Jas. H., Albion Chemical Co., Riverside, Charlton, S.E., Analytical Chemist.
- O.M. Pauli, Dr., Höchst a/Main, Germany, Chemical Manufacturer.
1900. Payas, Fred. Alexis, Calpe Pharmacy, 129, Waterport Street, Gibraltar, Pharmaceutical Chemist.
- O.M. Payne, J. B., 15, Mosley Street, Newcastle-on-Tyne, Manufacturing Chemist.
1888. Peak, C. P., Bridgewater Chemical Works, Wigan, Manufacturing Chemist.
1898. Pearce, Edw. D., Messrs. T. P. Shepard and Co., P.O. Box 1336, Providence, R.I., U.S.A., Manufacturing Chemist.
1894. Pearce, Jas. Stanley, Clements, Snaresbrook, Essex, Chemical Manufacturer.
1897. Pearce, Richard, Argo, Colorado, U.S.A., Smelting Works Manager.
1883. Pearce, W., Bow Common, London, E.; and (Journals) The Elms, Salway Hill, Woodford, Essex, Chemical Manufacturer.
1892. Pears, Andrew, jun., Spring Grove, Isleworth, Analytical Chemist.
1893. Pearson, Frank P., Arnold Printworks, North Adams, Mass., U.S.A., Printworks Manager.
1894. Pearson, Wm. H., 6, Fenchurch Buildings, London, E.C., Analytical Chemist.
- O.M. Pechiney, A. R., Salindres, Gard, France, Chemical Engineer.
1898. Peck, Dr. Ernest L., Claremont, Merrilocks Road, Biundellsands, near Liverpool, Analytical Chemist.
1898. Peckham, Stephen F., 1489, Pacific Street, Brooklyn, N.Y., U.S.A., Chemist.
1894. Peden, Jno., 30, Ardgowan Street West, Greenock, N.B., Analytical Chemist.
- O.M. Pedler, Prof. A., F.R.S., 31-32, Judges' Court Road, Alipore, Calcutta, India, Professor of Chemistry.
1886. Pedler, J. R., 47, Tregunter Road, South Kensington, S.W., Clerk.
1899. Pell, A., 7, Elphinstone Circle, Bombay, India, Chemist.
1897. Pellew, Chas. E., Columbia University, New York City, U.S.A., Adjunct Professor of Chemistry.
1888. Pemberton, Henry, jun., 1008, Clinton Street, Philadelphia, Pa., U.S., Manufacturing Chemist.
1896. Péniakoff, D. A., Selzaete, Belgium, Chemist and Physicist.



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1890. Pennock, J. D., c/o Solvay Process Co., Syracuse, N.Y., U.S.A., Technical Chemist.
1885. Pentecost, S. J., Nottingham Road, New Basford, Nottingham, Lace Dresser.
1887. Pentermann, H. T., 37, Clifton Crescent, Peckham, S.E., Brewing Chemist.
1892. Peplow, D. H. T., Seale Lodge, Farnham, Surrey.
1899. Peppel, S. Vernon, 169, King Avenue, Columbus, Ohio, U.S.A., Chemist.
1885. Perkin, A. G., 8, Montpelier Terrace, Hyde Park, Leeds, Technical Chemist.
1898. Perkin, Dr. F. Mollwo, Borough Polytechnic, Borough Road, S.E., Head of Chemical Department.
- O.M. Perkin, Dr. W. H., F.R.S., The Chestnuts, Sudbury, Harrow, Research Chemist.
1887. Perkin, Dr. W. H., jun., F.R.S., Fairview, Wilbraham Road, Fallowfield, Manchester, Professor of Chemistry.
1896. Perkins, Chas. W., P.O. Box 573, Waterbury, Conn., U.S.A., Chemist and Druggist.
1899. Perkins, Prof. Maurice, Union College, Schenectady, N.Y., U.S.A., Professor of Chemistry.
1893. Perkins, T. S., c/o Californian Tartar Co., 318, Front Street, San Francisco, Cal., U.S.A., Chemist.
1899. Perks, Walter G., Glanafon, Hayle, Cornwall, Manufacturer.
1887. Perry, D., Forth and Clyde Chemical Works, Kirkintilloch, N.B., Manufacturing Chemist.
1895. Perry, Jos. H., 176, Highland Street, Worcester, Mass., U.S.A., Teacher of Chemistry.
1897. Peter, Dr. A. H., 205, Third Avenue, New York, U.S.A., Chemist.
1893. Pethybridge, Walter, 3, Rhodesia Road, Clapham Rise, S.W., Chemist and Assayer.
1888. Pettigrew, J., 6, St. Helen's Place, Bishopgate, London, E.C., Technical Chemist.
1892. Pettigrew, Robt., c/o Mersey and Irwell Joint Committee, 44, Mosley Street, Manchester, Electro-chemist.
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1900. Peyton, Wm. C., Mutual Life Building, San Francisco, Cal., U.S.A., Chemist.
1888. Philip, Arnold, 67, Waverley Road, Redland, Bristol, Electro-Metallurgist and Electrical Engineer.
1886. Phillips, A. G., 11, Essex Villas, Phillimore Gardens, Kensington, W., Barrister-at-law.
1891. Phillips, George Brinton, 622, Race Street, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
- O.M. Phillips, Harcourt, 9, Crawford Avenue, Bolton, Analytical Chemist.
1895. Phillips, S. Chas., 47, Cannon Street, London, E.C., Chemical Engineer.
1898. Phillips, Wm. H., 100, Milton Avenue, East Ham, E., Soapmakers' Assistant.
1883. Phipson, Dr. T. L., 83, Erpingham Road, Putney Common, S.W., Analytical and Consulting Chemist.
1894. Picard, Hugh F. K., c/o H. L. Sulman, 60, Gracechurch Street, London, E.C., Metallurgist.
- O.M. Pick, Dr. S., Direction der Soda Fabrik, Szczaikowa, Galizien, Austria, Chemical Engineer and Manager.
1897. Pickert, Leo W., American Sugar Refining Co., Granite Street, South Boston, Mass., U.S.A., Chemist.
1884. Pickles, H., Prussiate Works, Droylsden, Manchester, Technical Chemist.
1899. Pidduck, E. W., 28, Portland Street, Aberystwith, Wales, Assistant Chemist.
1901. Pierce, Ira L., Gibbstown, Gloucester Co., N.J., U.S.A., Chemist (Repauno Chemical Co.).
1899. Pilgrim, Julius A., 67, Poulton Road, Seacombe, Cheshire, Dyer's Chemist.
1897. Pilhashy, B. M., c/o Rheinstrom, Bettman, Johnson, and Co., 906-910, Sycamore Street, Cincinnati, Ohio, U.S.A., Distiller's Chemist.
1888. Pilkington, G., Laboratory, Victoria Buildings, Silver Street, Bury, Lancashire, Analytical Chemist.
1893. Pillely, Thos. W., 33, Grove Hill Road, Denmark Hill, S.E., Analytical Chemist.
1894. Pilling, John E., 28, Agnew Villas, Whitegate Lane, Blackpool, Chemist.
1900. Pinto-Leite, A., Manufacturing Chemist.
1883. Pipe, Jas., Messrs. Wm. Henderson & Co., Irvine, N.B., Chemical Manufacturer.
1896. Piper, Walter E., Boston Rubber Shoe Co., Malden, Mass., U.S.A., Chemist.
1899. Pirie, Alex. G., Messrs. Alex. Pirie and Sons, Ltd., Stonewood Works, Bucksburn, Aberdeenshire, Paper Manufacturer.
1900. Pitman, Jno. R., c/o Laffin and Rand Powder Co., Pompton Lakes, N.J., U.S.A., Chemist.
- O.M. Pitt, T., 16, Coleman Street, London, E.C., Manufacturing Chemist.
1884. Pittuck, F. W., 19, Stratford Grove, Newcastle-on-Tyne, Technical Chemist.
1899. Pizey, Jas. H., 11, St. Albans Villas, Highgate Road, London, N., Chemist.
1894. Platten, Frank, c/o Elliot's Metal Co., Limited, Selly Oak, near Birmingham, Metallurgical Chemist.
1890. Platts, Jno. C., Heaton Moor Lodge, Heaton Chapel, Stockport, Metallurgical Chemist.
1896. Plaut, Albert, 128, William Street, New York, U.S.A., Wholesale Druggist.
1888. Playfair, David J., 7, Victoria Crescent, Dowanhill, Glasgow, Manufacturing Chemist.
1891. Pocklington, Hy., 41, Virginia Road, Leeds, Assurance Co.'s Local Manager.
1893. Pollitt, R. B., De Beers Explosives Works, Cape Town, South Africa, Civil Engineer.
1883. Pollock, A., Dillichip Turkey-red Dyeworks, Bonhill, Dumbartonshire, Dyeworks Manager.
1890. Pomeroy, Dr. Chas. T., 55, Broad Street, Newark, N.J., U.S.A., Ink Manufacturer.
1896. Pond, Prof. G. G., State College, Centre Co., Pa., U.S.A., Professor of Chemistry.
- O.M. Pond, J. A., 99, Queen Street, Auckland, New Zealand, Analytical Chemist.
1900. Pont, Francis G. du, Wilmington, Del., U.S.A., Manufacturer.
1895. Pont, Pierre S. du, Lorain, Ohio, U.S.A., Explosives Manufacturer.
1896. Poole, Herman, 357, Canal Street, New York, U.S.A., Manufacturing Chemist.
- O.M. Pooley, T. A., 76, Grove Lane, Denmark Hill, S.E., Analytical Chemist.
1892. Pope, Frank, c/o, Jobbins, W. F., P.O. Box 422, Aurora, Kane Co., Ill., U.S.A., Chemist.
- O.M. Pope, S., 35, Victoria Road, Runcorn, Chemical Works Manager.
1899. Pope, Thos. H., South Street, Ponders End, Middlesex, Chemist.
1900. Pope, W. J., Goldsmiths' Institute, New Cross, London, S.E. Chemist.
1900. Popplewell, Jos. M., c/o Brotherton and Co., Holmes Street, Dewsbury Road, Leeds, Chemist.
1899. Porter, A. Felix, Pompton Lakes, N.J., U.S.A., Explosives Chemist.
1896. Porter, Herbert, Ivy House, Polygon Road, Crumpsall, Manchester, Alkali Inspector.
- O.M. Pott, W. Hamilton, 68, Sumner Street, Southwark, S.E., Vinegar Brewer.
1899. Potter, Chas. A., 198, Waterman Street, Providence, R.I., U.S.A., Chemist.
1884. Potter, Chas. E., Love Lane Sugar Refinery, Liverpool, Sugar Works Chemist.
1888. Potter, Chas. J., Heaton Hall, Newcastle-on-Tyne, Cement Manufacturer.
- O.M. Potter, E. P., Fernclough, Bolton-le-Moors, Alkali Manufacturer.
1899. Potter, Rowland S., 44, Margaret Street, Beverley Road, Hull, Chemist.
1900. Potts, Geo., E., Dover, N.J., U.S.A., Explosives Manufacturer.



1892. Potts, Joseph T., Price's Patent Candle Co., Bromboro' Pool, near Birkenhead, Chemist.
1900. Pough, Frank H., 146, Hicks Street, Brooklyn, N.Y., U.S.A., Manager (Bergen Point Sulphur Works).
1889. Powell, A. Ernest, Craigowan, Clarendon Road, Whalley Range, Manchester, Oil Merchant.
1900. Powell, Harry J., Whitefriars Glass Works, London, E.C., Glass Manufacturer.
1884. Powell, L. S., 5, Campden Hill Square, London, W., Electrician.
1897. Power, Dr. Fred. B., Wellcome Research Laboratories, 6, King Street, Snow Hill, London, E.C., Director.
1900. Pratt, N. P., Laboratory, Atlanta, Ga., U.S.A., Manufacturing Chemist.
1889. Pratt, Walter E., 35, Regent Street, Lancaster, Analytical Chemist.
1897. Prentice, Dr. Bertram, Royal Technical Institute, Salford, Lecturer on Chemistry.
1897. Prentiss, Geo. N., North-western Iron Co., Mayville, Wis., U.S.A., Analyst and Assayer.
1888. Prescott, Dr. Albert B., Ann Arbor, Mich., U.S.A.
1900. Prescott, Saml. C., Mass. Inst. of Technology, Boston, Mass., U.S.A., Instructor in Bacteriology.
1891. Preston, Alf., Park Hill View, Bury, Lancashire, Chemist.
1883. Preston, R., Ryecroft, Manchester Road, Bury, Lancashire, Manufacturing Chemist.
- O.M. Price, A. F., 524, Sacramento Street, San Francisco, Cal., U.S.A., Analytical Chemist.
1899. Prinsen-Geerligns, H. C., Fegal, Java, Netherlands Indies, Director of Sugar Cane Experimental Station.
1893. Pritchard, Edgar J., Burrows, Swansea, Works Manager.
1896. Prochazka, Dr. Geo. A., 138, West 13th Street, New York, U.S.A., Colour Manufacturer.
1897. Prochazka, John, 15, East 12th Street, New York, U.S.A., Coal-Tar Colour Chemist.
- O.M. Procter, H. R., Yorkshire College, Leeds; and (Journals) Thornleigh, Wheatley Road, Ilkley, Yorks, Lecturer on Tanning.
1884. Procter, J. W., Skeldergate Bridge, York, Manure Manufacturer.
1890. Proctor, Miss Anne J., Free Library, Widnes, Librarian.
- O.M. Proctor, C., 99, Underhill Road, East Dulwich, S.E., Analytical Chemist.
- O.M. Proctor, W. W., 33, The Side, Newcastle-on-Tyne, Assayer and Analytical Chemist.
1901. Propach, C., 189, Kinzir Street, Chicago, Ill., U.S.A., Colour Merchant.
1894. Proude, Jas., 30, Cromwell Terrace, Halifax, Yorks, Soap Works Chemist and Manager.
1899. Pullar, Edmund, Keirfield, Bridge of Allan, N.B., Manufacturer.
1894. Pullar, Herbert S., Rosebank, Perth, N.B., Dyer.
- O.M. Pullar, Sir Robert; Journals to J. Minto, Sandeman Public Library, Perth, N.B., Dyer.
- O.M. Pullar, R. D., Pullar's Dyeworks, Perth, N.B., Dyer.
1899. Pullman, Edw. E., 13, Claremont Gardens, Surbiton, Leather Manufacturer.
1894. Purdie, Dr. Thos., F.R.S., 14, South Street, St. Andrews, N.B., Professor of Chemistry.

Q

1887. Quibell, Oliver, Manure Manufacturer.
1897. Quinan, Wm. R., De Beers Explosives Works, Cape Town, South Africa, Superintendent (Powder Works).
1891. Quincke, Dr. F., Farbenfabriken Leverkusen, Mulheim (Rhein), Germany, Chemical Works Director.
1891. Quinn, J. Cardwell, Hillesdon, Barnstaple, N. Devon, Consultant on India Rubber.

1897. Quirk, Jno. S., Lead Smelting Works, St. Helens, Lancashire, Manager.

R

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1884. Rademacher, H. A., P.O. Box 243, Lawrence, Mass., U.S.A., Consulting Technical Chemist.
1900. Radley, Ernest, 49, Ernest Street, West Norwood, S.E.
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1897. Rae, Roderic H., 103, Sotheby Road, Highbury Park, N., Engineer (Edison-Swan Electric Works).
1895. Raegener, Louis C., 280, Broadway, New York, U.S.A., Lawyer.
- O.M. Ramsay, Dr. W., F.R.S., University College, Gower Street, London, W.C.; Journals to 12, Arundel Gardens, W., Professor of Chemistry.
1888. Ramsay, W., c/o Laird Bros., Ironworks, Birkenhead, Chemist and Assayer.
1898. Ramsden, Andrew, Deccan Sugar Co., Ltd., Samalkot, Godaveri District, India, Manager.
1887. Ramsden, Edw., 11, Cecil Avenue, Horton Park, Bradford, Spinner.
1883. Ramsden, J., Lion Brewery, Belvedere Road, Lambeth, London, S.E., Brewer.
1895. Raper, Arthur E., Alston House, Thornton Road, Bradford, Yorks, Works Chemist.
1897. Raper, Thos. H., 18, Victoria Embankment, Darlington, Analytical Chemist.
1898. Raschen, Dr. Julius, The Highlands, Runcorn, Cheshire, Consulting Chemist (United Alkali Co.).
1893. Ratcliff, F. D., 108, Varna Road, Birmingham, Vinegar Brewer.
1898. Ratcliffe, Walter, 21, Mawdsley Street, Bolton, Analytical Chemist.
1895. Rau, Dr. H. M., 130-132, Pearl Street, New York, U.S.A., Chemist.
1901. Rauter, Dr. G., Sofienstrasse 8-17, Charlottenburg 2, bei Berlin, Germany, Engineering Chemist.
1901. Rawlins, Herbert J. L., Hope Cottage, Rainhill Lancashire, Managing Director.
- O.M. Rawson, C., 2, Melbourne Place, Bradford; and (Journals) Planter's Club, Mozufferpore, Tirhoot, India, Analytical and Consulting Chemist.
1883. Rawson, Dr. S. G., Technical Schools, Huddersfield, Analytical Chemist.
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1895. Read, E. J., 69, Sheen Lane, Mortlake, Surrey, Analyst.
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- O.M. Reddrop, J., Sound Cottage, Sound, near Nantwich, Analytical Chemist.
1890. Redgate, J. G., Traffic Street, Nottingham, Aërated Water Manufacturer.
- O.M. Redwood, Dr. Boverton, 4, Bishopsgate Street Within, London, E.C., Petroleum Expert.
1884. Redwood, I. L., Bantry House, Picardy Hill, Belvedere, Kent, Technical Chemist.
1887. Redwood, Robt., 4, Bishopsgate Street Within, London, E.C., Secretary.
1891. Redwood, T. Horne, Olveston, Sedlescombe Road, St. Leonard's-on-Sea, Analytical Chemist.
1886. Rée, Dr. A., 15, Mauldeth Road, Withington, Manchester, Aniline Dye Manufacturer.
1884. Reed, Albert E., The Grange, Leigham Court Road, Streatham, S.W., Paper Works Chemist.
1895. Reed, Dr. J. Hastings, Hambledon, Cairns, North Queensland, Sugar Manufacturer.
1893. Reekie, J. A., Shaw Lane, Dinting, near Manchester, Calico Printer's Colour Mixer.



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1897. Rees, W. H., Big Pine, Inyo Co., Cal., U.S.A., Chemist.
1900. Reese, Dr. Chas. L., c/o New Jersey Zinc Co., Passaic Avenue, Newark, N.J., U.S.A., Chemist.
1897. Reid, Andrew, 133, Minard Road, Crossmyloof, Glasgow, Chemist.
1896. Reid, Robt., Oil Mills, Horbury Bridge, near Wakefield, Chemical Student.
1895. Reid, T. Anderson, 8, Ashton Drive, Hunt's Cross, Liverpool, Works Manager.
1894. Reid, Walter C., Broomlee, Haydon Bridge-on-Tyne, Manufacturer.
- O.M. Reid, Walter F., Fieldside, Addlestone, Surrey, Technical Chemist.
1893. Reid, Wm., jun., Bombay Dyeworks, Dadur, Bombay, India, Dyer.
1898. Reitmeyer, Robt. E. D., 1 & 2, Rangoon Street, London, E.C., Chemical Merchant.
1900. Remington, J. Stewart, Laboratory, Corporation Street, Lancaster, Consulting Chemist.
1884. Renaut, F. W., The Brambles, Elmbourne Road, Tooting Common, S.W., Secretary.
- O.M. Rennie, Dr. E. H., University of Adelaide, South Australia, Professor of Chemistry.
- O.M. Rennoldson, W. L., c/o United Alkali Co., Lim., Allhusen's Works, Gateshead, Manager.
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1894. Rottie, Theodore, 16, Great King Street, Edinburgh, Metallurgical Chemist.
1895. Reubens, Chas. M., 108, West 113th Street, New York, U.S.A., Chemist.
1896. Reuter, Dr. L., 17, Rue de Mérode, Bruxelles-Midi, Belgium, Chemist.
1899. Reynolds, F. Emory, Columbian G.M. and Milling Co., York, Montana, U.S.A., Chemist.
- O.M. Reynolds, Dr. J. Emerson, F.R.S., Trinity College, Dublin, Professor of Chemistry.
- O.M. Rhodes, E., c/o Thos. Vickers & Sons, Widnes, Technical Chemist.
1892. Rhodes, Jos., Fairview, New Mills, Derbyshire, Print Works Chemist.
1900. Rhodin, Jno. G. A., 47, Victoria Buildings, Manchester, Analytical Chemist.
1895. Ricarde-Seaver, Major F. J., 16, Grafton Street, Bond Street, W., Metallurgist.
1889. Richards, Edgar, 341, West 88th Street, New York, U.S.A., Analytical Chemist.
1898. Richards, Harry E., 159, Franklin Street, Bloomfield, N.J., U.S.A., Lawyer.
- O.M. Richards, W. A., Sandbach, Cheshire, Alkali Works Manager.
1888. Richardson, Clifford, New York Testing Laboratory, Long Island City, N.Y., U.S.A., Chemical Engineer.
1898. Richardson, C. Gordon, c/o N.Y. Chemical Refining Co., 38, Park Row, New York, U.S.A., Chemist.
1888. Richardson, D. B., Glen Aros, Isle of Mull, N.B., Chemical Merchant.
1884. Richardson, F. W., Broad Oak, Oak Avenue, Bradford, Yorkshire, Analytical Chemist.
1892. Richardson, G. E., Branch House, Batley, Yorks, Manufacturing Chemist.
1894. Richardson, Jas. C., 19, Claremont Square, London, N., Electro-chemical Engineer.
1900. Richardson, Jno. H., c/o H. D. Pochin and Co., Ltd., Salford, Manchester, Manager.
1889. Richardson, S. M., 415, Main Street, Bonhill, N.B., Analytical Chemist.
1891. Richardson, Walter W., 1, Montpellier Terrace, Cliff Road, Leeds, Manufacturing Chemist.
1894. Richardson, Wm. H., Newsky Thread Mills, Malaja Bolotnaja, St. Petersburg, Russia, Textile Chemist.
1899. Richmond, Edmund W. T., 132, Queen Victoria Street, London, E.C., Gas Engineer.
1886. Richmond, H. D., 24, Baronsfield Road, Twickenham, Chief Chemist (Aylesbury Dairy Co.).
1898. Richmond, Jno. R., Woodend Park, Grassendale, Liverpool, Alkali Works Manager.
1884. Richmond, W. H., Liver Alkali Co., Limited, Ditton Road, Widnes, Alkali Manufacturer.
1886. Riddell, R., 87, Horninglow Street, Burton-on-Trent, Brewer.
1894. Ridding, Howard C., A.R.S.M., 8, Grove Place, Shelton, Stoke-on-Trent, Analytical Chemist.
1884. Rideal, Dr. Samuel, Chemical Laboratory, 28, Victoria Street, Westminster, S.W., Analytical and Consulting Chemist.
- O.M. Ridsdale, C. H., Milton Lodge, Southfield Road, Middlesbrough, Yorks, Analytical Chemist.
1899. Riederer, Emil J., Hercules Powder Works, Ashburn, Mo., U.S.A., Chemist.
1888. Rigby, John S., West Thurrock, Essex, Chemical Manufacturer.
1892. Riker, Jno. J., 45, Cedar Street, New York City, U.S.A., Merchant.
- O.M. Riley, E., 2, City Road, Finsbury Square, London, E.C., Metallurgical Chemist.
- O.M. Riley, J. E., Arden Hall, near Accrington, Chemical Manufacturer.
1884. Riley, Jno., Thornliebank, near Glasgow, Print Works Manager.
1899. Riley, Walter A., jun., Brunswick Lodge, Newmarket Road, Norwich, Brewer.
1893. Riley, Wm., Castleton, Manchester, Chemical Manufacturer.
1899. Rink, Arnold, 9, Butler Street, Milton Street, London, E.C., Tannin Extract Manufacturer.
1889. Rintoul, Wm., Royal Gunpowder Factory, Waltham Abbey, Essex, Explosives Chemist.
- O.M. Ripley, H., Bowling Dyeworks, Bradford, Yorkshire, Dyer.
1901. Ripley, Philip F., Andover, Mass., U.S.A., Chemist.
1900. Rising, Willard B., Berkeley, Cal., U.S.A., Professor of Chemistry.
1888. Ritchie, Robt., Shawfield Works, Rutherglen, near Glasgow, Technical Chemist.
1885. Ritson, T. N., Gas Works, Kendal, Gas Engineer.
1899. Rivington, W. John, 24, Mark Lane, London, E.C., Newspaper Proprietor.
- O.M. Rix, W. P., Ashfield Cottage, Liverpool Road, Newcastle, Staffordshire, Potter.
- O.M. Robbins, J., 57, Warrington Crescent, Maida Vale, London, W., Pharmaceutical Chemist.
1898. Roberts, Caryl C., 14, Wesley Street, Waterloo, Liverpool, Teacher of Chemistry.
1890. Roberts, C. F., Linfits, Delph, via Oldham, Chemical Merchant.
1887. Roberts, F. A., Cornbrook Chemical Works, Manchester, Chemical Manufacturer.
- O.M. Roberts, F. G. Adair, Lion House, Amhurst Park, Stamford Hill, N., Chemical Manufacturer.
1885. Roberts, R. Wightwick, 22, Calle Arturo Prat, Valparaiso, Chili, Analytical and Consulting Chemist.
1900. Roberts, Wm. Brittain, Wilderspool House, Warrington, Brewer and Analyst.
1894. Robertson, Alex., Argyle Chemical Works, Oban, N.B., Manufacturing Chemist.
1891. Robertson, Alex. A., 12, Bennison Drive, Grassendale, Liverpool, Technical Chemist.
1897. Robertson, Andrew J., Williamsburg Avenue, Richmond, Va., U.S.A., Analytical Chemist.
1892. Robertson, Geo. H., 30, Hemstall Road, West Hampstead, N.W., Electro-Chemist.
1900. Robertson, Jas., 103, Whifflet Street, Coatbridge, N.B., Analytical Chemist.
1891. Robertson, Robt., Royal Gunpowder Factory, Waltham Abbey, E., Analytical Chemist.
1895. Robins, Walter, 9, Northbrook Road, Lee, S.E., Chemist.
1897. Robinson, Clarence J., Westerleigh, West New Brighton, N.Y., U.S.A., Chemist.
1900. Robinson, Edw. B., Wellington Works, South Wellington Street, Glasgow, Oil Distiller.



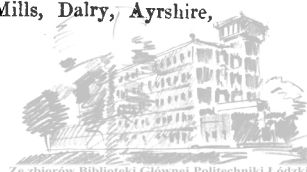
- O.M. Robinson, Prof. H. H., 9, The Barons, Twickenham, Professor of Chemistry.
- O.M. Robinson, Jos., Farnworth, Widnes, Chemical Manufacturer.
- O.M. Robinson, Jno., 8, May Bell Avenue, Blackpool, Chemical Engineer.
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1894. Robson, Jas., 204, George Street, Glasgow, Chemist.
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1884. Rodger, Edw., 1, Clairmont Gardens, Glasgow, W.
1900. Rogers, Geo. J., Wallaroo Smelting Works, South Australia, Chemist.
1890. Rogers, Harry, 5, Stoke Newington Common, London, N.
1899. Rogers, John, Nobel's Explosives Co., Ltd., Ardeer, Stevenston, Ayrshire, Chemist.
1890. Rogerson, W. J., 38, Southwark Street, London, S.E., Wholesale Druggist.
1898. Roller, H. C., Roselle, N.J., U.S.A., Chemist.
1899. Rollin, Chas., 1, St. Nicholas Buildings, Newcastle-on-Tyne, Chemical Manufacturer.
- O.M. Rollin, J. C., 1, St. Nicholas Buildings, Newcastle-on-Tyne, Chemical Manufacturer.
1898. Roode, Rudolf de, International Paper Co., Glens Falls, N.Y., U.S.A., Chemist and Superintendent.
- O.M. Roscoe, Sir Henry, F.R.S., 10, Bramham Gardens, South Kensington, S.W., Consulting Chemist.
1901. Roscow, Jas., 471, Park Avenue, Paterson, N.J., U.S.A., Colourist and Chemist.
1893. Roscow, Jno. F., c/o United States Finishing Co., Norwich, Conn., U.S.A., Print Works Chemist.
1899. Roscow, Wm., 102, Central Avenue, Pawtucket, R.I., U.S.A., Analytical Chemist.
1901. Rose, Jno. Leonard, 454, Cheetham Hill Road, Manchester, Chemist.
1890. Rosell, Dr. Claude A. O., "The Pierrepont," 45, West 32nd Street, New York, U.S.A., Chemist.
1897. Rosengarten, Dr. Geo. D., 1700, Fitzwater Street, Station D, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1896. Rosenheim, Dr. Otto, 68, Belsize Park Gardens, Hampstead, N.W., Analytical and Research Chemist.
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1893. Ross, Arthur, 1, Glengall Road, Old Kent Road, London, S.E., Analytical Chemist.
1901. Ross, Herbert W., 1070, 16th Street, Oakland, Cal., U.S.A., Chemist.
1887. Ross, J. G., Sunbury, Belford Road, Edinburgh, Analytical Chemist.
1900. Ross, Raymond, Public Analyst's Office, Barnley, Lancashire, Analytical Chemist.
1901. Rothberg, Dr. M. E., Johnstown, Pa., U.S.A., Chemist.
1888. Rothwell, C. F. Seymour, 15, Skerton Road, Old Trafford, Manchester, Print Works Chemist.
1896. Rothwell, Rich. P., Room 368, 20, Bucklersbury, E.C., Editor "Engineering and Mining Journal."
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1896. Round, Wm., 100, Bagot Street, Birmingham, Analytical Chemist.
1900. Rountree, Walter B., c/o Mountain Copper Co., Keswick, Shasta Co., Cal., U.S.A., Chemist.
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1884. Roxburgh, J. W., Levenbank Cottage, Jamestown, Dumbartonshire, N.B., Print Works Manager.
1899. Roy, Benjamin, Ailsa Lodge, Whitelaw Road, Chorlton-cum-Hardy, Manchester, Chemist.
1896. Royal-Dawson, H., 3, Kenilworth Road, Ealing, W., Chemist.
1898. Royle, Chas. L., c/o East India Distilleries and Sugar Factories, Ltd., Nellikuppam, S. Arcot, Madras, India, Sugar Chemist.
1898. Royle, Thos. H., c/o Messrs. Carew and Co., Rosa, N.W.P., India, Chemist.
- O.M. Royle, T., Dalton House, Upton Lane, E., and (Journals) 41, George Street, Cheetham Hill, Manchester, Chemical Engineer.
- O.M. Royle, S. W., St. Andrew's Chambers, Albert Square, Manchester, Chemical Engineer.
1890. Royston, Ernest R., 15, Water Street, Liverpool, Patent Agent.
1896. Ruddock, Fred. G., 19, Stanley Street, Warrington, Analytical Chemist.
1895. Rudge, Alfred, Sutton Alkali Works, St. Helens, Analytical Chemist.
1884. Ruffie, Jno., Musley, Ware, Herts, Consulting Chemist and Electrician.
1898. Ruhl, Louis, c/o Roessler and Hasslacher Chemical Co., P.O. Box 1999, New York, U.S.A., Chemical Merchant.
- O.M. Rumble, C., Belmont Works, Battersea, London, S.W., Candle Works Chemist.
1899. Rumbold, Wm. R., 569, Chester Road, Old Trafford, Manchester, Electro-Metallurgist.
1895. Rump, Ernst, The Leeds Phosphate Works, Hunslet, Leeds, Manager.
1899. Rushby, Wm., Cheapside, Batley, Yorks, Analyst.
1901. Rushton, Benjamin, Waterloo, Whalley Road, Accrington, Analytical Chemist.
1887. Russell, D., Cadham, Markinch, Fife, N.B., Paper Maker.
1896. Russell, G. H., c/o Thomson Bros., New Chester Road, Birkenhead, Chemist (Glue and Gelatin Works).
1884. Russell, Jno., Anchor Brewery, Britten Street, Chelsea, London, S.W., Brewer.
- O.M. Russell, Dr. W. J., F.R.S., 34, Upper Hamilton Terrace, London, N.W., Professor of Chemistry.
1892. Russell, Wm., c/o Gold and Silver Extraction Co. of America, Box 1606, Denver, Col., U.S.A., Analytical Chemist.
1883. Ryder, C. E., Northfield, near Birmingham, Electro-Metallurgist.
1884. Ryland, Howard P., Moxhull Park, Erdington, Birmingham, Agricultural Chemist.

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1883. Sadler, A. E., Sand Hall, Ulverston, Lancashire, Manufacturing Chemist.
- O.M. Sadler, Dr. S. A., M.P., Middlesbrough-on-Tees, Colour Manufacturer.
1884. Sadtler, Dr. S. P., 145, North 10th Street, Philadelphia, Pa., U.S.A., Consulting Chemist.
1896. Sadtler, Dr. S. S., 336, West Franklin Street, Germantown, Pa., U.S.A., Chemist (U.S. Customs).
1897. Sage, C. Edward, 2, Charterhouse Street, London, E.C., Consulting Chemist.
1897. St. John, Harry, Queen Street Brewery, Sunderland, Brewer and Analyst.
1884. Salamon, A. G., 1, Fenchurch Avenue, London, E.C., Consulting Chemist.
1885. Salamon, Jno., Rainham, S.O., Essex, Manufacturing Chemist.
1884. Salis-Mayenfeld, Dr. E. von., P.O. Box 165, Albany, N.Y., U.S.A., Technical Chemist.
1894. Salter, Chas. T. C., 33, Park Hall Road, East Finchley, N., Scientific Journalist.
- O.M. Samuel, W. Cobden, 337, Norwood Road, West Norwood, S.E., Analytical Chemist.
- O.M. Samuelson, Rt. Hon. Sir Bernhard, Bart., F.R.S., 56, Prince's Gate, London, S.W., Ironmaster.



1896. Samuelson, Francis A. E., Sir B. Samuelson and Co., Ltd., Middlesbrough, Ironmaster.
1895. Samuelson, Godfrey B., c/o Messrs. W. T. Glover and Co., Salford, Electrical Manufacturer.
1901. Sanders, C. Newell, Roanoke, Va., U.S.A., Railway Chemist.
1895. Sanderson, John, Chemist.
1898. Sanderson, T. Crisp, c/o Matheson and Co., 25-27, Cedar Street, New York City, U.S.A., Chemical Engineer.
1899. Sandford, J. Wallace, c/o A. W. Sandford and Co., Grenfell Street, Adelaide, S. Australia, Analytical Chemist.
1884. Sandon, R., 42, Lewisham Road, Dartmouth Park, N.W., Examiner at Patent Office.
- O.M. Sanford, P. Gerald, Analytical Laboratory, 20, Cullum Street, E.C., Analytical and Consulting Chemist.
1390. Saniter, E. H., 51, Grange Road West, Middlesbrough, Analytical Chemist.
1891. Sankey, Chas. H., Iron Bridge and Essex Wharves, Canning Town, E., Fire- and Acid-Proof Goods Maker.
1896. Saunders, Walter M., 20, Dewey Street, Olneyville, R.I., U.S.A., Analytical Chemist.
1895. Savage, Arthur E., Sulphide Corporation Works, Cockle Creek, Newcastle, N.S.W., Metallurgist.
1895. Sawers, Wm. D., 70, Barrington Drive, Glasgow, W., Chemist.
1901. Sawyer, Harris E., 172, Federal Street, Boston, Mass., U.S.A., Chemist and Bacteriologist.
1898. Saxe, Sigmond, 108, Fulton Street, New York City, U.S.A., Manufacturing Chemist.
1895. Sayer, Harry, 29, St. George's Square, London, S.W., Metallurgical Chemist.
1894. Sayers, Jos. J., Mayville, Stevenston, Ayrshire, Explosives Chemist.
1895. Scales, F. Shillington, Wearmouth Paper Mill, Sunderland, Paper Maker.
1899. Schaak, Dr. Milton F., 108, Penn Street, Brooklyn, N.Y., U.S.A., Chemist.
- O.M. Schack-Sommer, Dr. G., 48, Marlborough Mansions, Victoria Street, S.W., Sugar Refiner.
1884. Schad, Julius, York Buildings, 33, Mosley Street, Manchester, Aniline Co.'s Agent.
1899. Schaefer, Dr. L., Maywood, N.J., U.S.A., Manufacturing Chemist.
1898. Schaffer, Herbert A., 347, Brodhead Street, Easton, Pa., U.S.A., Chemist (Vulcanite Portland Cement Co.).
- O.M. Schäppi, Dr. H., Mitlödi, Canton Glarus, Switzerland, Analytical Chemist.
1886. Schellhaas, H., Thornhill, Beach Road, Hartford, Norwich, Mechanical Engineer.
1894. Schidowitz, Dr. P., 57, Chancery Lane, W.C., Research Chemist.
1895. Schieffelin, Dr. W. Jay, 841, Southern Boulevard, New York, U.S.A., Manufacturing Chemist.
1893. Schleicher, Francis J., 38, West Tenth Street, Long Island City, N.Y., U.S.A., Technical Chemist.
1899. Schniewind, Dr. F., 277, Broadway, New York City, U.S.A., Chemist.
1897. Schoder, Dr. Robt., The Incandescent Gas Light Co., 14, Palmer Street, Westminster, S.W., Chemist.
- O.M. Scholefield, H. E., Greenwood, Victoria Park, Waver-tree, Liverpool, Chemical Manufacturer.
1898. Scholes, Geo. R., 27, Station Road, Urmston, Manchester, Analytical Chemist.
1895. Schroeder, E. August, c/o Church and Co., 36, Ash Street, Brooklyn, N.Y., U.S.A., Chemist.
1900. Schroller, Wm., 20, Mount Street, Manchester, Engineer.
1894. Schryver, Dr. S. B., Chemist.
1888. Schulze, Dr. Karl E., Winkel, Rheingau, Germany, Technical Chemist.
- O.M. Schunck, Dr. E., F.R.S., Kersal, near Manchester, Colour Chemist.
1893. Schüpphaus, Dr. R. C., 174, Broadway, New York, U.S.A., Consulting Chemist.
1893. Schwab, Dr. L. C., Sedanstrasse 53, Bernburg, Anhalt, Technical Chemist.
1900. Schwarz, Dr. Henry P., c/o Haas Bros., 27, William Street, New York City, U.S.A., Chemist.
1889. Schweich, Emil, 85, Belgrave Road, London, S.W., Technical Chemist.
1894. Schweitzer, Dr. H., 40, Stone Street, New York City, U.S.A., Analytical Chemist.
1891. Scott, Andrew, Royal Gunpowder Factory, Waltham Abbey, Essex, Analytical Chemist.
1893. Scott, A. Ross, Verreville, Lenzie, N.B., Manufacturing Chemist.
1889. Scott, Ernest G., 2, Talbot Court, Gracechurch Street, London, E.C., Soap Works Chemist.
1898. Scott, Jas., Cawnpore Woollen Mills, Cawnpore, India, Chemist.
1894. Scott, Jno. Gillespie, Annislea, Northfield, Liberton, near Edinburgh, Analytical Chemist.
1894. Scott-Smith, G. E., 67, Surrey Street, Sheffield, Analytical Chemist.
1889. Scovell, M. A., Lexington, Kentucky, U.S.A., Agricultural Chemist.
1887. Scrutton, Willis, Analytical Chemist.
1896. Scrymgeour, Wm., Box 92, Kalgoorlie, West Australia, Chemist.
- O.M. Scudder, F., Mersey and Irwell Joint Committee, 44, Mosley Street, Manchester, Analytical Chemist.
1895. Seabrooke, H. Cecil, Laboratory, The Brewery, Reading, Research Chemist.
1898. Seal, Alf. N., 504, 11th Street N.W., Washington, D.C., U.S.A., Chemist.
1900. Searby, Fred. W., West Berkeley, Cal., U.S.A., Oilworks Superintendent.
1889. Searl, Albert, Montreux, Victoria Road, Sidcup, Kent, Technical Chemist.
1898. Searle, Alf. B., 280, Western Bank, Sheffield, Analytical Chemist.
1896. Sedding, G. H. P., c/o Florida Syndicate, Jacksonville, Florida, U.S.A., Chemist.
1901. Sederholm, Erik, 28, Jakopsgatan, Stockholm, Sweden, Chemist (Royal Navy Board).
1901. Seeler, Dr. F., c/o Geo. Lueders and Co., Chemical Works, Elizabeth, N.J., U.S.A., Manufacturing Chemist.
1893. Sefton-Jones, Herbert, c/o W. P. Thompson and Co., 322, High Holborn, W.C., Analytical Chemist.
1899. Seher, A., c/o Maas and Waldstein, Riverside Avenue, Newark, N.J., U.S.A., Chemist.
1896. Seldner, Rudolph, 217, Jefferson Avenue, Brooklyn, New York, U.S.A., Instructor in Chemistry.
1884. Senet, Louis, 217, Chaussée de Vleurgat, Brussels, Alkali Manufacturer.
1900. Semonite, Radeliffe G. C., 910a, Greene Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1898. Sen (Gupta), Nagendra Nath, 18, Lower Chitpur Road, Calcutta, India, Physician and Chemist.
1895. Senger, Robt., 37, Warren Street, New York City, U.S.A., Manufacturing Chemist.
1899. Senior, Francis L., Lock 28, Sanford, Maine, U.S.A., Mill Chemist.
- O.M. Sevin, C., c/o Dollman & Pritchard, 9 and 10, King Street, Chapside, E.C., Chemical Engineer and Oil Refiner.
1900. Seward, Geo. O., Holcomb Rock, Va., U.S.A., Chemist.
1896. Seyler, Clarence A., Technical Institute, Nelson Terrace, Swansea, Chemist and Assayer.
1889. Seymour-Jones, A., Cambrian Leather Works, Wrexham, Leather Manufacturer.
1894. Shallcross, Arthur, Excelsior Chemical Works, Corbett Street, Bradford, near Manchester, Chemical Manufacturer.
1892. Shanks, Arch., Bridgend Mills, Dalry, Ayrshire, N.B., Chemist.



- O.M. Shapleigh, W., Welsbach Incandescent Gas Light Co., Gloucester City, N.J., U.S.A., Technical Chemist.
1883. Sharp, James, Shirley Manor, Wyke, near Bradford, Yorks, Dyer.
1891. Sharpe, Granville H., 11 & 12, Great Tower Street, London E.C., Analytical Chemist.
1884. Sharples, Stephen P., 13, Broad Street, Boston, Mass., U.S.A., Analytical Chemist.
1896. Sharpley, Wm. P., Ditton Copper Works, Widnes, Lancashire, Analytical Chemist.
1900. Sharwood, Wm. J., c/o Montana Mining Co., Marysville, Lewis and Clarke Co., Mont., U.S.A., Metallurgical Chemist.
1900. Shattuck, A. F., The Solvay Process Co., Detroit, Mich., U.S.A., Chemist.
1885. Shaw, F. W., Temple House, Heapey, near Chorley, Lancashire, Analytical Chemist.
1883. Shaw, Geo., 35, Temple Row, Birmingham, Patent Agent.
1890. Shaw, H. Dixon, Bond Street, Dewsbury, Yorks, Analytical and Consulting Chemist.
- O.M. Shearer, A., 36, Demesne Road, Alexandra Park, Manchester, Technical Chemist.
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1892. Shenton, Jas. P., 34, Lansdowne Road, Albert Park, Didsbury, Manchester, Analytical Chemist.
1889. Shepard, Dr. Chas. U., 56-59, Broad Street, Charleston, S.C., U.S.A.
1900. Shepherd, E. Sanger, 5-7, Gray's Inn Passage, Holborn, W.C., Scientific Instrument Maker.
1893. Shepherd, H. H. B., Northcote, Mount Pleasant Lane, Upper Clapton, N.E., Chemist.
1898. Shepherd, Reginald des F., Handforth, Cheshire, Printworks Chemist.
1895. Sherman, G. W., Room 509, Exchange Building, 53, State Street, Boston, Mass., U.S.A., Chemical Engineer.
1899. Shero, John E., c/o Pittsburgh Reduction Co., Niagara Falls, N.Y., U.S.A., Chemist.
1893. Shields, Dr. J., Scottish Cyanide Co., Ltd., Leven, Fife, N.B., Chemist.
1899. Shillitoe, Frank, Pontefract Road, Castleford, Yorks, Chemist.
1896. Shimomura, K., c/o Osaka Seimi Works Co., Kawagishicho, Nishiku, Osaka, Japan, Chemist.
1886. Shimosé, Masachika, Shimosé Powder Works, Takinogawa, near Oji, Tokyo, Japan, Chemical Engineer.
1888. Shishkoff, Sergius A., Elabouga, Govt. of Viatka, Russia, Manager (Glass Works).
1893. Shishkoff, Waldemar A., Russia, Chemical Engineer.
1899. Sholes, Chas. E., c/o General Chemical Co., Syracuse, N.Y., U.S.A., Chemical Salesman.
1900. Shonk, Albert, 168, Malmesbury Road, Canning Town, E., Analytical Chemist.
1899. Shores, Jeff H., Mill Brow, Widnes, Chemist.
1897. Shorey, Dr. Edmund C., Office of Board of Health, Honolulu, H.I., Chemist.
1901. Shukoff, Dr. Alexis A., c/o A. M. Shukoff, St. Petersburg, Russia, Technical Chemist.
1899. Shuler, Darius P., Sudbury, Ont., Canada, Chemist.
1890. Shutt, Frank T., Central Experimental Farm, Ottawa, Canada, Agricultural Chemist.
- O.M. Siebold, L., Broomville Avenue, Sale, Manchester, Analytical Chemist.
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1884. Sillar, W. Cameron, The Native Guano Co., Limited, 29, New Bridge Street, Blackfriars, E.C., Director (Native Guano Co.).
1892. Silvester, Harry, Holyhead Road, Handsworth, Birmingham, Analytical and Consulting Chemist.
1899. Simeons, Carl, 70, Finsbury Pavement, London, E.C., Gelatine Manufacturer.
1898. Simon, Dr. A., 55-56, Bishopsgate Street, E.C., Chemical Engineer.
1890. Simonds, Dr. F. M., 159, Front Street, New York, U.S.A., Mining Engineer and Assayer.
1897. Simpson, Edw. S., Geological Survey Office, 395, St. George's Terrace, Perth, West Australia, Government Assayer.
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1900. Sims, W. Edgar, 11, Brampton Grove, Cheetham, Manchester, Technical Chemist.
1894. Sinclair, Dr. W., 60, Stirling Road, Trinity, Edinburgh, Chemist.
1890. Sindall, R. W., c/o Lloyd Ltd., Sturgeon Falls, Ont., Canada, Paper Mills Chemist.
1889. Singer, Ignatius, Petone, near Wellington, New Zealand, Manufacturing Chemist.
1899. Singmaster, Jas. A., Palmerston, Pa., U.S.A., Chemist (India Refining Co.).
- O.M. Sisson, G., jun., c/o Washington Chemical Co., Lim., Washington Station, R.S.O., Co. Durham, Works Manager.
1885. Skaife, Wilfred T., 630, Sherbrooke Street, Montreal, Canada, Sugar Chemist.
1894. Skelton, John R., St. Augustine's Crape Factory, Norwich, Technical Chemist.
1897. Skertchley, W. P., Laboratory, 11, Billiter Square, E.C., Analytical Chemist.
1891. Skilton, C. F. E., Brewery House, Staines, Brewer.
1896. Skurray, Thos., United Breweries, Abingdon, Berks, Brewer.
1897. Skvortzoff, Basil N., Works of Oushkoff & Co., Kazan, Russia, Chemical Technologist.
- O.M. Slade, H. E., Streatham Common, London, S.W., Rubber Works Manager.
1887. Slatter, Geo. W., Carlton Terrace, Nab Wood, Shipley, Yorkshire, Analytical Chemist.
1895. Slocum, Frank L., 401, South Linden Avenue, E.E., Pittsburgh, Pa., U.S.A., Chemist.
1899. Slosson, Edwin E., University of Wyoming, Laramie, Wyoming, U.S.A., Professor of Chemistry.
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1898. Small, Fritz H., c/o Graton and Knight Manufacturing Co., Worcester, Mass., U.S.A., Chemist.
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1884. Smiles, Jas., Blandfield Chemical Works, Canonmills, Edinburgh, Manufacturing Chemist.
1900. Smith, A. George, 9, Forest Road, Aberdeen, Optician.
1898. Smith, Alf. B., Whiteley House, Glossop, Derbyshire, Bleacher and Dyer's Manager.
1886. Smith, Alfred, Excelsior Chemical Works, Clayton, Manchester, Manufacturing Chemist.
1897. Smith, Allan, c/o Kellner-Partridge Paper Pulp Co., Hallein, bei Salzburg, Austria, Paper Mills Chemist.
1898. Smith, Andrew B., c/o Mr. Armstrong, Chemist, Queenstown, C.C., S. Africa.
1896. Smith, Andrew T., 43, Castle Street, Liverpool, Chemical Broker.
1895. Smith, E. Ellsworth, 36, East 29th Street, New York, U.S.A., Consulting Physiological Chemist.
1893. Smith, Edgar B., Prince Regent's Wharf, Silvertown, E., Chemist.
- O.M. Smith, Edgar F., c/o E. M. Robson, Trelawny, Fairfax Road, Bedford Park, W., Analytical Chemist.
1892. Smith, Ernest A., The Assay Office, Leopold Street, Sheffield, Assayer.
1900. Smith, E. Sell, c/o Grasselli Chemical Co., East Chicago, Indiana, U.S.A., Manufacturing Chemist.
1898. Smith, E. Shrapnell, 35, Botanic Road, Wavertree, Liverpool, Chemical Engineer.
1891. Smith, Francis P., Room 2, Bryson Block, Los Angeles, Cal., U.S.A., Chemist.
1885. Smith, Fred., Analytical Chemist.
- O.M. Smith, G., Polmont Station, Scotland, Explosives Works Manager.



1897. Smith, Sir Geo. J., Messrs. Bickford, Smith, & Co., Ltd., Tuckingmill, Cornwall, Fuse Manufacturer.
1890. Smith, Harry, 74, Fairfield Road, West Jesmond, Newcastle-on-Tyne, Technical Chemist.
1890. Smith, Harry E., 29, 31st Street, Milwaukee, Wis., U.S.A., Analytical Chemist.
1900. Smith, H. Ewing, 22, City Road, London, E.C., Manufacturing Chemist.
1898. Smith, H. Gilbertson, Hollies, Park Hill, Clapham, S.W.
- O.M. Smith, H. R., 1, Aubert Park, Highbury, London, N., Analytical Chemist.
1890. Smith, H. Wood, c/o British Cyanides Co., Ltd., Oldbury, near Birmingham, Analytical Chemist.
1897. Smith, James, 14, Mersey Road, Aigburth, Liverpool, Analytical Chemist.
1893. Smith, Jas. F., 30, Chester Road, Akroydon, Halifax, Analytical Chemist.
- O.M. Smith, J., Ash Grove House, Radcliffe, Manchester.
- O.M. Smith, Dr. J. H., Wollishofen, Zurich, Switzerland, Chemical Manufacturer.
1884. Smith, J. Johnstone, Lockwood Brewery, Huddersfield, Brewing Chemist.
1898. Smith, John, Hartley Street Dycworks, Dewsbury, Yorks, Dyer.
1896. Smith, Joseph Kent, Oakville, Alsager, Cheshire, Metallurgical Chemist.
1888. Smith, J. Tertius, c/o Jeyes' Sanitary Compound Co., Ltd., Plaistow, Essex, Technical Chemist.
- O.M. Smith, Jno. W., Massachusetts Institute of Technology, Boston, Mass., U.S.A., Analytical Chemist.
1890. Smith, J. Wm., Solvay Process Co., Syracuse, N.Y., U.S.A., Alkali Works Manager.
1898. Smith, R. F. Wood, Laboratory, 89, Bartholomew Close, E.C., Consulting Chemist.
1890. Smith, R. Greig, Linnean Society's House, Elizabeth Bay, Sydney, N.S.W., Analytical Chemist.
1890. Smith, R. Watson, c/o J. and J. Cunningham, Ltd., Salamander Street, Leith, N.B., Chemical Works Manager.
- O.M. Smith, S., Hacienda, Leicester Road, New Barnet, Analytical Chemist.
1900. Smith, T. Connell, Blandfield Chemical Works, Edinburgh, Manufacturing Chemist.
1896. Smith, T. Reader, Urban District Council, Kettering, Surveyor, Assoc. M. Inst. C.E.
1897. Smith, Theophilus R., c/o Brotherton & Co., Haigh Park Chemical Works, Stourton, near Leeds, Chemist.
1896. Smith, Walter E., 47, Jenkins Street, Providence, R.I., U.S.A., Instructor in Chemistry.
- O.M. Smith, Watson, 34, Upper Park Road, Haverstock Hill, N.W., Editor of Society's Journal.
- O.M. Smith, Wilfred, 182, West Street, Glasgow, Chemical Manufacturer.
1896. Smith, W. Stanley, Highfield, near Wrexham, North Wales, Brewer.
- O.M. Smithells, Prof. A., Yorkshire College, Leeds, Professor of Chemistry.
- O.M. Smithers, F. O., Dashwood House, 9, New Broad Street, London, E.C., Chemical Agent.
- O.M. Smithson, J., Park Printworks, Halifax, Stuff Printer.
1892. Smithson, Saml., Ravensthorpe, near Dewsbury, Yorks, Dyer and Drysalter.
1888. Snape, Dr. H. Lloyd, University College, Aberystwith, Professor of Chemistry.
1896. Snowdon, Charlie, 269, West Ferry Road, Millwall, E., Chemical Works Manager.
1896. Snowdon, Jno. jun., Messrs. Snowdon, Sons, & Co., Millwall, E., Chemical and Oil Manufacturer.
1900. Snyder, Geo. D., 31, Bradford Street, Brooklyn, N.Y., U.S.A., Chemist.
1900. Sodeau, Wm. H., 25, Shore Road, London, N.E., Chemist to Explosives Committee.
1894. Sohn, Chas. E., 2, Harpur Street, Bedford Row, London, W.C., Analyst.
1895. Solvay, Armand, 25, Rue Prince Albert, Brussels, Gérant de la Société Solvay et Cie.
1884. Solvay, Ernest, 43, Rue des Champs Elysées, Brussels, Alkali Manufacturer.
1897. Somerset, H. St. John, jun., Mount Morgan Gold Mining Co., Mount Morgan, Queensland, Assayer.
1884. Sommer, Adolf, corner 1st and Binney Streets, East Cambridge, Boston, Mass., U.S.A., Pharmaceutical Chemist.
1898. Sommerville, Jno. D., 45, Montgomerie Street, Kelvinside, Glasgow, Analytical Chemist.
1894. Sonstadt, Edw., Church Fields, Cheshunt, Herts, Chemical Technologist.
1896. Sorel, Ernest, 93, Avenue d'Orleans, Paris, Engineer.
1896. Souther, H., 440, Capitol Avenue, Hartford, Conn., U.S.A., Chemical and Metallurgical Engineer.
1892. Southern, Thos., Jr., Wheathill Chemical Works, St. Simon Street, Salford, Manufacturing Chemist.
1883. Soward, A. W., 28, Therapia Road, Honor Oak, S.E., Principal Clerk (Legacy Duty Office).
1890. Sowerby, Thos. H., Canal Soap Works, Verney Road, Rotherhithe New Road, S.E., Soap Manufacturer.
- O.M. Sowerby, W. M., 12, Upper Queen's Terrace, Flectwood, Lancashire, Alkali Works Manager.
1887. Spackman, Chas., Rosehaugh, Clitheroe, Lancashire, Portland Cement Manufacturer.
1900. Sparks, John C., Bement Avenue, Livingston, S.I., N.Y., U.S.A., Chemist.
1883. Spence, D., Alum Works, Manchester, Alum Manufacturer.
- O.M. Spence, F., Alum Works, Manchester, Alum Manufacturer.
1900. Spence, Howard, Audley, Broad Road, Sale, Cheshire, Chemical Manufacturer.
1894. Spence, J. Napier, Heathfield, Harrow-on-the-Hill, Teacher of Chemistry.
1883. Spence, J. W., 58, Dobbie's Loan, Glasgow, Drysalter.
1900. Spencer, Harold, Springside, Sharples, Bolton, Lancashire, Paper Maker.
1884. Spencer, Jno., Globe Tube Works, Wednesbury, Tube Manufacturer.
- O.M. Spencer, J. W., Newbiggin House, Keaton, Newcastle-on-Tyne, Steel Manufacturer.
1897. Sperry, Erwin S., 208, Colorado Avenue, Bridgeport, Conn., U.S.A., Metallurgist.
1884. Spiegel, Dr. Adolf, Messel, bei Darmstadt, Germany, Analytical Chemist.
1899. Spieler, Aug. J., c/o The Will and Baumer Co., Syracuse, N.Y., U.S.A., Stearic Acid Works Superintendent.
1889. Spies, Adolph, 102, Fenchurch Street, London, E.C., Chemical Merchant.
1889. Spies, Hermann, 102, Fenchurch Street, London, E.C., Chemical Merchant.
1885. Spiller, A., Edison-Swan Electric Co., South Benwell Works, Newcastle-on-Tyne, Electrician.
- O.M. Spiller, J., 2, St. Mary's Road, Canonbury, London, N., Consulting Chemist.
1896. Spoor, J. L., Madras Cement Works, Madras, India; and (Journals), Culver House, Gravesend, Kent, Portland Cement Manufacturer.
- O.M. Sprengel, Hermann Johann Philipp, Ph.D. (Heidelb.), F.R.S., Royal Prussian Professor (titular); Journals to Prof. Sprengel, F.R.S., Savile Club, 107, Piccadilly, London, W., Chemist.
1900. Spurge, Edw. C., 11, Gotha Street, Victoria Park Road, London, N.E., Chemist.
- O.M. Squire, P. W., 413, Oxford Street, London, W., Pharmaceutical Chemist.
- O.M. Squire, Dr. W. S., Clarendon House, St. John's Wood Park, N.W., Chemical Engineer.
1896. Stafford, Chas. H., c/o The Birkaere Printing Co., Birkaere, Chorley, Colourist.
1898. Stainton, Wm. J., 378, Elmwood Avenue, Buffalo, N.Y., U.S.A., Analytical Chemist.
- O.M. Stahl, Dr. K. F., 57th Street and A. V. Ry., Pittsburgh, Pa., U.S.A., Chemical Works Manager.
1891. Stanger, W. Harry, Broadway Testing Works, Westminster, S.W., Engineer.



1884. Stanning, John, Broadfield, Leyland, near Preston, Bleacher.
1888. Stantial, Frank G., c/o Cochrane Chemical Co., Everett, Mass., U.S.A., Technical Chemist.
1885. Staples, H. J., Spondon, Derby, Colour Manufacturer.
- O.M. Stark, J. F., 9, Allfarthing Lane, Wandsworth, S.W., Works Superintendent.
1896. Statham, Noel, Penny Lane Farm, Cronton, Prescott, Lancashire, Engineer.
1895. Stead, J. Christopher, Mitre Works, Cordova Road, Bow, E., Chemist and Manager.
- O.M. Stead, J. E., 11, Queen's Terrace, Middlesbrough-on-Tees, Analytical Chemist.
1898. Stearns, Theron C., 44, Montgomery Street, Jersey City, N.J., U.S.A., Consulting Chemist.
- O.M. Stebbins, J. H., 80, Madison Avenue, New York, U.S.A., Analytical Chemist.
- O.M. Steedman, R. H., Goltfyn, Carric kRoad, Ayr, N.B., Chemical Manufacturer.
1896. Steel, Fred. W., c/o Cuming, Smith, and Co., Yarraville, Melbourne, Vic., Analytical Chemist.
1900. Steel, Jno. S., Fitzroy Meat Works, Lake Creek, Rockhampton, Queensland, Chemist.
1884. Steel, R. Elliott, Northampton and County School, Northampton, Headmaster.
- O.M. Steel, Thcs., Colonial Sugar Refinery, Sydney, N.S.W., Sugar Chemist.
1897. Stein, Sigmund, 323, Vauxhall Road, Liverpool, Sugar Refinery Manager.
1897. Steinhart, Dr. Oscar J., 4, Palace Street Mansions, Buckingham Gate, S.W., Manufacturing Chemist.
1887. Stenhouse, T., Townhead, Rochdale, Analytical Chemist.
1892. Stephens, M. E., 4, Carlton Gardens, London, S.W., Ink Manufacturer.
1884. Stephens, H. Chas., M.P., Avenue House, Finchley, N., Ink Manufacturer.
1889. Stern, Arthur L., 170, Ashby Road, Burton-on-Trent, Brewing Chemist.
- O.M. Steuart, D. R., Broxburn, near Edinburgh, N.B., Oilworks Chemist.
1899. Stevenot, G. A., c/o Schoellkopf, Hartford, and Hanna Co., 100, William Street, New York, U.S.A., Chemist.
1898. Stevens, Arthur F., 61, Balfour Road, Highbury New Park, N., Paper Examiner.
1894. Stevens, Jno. H., 295, Ferry Street, Newark, N.J., U.S.A., Manufacturing Chemist.
1884. Stevens, Wm., The Native Guano Co., Ltd., 29, New Bridge Street, Blackfriars, E.C., Secretary.
1899. Stevenson, Arnold, 4, Porchester Gardens, London, W., Chemist.
1884. Stevenson, Jas., 23, West Nile Street, Glasgow; and Hailie, Largs, N.B., Manufacturing Chemist.
- O.M. Stevenson, Dr. T., Guy's Hospital, London, S.E., Chemical Lecturer.
- O.M. Stevenson, W., Standard Works, 95A, Southwark Street, London, S.E., Chemical Manufacturer.
1893. Stewart, Alex. F., 1, Maybank Street, Crosshill, Glasgow, Assayer.
1891. Stewart, Jeffrey, Albert Mills, The Mall, Hammer-smith, Sugar Works Manager.
1890. Stewart, Robt., c/o Boake, Roberts, and Co., Warton Road, Stratford, E., Chemical Works Manager.
1896. Stewart, R. Patrick, 21, Industry Place, Kirkintilloch, N.B., Analytical Chemist.
- O.M. Stewart, S., c/o Michael Nairn and Co., Ltd., Linoleum Works, Kirkealdy, N.B., Technical Chemist.
1899. Stewart, Saml., 16, Great George Street, Westminster, S.W., Managing Director (Explosives Co.).
1896. Stiebel, G. L., Manager.
1890. Stillman, Dr. T. B., Stevens Institute of Technology, Hoboken, N.J., U.S.A., Professor of Analytical Chemistry.
1884. Stillwell, Chas. M., 55, Fulton Street, New York, U.S.A., Analytical and Consulting Chemist.
1886. Stirck, Jos., Ferneliffe, Elm Bank, Nottingham, Brewer's Engineer.
1893. Stock, F. W. Keating, County Analyst's Office, Darlington, Analytical and Consulting Chemist.
1900. Stockdale, Edgar, Printworks, Birstall, Yorks, Colour Mixer.
1888. Stockdale, Wm., Irwell Printworks, Stacksteads, near Manchester, Calico Printer.
1887. Stocks, H. B., 6, Sydney Road, Churchtown, Southport, Analytical Chemist.
1885. Stoddart, F. Wallis, Western Counties Laboratory, Bristol, Analytical Chemist.
1899. Stoddart, Reginald T., Belgrave Terrace, Queen's Road, Cheetham, Manchester, Chemist.
- O.M. Stoer, J., 6, Hanover Quay, Dublin.
- O.M. Stoker, G. N., Government Laboratory, Clement's Inn Passage, Strand, W.C., Analytical Chemist.
1899. Stokes, Alf. W., Laboratory, Vestry Hall, Paddington Green, W., Public Analyst.
1898. Stokes, Dr. Henry N., U.S. Geological Survey, Washington, D.C., U.S.A., Chemist.
1892. Stone, Frank, Laboratory, 193, Collins Street, Melbourne, Victoria, Analytical Chemist and Assayer.
- O.M. Stone, F. B., Eardley Villa, Picardy Hill, Belvedere, Kent, Technical Chemist.
1900. Stone, Geo. C., c/o New Jersey Zinc Co., 115, Broadway, New York City, U.S.A., Engineer.
1899. Stone, J. F., 157, Maiden Lane, New York, U.S.A., Chemical Merchant.
1888. Stone, Thos. W., Chemical Works, St. George, Bristol, Chemical Manufacturer.
- O.M. Storey, I. H., Haverbreaks, Lancaster, Chemical Manufacturer.
1888. Stowe, W. T., Inland Revenue, Wellington, Salop, Analytical Chemist.
1883. Strangman, J. Pim, 38, Rue Desbordes - Valmore, Passy, Paris, Bleacher.
1887. Strong, Colin R., 13, St. Ann Street, Manchester, Oil Merchant.
- O.M. Stuart, C. E., 29, Mosley Street, Newcastle-on-Tyne, Chemical Apparatus Dealer.
1896. Stuart, Harry T. R., Know Mill House, Entwistle, near Bolton, Printworks Sub-Manager.
- O.M. Stuart, T. W., 7, Livingston Drive, Sefton Park, Liverpool, Alkali Works Manager.
1896. Stubbs, Augustus J., Cástaras, Prov. de Granada, Spain.
- O.M. Studer, Dr. A., 10, Marsden Street, Manchester, Consulting Chemist.
1890. Studer, Simon J., Grappenhall Road, Stockton Heath, near Warrington, Technical Chemist.
1898. Styles, R. Curling, Knockhall, Greenhithe, Kent, Analytical Chemist.
1900. Suart, Arthur B., St. Paul's Works, Paul Street, Finsbury, E.C., Manager of Melting Department.
1896. Suckert, Dr. J. J., 253, Broadway, New York City, U.S.A., Manufacturing Chemist.
1895. Sudborough, Dr. J. J., University College, Nottingham, Lecturer in Chemistry.
1889. Sulman, H. L., 60, Gracechurch Street, London, E.C., Chemist and Metallurgist.
1895. Summers, Bertrand S., c/o McCormick Harvesting Machine Co., Western and Blue Island Avenues, Chicago, Ill., U.S.A., Electro-Chemist.
1890. Sumner, Harold, Worthington, near Wigan, Dyer and Bleacher.
1896. Sunderland, A., 84, Hainworth Wood Road, Ingrow, Keighley, Teacher of Chemistry.
1899. Sundstrom, Carl, c/o Solvay Process Co., Detroit, Mich., U.S.A., Chemist.
1895. Sundström, Karl J., Trenton, Wayne Co., Mich., U.S.A., Manufacturing Chemist.
1884. Sutherland, D. A., 28, Victoria Street, Westminster, S.W., Consulting Technical Chemist and Assayer.
1894. Sutherland, Geo., Croft Cottage, Bonhill, N.B., Chemist.
1887. Sutherland, Jas., c/o British Aluminium Co., Ltd., Larne Harbour, Co. Antrim, Ireland, Chemist.
- O.M. Sutherland, R. M., Lime Wharf Chemical Works, Falkirk, N.B., Chemical Manufacturer.



1899. Sutherst, Dr. Walter F., Agricultural College, Holmes Chapel, Crewe, Science Master.
1901. Sutro, H. H., 60, West 49th Street, New York City, U.S.A., Chemist.
- O.M. Sutton, Francis, Norfolk County Laboratory, Redwell Street, Norwich, Analytical Chemist.
1886. Sutton, F. Napier, 6, Grosvenor Gardens, Willesden Green, N.W., Alkali Works Inspector.
1900. Sutton, W. Linclne, 11, Thorpe Dene, Norwich, Public Analyst.
- O.M. Swan, J. Cameron, 4, Nicholas Buildings, Newcastle-on-Tyne, Manufacturing Chemist.
- O.M. Swan, J. W., F.R.S., 58, Holland Park, London, W., Chemist and Electrician.
1898. Swanson, Jas. F. (Journals) c/o Gibbs and Co., Iquique, Chile; and (subs.) c/o W. J. Andrew, Bank Buildings, Coatbridge, N.B., Technical Chemist.
1884. Swinburne, Geo., c/o J. Coates & Co., Planet Chambers, 8, Collins Street East, Melbourne, Australia; (subs.) Suffolk House, Laurence Pountrey Hill, E.C., Gas Engineer.
1892. Sykes, James, Heckmondwike Oil and Chemical Works, Heckmondwike, Yorks, Oil Refiner.
- O.M. Syme, W. B., c/o Young's Paraffin Oil Co., Addiewell, West Calder, N.B., Oil Works Chemist.
1900. Symes, Dr. W. H., 176, Worcester Street, Christchurch, New Zealand, Government Health Officer.
- T**
1895. Taber, G. H., jun., 4134, Girard Avenue, Philadelphia, Pa., U.S.A., Dept. Superintendent (Atlantic Refining Co.)
1895. Tait, Thos., S., Inverurie, N.B., Paper Maker.
1896. Takagi, T., c/o Sumitomo, Kobé, Japan, Chemical Engineer.
- O.M. Takamatsu, T., Tokyo University, Japan, Analytical Chemist.
- O.M. Takamine, Dr. J., 475, Central Park West, New York City, U.S.A., Engineer.
1890. Takayama, Jintaro, Imperial Geological Survey Office, Dept. of Agriculture, Tokio, Japan, Agricultural Chemist.
1898. Tanaka, Keishin, c/o Tokio Gas Co., 92, Sarnechô, Fukugawa, Tokio, Japan, Chemist.
1900. Tankard, Arnold R., 67, Surrey Street, Sheffield, Analytical Chemist.
- O.M. Tate, F. H., 9, Hackins Hey, Liverpool, Analytical and Technical Chemist.
- O.M. Tate, H., Sugar Refiner.
- O.M. Tatlock, J., 40, Renfrew Street, Glasgow, Laboratory Furnisher.
- O.M. Tatlock, R. R., 156, Bath Street, Glasgow, Consulting Chemist.
1892. Tatton, Reginald A., 44, Mosley Street, Manchester, Civil Engineer.
- O.M. Taubman, R., 12, Eton Road, Haverstock Hill, N.W., Analytical Chemist.
1898. Taverner, W., Burnden, Hamilton Road, Burton-on-Trent, Brewers' Chemist.
1901. Tayler, Jno. Bernard, 2, Alma Terrace, Wavertree, Liverpool, Works Chemist.
1898. Taylor, B. Franklin, Lathrop Oil Mill Co., Hawkinsville, Ga., U.S.A., Manufacturing Chemist.
1895. Taylor, Edwin, 146, Hooper Street, Brooklyn, N.Y., U.S.A., Explosives Chemist.
1886. Taylor, G. Crosland, Ravenscar, Helsby, near Warrington, Electrical Engineer.
1894. Taylor, G. Midgley, 27, Great George Street, Westminster, S.W., Analytical Chemist.
1893. Taylor, G. W., Dinting Vale Printworks, Dinting, near Manchester, Printworks Chemist.
- O.M. Taylor, H. E., 702, Alexandra Parade, Dennistoun, Glasgow, Lead Works Manager.
1883. Taylor, Jas., Department of Mines, Sydney, N.S.W., Government Metallurgist.
1888. Taylor, Jas. Davis, 9, Mincing Lane, London, E.C., Chemical Merchant.
1898. Taylor, Jas. M., 59, Kenmare Road, Sefton Park, Liverpool, Analytical Chemist.
1888. Taylor, J. Scott, c/o Winsor and Newton, Limited, 38, Rathbone Place, London, W., Technical Chemist.
1901. Taylor, Jno., 42, Thorndale Road, Waterloo, near Liverpool, Works Chemist.
1896. Taylor, Martin, Ingersley, Palmerston Road, Buckhurst Hill, Essex, Chemical Works Manager.
1898. Taylor, Newman, Linden House, Stamford Place, Sale, near Manchester, "Water Specialist."
1898. Taylor, Walter, Technical Chemist.
1892. Taylor, W. G. H., 56, Meanley Road, Manor Park, Essex, Analytical Chemist.
1885. Taylor, W. J., 55, Forsyth Street, Greenock, N.B., Technical Chemist.
1887. Teanby, G. W. A., Elvin Lodge, East Dereham, Norfolk, Analytical Chemist.
- O.M. Teed, Dr. F. L., Chem. Laby., 9, Mincing Lane, London, E.C., Analytical Chemist.
- O.M. Tennant, Sir Chas., Bart., 35, Grosvenor Square, S.W.; and Glen, Peeblesshire, N.B. (Journals to St. Rollox, Glasgow), Alkali Manufacturer.
1884. Tennant, Jas., United Alkali Co., Ltd., City Road, Newcastle-on-Tyne, Alkali Manufacturer.
1896. Tennille, Geo. F., c/o Southern Cotton Oil Co., Savannah, Ga., U.S.A., Chemist.
1888. Terry, Albert, Verulam, Mount Albert Road, Balwyn, near Melbourne, Victoria, Brewer.
1884. Terry, Hubert L., 14, Herbert Street, Moss Side, Manchester, Technical Chemist.
- O.M. Tervet, R., 54, Penshurst Road, South Hackney, E., Oil Works Manager.
1893. Tetley, C. F., Messrs. Jos. Tetley and Son, The Brewery, Leeds, Brewer.
1897. Tetlow, Wm. E., Ash Cottage, Ashfield, Dunblane, N.B., Chemist.
1886. Thew, Walter H., Talbot House, Arundel Street, Strand, W.C., Director.
1897. Thiel, Dr. C. Walther, c/o F. Reddaway and Co., Ltd., Pendleton, Manchester, Chemist.
- O.M. Thomas, C., Pitch and Pay, Stoke Bishop, near Bristol, Soap Manufacturer; Deputy Chairman, Midland Railway.
1894. Thomas, H. Russell, Broad Plain Soap Works, Bristol, Soap Manufacturer.
- O.M. Thomas, J., Brook House, Wooburn, Woobarn Green, S.O., Paper Maker.
- O.M. Thomas, J. W., 2, Hampstead Hill Mansions, London, N.W., Analytical Chemist.
1901. Thomas, Octavius, Gas and Water Offices, Pentre, Glamorganshire, Gas and Water Engineer.
1884. Thomas, R. Schofield, 4, South Road, Handsworth, Staffordshire, Chemical Merchant.
1888. Thomas, S. Percy, 2, Landrock Road, Hornsey, N., Technical Chemist.
1898. Thomas, Wm. Harrison, jun., Colonial Bleaching and Printing Co., St. Heury, Montreal, Canada, Printworks Chemist.
1892. Thomason, Wm., c/o Doulton and Co., Lambeth Pottery, London, S.E., Chemist.
1885. Thompson, Prof. Claude M., 38, Park Place, Cardiff, Professor of Chemistry.
1898. Thompson, Edw. C., 139, Church Lane, Charlton, Kent, Manufacturing Chemist.
1899. Thompson, Erwin W., Charlotte, N.C., U.S.A., Mill Engineer.
1893. Thompson, G. Rudd, 69, Dock Street, Newport, Mon., Analytical and Consulting Chemist.
1895. Thompson, Gustave W., c/o National Lead Co., Marshall Street, Brooklyn, N.Y., U.S.A., Chemist.
1885. Thompson, W., Sankey Hill, Earlestown, Lancashire, Sugar Refiner.
1884. Thompson, W. G., Tonge Springs Works, Middleton, near Manchester, Colour Manufacturer.

- O.M. Thompson, W. P., Patent Office, 6, Lord Street
Liverpool, Patent Agent.
1896. Thomsen, Alonzo L., 33, South Holliday Street,
Baltimore, Md., U.S.A., Manufacturing Chemist.
1889. Thomson, Dr. Andrew, 8, Ardenlea, Pitcullen, Perth,
Chemical Lecturer.
1884. Thomson, G. Carruthers, 53, Bedford Road, Rock
Ferry, Birkenhead, Engineer.
1891. Thomson, Jas. M., Royal Gunpowder Factory,
Waltham Abbey, Essex, Manager (Cordite
Branch).
1894. Thomson, John, The Grange, Buckton Vale, Staly-
bridge, Printworks Manager.
- O.M. Thomson, J. S., c/o Messrs. Grieve and Co., West
Tower Street, Carlisle, Technical Chemist.
1884. Thomson, Robt. T., 156, Bath Street, Glasgow,
Analytical Chemist.
1899. Thomson, Thos., Waterproofing Co., Barrhead, near
Glasgow, Manufacturer.
- O.M. Thomson, W., Royal Institution, Manchester,
Analytical and Consulting Chemist.
1890. Thomson, Wm. Thos., Royal Gunpowder Factory,
Waltham Abbey, Essex, Explosives Chemist.
1900. Thorman, J. Stanley, West Ham Gasworks, Stratford,
E., Chemist.
- O.M. Thorne, Dr. L. T., 8, Dynevor Road, Richmond-on-
Thames; and (Journals) Southampton Wharf,
Battersea, S.W., Technical Chemist.
- O.M. Thornycroft, Wallace, Rockdale Lodge, Stirling,
N.B., Technical Chemist.
1891. Thornton, Christopher, Allen's Printworks, Providence,
R.I., U.S.A., Printworks Manager.
1891. Thornton, David H., Brookfoot Dyeworks, Brighouse,
Yorks, Dyer.
1887. Thornton, H., Redbourn, Ashford, Middlesex,
Analytical Chemist.
1899. Thornton, Wm., (Journals) c/o Isaac Brandon &
Bros., Panama, Central America; and (subsn.)
c/o Thos. Thornton, Hermand, West Calder, N.B.,
Chemist.
1895. Thorp, Frank H., Mass. Inst. of Technology, Boston,
Mass., U.S.A., Instructor in Industrial Chemistry.
- O.M. Thorpe, Dr. T. E., F.R.S., Government Laboratory,
Clement's Inn Passage, Strand, W.C.; and
(Journals) 61, Ladbroke Grove, Notting Hill, W.,
Chief Chemist (Customs and Inland Revenue).
1898. Thurnauer, Gustav, c/o Aurora Metal Co., Aurora,
Ill., U.S.A., Chemist.
1899. Tiemann, Hugh P., 125, West 43rd Street, New York
City, U.S.A., Student.
1900. Tiffany, Walton C., 21½, Spruce Street, Manhattan,
N.Y., U.S.A., President (Trade Chemists' Co.).
- O.M. Tilden, Prof. W. A., F.R.S., The Oaks, Murray Road,
Northwood, Middlesex, Professor of Chemistry.
1900. Tilley, Jas. W., 2, Stockwell Crescent, London, S.W.,
Research Chemist.
1886. Timmins, A., Argyll Lodge, Higher Runcorn, Civil
Engineer.
- O.M. Timmis, T. Sutton, Widnes, Chemical Manufacturer.
1894. Tipler, Fred. C., 48, Brooklyn Street, Crewe,
Analytical Chemist.
1890. Tobey, C. H., Collingwood, Ontario, Canada, Tannery
Chemist.
1894. Toch, Maximilian, c/o Toch Bros., 468-472, West
Broadway, New York City, U.S.A., Chemist.
1893. Tocher, Jas. F., 1, Chapel Street, Peterhead, N.B.,
Pharmaceutical Chemist.
1886. Todd, A. M., 204, North Rose Street, Kalamazoo,
Mich., U.S.A., Manufacturing Chemist.
1899. Tompkins, Vreeland, 533, Communipaw Ave., Jersey
City N.J., U.S.A., Analytical Chemist.
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Heliers, Jersey, Analytical Chemist.
1899. Tone, Jay E., 1427, Woodland Avenue, Des Moines,
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1896. Tonkin, John, 2603, East Broad Street, Richmond,
Va., U.S.A., Manufacturing Chemist.
1889. Tothill, M. A. L., Castle and Buitengracht Streets,
Cape Town, S. Africa, Manufacturing Chemist.
- O.M. Towers, J. W., Brantwood, Allerton, near Liverpool,
Analytical Chemist.
1893. Townsend, Chas. F., West View, Swanley Junction,
Kent, Chemist.
1892. Townsend, Chas. W., 19, Crawford Street, Port
Dundas, Glasgow, Chemical Manufacturer.
1892. Townsend, Oliver C., Kirkland Works, Leven, Fife,
N.B., Chemical Manufacturer.
1897. Towse, Walter, Woodleigh, Holly Road, Retford,
Technical Chemist.
1899. Trantom, Dr. Wm., 6, Newland Avenue, Hull,
Chemist.
1894. Traphagen, Dr. Frank W., Montana Agricultural
Experimental Station, Bozeman, Mont., U.S.A.,
Chief Chemist.
1900. Traquair, Jno., Glenfield Starch Works, Paisley, N.B.,
Analytical Chemist.
1893. Travers, Morris W., 2, Phillimore Gardens, Kensing-
ton, W., Chemist.
1889. Trechmann, A. O., Holborough Cottage, Snodland,
Kent, Cement Works Chemist.
1885. Trechmann, Dr. C. O., Warren Cement Works,
Hartlepool, Cement Manufacturer.
1895. Treharne, F. Gwilym, Wrangbrook, Llanishen, near
Cardiff, Analytical Chemist.
- O.M. Trench, G., Pilton Villa, Herne Bay, Kent, Explosives
Works Manager.
1893. Trevaile-Williams, T., Assayer and Manager.
1885. Trewby, Herbert, 62, St. John Street, London, E.C.,
Analytical Chemist.
1883. Tribe, P. C. M., Oswego, New York, U.S.A.,
Secretary.
1901. Trigger, Oliver, Chem. Dept., Royal Arsenal,
Woolwich, S.E., Analytical Chemist.
1898. Tripp, Dr. E. Howard, The Grammar School,
Swansea, Science Master.
- O.M. Trobridge, A., 28, Rectory Road, Gosforth, Northum-
berland, Technical Chemist.
1897. Trotman, Saml. R., University College, Nottingham,
Public Analyst.
- O.M. Truby, Charles, 20, High Street, Manchester, Chemi-
cal Manufacturer.
1900. True, Percival E., Bowker Chemical Co., Elizabeth,
N.J., U.S.A., Chemical Engineer.
1887. Tsukiyama, S., Nippon Seito Kaisha, Osaka, Japan,
Paper Mills Chemist.
1894. Tucker, Alex. E., 35, Paradise Street, Birming-
ham, Metallurgist and Chemist.
1897. Tucker, Samuel A., Columbia University, New York
City, U.S.A., Tutor in Industrial Chemistry.
1886. Tuer, Arthur H., Thornhill, near Wigan, Analytical
Chemist.
1899. Tufts, J. Lawrence, c/o General Chemical Co., Laure-
Hill, Long Island, N.Y., U.S.A., Chemist.
1899. Tullis, John K., The Moorings, Kelvinside, Glasgow,
Tanner.
1888. Tulloch, John, Rossie House, Hebburn-on-Tyne,
Analytical Chemist.
1899. Turnbull, Dr. Andrew, Leather Industries Depart-
ment, Yorkshire College, Leeds, Assistant.
1888. Turnbull, G. W., 35, Lancaster Road, Carnforth,
Lancashire, Metallurgical Chemist.
1884. Turnbull, W. S., Place of Bonhill, Renton, Dumbar-
tonshire, Chemical Manufacturer.
1889. Turner, H. B. H., 68, Upper Berkeley Street,
Portman Square, W., Sugar Refiner.
1897. Turney, Fred. N., Whitemoor Leather Works,
Nottingham, Leather Dresser.
1887. Turney, Sir J., Springfield, Alexandra Park, Notting-
ham, Tanner.
1891. Turri, Geo. G., Salisbury Building, cor. of Queen
and Bourke Streets, Melbourne, Victoria, Patent
Agent.
1896. Tuthill, Jos. B. T., Salem Gas Light Co., Salem,
Oregon, U.S.A., Chemist.
1890. Tweedy, Jas., 1306A, Burdett Road, Limehouse, E.,
Metallurgical Chemist.
1891. Twitchell, E., Wyoming, Ohio, U.S.A., Candle Works
Manager.



1897. Twynam, H., c/o Mount Morgan Gold Mining Co. Mount Morgan, Queensland, Mining Engineer.
 O.M. Twynam, T., Elmhurst, Egham Hill, Surrey, Metallurgist.
 O.M. Typke, P. G. W., Lawn House, New Malden, Surrey, Chemical Manufacturer.
 1893. Tyrer, Chas. T., Stirling Chemical Works, Stratford, E., Manufacturing Chemist.
 O.M. Tyrer, T., Stirling Chemical Works, Stratford, E., Chemical Manufacturer.
 1899. Tysoe, Jos., South Metropolitan Gas Co., East Greenwich, S.E., M. Inst. C.E., Gas Engineer.

U

1894. Uhlig, E. C., 48, Barclay Street, New York City, U.S.A., Glass Works Chemist.
 1900. Uhlig, W. C., c/o H. W. Johns Manufacturing Co., 39th Street, South Brooklyn, N.Y., U.S.A., Chemist.
 1897. Ullman, Jas. A., c/o Sigmund-Ullman Co., 146th Street and Park Avenue, New York City, U.S.A., Chemist and Superintendent (Printing Ink Works).
 1900. Ulmer, Geo. F., c/o Arbuckle Bros., Sugar Refinery, Foot of Pearl Street, Brooklyn, N.Y., U.S.A., Chemist.
 O.M. Umney, C., 50, Southwark Street, London, S.E., Manufacturing Chemist.
 1889. Underhill, Thos. J., H.M. Victualling Yard, Deptford, S.E., Inspector of Stores.
 1885. Underwood, G. R., Box 460, Peabody, Mass., U.S.A., Glue Works Chemist.
 1898. Unglaub, Oscar, c/o Thom, Domeier, and Co., Ltd., Pendleton, Manchester, Soap Manufacturer.
 1883. Usmar, J. H., 22, Billiter Street, London, E.C., Chemical Merchant.

V

1896. Van der Linde, Harold, 61, Front Street West, Toronto, Canada, Chemist (India-rubber and Gutta-percha Manufacturing Co.).
 1895. Vanderpoel, Dr. Frank, 153, Center Street, Orange, N.J., U.S.A., Chemist.
 1897. Van Gelder, Arthur P., c/o Atlantic Dynamite Co., Rustic P.O., N.J., U.S.A., Chemist.
 1891. Van Gundy, Chas. P., Laboratory, B. & O. R. R., Baltimore, Md., U.S.A., Metallurgical Chemist.
 1896. Van Ingen, Dudley A., New Jersey Zinc Co., Newark, N.J., U.S.A., Chemist.
 1896. Van Laer, Norbert, Black Eagle Brewery, Burton-on-Trent, Brewer's Chemist.
 1897. Van Marken, J. C., 59, Seymour Street, Portman Square, W., Chemical Engineer.
 1899. Van Slooten, Wm., 52, Sidney Place, Brooklyn, N.Y., U.S.A., Mining Engineer and Metallurgist.
 1888. Vargas-Vergara, J. M., Apartado No. 237, Bogota, Republic of Colombia, S. America, Metallurgical Chemist.
 1898. Varley, Reginald W., 2, Hyde Park Terrace, Headingley, Leeds, Steelworks Chemist.
 O.M. Vasey, T. E., 5, South Parade, Leeds; Journals to P.O. Box 1149, Montreal, Canada, Chemical Engineer.
 1900. Veitch, Alex., Clifton, Arizona, U.S.A., Acid Manufacturer.
 1894. Veitch, Geo., Chemical Works, Crieff, N.B., Manufacturing Chemist.
 1898. Verity, Ben, Magog, Prov. Quebec, Canada, Printworks Chemist.
 1897. Verity, Victor, 83, Lexington Street, East Boston, Mass., U.S.A., Chemical Works Foreman.
 1900. Verley, Albert, 7, Quai de Seine, Courbevoie, Paris, France, Chemist.

- O.M. Vickers, W., Rose Hill, Smedley Lane, Manchester, Chemical Manufacturer.
 1895. Vigelius, Carl, 175, Pearl Street, New York City, U.S.A., Shellac Bleacher.
 1896. Vincent, Jos. A., Rooms 207-8, 421, Chestnut Street, Philadelphia, Pa., U.S.A., Mechanical Engineer.
 1897. Vlies, Leonard E., Fernroyd, Wellington Road, Whalley Range, Manchester.
 O.M. Voelcker, E. W., 22, Tudor Street, London, E.C., Agricultural Chemist.
 1887. Voelcker, Dr. J. A., 20, Upper Phillimore Gardens, Kensington, W., Agricultural Chemist.
 1897. Vogel, Julius L., 91, Blackfriars Road, S.E., Engineer.
 1899. Vogeler, Gustav, 17, Philpot Lane, London, E.C., Merchant.
 1900. Volney, Dr. C. H., 173, West 81st Street, New York City, U.S.A., Chemist (Smokeless Powder Co.).
 1897. Voorhees, Louis A., P.O. Box 357, New Brunswick, N.J., U.S.A., Agricultural Chemist.
 1899. Voorhees, Samuel S., c/o N.Y. Central and Hudson River R.R., West Albany, N.Y., U.S.A., Chemist.
 1888. Vörster, Fritz, Cöln-Marienburg, Germany, Manufacturing Chemist.
 1885. Voss, Hermann, 19, Beckenham Road, Beckenham, Kent, Manure Works Manager.
 1899. Voss, Walter A., 16, Outram Road, Addiscombe, Manufacturing Chemist.
 1899. Vreeland, Cornelius D., Chicago Heights, Ill., U.S.A., Manufacturing Chemist.

W

1885. Waché, Alf., 27, Rue Morel, Douai, France, Caustic Potash Manufacturer.
 1896. Wachtel, Gregory, 6, Manejny Pereulok, St. Petersburg, Russia, Chemical Engineer.
 1895. Waddington, Thos. W., 74, Blackburn Road, Padiham, Lancashire, River Inspector.
 1898. Wade, Arthur Luvian, 28, West Kensington Gardens, W., Analyst.
 1890. Wade, Jas. L., 28, West Kensington Gardens, London, W., Chemical Manufacturer.
 1894. Wade, W. L., 28, West Kensington Gardens, W., and (Journals) Staines Linoleum Works, Staines, Chemist.
 1889. Wadman, W. E., 102, Lord Avenue, Bayonne, N.J., U.S.A., Manufacturing Chemist.
 1897. Wagner, Dr. Theodore B., 52, Walton Place, Chicago, Ill., U.S.A., Chemist.
 1893. Wagner, W. G., Glyndhurst, Ealing Common, W., Analytical and Consulting Chemist.
 1897. Wahl, André R., Institut Chimique, Nancy, France, Technical Chemist.
 1884. Wainwright, Dr. J. H., 159, Front Street, New York U.S.A., Analytical Chemist.
 1895. Wainwright, Wm., c/o Spooner and Bailey, Chemical Manure Works, Eling, near Southampton, Chemist.
 1899. Wakefield, Wm. C., 3, St. Mary's Place, Savile Town, Dewsbury, Chemist.
 1894. Waldman, Louis J., P. O. Box 162, Albany, N.Y., U.S.A., Aniline Dye Manufacturer.
 1895. Waldstein, Dr. Martin E., 44, Trinity Place, New York, U.S.A., Manufacturing Chemist.
 1887. Walker, Archibald, 8, Crown Terrace, Glasgow, Distiller.
 1900. Walker, David C., Anaconda, Montana, U.S.A., Analytical Chemist.
 1886. Walker, E. Robinson, 18, St. Ann's Street, Manchester, Patent Agent.
 1897. Walker, H. V., 38, Clinton Street, Brooklyn, N.Y., U.S.A., Chemist.
 1894. Walker, Dr. Jas., University College, Dundee, Professor of Chemistry.
 1897. Walker, Jas. W., Messrs. Alex. Walker & Co., Irvine, N.B., Chemical Manufacturer.



1884. Walker, S. R., 19, Wolsey Street, Radcliffe, Manchester, Foreman Dyer.
1895. Walker, W. Sloane, c/o Walker, Ltd., Litherland, near Liverpool, Tanner.
1900. Walker, Dr. Wm. H., 7, Exchange Place, Boston, Mass., U.S.A., Chemical Expert.
1897. Wallace, Edwin C., Foot of 6th Street, Long Island City, N.Y., U.S.A., Chemist.
1897. Wallace, Robt. A., Dorset Hall, Merton, Surrey, Chemical Manufacturer.
1883. Wallace, Robert, 20, Murrayfield Avenue, Edinburgh, Distiller.
- O.M. Waller, Dr. E., 440, First Avenue, New York, U.S.A., Professor of Chemistry.
1899. Wallerstein, Dr. Max, 200, Worth Street, New York, U.S.A., Chemist.
1900. Walls, Arthur W., North Woburn, Mass., U.S.A., Chemist (Acid Works).
1886. Walsh, F. T., Lowell Dyeworks, Lowell, Mass., U.S.A., Colour Printer.
1900. Walters, H., Morrin College, Quebec, Canada, Professor of Chemistry.
1895. Want, W. Philip, 44, Bishopsgate Street Without, London, E.C., Pharmacist and Editor.
1896. Warburton, Thos., Clayton Aniline Co., Ltd., Clayton, Manchester, Chemist.
1899. Ward, Alf. B., 210, Trinity Road, Wandsworth Common, S.W., Bread-Improver Manufacturer.
- O.M. Ward, G., Messrs. Hirst, Brooke and Hirst, Leeds, Chemical Works Manager.
1891. Ward, G. J., The Cottage, Hallam Fields, near Nottingham, Civil Engineer.
1884. Ward, Howard Chas., Yeatton, Hordle, Lymington, Hants, Deputy Chairman of Gas Co.
1898. Ward, John, Barnstone Blue Lias Lime Co., Ltd., Barnstone, Notts, Manager.
1888. Ward, Thos., Wadebrook House, Northwich, Salt Manufacturer.
1899. Ward, Wm. J., c/o Olive and Partington, Broughton Bridge Paper Mills, Manchester, Chemist.
- O.M. Wardale, J. D., Redheugh Engine Works, Gateshead-on-Tyne, Engineer.
1892. Warden, Jno. B., Bank of B.N.A., Dawson City N.W.T., Canada; and (Journals) to 5, Eton Gardens, Glasgow, Analytical Chemist.
1897. Wardle, Sir Thos., Leek, Staffordshire, Silk Dyer.
1885. Warington, Robt., F.R.S., Harpenden, Herts, Agricultural Chemist.
1899. Warnes, Arthur R., c/o Major & Co., Ltd., Sculceates, Hull, Soapworks Chemist.
1890. Warren, Fiske, 220, Devonshire Street, Boston, Mass., U.S.A., Paper Manufacturer.
1890. Warren, Jno. Davis, 7, Essex Road, Acton, W., Manufacturing Chemist.
1885. Warren, T. T. P. Bruce, Tamworth Villa, Earlharn Grove, Forest Gate, Essex, Analytical Chemist.
1885. Waterfall, W. B., c/o Avon Manure Co., Bristol; and (Journals) Thirlmere, Clavering Road, Redland, Bristol, Manure Manufacturer.
1890. Waterhouse, Major-General Jas., Oak Lodge, Court Road, Eltham, Kent, Assistant Surveyor-General of India (retired).
1891. Waterhouse, Robt., Phoenix Chemical Works, Queen Street, Bradford, Manchester, Analytical and Agricultural Chemist.
1888. Wates, Edw. A., 56, Breakspeare's Road, Brockley, S.E., Metallurgical Chemist.
1893. Watkins, Willard H., 87, Poplar Street, Roslindale, Mass., U.S.A., Colourist.
1894. Watmough, B., 1, Ryeburn, Stazley Road, Wakefield, Analytical Chemist.
1894. Watson, Alex. Forbes, 22, Trafalgar Terrace, Monkstown, Co. Dublin, Chemist.
1894. Watson, Chas. Ernest, c/o Peter Spence and Sons, Manchester Alum Works, Manchester, Chemical Assistant.
1894. Watson, Chas. S., P.O. Box 27, Charters Towers, Queensland, Analytical Chemist.
1884. Watson, Chas., c/o English Literary Society, San Martin, 243, Buenos Ayres, Argentina, Manufacturing Chemist.
1890. Watson, Eric E., c/o Cia Explotadora de Lota y Coronel, Lota, Chile, Metallurgical Chemist.
1895. Watson, H. Ard, 17, Cavendish Road, Leeds, Tar Distiller.
1894. Watson, Jas., 60, West Park Terrace, South Shields, Alkali Works Manager.
- O.M. Watson, Jno. C., c/o Brookside Printworks, West Leigh, Lanc., Technical Chemist.
- O.M. Watson, Jno., Cement Works, Gateshead-on-Tyne, Cement Manufacturer.
- O.M. Watson, Jno., Technical Chemist.
1891. Watson, Jno., Henham Villa, Cantwell Road, Plumstead, S.E., Analytical Chemist.
1898. Watson, Robt., Gasworks, Hertford, Gas Engineer.
- O.M. Watt, A., c/o Macfie & Sons, 34, Moorfields, Liverpool, Sugar Works Chemist.
1883. Watts, A. J., 130, Caixa, Pernambuco, Brazil, Sugar Works Chemist.
1900. Watts, Chas. J., 40, City Road, London, E.C., Manufacturer.
1893. Watts, Jno. Isaac, Fairleigh, Hartford, Cheshire, Alkali Works Manager.
1900. Webb, Jno. Fred., Ormond House, 63, Queen Victoria Street, London, E.C., Mining and Electrical Engineer.
1888. Webb, Wm. Hubert, Randalstown, co. Antrim, Ireland, Linen Manufacturer.
1891. Weber, C. Otto, Heathfield, Middleton Road, Crumpsall, Manchester, Analytical Chemist.
1884. Webster, C. S. Stanford, Malvern House, Redland, Bristol, Professor of Chemistry.
1897. Wedge, Utley, Bayonne, N.J., U.S.A., Oil Refiner (Standard Oil Co.'s Chemical Works).
1893. Weeks, H. B., 29, Ainslie Street, Barrow-in-Furness, Analytical Chemist.
1895. Weems, Dr. J. B., Iowa Agricultural College, Ames, Iowa, U.S.A., Agricultural Chemist.
1898. Weeple, Lawrence, Pinchin's Wharf, Broad Street, Ratcliff, E., Colour Works Chemist.
1896. Weicker, Theodore, c/o Merck and Co., New York, U.S.A., Chemical Manufacturer.
1897. Weigall, Arthur R., Kechau Mine, P. O. Kuala Lipis, Pahang, via S.S., Metallurgical Engineer.
1896. Weightman, Alf. T., 6, Chepstow Rise, Croydon, Electro-Chemist.
1898. Weissmüller, Rudolf E., 36, Halesworth Road, Lewisham, S.E., Chemist.
1893. Welch, J. Cuthbert, Canadian Smelting Works, Trail, British Columbia, Chemist.
1896. Welch, Thos., Green Vale Printworks, Westhoughton, Lancashire, Calico Printer.
1899. Weldon, Leonard E., Lime Villas, Egypt Road, Nottingham, Dyer.
1891. Wells, Jas. Gray, Selwood House, Shobnall Street, Burton-on-Trent, Brewing Chemist.
1894. Wells, Pierson L., 86, Joramemon Street, Brooklyn, N.Y., U.S.A., Patent Lawyer and Engineer.
1885. Welsh, Jas., Horrocks Lane Dyeworks, Red Bank, Manchester, Printworks Manager.
1890. Welsh, Thos. L., 3, Prince's Gardens, Downhill, Glasgow, Analytical Chemist.
- O.M. Welsh, W., Holt Town, Manchester.
1897. Wense, Dr. W., Westeregeln, Prov. Sachsen, Germany.
1890. Werner, Emil A., 5, Church Avenue, Rathmines, Dublin, Chemical Demonstrator.
1899. Wertheimer, Alf., Stirling Chemical Works, Abbey Lane, Stratford, E.
1884. Wessel, Carl, Bernburg, Anhalt, Germany, Alkali Manufacturer.
1889. Wesson, D., P.O. Box 458, Savannah, Ga., U.S.A., Technical Chemist and Cotton-Oil Expert.
1899. Westall, Harold, Brinscall, near Chorley, Lancashire, Chemist.



1900. Westenfelder, B. D., c/o American Oak Leather Co., Cincinnati, Ohio, U.S.A., Chemist.
1885. Westmoreland, J. W., 3, Love Lane, Eastcheap, E.C., Metallurgical Chemist.
1898. Weston, David B., P.O. Box 202, Watertown, Mass., U.S.A., Chemist.
1894. Weston, Robt. S., 14, Beacon Street, Boston, Mass., U.S.A., Chemist and Bacteriologist.
1885. Weston, Wm., H.M. Dockyard, Portsmouth, Analytical Chemist.
1890. Wetter, Jasper, 37-39, Essex Street, Strand, W.C., Patent Agent.
1883. Wetzel, H. A., Box 488, Detroit, Michigan, U.S.A., Manufacturing Chemist.
- O.M. Whalley, L. J. de, 172, Erlanger Road, New Cross, S.E., Sugar Chemist.
1898. Wheeler, Edw. J., 79, Chapel Street, Albany, N.Y., U.S.A., Analytical Chemist.
1895. Wheelwright, Dr. E. W., Greenholme, Westfield Road, Acock's Green, near Birmingham.
1898. Whichelo, Matthew A., Clydesdale, Enfield, Middlesex, Aërated Water Manufacturer.
- O.M. Whiffen, T., Lombard Road, Battersea, London, S.W., Manufacturing Chemist.
- O.M. Whiffen, Thos. J., Harefield, Southfields, S.W., Manufacturing Chemist.
- O.M. Whiffen, W. G., Lombard Road, Battersea, London, S.W., Manufacturing Chemist.
1893. Whitaker, Alf. Glenmaye, Horsforth, Leeds, Dyer.
1890. Whitaker, H. L., Coudong Sugar Mill, Tweed River, New South Wales, Sugar Chemist.
1899. Whitaker, Milton C., Department of Chemistry, Columbia University, New York, U.S.A., Tutor in Chemistry.
1895. Whitaker, Thos., Newlay Hall, near Leeds, Dyer.
- O.M. Whitaker, Thorp, Bradford Dyers' Association Ltd., Bradford, Yorks, Dyer's Chemist.
- O.M. White, A. D., Avenue House, West Drayton, Middlesex, Chemical Manufacturer.
1898. White, Alf. H., 626, Forest Avenue, Ann Arbor, Mich., U.S.A., Instructor in Chemical Technology.
1893. White, Arthur F., 30, Cornwall Terrace, Manningham, Bradford, Yorks, Manufacturing Druggist.
1894. White, B. Newport, Manor Hill, Marple, Cheshire, Consulting Brewer.
1896. White, G. Rantoul, Exeter, New Hampshire, U.S.A., Chemist.
1889. White, Henry, 2, Bransby Street, Upperthorpe, Sheffield, Manufacturing Chemist.
1887. White, J. Campbell. See Overtoun, Lord.
1898. White, Jno., County Offices, St. Mary's Gate, Derby, Public Analyst to County of Derby.
- O.M. White, P. T., Castle Street, Saffron Hill, London, E.C., Chemical Manufacturer.
1894. White, W. Gilchrist, 75, West End Villas, Broadbottom, near Manchester, Calico Printer's Chemist.
- O.M. White, W. H., The Cottage, Killingworth, Newcastle-on-Tyne, Chemical Manufacturer.
1892. Whitehead, J., 8, West Street, Rochdale, Dyer.
1897. Whitehead, Robt. J. G., 4, Lethington Avenue, Langside, Glasgow, Chemist.
1885. Whiteley, R. Lloyd, 80, Beeches Road, West Bromwich, Staffordshire, Chemical Lecturer.
1892. Whiteside, Jno. L., 51, Cannon Street, Bolton-le-Moors, Chemical Lecturer.
1885. Whittaker, C. J., West Bank, Lytham, Lancashire, Chemical Engineer.
1884. Whowell, F., Carr Bank, Tottington, Bury, Lancashire, Bleacher.
1899. Wiarda, Jno. C., 259-273, Green Street, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
1897. Wiborg, F. B., The Ault and Wiborg Co., Cincinnati, Ohio, U.S.A., Manufacturer.
1890. Wickens, B. Foster, 83, Queen Street, Cheapside, London, E.C., Managing Director (Wickens, Pease & Co., Ltd.).
1887. Wielandt, Dr. Wm., c/o Coal Distillation Co., Middlesbrough, Chemist.
1900. Wiener, Aug. F., c/o Alloys Syndicate, 31, Lombard Street, London, E.C., General Manager.
1883. Wiggin, W. W., Wiggin Street, Birmingham Heath, Birmingham, Nickel Refiner.
1897. Wigglesworth, Henry, 32, Liberty Street, New York City, U.S.A., Manufacturing Chemist.
- O.M. Wightman, C., 1, Fenchurch Avenue, London, E.C., Chemical Merchant.
1899. Wild, Roland C., The Grange, New Eltham, Kent, Analytical Chemist.
1893. Wilder, F. L., Morro Velho, Villa Nova de Lima, Estado de Minas Geraes, Brazil, Assayer.
1899. Wildman, Arthur J., 17, Streatfield Avenue, East Ham, E., Chemist.
1885. Wilkin, Sir Walter, K.C.M.G., Appold Street, Finsbury, E.C., Yeast Manufacturer.
1895. Wilkins, Charles, 40, Church Lane, Hornsey Old Church, N., Manufacturing Perfumer.
1899. Wilkins, H. A. J., c/o New Jersey Zinc Co., 71, Broadway, New York, U.S.A., Mining Engineer.
1900. Wilkins, W. G., 59, Uttoxeter Road, Derby, Colour Manufacturer.
1886. Wilkinson, J. B., Tong Street, Dudley Hill, Bradford, Yorks, Chemical Manufacturer.
1898. Wilkinson, Walter S., P.O. Box 835, Baltimore, Md., U.S.A., Asphalt Block Manufacturer.
1884. Will, W. Watson, 1, St. Agnes Place, Kennington Park, S.E., Professor of Organic Chemistry.
1893. Willcox, Benjamin, 47, Lincoln's Inn Fields, London, W.C., Patent Agent.
1898. Willcox, Frank A., The Oaks, West, Sunderland, Explosives Chemist.
1895. Willcox, Oliver, 81st between 10th and 11th Avenues, Brooklyn, N.Y., U.S.A., Technical Chemist.
1894. Willdigg, A. E., Granton House, Coventry, Varnish Maker.
1900. Willenz, Dr. Michel, Rue Haringrode 4, Antwerp, Belgium, Leather Trades Chemist.
1895. Williams, David T., 9, Calvert Terrace, Swansea, Chemist.
1889. Williams, Geo. G., 624, South 24th Street, Philadelphia, Pa., U.S.A., Analytical Chemist.
1891. Williams, Henry J., 161, Tremont Street, Boston, Mass., U.S.A., Chemical Engineer.
1896. Williams, Jno. Taylor, 2, Queen Street, Wellington, Salop, Brewer.
1885. Williams, Rowland, Sunny Lea, Aldcliffe Road, Lancaster, Analytical Chemist.
1889. Williams, R. Greville, Simpson Hill House, Heywood, near Manchester, Colour Manufacturer.
1900. Williams, Saml. H., Glastonbury, Conn., U.S.A., Soap Manufacturer.
1891. Williams, Seward W., 8, Brighton Avenue, East Orange, N.J., U.S.A., Pharmaceutical Laboratory Manager.
1893. Williams, Thos. See Trevaile-Williams, T.
1885. Williams, T. Howell. See Idris, T. H. W.
1884. Williams, Prof. W. Carleton, Firth College, and 23, Broomgrove Road, Sheffield, Professor of Chemistry.
1898. Williams, Walter A., Buckingham, Prov. Quebec, Canada, Chemical Manufacturer.
1887. Williams, W. Collingwood, 68, Grove Street, Liverpool, Analytical Chemist.
- O.M. Williams, W. J., Station F., 2215, Bridge Street, Frankford, Philadelphia, Pa., U.S.A., Analytical Chemist.
1899. Williamson, G. N., 14, Dey Street, New York, U.S.A., Manufacturing Chemist.
1894. Williamson, J. Alex., 14, Milton Avenue, Highgate, N., Analytical Chemist.
- O.M. Williamson, Robt., Low Walker, Newcastle-on-Tyne, Technical Chemist.
1900. Wills, G. S. V., 76, Croham Road, South Croydon, Pharmaceutical Tutor.
1895. Willson, Thos. L., St. Catherine's, Ont., Canada, Electrical Engineer.



1891. Wilson, A. Poole, Royal Arms Hotel, Omagh, Co. Tyrone, Ireland, Analytical Chemist.
1890. Wilson, Alf., c/o Messrs. J. and E. Sturge, 18, Wheeley's Lane, Birmingham, Manufacturing Chemist.
1884. Wilson, Anthony W., 20, Westcott Street, Hull, Colour Works Manager.
1888. Wilson, Cecil H., 31, Minna Road, Burngreave Road, Sheffield, Metallurgical Chemist.
- O.M. Wilson, C. J., 14, Old Queen Street, Westminster, S.W.
1888. Wilson, David, jun., Carbeth, Killearn, by Glasgow.
1897. Wilson, Ellwood, Box 628, Liberty, Sullivan Co., N.Y., U.S.A., Chemist.
1897. Wilson, E. S., c/o Stewart Bros. and Spencer, Rochester, Kent, Chemist.
1885. Wilson, Frank, 7, Bedford Square, London, W.C., Brewer.
- O.M. Wilson, G. E., The Chemical Works, Oldbury, near Birmingham, Chemical Manufacturer.
1899. Wilson, Gordon, 8, Calle de Gante, Mexico, D.F., Chemist and Assayer.
1886. Wilson, Jno., 74, Bearwood Road, Smethwick, near Birmingham, Technical Chemist.
1896. Wilson, Jno., The Vines, Oxford Road, Runcorn, Chemical Engineer.
- O.M. Wilson, J. H., 6, Fenchurch Buildings, E.C., Chemical Manufacturer.
- O.M. Wilson, R. H., Eggescliffe, Yarm-on-Tees, Chemical Manufacturer.
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In the Journal for October 1900 will be found a Nomination Form and Prospectus for the use of those members who have a candidate for election to propose. Please keep for use in case of need.

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 Barlow, John J., 177, Manchester Road, Accrington, Calico Printers' Chemist.
 Bentley, Wm. H., 3, Woodbine Terrace, Irlam, near Manchester, Technical Chemist.
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 Ashton, Jas., 1/o Ormskirk; Hacken Sewage Works, Moses Gate, Bolton.
 Birmingham, Jno., jun., 1/o Taylor Street; California Powder Works, 2572, California Street, San Francisco, Cal., U.S.A.
 Berolzheimer, D. D., 1/o New York; 317, South 18th Street, Philadelphia, Pa., U.S.A.



- Bishop, G. A., 1/o Coatbridge; Gartverrie Fireclay Works, Glenboig, N.B.
- Brandwood, Jno., 1/o Edenfield; 175, Walshaw Road, Bury, Lancashire.
- Bult, Herbert J., 1/o Brixton Hill; 18, Billiter Street, E.C.
- Burkhardt, Dr. A., 1/o Antwerp; Luisenplatz, Pforzheim, Germany.
- Cawley, T. A., 1/o London; British Gelatin Works, Luton, Beds.
- Christy, Thos., 1/o Lime Street; 4, 10, 12, Old Swan Lane, London, E.C.
- Claus, W. H., 1/o Withington; c/o Claus and Ree, Clayton, Manchester.
- Clymer, W. R., 1/o White Hall Hotel; 2012, Detroit Street, Cleveland, Ohio, U.S.A.
- Deakin, H. T., 1/o Belmont; Dewhurst House, Egerton, near Bolton.
- Dewar, John A., M.P., 1/o Scone; Murrayshall, Perth, N.B.
- Douglas, L. M., 1/o Farringdon Road; Baltic Wharf, Putney, S.W.
- Duckham, A., 1/o Greenwich; The Red House, Blackheath, S.E.
- Duryea, C. B.; Journals to 34 (not 24), Gramercy Park, New York City, U.S.A.
- Dyson, Septimus, 1/o Middlesbrough; 8, Belmont Avenue, Harrogate.
- Fallon, J. M. H.; Journals to 61, Birdhurst Rise, South Crondon.
- Fawcett, J. H.; Journals to Federal Metal Agency Co., Ltd., 1, Leadenhall Street, E.C.
- Fowler, Gilbert J., 1/o Flixton Road; Broad Oak, Urmston, near Manchester.
- France, H. C. D., 1/o Edgbaston; Avondale, Salford Priors, near Evesham.
- Frankland, Prof. Percy F.; Journals to the University, Birmingham.
- Frasch, Hermann, 1/o 53; 681, Euclid Avenue, Cleveland, Ohio, U.S.A.
- Frost, Dr. Howard V., 1/o Arlington; 3958, Drexel Boulevard, Chicago, Ill., U.S.A.
- Fuller, W. M., 1/o Lawn Side; Bryn Tigid, Gold Tops, Newport, Mon.
- Garfield, Jos., 1/o Wolverhampton; 7, Apsley Villas, Bradford, Yorks.
- Goetz, Isidor, 1/o France; c/o Rio Negro Mines, Ltd., 6, Suffolk Street, Pall Mall, S.W.
- Haddock, A. G., 1/o Runcorn; c/o Castner Kellner Alkali Co., Ltd., 13, Abchurch Lane, E.C.
- Hargreaves, L., 1/o Widnes; c/o Electrolytic Alkali Co., Ltd., Middlewich, Cheshire.
- Hill, Jas. Kay; Journals to 13, Osborne Place, Govan, N.B.
- Holmes, Ellwood, 1/o Fenwick Terrace; Wyncote, Jesmond Park East, Newcastle-on-Tyne.
- Isaacs, L. A., 1/o Belsize Road; 110, Greencroft Gardens, West Hampstead, N.W.
- Jackson, Fred., 1/o Half Moon Street; 14, Cross Street, Manchester.
- Jenkin, W. A., 1/o 24; 5, Bella Vista, Rio Tinto, Prov. de Huelva, Spain.
- Johnson, Jno. Edmund, 1/o Franklin Square; 95, Liberty Street, New York City, U.S.A.
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- Kraftmeier, E., 1/o Charing Cross; 54, Parliament Street, Westminster, S.W.
- Lagerwall, Dr. I., 1/o Homefield; Sunthorpe, Wallington, Surrey.
- Laing, Wm., 1/o Laisterdyke; all communications to 10-11, The Exchange, Bradford.
- Latham, J. J., 1/o Deacon Road; Mill House, Bold, Widnes.
- Linton, Jas., 1/o Birmingham; c/o Tennessee Coal, Iron, and R. R. Co., Ensley, Ala., U.S.A.
- Lloyd, Thos. H., 1/o Rhondda; 121, Kingsley Road, Prince's Park, Liverpool.
- Lye, W. T., 1/o Cromwell Road; Legrave Hall, near Luton, Beds.
- MacKensie, Alex. H., North Adams, Mass., U.S.A.; note spelling of name.
- Mann, Harold H., 1/o York; Indian Tea Association, Royal Exchange Buildings, Calcutta, India.
- Marshall, F. G., 1/o Noble Terrace; 4, Woodhouse Terrace, Bewick Road, Gateshead.
- Matthews, Donald J., 1/o Milton; 165, Ebury Street, London, S.W.
- Meeds, Alonzo D., 1/o City Hall; 103, Boston Block, Minneapolis, Minn., U.S.A.
- Meikle, Jno., 1/o Woodlands Road; 8, Melrose Street, Great Western Road, Glasgow.
- Norton, Dr. T. H., 1/o Cincinnati; Kharpur, Turkey in Asia, (open mail *via* Constantinople), U.S. Consul.
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- Parke, G. A., 1/o Muckamore; Hayfield, Antrim, Ireland.
- Preston, R., 1/o Holcombe; Ryecroft, Manchester Road, Bury, Lancashire.
- Raschen, Dr. Julius; Journals to The Highlands, Runcorn.
- Reuter, Dr. L., 1/o New York; 17, Rue de Mérode, Bruxelles-midi, Belgium.
- Robertson, Alex. A., 1/o Cressington; 12, Bennison Drive, Grassendale, Liverpool.
- Roller, H. C., 1/o Toronto; Roselle, N.J., U.S.A.
- Rothwell, R. P., 1/o 383; Room 368, 20, Bucklersbury, London, E.C.
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- Stevenson, Jas., 1/o The Bromfields; Hailie, Largs, N.B.
- Studer, S. J., 1/o Padgate; Grappenhall Road, Stockton Heath, near Warrington.
- Sutton, Francis, 1/o London Street; Norfolk County Laboratory, Redwell Street, Norwich.
- Thompson, Geo. R., 1/o 57; 69, Dock Street, Newport, Mon.
- Voorhees, L. A., 1/o Box 290; P.O. Box 357, New Brunswick, N.J., U.S.A.
- Ward, Alf. B., 1/o Bolingbroke Grove; 210, Trinity Road, Wandsworth Common, S.W.
- Warnes, A. R., 1/o Denmark Hill; c/o Major and Co., Ltd., Sculcoates, Hull.
- White, Alf. H., 1/o East Liberty Street; 626, Forest Avenue, Ann Arbor, Mich., U.S.A.
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- Wilson, Ellwood, 1/o London; Box 628, Liberty, Sullivan Co., N.Y., U.S.A.
- Wingate, Hamilton M., 1/o Paeron; Laboratory, 20, Fort Street, Auckland, N.Z., Technical Chemist and Metallurgist.
- Winstanley, W. H. J., 1/o Stockport; Mayfield, Sutton Road, Heaton Norris, near Stockport.
- Wyatt, Dr. Francis; Journals to 39, South William Street and 29, Stone Street, New York City, U.S.A.



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Deaths.

Kershaw, Jos., Hollinwood, near Oldham.

Macadam, Dr. Stevenson, Surgeons' Hall, Edinburgh.

Manning, F. A., 1/o 18, Billiter Street, London, E.C.

Robertson, R. A., 8, Park Circus Place, Glasgow.

Smith, Wm., 38, Corn Street, Bristol.

Taylor, Thos., Walmersley, Bury.

London Section.

Meeting held on Monday, January 7th, 1901.

MR. OTTO HEHNER IN THE CHAIR.

THE EARLY MANUFACTURE OF SULPHURIC AND NITRIC ACID.

BY OSCAR GUTTMANN, M. INST. C.E., F.I.C., F.C.S.

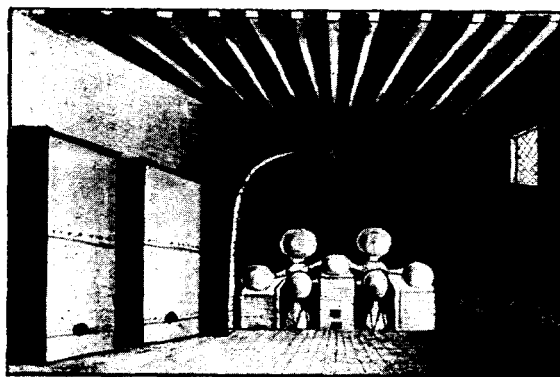
A. Sulphuric Acid.—Most of you are aware that sulphuric acid was in olden times made "by the bell." An earthenware dish with a burning charge of sulphur rested on an iron tripod in an earthenware pan, and a glass bell was suspended over it. It was recommended to work during the two equinoxes, because the air contains more moisture at these times of the year, and that of course helped condensation. Later on it was recommended (in 1683 by Sir Kenelm Digby) to put water into the pan, so as to condense the fumes. Glauber, in 1648, already taught to mix some nitre with the sulphur. Nevertheless, this method does not seem to have become universal, because in "The Chemical Works of Caspar Neumann, F.R.S., London, 1759," a standard work at this time, we still find the bell described as "the most common apparatus for this purpose." In a foot-note Neumann says: "This process has of late been so far improved by some particular persons as to furnish, at a very low price, almost all the acid now sold under the name of oil of vitriol. The improvement consists in employing very large glass vessels of the capacity of a hogshead or more, in which is placed a little water, whose steam collects and condenses the fumes; but principally in mixing with the sulphur a small portion of nitre, about 6 lb. to an hundredweight, which enables it to burn much more speedily than sulphur by itself, and without communication with the external air. By this means nearly all the fumes are preserved. It does not appear that the spirit thus collected contains any of the nitrous acid, for the acid of nitre is destroyed by deflagration."

This improvement, as described by Neumann in 1759, was patented in 1749 (No. 644, 23rd June) by Dr. Joshua Ward and John White in London, but, according to Lunge, Ward made oil of vitriol on a large scale at Richmond in 1736 already.

In 1746 Dr. Roebuck, of Birmingham, invented a "lead house," viz., a square lead chamber, wherein the sulphur was burnt and the fumes collected in water placed below. Evidently there was some trouble with the glass bells on a large scale. In 1749 (the same year as Ward and White's patent) Dr. Roebuck and a Mr. Garbett erected works at Prestonpans, on the east coast of Scotland; these must be considered as the first sulphuric acid factory, because Ward's works in Richmond were merely a large laboratory.

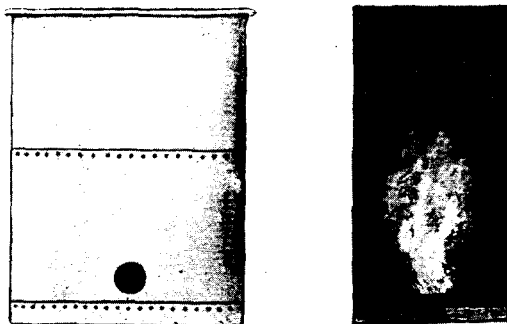
It has been my good fortune to find an old manuscript book, evidently recipes and experiments of a chemist named W. E. Sheffield, who lived in Birmingham from 1771 to 1790 (the dates occurring in the manuscript). The book contains, amongst various descriptions of chemical processes, an account of the manufacture of sulphuric and nitric acid at that time, together with beautifully executed drawings in Indian ink of the apparatus employed, and a general view of such a factory. This is reproduced in Fig. 1, where on the left are the "lead houses" for the sulphuric acid, and lower down, in the centre, the nitric acid plant.

Fig. 1.



I will give briefly, and partly in the quaint language of the manuscript, what he says "is the exact definition of Mr. Garbett; he has 30 in one room, each lies him in 8l." The "lead house" (Fig. 2) is 6 ft. wide in front at

Fig. 2.



bottom, 4 ft. broad from front to back, and "raised or cast in the solid, without any soldering, 6 ins. deep." The bottom is made of 9-lb. lead. Two sheets of milled lead, $3\frac{1}{2}$ lb. to the foot, are riveted together and joined one upon the other, each 4 ft. broad and 20 ft. long, and also joined with lead rivets to the bottom. Thus the "house" is $8\frac{1}{2}$ ft. high, 6 ft. long, 4 ft. wide. The top of the "house" is slightly convex, and fastened by "breasting over the sides." The whole is well supported with the back wall and wood framing, to which latter it is riveted with lead rivets both at the top and the sides. In the front, 8 ins. from the bottom, is a round hole of 10 ins. diameter, cut out with the edge turned up, so that a lead stopper may be inserted.

The lead house stands solid on sand, and on the common floor of the building. To each belonged also a pedestal of lead 7 ins. high, and a dish of lead 10 ins. wide, turned up 1 in. to receive the sulphur and nitre, of which it

held 1 lb. As stated above, the lead house cost 8*l.*, and, considering that it weighed nearly 10 cwt., lead constructions do not seem to have been expensive at that time.

In the lead house are put 5 cwt. of water for the first time, but only 4 cwt. at each subsequent operation, "because you can't crane it all out by 1 cwt." A mixture is made of 112 lb. of sulphur and 14 lb. of rough nitre (12.5 per cent.*) by first breaking up the sulphur and sifting it, until small enough for the mill, then mixing it with the well dried nitre, and grinding in a hand mill until as fine as meal. A ladle full, holding 1 lb., is put into the dish, and the mixture touched with a red hot iron bar. Then the stopper is put in, and after burning for two hours the hole is left open for an hour. This is twice repeated, after which the dish is taken out to remove the "salts." This operation is continued with 10 houses, served by one man, day and night for a month, or until the water weighs 20 oz.

Some explanation may be here interposed about the terms then used for expressing the density of a liquid. This is given as the weight of a volume of the liquid, which is equivalent to the volume of 1 lb. of water. Thus, if the acid "weighs 20 oz.," or is "4 oz. heavier than water," it means that a measure holding 1 lb. of water would hold $1\frac{1}{4}$ lb. of the acid.

It can be readily understood that by the way the sulphur and nitre were burnt, a large amount of unconsumed sulphur was left in the "salts." They were therefore carefully saved in a box, ground over again with 7 lb. of fresh nitre per cwt., and on burning they yielded as much acid as before. The "salts" now resulting were called "thirds," and were again ground together with $3\frac{1}{2}$ lb. of nitre per cwt., but those obtained from this operation were thrown away.

There is a note in a later handwriting that the "thirds" must be burnt in cast-iron pans about 8 ins. diameter, $\frac{1}{2}$ in. thick, turned up $1\frac{1}{2}$ in. The pans had to be made red hot before the salts were put in, because no doubt the mixture would not burn readily any more.

After a month's working the acid was craned out with a lead crane or a siphon. The water put in at first stood 4 ins. deep in the bottom. This increased by 400 oz. weekly, and in a month would be 5 ins. deep. We can thus arrive at an estimate of the work done. At six charges per day, in 26 working days, 156 lb. of sulphur would be burnt in a month, yielding 737 lb. of sulphuric acid of 1.250 sp. gr., or 33.43 per cent. H_2SO_4 , which is a yield of 158 per cent. monohydrate for 100 sulphur burnt, against the theoretical 306 $\frac{1}{2}$ per cent.

The weak acid was boiled down in open lead pans, 6 ft. long, 2 ft. wide, 1 ft. deep, until it weighed 24 oz. (1.500 sp. gr.), and it was then called "weak spirit of salt" or "pickle." The manuscript then says: "In order to make it into oil of vitriol continue to boil away until 32 oz., which is the adopted standard of oil of vitriol."

This would mean that the standard sulphuric acid at that time had a specific gravity of 2.000. Mr. James Mactear, F.I.C., in two very valuable papers read before the British Association in 1876, and before the Glasgow Philosophical Society in 1881, respectively, gave a very detailed history of the manufacture of sulphuric acid from the earliest times, and more especially in the Glasgow district. He gives there a copy of a calculation made in 1799 about the temperature to be aimed at in burning the sulphur, and therein the strength of sulphuric acid is also mentioned at 2.000, "which Kirwan calls his standard acid." † Although in Neumann's Chemistry of 1759 it is already stated to be 1.8775 on the authority of Fahrenheit, which is approximately the maximum gravity as found by Lunge and Naef, yet Kirwan, in 1791, ‡ still made the following statement, which is evidently the basis of the

* Rough nitre in 1780 contained only about 70 per cent. of KNO_3 (Bottée et Riffault, *Traité de l'art de fabriquer la poudre à canon*, Paris, 1811).

† From a very interesting paper by Mr. Bennett H. Brough, F.I.C., published in the "Ars Quatuor Coronatorum" of 1900, I find that Richard Kirwan, F.R.S., lived in Dublin, and was a very eccentric scientist, who received the Copley Medal in 1782.

‡ Of the strength of acids and the proportion of ingredients in neutral salts. By Richard Kirwan, F.R.S., Dublin, 1791, p. 7.

standard 2.000: "I neither could make nor procure oil of vitriol whose specific gravity is 2.000 in the temperature of 60°. Yet in cold climates this acid has frequently been produced, and as it is the strongest, or nearly so, than can be exhibited by art, I take it as the standard of the strength of all other acids of this kind." Kirwan was probably the first who made tables showing the gravity of various acids of different percentages and at varying temperatures. My informant, Mr. Sheffield, seems to have been equally puzzled, because he makes the following note: "N.B.—I have weighed both Mr. Skey's* and Mr. Garbett's, and it weighs but 30 oz. (1.875 sp. gr.), which is a very considerable profit."

At the end of the manuscript, perhaps also written about 1790, are particulars about a factory belonging to Mr. Margett, which are also very interesting. This "lead house" was already larger, 20 ft. square and 11 feet high, containing 4,400 cubic feet. It had three doors in front and a water-luted valve of 10 $\frac{1}{2}$ ins. diameter on the top. There were three rectangular pans, 29 ins. by 19 ins., charged with a mixture of 100 sulphur to 18 nitre, each pan receiving 12 lb. of sulphur and 2 lb. 2 $\frac{1}{2}$ oz. of nitre. Six charges were made in 24 hours, and thus in six working days 1,296 lb. of sulphur and 234 lb. of nitre were used. The time for burning each charge was three hours, but air was admitted for half an hour only, and the process was continued for six weeks, until the acid weighed 27 $\frac{1}{2}$ or 28 oz. (1.719 to 1.750). The bottom of some houses was divided by a partition, so that the acid of one compartment could be used whilst the other gained strength.

From the data given the cost of the acid was as follows:—

1,296 lb. of sulphur at 2 $\frac{1}{4}$ d. per lb.	£ s. d.
234 " nitre at 70s. per cwt.	13 10 0
	7 6 3
	20 16 3
Deduct drawback on sulphur used for making O.V., paid every January, at 10% per ton.	5 15 9
	15 0 6
Retorting, 1d. per lb. yield.	10 16 0
	25 16 6
Yield, double the weight of sulphur employed = 2,592 lb., weighing 29 $\frac{1}{2}$ oz. (1.844 sp. gr.) Cost per ton, without reckoning labour.	22 6 4

The acid was sold on four months' credit at 3 $\frac{3}{4}$ d. per lb. = 35*l.* per ton, and at six months' credit for 4d. per lb. = 37*l.* 6*s.* 8*d.* per ton, which sum was paid at the end of the credit by a two months' bill; thus, giving long credit was then also known. The price was said to leave 25 per cent. profit.

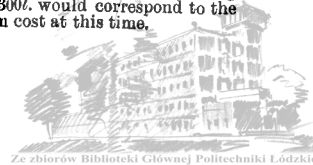
The "retorting" (concentration) was done in glass vessels, but platinum vessels were also used, and Mr. Sheffield states that one, holding 30 gallons, cost about 300*l.* †

At the end occurs the following remark: "I think it would be an improvement to agitate the gases by placing a fan of lead in the house, and I suspect it is not necessary to let the gases escape indiscriminately."

The method of making oil of vitriol given here seems to have been in use all over Great Britain at this time. Mr. Mactear enumerates 23 factories in England alone in 1820, of which seven were in London. The oldest factory still in existence is that of Thomas Farmer and Co., Ltd., which was started at Kennington Common in 1778. Brick furnaces attached to the chambers for burning the sulphur were erected in 1807, and steam was introduced into the chambers in 1813 or 1814.

* Skey's factory was in Dowles, in Worcestershire.

† This statement causes me to doubt whether this last note was written in 1790. Although the first platinum crucible was made by Achard in 1784, yet Mr. Sellow, of Messrs. Johnson and Matthey, has no knowledge of a platinum vessel for sulphuric acid having been made before 1804; the price of 300*l.* would correspond to the price of 14*s.* per ounce, which platinum cost at this time.

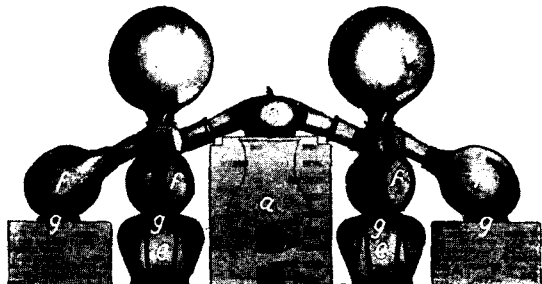


The character of sulphuric acid at that time is given by Kirwan* as follows: "Though pale, yet a little inclined to red. It contained some whitish matter, as I perceived by its growing milky on the affusion of pure distilled water. How far this may alter the result of the following experiments I have not tried; but believe it to be as pure as that which is commonly used in all experiments, and therefore the fittest for my purpose."

B. Nitric Acid.—Nitric acid seems to have been known in the earliest times. It is said that the black drawings on the clothes of mummies were made with silver nitrate, but the first description of the production of nitric acid (aqua dissolutiva, aqua fortis) is given by Geber in 778, who made it by distilling nitre with copper sulphate and alum. Raymond Lullius, in the 13th century, made it from nitre and iron sulphate, and Glauber, in 1648, taught us to make it from nitre and oil of vitriol. In 1759 it was still made, according to Neumann, by charging a tubulated retort placed on sand with powdered nitre, luting on a large receiver, and pouring in oil of vitriol in small quantities through the tubulure.

Mr. Sheffield's manuscript of 1771 gives many details about the manufacture on a large scale. The general arrangement is shown in Fig. 1; but instead of reproducing each part of the apparatus singly, as drawn by him, I have preferred to put them together, so that the function of each can be seen at a glance.

Fig. 3.



The retort was an iron pot *a* (Fig. 3), holding $37\frac{1}{2}$ galls. and weighing 20 cwt. It could take a charge of 200 lb. of nitre and 104 lb. of oil of vitriol; thus neutral sulphate was aimed at, which was called "sal enixum." The pot was closed by a pothead *b*, with two arms, "made at Vauxhall" from earthenware. Each of these arms was connected to a condensing plant. This consisted of a kind of crosspiece *c*, called the pipe receiver, which was surmounted by a "ballon" or large globe receiver *d*, holding 60 gallons. The lower part was luted to a "perpendicular receiver" *e*, and the arms to "large common receivers" *f, f*, holding 30 gallons each. The latter rested on "bosses" *g*, made of twine. The luting was made of equal parts of clean sand and "hufcap," a kind of clay, with one-quarter part of "sal enixum" and some water.

The distillation lasted four days. Towards the end the fire was raised "intensely high." The consumption of coal was 5 cwt., and the production 200 lb. of "gilder's aqua fortis" (1.375 sp. gr.; see later on), which works out at about $96\frac{1}{2}$ per cent. of the theoretical yield.

The cost of production works out as follows:—

	£ s. d.
200 lb. of nitre at 70s. per cwt.	6 5 0
104 " O.V. at 3½d. per lb.	1 15 1
5 cwt. of coal at 5d. per cwt.	0 2 1
For 200 lb. of gilders' acid	8 2 2

Cost without labour, per lb., approximately, 9½d.

It will be noticed that the distillation of a 200 lb. charge lasted four days, which is explained by the fact that the condensing plant had no vent for the uncondensed gases, and had therefore to be worked very slowly.

* Philosophical Transactions of the Royal Society, 1781, p. 22.

There were many kinds of aqua fortis sold, which are enumerated in the following table:—

	Weight.	Sp. Gr.	Price per lb.
	oz. dr.		s. d.
Pure spirit of nitre	23 12	1.485	3 6
Gilders' aqua fortis	22 0	1.375	1 8
Brass-founders' aqua fortis..	24 0	1.500	1 8
Syers' (assayers') aqua fortis	} 20 0	1.250	1 8
Refiners' aqua fortis			
Best platina	24 15	1.559	1 1
Single aqua fortis, or weak platina.	23 0	1.437	0 10
Twelve-penny aqua fortis ...	24 6	1.523	1 0

Some explanation for this table is, of course, necessary, and given. The various receivers had generally some water put in before starting, but if no water was put into the perpendicular receiver, then "pure spirit of nitre" was obtained. If, on the other hand, 10 lb. of water are put into it, then gilders' acid resulted; and if this was not up to standard, pure spirit of nitre was added, whilst, if too strong, weak aqua fortis or water was used for dilution. Gilders' acid is the most useful, because most other sorts are made from it by mere mixing.

For making syers' and refiners' aqua fortis, 30 lb. of water are put into each of the other receivers, and the various acids mixed together.

Brass-founders' aqua fortis is made by mixing 60 parts of gilders' aqua fortis with 10 parts of oil of vitriol. The manuscript naïvely adds: "Sells for 20 pence, the same price of gilders', tho' lowered with 1/6 of oil of vitriol; this justly esteemed a very particular secret in this branch of business."

Platina aqua fortis is made from 16 parts of gilders' acid and 40 lb. of oil of vitriol lowered to 25 oz. "It is used for best dip for platina."

Single aqua fortis, or weak platina, is made from 16 lb. of gilders' acid brought down to $21\frac{1}{2}$ oz., and 40 lb. of oil of vitriol lowered to $24\frac{1}{2}$ oz. "Used for the first dipping of platina work."

Twelve-penny aqua fortis is the same as the weak platina, only the gilders' acid is of the proper strength. It is also used for finishing platina.

The manuscript also contains an account of the manufacture of nitric acid in glass retorts, 9 ins. diameter, 12 ins. high, and called quart retorts, which were made by Stocks, near Blackfriars Bridge, and could be charged with 14 lb. of nitre. The coal consumption was excessively high—about 11 lb. per pound of gilders' acid; yet there was a profit of about 25 per cent.

Improvements in plant for the manufacture of nitric acid were made in recent years only. Plain pots can still be found in some factories, and the condensing plant is also frequently of a very primitive nature.

DISCUSSION.

Mr. FORBES CARPENTER said that he had with him a few notes of one of the oldest sulphuric acid works in England, which had been in continuous operation since 1791. Messrs. Bealey, of Radcliffe, near Manchester, began as a bleach works in 1683, and in 1791 commenced the manufacture of vitriol for bleaching purposes. He had obtained from them some account of the operations carried on in those early years, and Mr. Mactear, in his paper read before the British Association in Glasgow in 1876, gave a description of working in use at Messrs. Bealey's in 1799, as follows:—"There were six chambers, 12 ft. by 10 ft. by 10 ft., roofed like a cottage. They were placed in houses having openings in the brick walls, leaving the lead to be exposed to the atmosphere. This is perhaps of more use in expediting the filling of the chambers with fresh air than in aiding condensation. Mr. Laird (a Glasgow manufacturer of that period) says that the hotter the chambers are kept the more perfect is the condensation. Each of these chambers has a valve, which is opened between the burnings. In them there is burned each week 1,386 lb. sulphur and 198 lb. nitre, burnt in double pan^o the larger

above the lesser, and yielding 1,800 lb. of O.V. of 1·8 sp. gr. (equal to a produce of 130 per cent. on sulphur, with 14·28 per cent. of nitre); 8 to 9 ins. of water on the floor of the chamber. The sulphur and nitre are mixed in the proportion of one of nitre and seven of sulphur. Of this mixture 8 lb. are burned in each chamber every four hours. The mixture is burned on iron plates or trays, of which there are two sets only in each chamber (more not being found so productive), each set consisting of two plates, one placed over the other, about 3½ ins. apart. The iron is of best quality and very thin, so that they heat quickly. They are supported on a frame, which can be drawn out at the door of the chamber. 1 lb. weight of the mixture is put upon the lower plate, and 3 lb. on the upper plate. The plates being charged, the lower plates are first ignited, and, when fairly lit, then the upper plates; the frame is then pushed into the chamber and the door shut. The whole will be finished burning in one hour. Charge again three hours after the burning is over, or once every four hours, opening the doors and valves a quarter of an hour beforehand. The plates to be cleaned each time. By keeping this going on, they in six weeks made their O.V. attain a gravity of 20 oz. (1·250 sp. gr.), when it is run off for concentration to 22 oz. (1·375 sp. gr.), when it is used for bleaching liquors, &c. Having six chambers, therefore, affords one for drawing off each week.

State agreeable to the above.

	£	s.	d.
1,386 lb. sulphur at 2 <i>l.</i>	13	12	3
198 lb. nitre at 6 <i>l.</i>	5	13	1½
Labour	1	1	0
Tear and wear	1	1	0
	21	7	4½
Off for drawback on sulphur, at 6 <i>l.</i> 12 <i>s.</i> 8 <i>d.</i> per ton	4	2	0½
Producing 1,800 lb. O.V., costing	17	5	4

Equal to 2½*d.* per lb., or 21*l.* 10*s.* per ton.
Interest on sunk capital omitted in this state."

As the works at Prestonpans had been mentioned, he might say that this was the first works of which Mr. Macartear had found any record. Dr. Roebuck, who erected them, was active in many branches of industry in Scotland, and, with some friends, set up, among other ventures, the Carron Ironworks, celebrated for the casting of "caronades." At the Prestonpans works there were 108 chambers, each 14 ft. long by 4 ft. wide and 10 ft. high, and at Burntisland they had 360 chambers, 8 ft. by 4 ft. by 6 ft. high. He himself had seen and talked with men who had seen such small chambers in use (described to him as of the size of tramcars), and whose fathers had worked them. Messrs. Bealey were unable to give the price of acids sold then, 1790—1800, as they made principally for their own use; but from inventories taken at different periods from 1802 to 1813 it was found that the price of brimstone varied from 20*l.* to 27*l.* per ton, and nitre from 49*l.* to 50*l.* per ton. The oil of vitriol bottles cost 4*s.* each, and the contents 2*l.* In Cornwall he had come across the remains of a work where the manufacture of sulphuric acid was attempted in chambers (and that seemed a solitary instance) whose sides were of dressed native granite, which was put together with as little tar and china-clay cement as possible. He had seen some of these dressed blocks still in existence, but of course used now for other purposes. The top and bottom of the chamber were of lead, he was told.

Mr. W. F. REID said the members were very much indebted to Mr. Guttmann for rescuing from oblivion the interesting records of early days. In every new process that came out the first fight was with the development of the plant, and in an industry of that kind it was interesting to know how they got over their difficulties in the beginning. He had looked up some old authorities on the matter, and had come across some very early instances of the manufacture of nitric acid and sulphuric acid, and the methods were interesting. The knowledge of the subject seemed to have been widely spread in Germany about the beginning of the 16th century. In a book entitled "The

Treasure of Eudonymus," translated from the German in 1565, most of the references were to German writers, and the sources of some of the materials specified were in Germany. With regard to the manufacture of "oyle of brimstone," or "oyle of vitriol," the method chiefly used was to distil sulphate of iron, either alone or with some substances which liberated the acid, or to burn sulphur in very large vessels. They knew the use of nitric acid in connection with this manufacture.

"For the making of oyle of brimstone, a mā must chose out y^e which is pure and neuer touched the fire, chiefly aluie and of an ashy colour. This oyl is made many waies at Rome, by sublimatiō and descencion, &c. Take a vessell of glasse, not much unlyke to a little bel, daubed wyth potters claye, hang it the space of a cubit from the gronde, by a wyer of bras or yron, under y^e which thou shalt set a basē of glas of a great cōpas, wyth a pot turnde upsyde downe. Moreouer the botom of the potte shal hold up an yron plate of four fingars broade, made redhoat, wherupon the brymstone may be brent. Whyles this is brēt new shalbe added upō it. Therupon it shal com to pas that by the smoke ascending, the hanging vessell in short space shall destill drop down into the basen that standes under, an oyl whych gathered diligently thou shalt serve in a pihal of glasse."

"The oyl of vitriol is maruelous, burning lyke a hoat irō without grief, and is made in this maner: 30 ounces of vitriol of Rome or of Cypres, sal nitrum, roche alum, of ether 4 ounces. When they are all beate let them be calcionated with fire according to art. Afterward put this calcionated in a croked bocia clayed for the fire of an alchymists fornace, and by the fyre thou shalt have the oyl incresed in the receiuer; whych is a meruelous cauterium or burning thing, and hath no pere in any operation, and chiefly in taking away of wens and great wartes. But the receiuer muste be greate, if thou wilt make the foresayd oyl."

"While y^e oyle is prepyaryng ye must take hede of y^e smoke: because it doth not ouely kil men, but also y^e trees that be nye, it drieth thē vp."

There was a curious reference to "oil of salt" also, and they were thus evidently acquainted with hydrochloric acid in those days. With regard to *aqua fortis*, there was a very curious description. They distilled *aqua fortis* from vitriol, *sal nitrum* and alum. These products were chiefly used medicinally. "If a man put a drop of them into a wen or warte fyrst cut they take it away; of the which thyng I made a tryall in myself upon a warte on my fyngars end, and although it went not away by and by, yet within a fewe wekes it was gone."

The following appeared on page 320:—

"Aqua fortis or to separate metalles is thus made. One part of sal nitrum, liquid or molten alum (that they cal roche) three parts: sand half a part, whē they are dried diligently and purgeth with the fyre, let them be destilled in a vessell of glasse. It is gathered by itselfe, that which issueth out fyrst, at length whē yē glasse loketh lyke a saffron colour, increase the fyre and an other followeth: which is receaued in the fyrst for the moste parte, and yet if thou take it in water of the fountain or well, it is yet so sharpe that neuertheles it dissolueth siluer, and separateth it from golde."

He thought it might be interesting to the members to know that in those early times they made use of the same reactions; they practically liberated sulphuric acid from sulphate of iron and caught it in vessels of glass, and obtained the oil of vitriol. It would also be of great interest if they could determine when nitric acid was first discovered; he himself had not seen any article recording it.

NOTES ON THE SO-CALLED "HEAT TEST" FOR EXPLOSIVES.

BY W. CULLEN.

Few empirical tests have such an important influence on manufacturing processes as the so-called "heat test," which is used every day and all day in explosives factories. By it the stability or purification of the products is gauged at each successive stage of the manufacture.



Mr. Guttman, in a paper read before this Section of the Society in April 1897, proposed to substitute for it diphenylamine; and, later on, Dr. Giovanni Spica, in the "Bivista" of August 1899, finding serious objections to the use of this reagent, substituted for it hydrochloride of meta-phenylenediamine, which he asserted was preferable.

On the occasion already referred to, Mr. Guttman, among others, made the following statement:—

"The iodide test as at present prescribed is absolutely inapplicable for most of the modern smokeless powders and also some blasting explosives."

This is rather a sweeping assertion, but at the same time it must be admitted that the "test" leaves something to be desired. The object of the present paper is to show, however, that it is not quite so bad as it is made out to be, and to make an endeavour to remove some of the admitted defects.

At the present moment most firms engaged in the manufacture of explosives make their own test papers in as nearly as possible the manner prescribed by the Home Office. A point to be very particularly observed, however, is that it is a very rare occurrence for "test papers" obtained from different sources to give the same result, and sometimes the differences are very great.

Two separate series, carried out within the past twelve months with "cordite," may prove of interest. The papers were obtained from six separate sources:—

Paper.	Series I.	Series II.
		Minutes.
A	22	19
B	27	24
C	40	37
D	21	25
E	50	46
F	37	37

Maximum difference in first series, 28 minutes.
 " " second " 27 "

Examples like these could be multiplied *ad infinitum*, but with explosives, which do not withstand the "test" for such a long time as cordite, the differences are not so marked.

In investigating the subject I have come to the conclusion that the primary factor to be considered is the filter paper employed. The best English filter paper ought to be used, and it is prescribed that it must be washed in distilled water, then dried. Now, I can say with almost absolute certainty that if anyone will take the trouble to go to three different manufacturers, and from each procure a sample of filter paper, three different "heat-test" papers will be made from them, even although the same chemicals be used throughout. As has already been shown, the difference is not infrequently 50 per cent., and the question naturally arises which test ought to be taken. With empirical tests of this sort the only thing to be done is to standardise as far as possible, and it does not at all follow, as many assume, that because a batch of "test" papers gives low results the papers themselves are faulty. Thick papers invariably give a longer test than thin papers, but even the difference in texture has its influence. Again, papers which contain traces of the chemicals used in purifying the pulp, invariably give low "heat-test" papers.

In a general way, these facts are known to manufacturers, but it has been left to the War Office to recognise them in a practical manner, by having only one source of supply for their factories in this country and inspecting officers abroad. One source of filter paper alone is made use of, and enough is put on one side to last for a number of years. By this means, continuity is as far as possible attained, and each fresh batch, or "mark" as it is called, is standardised against previous issues. By the courtesy of Dr. Kellner and Major Nathan, I am able to reproduce the records for the past few years; but the following results, carried out in August of this year at Waltham Abbey, will illustrate the system of testing. It is observed that Mark O is a little

more insensitive than M or N, but in the more elaborate table which follows, it is seen to mellow with age:—

TABLE I.

Date of Test, 29th August.

Gun-cotton.			Mixed Material.			Nitro-glycerin.			Cordite.			Date of Receipt of Papers.
M.	N.	O.	M.	N.	O.	M.	N.	O.	M.	N.	O.	
14			8			21			68			25.11.1899
	15			11			22			68		22.8.1900
		19			18		24				70	22.8.1900
15			10			24			81			25.11.1899
	16			10			24			81		22.8.1900
		19			12		24				83	22.8.1900
16						19			55			25.11.1899
	17						19			55		22.8.1900
		20						20			53	22.8.1900
15	16	19½	9	10½	11½	22½	21½	22½	68	68	70½	Mean

The "mixed material" referred to in the foregoing table is the same as the "paste" of the next table, and is in reality the mixture of nitroglycerin and guncotton used in making cordite. The more elaborate table will well repay careful perusal, as it embodies all "standardising" results from 1897.

One point in connection with these records is that sensitiveness appears to diminish with age, while most experimenters find the opposite. On one point, however, all are agreed, *viz.*, that up to the age of six weeks results are erratic, but after this, for some reason at present unexplained, the papers settle down, and can be kept for years without alteration.

It may be of interest here to state that the paper used by the Government, or at least the War Office, is like ordinary thin blotting paper. The average thickness is 0.0082 in. thick, and the air-dry weight per square metre is 75 grms.

My proposal is that all engaged in carrying out this test ought to combine and have one source of supply only, the source, whoever or whatever it is, being under the direct control of an experienced explosives chemist. It would also form part of my scheme to buy or have prepared a special lot of paper, sufficient to last for at least five years, possibly longer. This central supply would naturally be in a favourable position for standardising its papers against those of the various Government departments, and of course, if they could be brought to join in the federation, matters would be still further simplified.

Such, then, in brief, is the proposal to rehabilitate the "heat test" in the eyes of many who even now look on it as more or less of a farce, and I think it will greatly assist in doing so. Even in its new form, abnormal results will sometimes be obtained, but it will certainly apply to 999 cases out of every 1,000. I am at present experimenting with very thin sheets of unglazed earthenware instead of paper, but the results are not yet sufficiently far advanced to be given.

The "heat test" does not claim, as many think, to measure the relative stability of *different* explosives. For instance, it is ridiculous to assert that, by the mere assembling together of the different ingredients which go to form cordite, an explosive is produced which is four times as stable as the guncotton used. The whole matter is one of the physical condition of the new explosive, its state of division, as also the temperature at which the test is carried out. We know that, given raw materials, such as those referred to in the tables, and a certain state of subdivision, a certain test is obtained. If the test is abnormal, then there is something which has to be looked for. The addition of vaseline altogether alters the physical condition of cordite, and, while it does act as a retarding agent for the gases of decomposition to a certain extent, it also increases the toughness and makes subdivision more difficult.



TABLE II.
Comparative Testing of Heat-Test Papers.

Date of Test.	New Papers received from Woolwich.					Previous Supply in current use.				
	Mark and Date of Receipt.	Heat Tests with				Mark and Date of Receipt.	Heat Tests with			
		Gun-cotton.	Nitro-glycerin.	Paste.	Cordite.		Gun-cotton.	Nitro-glycerin.	Paste.	Cordite.
16.1.97	H	Mins. 16	Mins. 26	Mins. ..	Mins. 42	I	Mins. 16½	Mins. 30	Mins. ..	Mins. 46
20.5.97	H	13½	36, 35	..	..	H	13½	36, 35	..	..
19.7.97	H	13, 16	26	..	..	H	14, 17	25	..	..
26.8.97	K	16, 16	35, 35	16	..	H	15, 15	32, 32	16	..
15.10.97	K	14, 15, 16	27, 30	20	36	K	14, 16, 15	27, 30	20	33
3.12.97	K	15, 14½, 14, 14, 15	28, 21	15	50, 42, 46	K	13, 13, 12, 24, 17	13	..	43, 35, 38
3.3.98	K	15, 15	31, 25	15, 15	82, 54	K	12, 13, 13, 13	31, 25	13, 13	82, 54
"	L	"	30, 36	15, 17	58, 86	K	"	25, 31	13, 15	54, 82
7.6.98	K	15, 16, 13½	25, 27, 32, 25, 34	15, 15	90, 102	K	15, 15, 15	25, 27, 24, 23, 22	15, 15	90, 102
"	L	15, 16, 14	26, 28, 24, 24	"	"	L	"	37, 27, 26	..	..
28.9.98	L	18, 16	21, 21	17	72	L	15, 15	19, 19	17	66
11.1.99	L, 11.1.99	14, 14	19, 25	15	62, 64	L, 28.9.99	14, 14	19, 25	15	62, 64
3.3.99	M, 3.3.99	18, 14	35, 34	24	70, 71	"	16, 13	30, 29	..	65, 65
6.3.99	"	16, 16	..	24	80	"	14, 14	..	20	74
8.5.99	M, 6.5.99	19, 19	24, 26	20	78, 69	M, 3.3.99	19, 19	24, 26	20	78, 69
28.8.99	M, 26.8.99	18½, 19½	25, 24	20	80, 76	M, 6.5.99	18, 19	25, 24	20	80, 76
29.11.99	M, 25.11.99	18, 18	25, 25	23	84, 84	M, 26.8.99	17, 17	24, 24	22	84, 84
26.1.1900	N, 26.1.00	21, 22, 27, 20, 20	32, 33, 28, 30	17	102, 68, 122, 126	M, 25.11.99	17, 17, 22, 15, 15	31, 32, 26, 27	13	83, 48, 102, 105
1.6.1900	N, 31.5.00	16½, 15, 14	25, 24, 24½	16	78, 79, 46	"	16, 15, 14	24, 24, 24	15	78, 78, 46
4.7.1900	N, 2.7.00	20, 21, 22	22, 21, 25	12	38, 54, 60	"	21, 20, 21	21, 20, 24	12	38, 54, 60
29.8.1900	N, 22.8.00	15, 16, 17	22, 24, 19	11, 10	68, 81, 55	"	14, 15, 16	21, 24, 19	8, 10	68, 81, 55
"	O, "	18, 19, 20	24, 24, 20	11, 12	70, 83, 58	"	"	"	"	"
25 & 26.9.1900	O, 25.9.00	15, 20, 24	19, 19, 20	16, 16	45, 66, 42	"	15, 20, 24	19, 19, 20	16, 16	47, 67, 42

In other cases the converse takes place, and the heat test is lowered. Experience has shown, therefore, that by the assembling of certain materials a certain test is generally obtained, and is to be expected. If it is lower, instability may be looked for; if higher, then "masking," deliberate or accidental.

The presence of vaseline in cordite does not hide evidences of instability when this explosive has been stored in India for a time. But the test does fall to a most alarming extent, although it does not enter into the scope of this paper to discuss the causes.

Undoubtedly the advent of the horny smokeless powders of modern times has made it a little difficult to give the test the same scope as it had when first introduced; but here again it is only a question of adapting it in a common-sense manner to the special circumstances arising. As a rule, a simple explanation can be found for every apparently abnormal result, and, in the accidental retention of a portion of the solvent used in the manufacture, will frequently be found an explanation of the trouble experienced.

I have frequently found the heat test of the interiors of grains and cords to be quite different from the surfaces, and no doubt this is common enough. In cases of doubt it would certainly be advantageous to have some other verification test, and perhaps that of Mr. Guttman or Dr. Spica would form a very valuable adjunct to the present test. Most manufacturers know to their cost that a batch of explosive made from perfectly stable ingredients will frequently give a test much below the normal, and experience has led them to assume that bodies other than the products of decomposition do sometimes affect the papers adversely. What these bodies are remains yet to be discovered, but the mention of facts like these merely shows that there is still a field for research in this already much-investigated sphere.

Some years ago now, when carrying out a very comprehensive series of experiments in connection with this same subject, I found that a very good check was to carry out the following test. The explosive to be examined was subdivided as required and placed in a U tube, which was heated for 30 minutes in a water-bath kept at the requisite temperature. Through the tube purified air was passed, and the escaping gases made to bubble through absorption

bulbs containing *m*-phenylamine-diamine. I tried iodide and starch, as well as diphenylamine, by the same method, but the *m*-phenylamine-diamine turned out the most satisfactory. At the expiry of the 30 minutes the depth of colour was ascertained in much the same method as Nessler's test is carried out; and, of course, by doing a blank or standard explosive, or both, a ratio was established between this test and the heat-test results.

When all is said and done, however, I do not think it will be necessary to resort to a confirmatory test of this sort in one case in a thousand.

DISCUSSION.

The CHAIRMAN, in inviting discussion, said that it was a matter on which much discussion had already taken place, and it was of the utmost importance to manufacturers.

Major NATHAN said that he entirely agreed with Mr. Cullen as to the desirability of having standard test papers made in some central establishment, from whence all interested could obtain their supplies, for that would do away with the variabilities incidental to the manufacture of test papers at different establishments, of which Mr. Cullen had given examples. In the old days, before an arrangement had been come to with the Chemical Department at Woolwich there were endless arguments and discussions as to whether the heat tests at Waltham Abbey or those at Woolwich were right, but they eventually adopted one source of supply for test papers, and since then there had been no trouble. It was a fact that freshly made test papers were not reliable, but after a month or six weeks they had settled down, and remained constant for a considerable time. They had ascertained this by employing a standard explosive and testing the test papers with it, and they had found the results pretty constant. When one supply was nearly exhausted they obtained another supply from Woolwich, and tested the new papers against those previously in use, with the results shown in Mr. Cullen's tables. He thought that the heat test left a great deal to be desired. The chief difficulty arose from the fact that they did not know what it was in the explosive that affected the test paper. They did know that samples of apparently safe explosives would give a very low heat test; for instance, samples of cordite from India had gone



down to an alarming extent, alarming only because the heat-test figure was low; but that explosive, when tested for composition or ballistics, was found not to have suffered in the slightest degree, and having reached the low point of four or five minutes it did not seem to get any worse. He had had samples of cordite that had failed to stand the heat test, and had then subjected them to considerable temperatures, with the idea that if decomposition had set in it would have been aggravated, and something much more alarming would have resulted. Strange to say, the heat test of those explosives had gone up in the process of heating, perhaps from five to twenty-five minutes. Therefore it did not follow that an explosive that had dropped in the heat test was dangerous. There were factors which affected the heat test which were still unknown, and until they were known one could not regard the test as infallible. At the same time it was most valuable, as it undoubtedly did give an intimation whether the manufacturer had thoroughly purified the raw materials and the finished nitro-explosives. He did not think, however, that a subsequent drop in the test meant that an explosive had gone bad. There were many remarkable things about the heat test. For instance, guncotton mixed with nitroglycerin would sometimes stand only a very low test, though the tests of both were good separately. Separate them again and they both came back to their original heat tests. That, in his opinion, required explanation. With regard to the other tests mentioned by Mr. Cullen, the diphenylamine test was a very good one when applied to explosives of the guncotton type. Some four years ago, when the question cropped up, he made a great number of experiments, and the diphenylamine solution for them was made by Mr. Guttman himself. As long as he stuck to guncotton explosives he got concordant results, but when he used it for testing nitroglycerin, or explosives containing it, he obtained neither the reaction he ought to have got nor any consistent results. Subjecting a volatile explosive to a heat test in which the reagent was dissolved in sulphuric acid probably had something to do with the unreliability of the results obtained. The metaphenylenediamine test referred to he had also tried, and although the results were claimed to be four times as sensitive as the Abel test, yet his results did not confirm that claim. He found that the heat tests were much the same when testing guncotton and nitroglycerin, whether he used Dr. Spica's reagent or the Abel reagent. But when he came to an explosive like cordite, or explosives containing much nitroglycerin, the results differed widely. Of the three tests, he considered the Abel test the most reliable, but there was much still to be found out about the subject. The most important point to be cleared up, in his opinion, was, what are the volatile bodies that affect the heat test? for it was evident that free acid, as at first supposed, was not by any means the only one.

Mr. O. GUTTMANN said that Mr. Cullen started by saying that the diphenylamine test he had indicated some years ago was not a better test than the iodide one, and that his statement as to the value of the iodide test was a sweeping one. He (the speaker) begged leave to repeat that statement in the most emphatic manner. The diphenylamine test could not be bad, because four Governments had adopted it, either as the sole test or to control others, and because the British Government had modified the iodide test so that the objections made to it were to some extent removed. If there was a justification needed for his statement, it was to be found in Mr. Cullen's table No. 1. One had only to look at the column "cordite paste" (a mixture of nitroglycerin and guncotton), standing only eight minutes, and the same, plus vaselin and acetone, standing 68 minutes, to show that the iodine test was fallacious for smokeless powders. The acetone and vaselin masked the heat test, and made it go up to ten times what it ought to be. Major Nathan had said, and perhaps there was some justification for it, that the diphenylamine test was not so reliable as he had expected. He was quite ready to admit that it had some faults, and he had never claimed to have found the test. He was not the inventor, but had simply adapted it to the purpose. What he claimed as a distinct merit was not the invention of a new test, but to have

shown that the old one was bad, and why. He had pointed out several other tests which might be used. Recently a foreign Government had reported to him that they found the guncotton supplied to them going up surprisingly in the heat test, which they could not explain, until, on making an examination, they found that the guncotton before being supplied to them was dried in a room in which smokeless powder with acetic ether as a solvent had been dried. That showed that the diphenylamine test was sufficient to reveal such a slight difference. He would not go very deeply into the objections made by Major Nathan; personally, he owed a great deal to that gentleman for his support in the early investigations. He had given him every opportunity, and had assisted him to the fullest extent. A paper was published in 1879 by General Hess, who had occupied himself very much with the heat tests of various descriptions. In that paper were stated the advantages and defects of the heat tests; and all that General Hess said 20 years ago still held good. Major Nathan had said that he found the diphenylamine test good for testing the prime materials, but failed when he came to cordite, because it gave such extraordinarily low results; this was exactly the reason why the diphenylamine test was good and the iodide test bad. Major Nathan thought the vaporised nitroglycerin was decomposed by the sulphuric acid used for dissolving the diphenylamine, but it was very strange that powders made with ether alcohol gave identical results with both tests, whilst whenever a masking solvent like acetone or acetic ether was used, a decomposition theory was necessary to explain the enormous discrepancies. He wished briefly to mention the present state of the question. The first man who made a test based on the development of nitrous acid on heating was Sir Frederick Abel. Very shortly after, the then Captain Hess made a test by which he aspirated air, very much in the way Mr. Cullen had described, through a bottle containing iodide, then through a tube with the explosive, then allowed it to bubble through a solution of iodide and observed the first appearance of the colour reaction, then the formation of a ring, and then coloration of the whole liquid. Later, he heated the explosives at high temperatures, and observed them from a distance through a telescope, and noted the time in which coloration took place, and also the time of explosion. Still later, but based on the same idea, he proposed that explosives should be heated at 75° under pressure, and for so long that perfect decomposition took place or an explosion. He published tables showing remarkable differences which could not be explained. Guncotton was found to stand the test for an incredibly long time—600 minutes—whereas dynamite would stand only 15. Within the last few years, probably because all the other heat tests failed, the French Government, and also the Dutch Government, had heated the explosives up to 130° C., exposing the vessels to that temperature in a sand bath, or otherwise, and noting the time in which the brown fumes would appear. That time was sometimes days, sometimes hours. The inherent fault of that plan was, that it was very difficult to maintain the same temperature for days and days, and to make sure of observing it. Quite recently a new method had been devised by the Central Institution for Technical Research at Neu Babelsberg, instituted by half a dozen manufacturers of explosives, mostly of the Nobel group, and which laboratory was under the direction of Professor Will. They heated the explosive to 135° C., probably in amyl alcohol, the boiling point of which is 137° C., and collected the gas in the usual way, measuring the time in which it was developed and the quantity developed in a certain time. That was rational, and gave a true indication of the possibility of an explosion through decomposition, but at the same time it is not a test adapted to the actual conditions of storage. On the other hand, when one heated an explosive to 70°, they did not get an indication of actual decomposition, but generally an indication that there were certain impurities in it. With guncotton and similar explosives which had a low heat test, after being kept for a long time the test improved, whilst, again, other explosives decomposed. When one heated to 135°, which was nearing the point of explosion, one had a possibility of a quick and reliable test, in, say, 30 or 40 minutes. He considered the



position was not yet exactly defined; more experiments would have to be made; possibly both tests would have to be combined. What was wanted was a quick means of knowing whether an explosive was suitable or not, and a means that would not be bound to show fallacious results, as the present one did in so many cases.

MR. W. F. REID said that he considered the last remarks made by Mr. Guttman of great importance, because, taken in conjunction with what Major Nathan had said, they showed a possibility of obtaining reliable tests. He would not say that the test just described was reliable, because if one heated an explosive to very much above the temperature it would ever be exposed to in practice, it would be subjecting it to conditions which were not natural. The same thing had been done with Portland cement; it was heated to a temperature that it would never require, and fallacious results were obtained. The heat test introduced into the explosives industry required modification, for one really did not know upon what the test was based, and he thought it was rather hard upon manufacturers that they should be bound by a test that, after all, might be erroneous. He believed it was in some cases absolutely fallacious. He had had explosives prepared with the greatest care, and had subjected them to all sorts of conditions, and they would not explode under practical tests, and yet they would be condemned by the heat test. Even the distinguished author of that test was unable to find the connection between the test and the danger of the explosive. With regard to the conditions of testing, Mr. Cullen had given a large number of figures, which represented much work done by himself or at Waltham, and he (the speaker) was very loth to find fault with anything which represented so much labour, but he could not see that the figures were of any earthly use to anybody who read them. The various test papers employed were represented by letters with no reference to their composition. If Mr. Cullen could give any information with reference to the papers themselves, some estimation of, say, the chlorine in them, which no doubt was very often present, and possibly went off after some time, or if he gave the percentage of pure cellulose in the papers, or any other means of identification, they would be useful. With regard to the impurities in the papers, they were very likely due to the bleaching of the pulp, and that was corroborated by the well-known fact that the thick papers gave a worse test than the thin ones. The fact had long been well known that different papers gave different results. He understood that the chief point Mr. Cullen wished to advocate in his paper was that there should be a place where uniform paper could be procured. That was a most difficult thing to bring about; but perhaps it could be arranged, and it would be a great benefit to those who had to use them. There was a firm on the Continent which guaranteed their paper as absolutely pure, but if compared with some English papers it might be found that the English papers came out at the top. What was wanted was not so much absolute purity as uniformity, and if Mr. Cullen could secure that it would be a good thing. He himself was not sure that paper was the best thing that could be used for the purpose. If it were possible to get the reagents on another substance they might eliminate one of the greatest sources of irregularity. He hoped the investigation would not stop until some relation had been found between the explosive and the test.

MR. H. DE MOSENTHAL said that no doubt a number of members present were not able to follow the discussion, as he himself had found to be the case on previous occasions when no explanatory remarks had preceded a paper on a subject with which he was not acquainted. He would perhaps be allowed to explain that in examining an explosive by the heat test, it was placed in a finely divided condition into a test tube, and suspended over it was starch iodide of potassium test paper prepared in a prescribed manner. The explosive was then heated and kept at a fixed temperature, and the test consisted in no coloration appearing within a prescribed time. If the coloration appears prior to the time fixed, the explosive is regarded as dangerous. The test was first applied to gun-cotton and dynamite, then to blasting gelatin and so-called gelatin

explosives, and lastly to cordite. An explosive which did not stand the test was, as already remarked, considered dangerous, and in some countries it was thrown into the sea. If, as Major Nathan had remarked, the fact that an explosive did not stand the test was not an indication of its dangerous nature, there ought surely to be a change in the test, or considerable hesitation on the part of the authorities to destroy large quantities of valuable merchandise.

MR. J. M. THOMSON said that when one began to speak of the heat test one had to be very careful to avoid dogmatism. There were so many things which affected the question that one could not speak confidently. Fortunately, Mr. Cullen's paper had not raised in itself any questions that might tend to discussion to any great extent. He quite agreed with Mr. Cullen that so long as the heat test was used as a standard for explosives a central supply would be a good thing, and would do away with many of the varying results shown under the present system. The difficulties of the heat test were not new. For 20 years past—for so long as dynamite had been manufactured—those difficulties had cropped up. Even when carbonate of ammonia had been present in the dynamite a very low heat test would often occur, and therefore was not due to any acid present in the substance or in the atmosphere of the tube, so that one was forced to the conclusion that it was volatile nitro bodies which affected the iodide of starch paper. So far as the heat test by diphenylamine was concerned, there were many tests made several years ago on the suggestion of Mr. Guttman, and it was pointed out that they applied very well to gun-cotton, but when used for nitroglycerin, which was to some extent volatile, the diphenylamine paper could not be relied on. That was accounted for by the fact that the diphenylamine was in dilute sulphuric acid solution, so that when the volatilised nitroglycerin came in contact with it a reaction took place. If that were the case, it might be taken to apply also to cordite as well as to nitroglycerin, and he believed the heat test of cordite approximated very closely to that of nitroglycerin. The question therefore arose as to whether they could depend upon this heat test, or whether they should look upon it with a certain degree of suspicion as being affected by the volatile nitroglycerin. He considered that so long as the heat test was used—and they had nothing better at the present time—they were greatly indebted to it, and especially for its services in the past. No doubt some other test would be discovered, and the sooner the better; but one had to be very careful in casting aside a test of purity. He understood that with the present test the standard of minutes for each explosive was based on tests of samples of the explosive which had been prepared from carefully purified materials, a fair margin being allowed for manufacturing conditions. He considered that at present they were quite justified in relying on the heat test so far as it went, and he hoped that some better test would soon be forthcoming.

The CHAIRMAN said that he would not like it to be thought that the meeting was opposed to the application of either Abel's heat test or modifications of the same. Every manufacturer of explosives must acknowledge that the heat test had been of inestimable service; that until the heat test was introduced and enforced, the manufacture of high explosives had been on a most insecure footing, and that only by its continuous use had the high security of manufacture of explosives become possible. At the same time it appeared to him that the time was approaching for an alteration in the test, and he believed that the discussion that evening would assist to that end. The discussion had somewhat strayed from the main point which Mr. Cullen had brought before them, namely, that while iodide paper was to be used, there should be one uniform supply of the test paper for the whole country. Mr. Reid had lightly touched upon the question whether paper was a desirable substratum for the iodide. He (the Chairman) equally had his doubts on that point. The text-book knowledge, that paper consisted of cellulose, should be disregarded, and it should be recognised that paper contained substances liable to alteration, whereby the sensitiveness of the reagent might be altered. It did not follow that because a large stock of



uniform paper might be obtained for the purpose of preparing heat-test papers, that stock would be of the same nature after a lapse of years. A substance less liable to alteration should be sought after.

Mr. W. CULLEN, in reply, said that he considered that the Chairman had struck the keynote in his last remark, as the discussion had wandered away from the original purpose of the paper, which was simply to make the best of a test which admittedly had defects. He did not think that the heat test as at present carried out was altogether a bad one. After 20 years' experience it was the best they had, and it might be another 20 years before a better test came into use. He had conducted many thousands of those tests, and had found that one got very much into a circle in carrying out experiments of the sort. Mention had been made of the point of explosion as an indication of the stability of an explosive, but exhaustive experiments had shown this to be quite fallacious, and no ratio had ever been established between it and any other recognised method. Mr. Guttman had referred to Hess's work. He was not familiar with it, but it seemed very similar to that of Abel on gun-cotton, which formed the subject-matter of communications to the Royal Society 20 years ago. Abel heated gun-cotton at various temperatures *in vacuo*, collected the gases, and observed the amount given off in a certain time. The experiments sometimes took weeks and sometimes months, but one could not wait for six weeks in a manufacturing works in order to know whether an explosive was suitable or not. They must be able to obtain a result in half a day. Mr. Reid considered it would be difficult to get manufacturers to combine. He might say that already most of the manufacturers had agreed to the proposal, and were very thankful for it. He was very sorry Dr. Dupré was not present, but the scheme had his hearty approval, as also that of Dr. Kellner. He could not agree with Mr. Reid that the tables shown were not intelligible. They certainly required a little study, which would repay the trouble. After all, the heat test did not pretend to indicate the relative stability of a number of explosives, and a most important point about it was that the physical condition was a function of the utmost moment. In one instance in the tables the two bodies, gun-cotton and nitroglycerin, had been brought together. The former possessed a heat test of 14 and the latter 20; combined they gave an average of 8; but that was because the surface exposed in the one case was very different from the other. The heat test, as at present carried out, was, therefore, among other things, in a great measure dependent on the physical condition of the explosive. One could not assume that because the cordite stood 68 minutes as against eight minutes, that it was nine times as stable, for the physical conditions were altogether different. The same applied to dynamite. Nitroglycerin would, as a rule, stand the test for 20 minutes; dynamite would seldom stand more than 10 or 12 minutes. In his opinion, that was principally because the physical state was altered. Replying to Mr. Reid, he might say that all the tests shown were made with the one paper. He rather regretted that the discussion had strayed away from the main point which he had intended to bring out.

Manchester Section.

Meeting held on Friday, January 11th, 1901.

DR. J. GROSSMANN IN THE CHAIR.

PATENT LAW.

BY IVAN LEVINSTEIN.

In March 1900 I addressed, as delegate of the Manchester Chamber, the Associated Chambers of Commerce of the United Kingdom, on the defects of our patent laws.

The meeting unanimously resolved that preliminary examination into novelty was desirable. In the same month I read a paper on the same subject before the Manchester Section of our Society, when resolutions were

passed in favour of preliminary examination, patents of addition, and amendment of section 13 of the Patent Act of 1883.

This paper, with some additions, was issued in pamphlet form by the Manchester Chamber of Commerce, after the Board of Directors had placed, by special resolution, the *imprimatur* of the Chamber upon it, certifying thereby its approval and adoption.

In deference to these important representative bodies, I cannot ignore a paper by Mr. C. D. Abel, which was read before the Manchester Section in December last year.

A few years ago, Mr. Abel published a paper in which he was anxious to prove what other patent agents have attempted before and after him, *viz.*, that preliminary examination into novelty was not desirable, and that it did not conduce to confer greater security on German patents. He supported his arguments by certain figures showing that the proportion of litigated patents to annulled patents was practically the same in both countries; in England 29:13, and in Germany 102:43. I challenged his figures, as well as his conclusions, and gave some reasons for my objection, which I now briefly repeat:—

(1) Probably half the patents granted in this country are not worth fighting for.

(2) Patent litigation for a man of small capital spells ruin.

(3) Patent litigation in Germany is cheap; if an inventor or manufacturer believes that an injustice has been done to him, redress is open to him, even if possessed of only small means.

(4) That Mr. Abel does not take account of the respective life of British and German patents.

Mr. Abel now says my first reason is only an assertion; my second he accepts as true, but adds "wisely so"; to the third he rejoins that German litigation is "cheap and nasty"; to the fourth he attempts to give some explanation. I contend that he has not disproved any of these assertions.

Putting, however, aside, for the moment, my reasons, and assuming for the purpose of argument that Mr. Abel's figures are correct and represent a fair average of years, even then his conclusions as to the security of German patents will be fallacious. Mr. Abel says that I have overlooked the main point of his argument, that the proportion of litigated patents to annulled was practically the same in both countries. It does not matter, however, whether they are the same or not; the greater security or better title of a German patent lies in the fact that out of about 15,000 applications to the German Patent Office, less than 6,000 are granted. It is this weeding out of 9,000 patents by preliminary examination, carried out by a competent court, that enhances the value of a German patent.

I will, however, further show that little reliance can be placed on Mr. Abel's figures and conclusions, and for this purpose I reproduce his own table, and another table compiled from official sources. This latter table goes a little further back than Mr. Abel's. In covers 1896, the year selected by him, and four years preceding. I point out, however, that my table, for obvious reasons, has been somewhat differently arranged from Mr. Abel's. I do not show patents litigated nor patents partially invalidated, as no reliable statistics exist, and can only be at the best guesswork. Our leading authority in this country is the official report of patent cases, but this publication only reports decided cases of public interest, and a good deal of patent litigation is carried on without coming into court.

It is also misleading to classify under one heading patents wholly or partially invalidated.

Mr. Abel's Table.—Patents, 1896.

	Great Britain.	Germany.
Patents granted	14,105	5,410
Patents litigated	29	102
Patents wholly or partially invalidated.	13	43



Table compiled from German Official Sources for 1892 to 1896.

	1892.	1893.	1894.	1895.	1896.
Applications	13,126	14,265	14,964	15,063	16,486
Patents granted.....	5,900	6,430	6,280	5,720	5,410
Patents invalidated, including patents withdrawn.	10	12	22	18	32

It will be seen from the official table that 32 patents were withdrawn and invalidated in 1896, Mr. Abel's year, whilst the average for the four preceding years is less than half of this number, *viz.*, 15.5 per annum.

I leave it to Mr. Abel to explain—

- (1) Why he has picked out for his arguments the year 1896.
- (2) Whether or not any fair or reliable conclusions can be drawn from a single year's patents statistics.
- (3) What value can be attached to his statistics for patents partially invalidated and for patents litigated.

Mr. Abel having, in his opinion, disposed of my criticism of his figures and conclusions, contributes some information about German patent law; and to make this more forcible he refers to his lifelong experience. This does not, however, mean much, as the German patent law has existed only since 1877; whilst the new German patent law, which can only be the one under discussion, has only been in force since October 1891.

In 1886 the German Government appointed a commission consisting, not only of a few Government Officials, patent agents, and patent counsel, similar to that recently appointed here, but including, besides, members of the Patent Office, men eminent in science and largely interested in trades and industries, and also technical, industrial, and scientific experts. This commission was appointed for the purpose of advising the Government to amend the law of 1877. It is interesting and important to state that it was the unanimous opinion of this commission that preliminary examination should be retained. The new patent law of 1891 is a material improvement over that of 1877. It is not a mere addition or enlargement of the latter, but, as expressly stated in the preamble, is an entirely new Act.

Now, Mr. Abel is eminent in his profession. He is a member of a firm occupying a high position among patent agents. He ought to be well aware of the sources from which reliable information on German patent law and procedure can be obtained; yet he says: "In the first place when a patent action is commenced in the Landgericht (county court) where the patentee is domiciled, both parties to the suit are obliged to employ a barrister appointed to that particular court, and no other. Another feature of German litigation is that only written evidence can be produced in court, and the assessors' and lawyers' reports have to be in writing, the payment for such reports being at the rate of 2s. per hour occupied."

Most of these statements are absolutely erroneous.

(1) The Landgericht does not correspond to our county court; it is a higher court, consisting of a president and four judges. To the Landgericht, for example, in Berlin, about 500 qualified barristers are admitted. The employment of a barrister attached to this court is therefore no hardship, and the whole procedure is, after all, not dissimilar to our own practice.

(2) It is quite incorrect to state that only written evidence can be produced in court. In an action before the Patent Office, Reichsgericht, or Landgericht, the plaintiff, as well as the defendant, may personally appear to give evidence, together with their witnesses and experts.

(3) It is also quite erroneous to state that assessors and lawyers are paid at the rate of 2s. per hour. Barristers in Germany are paid proportionately to their professional standing, and to the importance of the case upon which they are engaged.

I now come to Mr. Abel's illustration of the German method of litigation, of which he says "that this is positive evidence of the absence of security of a German patent."

It is the Schlich case which he cites. I submit that this illustration is unfortunately chosen, as it proves nothing more or less than the security of a German patent, which is the very reverse of Mr. Abel's contention.

The patent was granted to Schlich by the first division of the Patent Office. Schlich brought an action for infringement of his patent against a manufacturing firm. The defendant thereupon applied to the second division of the Patent Office for an annulment of Schlich's patent on the ground of want of novelty. The defendant succeeded. Schlich thereupon appealed against this decision to the Reichsgericht, which quashed the decision of the second division and upheld the patent.

Mr. Abel then cites the well-threshed-out illustration of the Siemens case against the German system of examination, but this illustration is also unfortunately chosen. As the Siemens case has been so often wrongly quoted by patent agents and others as a blot on the German system of preliminary examination, it may be useful information to our members to briefly refer to the various single German States prior to the establishment of German patent law.

Most of the single German States, before the foundation of the German law, had their own patent laws. For example, Prussia established patent laws in the year 1815, Bavaria in 1825, Wurtemberg in 1836, Saxony in 1853. The laws of each of these States differed from each other, and each of them was widely different from German patent law. The patent laws of the various States have been defunct since 1877. The German patent law of 1877, as I have already stated, has been replaced by the law of 1891. The procedure of the defunct Prussian law was most arbitrary. The grant for inventions of great importance was often refused whilst smaller ones were accepted. My personal experience dates back to 1864, when I obtained a patent in Prussia. It is this defunct Prussian law which has been probably confused by Mr. Abel and other opponents to preliminary examination with German patent law.

Only recently Mr. Lloyd Wise, the well-known patent agent, in a paper read before the London Section and published in our Journal, November 1900, on preliminary examination into novelty, said: "It is almost superfluous to recall the facts that in Germany patents were refused for the Bessemer process and for the Siemens regenerative furnaces." Mr. A. G. Bloxam, who, I believe, is also engaged as a patent agent, said in the discussion: "Mr. Wise's interesting reference to the celebrated case of Siemens was most *apropos*."

But from the facts already stated it is quite evident that there never was a German patent refused to either Mr. Siemens or Mr. Bessemer by the German Patent Office and under German law.

Mr. Siemens' application for his regenerative furnaces was made more than 25 years before the existence of the German patent law, and Bessemer about 20 years previous to it. It is therefore waste of energy on the part of our patent agents to cite these cases against preliminary examination as carried out by the German law.

I have been, since its existence, and I am now, constantly in contact with the German Patent Office. I fought my own battles, and I have personally pleaded before it. My experience is that it is now of very rare occurrence that patents are refused which contain any novelty, provided that one perseveres, and also fully replies to the opposition raised by those interested.

In my pamphlet, however, I was not so much concerned to prove the superiority of the German patent system, although I do consider it as the best. On the other hand, I concede that preliminary examination is a controversial subject; but every unbiased student of patent law will agree with me that the want of conformity existing between our laws and those of our industrial rivals is doing an incalculable harm to our trades and industries.

For example, the grant of a patent to a foreign applicant which has been refused to him by his own country, benefits



the foreign country at our expense, the loss to us being proportionate to the value of the invention.

That the patent laws of Germany have been of the greatest possible aid to the growth and development of German industries is freely admitted by those who know the facts.

It is only recently that Privy Councillor Dr. Otto Witt, the eminent Professor of Technology in the Charlottenburg High School, said in his very admirable report on the collective chemical exhibits of Germany: "The beneficial effects which the German patent laws have exercised on the development of German industries, particularly of the chemical industries, are simply incalculable." I wish the same could be said of our patent laws.

I am, however, not in the least sanguine that we shall easily succeed in getting preliminary examination introduced, as it would be costly. Our present Government is already saddled with financial burdens, and any addition to these would no doubt be strenuously objected to, especially if there were the slightest opposition. The consequence, therefore, will be that speculative, bogus, bluff, and block patents will be taken out as hitherto, to the great disadvantage to inventors and manufacturers alike. The title of an English patent will continue to be valueless until established in a court of law; extortion and abuse will continue to flourish to the detriment of our traders.

The question then arises, Can no means be devised to amend, at least to some extent, this deplorable state of things? Is it within the range of practical politics to ameliorate the disadvantages under which we are labouring? I am quite alive to the fact that to carry any proposed amendment it must meet the interests of *bonâ fide* inventors and manufacturers; it must not be diametrically opposed to the interests of patent agents and counsel, and it must not seriously complicate the present machinery of patent legislation.

I submit to you, with some diffidence, some suggestions which, if carried out, will, in my opinion, amend the present chaotic state of our law.

(1) That in all patents which cannot be defined by drawings an applicant shall be permitted to claim in one patent only one single substance or compound, and, if demanded by the Patent Office, he shall deposit samples or specimens of his invention.

(2) That every patentee shall mark each article, or the package in which said article is made up and sold, "patented," together with the number of reference to the patent under which the article has been manufactured.

(3) If the patented article consists of a mixture, of which only a part is patented, it shall be so stated.

Now, in regard to the first proposition, it contains nothing more or less than what is law already in the United States, and partly so in Germany. If carried out, it would remove the fraud which is frequently practised on the public by patentees.

I have already shown in my pamphlet, under section 18, how this section is abused. It is quite a common procedure for a patentee, if he has really invented one thing, to include hundreds, nay, thousands, of others. It is also common practice to make, say, 50 claims, and when the time comes to establish the validity of the patent, to strike out, by help of the said section 18, say 49, and still retain a valid patent. I have also shown that, for example in organic chemistry, one may, by theoretical deduction, fix the potential existence of a large and almost unlimited number of substances which may never have been seen or made by anyone.

I have referred in my last pamphlet to several foreign patents, of which one covered 38 pages of print, whilst its corresponding German patent only covered three pages. I have referred to another German patent, which included in its claims thousands of possible products. This latter patent holds the unique position in as far as it only exists in England.

I had quite recently some unpleasant experience with this identical patent, which shows the widespread mischief which is done by this kind of speculative patents. It is not many weeks ago that we applied to the German Patent Office for a patent for a new colouring matter. We got a

reply that our invention was not new, and were referred to the very patent in question, granted to the foreign company in this country, but nowhere else. We at last convinced the German Patent Office that our invention was not anticipated by the speculative patentee. Whether we would have been so successful in our own courts is another question, but certainly not without first spending a small fortune.

Many of you are no doubt aware that, thanks to the efforts of the Manchester Chamber of Commerce, supported by you, and to the first test petition which my company lodged with the Board of Trade, section 22, which deals with compulsory licenses, has been made much more effective.

Now, the adoption of my propositions ought to be a natural sequence. It will be otherwise most difficult to ascertain whether the patent is worked in this country or not.

A foreign patentee, for example, has taken a patent in this country, claiming a thousand and one articles. How will it be possible to find out whether he works his whole patent or not, and, if worked, what part of it? Further, it is illegal in this country to mark an article patented if it is not protected by a patent, but the difficulty often occurs to discover whether the article so marked is patented or not. It further happens that an article is a mixture containing only perhaps 10 per cent. of a patented article, and I hold it is a deception of the public to mark such an article as patented unless the whole mixture has been patented.

To sum up: the advantages which I believe will follow if my suggestions were approved and adopted, are:—

- (1) They would assist in the carrying out of section 22.
- (2) They would amend section 18.
- (3) Litigation and search would be simplified.
- (4) The security of an English patent would be substantially increased, as the taking out of bluff, block, and other fraudulent patents would be made much more difficult.
- (5) The public would readily know, which is often very difficult, what the patentee has patented and what not.

I cannot conceive that *bonâ fide* inventors could raise any objection to these propositions, whilst their adoption would be conducive to honest trading and of benefit to our industrial and commercial interests. A patent is a public document, and should not be surrounded by any secret; its widest circulation and publication is a boon to all concerned.

The amendment of our patent laws will be again discussed at the annual meeting of the Associated Chambers of Commerce of the United Kingdom, which meeting takes place in March next.

Some important resolutions will be submitted. I venture to appeal to the Council of our Society to reappoint a patent committee and to support the efforts of our chambers of commerce.

Manchester has always done so, but little support has, so far, been given by London.

DISCUSSION.

The CHAIRMAN said the subject was not only very interesting, but of great importance. As Mr. Levinstein had stated, there were many different interests—many clashing interests—connected with the patent law, and it was a highly controversial subject. It had been before them at the March meeting. They had discussed the importance of search, and had come to the almost unanimous agreement that an official search for novelty was desirable. The practical difficulties, however, which stood in the way were enormous. Germany, before 1871, consisted of a number of independent states, some of which had patent laws. After 1871 the states became amalgamated, and it became possible to have one patent law for the whole. In 1877 Germany started with a clean sheet, and started in the right way. If the alterations which were advocated with regard to official search were carried out, it would be appalling to think of the litigation to which they would lead during the next 15 years. The difficulties were



enormous in the way of alteration, but alteration was desirable.

Mr. J. H. BUTTERWORTH, barrister, said he was a lecturer on the subject of the patent laws. The law of the country could create a right. Taking the land laws as the basis for argument, why could they not, in the matter of patents, have a search back, say, for 50 years? Anything further back should be taken no notice of. The Government might undertake the 50 years' search, and give the inventor a guarantee. The law could give a valid title. As to amendments the clause was vague. They might go to the Patent Office for amendments, and the result has been an omnibus clause in its specifications. His suggestion was that they should only do what was done with regard to leasehold and freehold properties. Only such amendments should be allowed as clerical errors and errors of description.

Mr. HEYS read from a speech recently delivered by the President of the German Patent Office, in which he said that they hoped to grant more than 50 per cent. of the applications for patents in future. Many of the patents applied for were valueless. The limit of anticipation in Germany was 100 years. Anyone making and working a patent at the time a patent was applied for was entitled to continue working it.

Mr. E. HELM, Secretary of the Manchester Chamber of Commerce, said that if Mr. Abel's paper had been read before any statistical society in the country it would have received a severe and hostile handling. It was the commonest form of the misuse of statistics to take the figures of one year and use them as averages, and it showed the fallacy of Mr. Abel's paper in that respect. He had been disappointed with Mr. Abel's paper. In the course of his duties he had studied the question very closely. The difference between the patent laws of this country and Germany operated to the serious disadvantage of the British people. He did not think they could judge of the importance of the question unless they called to mind the principles which underlay it. Monopolies, *per se*, were an injustice and an abomination. They knew that James I. was made to abolish monopolies. Our forefathers retained, for the benefit of the whole community, a certain class of monopoly. This was retained for the benefit of the people, but primarily for the benefit of the inventor. One reason why they should be careful as to the protection they gave to an inventor was, that many of the greater inventions were evolved from men's intelligence, which could not be protected, and which had benefited the nation highly. The protection they gave should be on the ground that it should be for the benefit of the nation. A good patent affected the interests of the whole nation. When they saw patents given to men for things which had no novelty, and which prevented rather than encouraged further improvements, they had to go deep down to consider the basis of the whole system. He had paid many visits to the Board of Trade, and had seen its work, and he did not know how it was, but from some occult influence what ought to be an assistance to the trade of the country was in some respects a serious hindrance to it. Powers had been conferred on that Board which it would not exercise. He contended that the principle of granting monopolies, and the obstruction they had to meet with at the Board of Trade in one way or another, should make them feel that this was not a question to be played with, but one to be pursued with all the energy possible.

Mr. GRIMSHAW agreed with Mr. Helm that patents were supposed to be primarily for the benefit of the trade of the country, the next person to be benefited being the inventor and the tradesman who used it. The difficulty was that in this country patents seemed to exist in great part for the benefit of the lawyer, and a Government department did not like to be irritated. Time after time statements were made by responsible men and no notice was taken of them. Mr. Goschen once said in a budget speech that the income of the law was greater than that from the cotton, iron, and coal trades put together. He had since seen no allusion to it, but the statement was so astounding that he thought it could not be true. With regard to the 50 years' limit, did Mr. Butterworth mean that if somebody patented a thing

over 50 years ago, somebody could patent it over again? He considered the three points put by Mr. Levinstein as desirable. They would tend to prevent fraud, whether a patent was novel or not. It was a source of infinite harm for a patent to be refused in Germany and granted here. The result was that anybody in Germany could make it in Germany. It was constantly recurring that a German manufacturer, developing his industry, had a free market, whereas the English manufacturer had to buy from a protected market.

Mr. BUTTERWORTH said there ought to be a separate court presided over by a special judge dealing with compulsory licenses. In the commercial court the whole proceedings were simplified, and cases were expedited. That was what they wanted in reference to patent cases. The 50 years' limit would cause difficulty. The patent law was an industrial measure for the benefit of the trade of the country.

The CHAIRMAN said that whilst they had heard a great deal about the interests of the public, little had been said in favour of the inventor. A patent was certainly a monopoly, but, in order to obtain the monopoly, the inventor had to disclose his methods, and after a certain number of years anybody could use his invention. Besides this, during that period, the publication of his invention might often direct others into lines of thought which might lead to other inventions.

Mr. LEVINSTEIN said, in reply, that they were all practically agreed. There were many patentees who were not inventors. A patent was a monopoly, but the country had to get something in return for setting aside the ordinary principles of law to benefit the inventor. Under the statute of monopolies the patentee had to make the article, and a patent was refused if it was mischievous to the State. After commenting upon the threatened ruin of natural indigo, India's most important industry, for which, he said, the nation gave its destroyer a reward by the grant of a patent, Mr. Levinstein said that he was against fraudulent patentees who went in for blocking progress and blocking inventors. He desired to protect honest inventors.

New York Section.

Meeting held on Friday, November 23rd, 1900.

DR. V. COBLENTZ IN THE CHAIR.

THE ANALYSIS OF OILS CONTAINING CARVONE.

BY EDWARD KREMERS, PH.D.

ABOUT five years ago the writer was interested in the more detailed examination of the non-ketone constituents of the oils containing carvone. A. v. Baeyer had, during the several years preceding, made a special study of carvone and its isomers and their reduction products. Among other things, he had demonstrated the readiness with which some of the reduction products decomposed, especially when exposed to somewhat higher temperatures. Thus, *e.g.*, tetrahydrocarveol, the isomer of menthol, designated carvomenthol by v. Baeyer, readily splits up into a hydrocarbon and water. That a stereo-isomer of the common menthol also splits up readily in the same manner has been demonstrated more recently.

Those who have worked with oils containing carvone know that upon fractional distillation, which is very imperfect at its very best as a method of separating the individual constituents of a complex mixture, a resinous residue is apt to remain in the flask, thus indicating decomposition. A method, which has been employed to separate the carvone in a pure state from the oils that contain it, consists in converting this ketone into its crystalline hydrogen sulphide addition product from which, after recrystallisation, carvone can readily be regenerated in a fairly pure state. This method, however, is scarcely applicable as a means of obtaining the non-ketone constituents of oils containing carvone, as everyone knows who has prepared carvone hydrosulphide. Not only does



a part of this compound remain in solution, but some of the other constituents of the oil are apparently acted upon by the hydrogen sulphide. The product is what German chemists so characteristically designate a "Schmiere."

It occurred to the writer, therefore, to remove the carvone from the oils of caraway and spearmint by converting it into carvoxime. In this reaction hydroxylamine hydrochloride, sodium bicarbonate, alcohol, and the temperature of the water-bath are employed. The resulting product is distilled with water vapour. According to the age of the oil employed a relatively pure carvoxime remains behind and the distillate is an agreeable product in every way to work with. The principle non-ketone constituent of the oils of caraway and spearmint is limonene, the former oil containing the dextro-rotatory variety—corresponding to the dextro-rotatory carvone—the latter the lævo-rotatory variety—corresponding to the lævo-rotatory carvone which it contains. From the non-ketone fraction of spearmint oil an alcohol of the formula $C_{10}H_{17}OH$ was isolated by the calcium chloride method, first applied by Jacobsen to the study of the alcohols of geranium oil.

At this early point these investigations were interrupted. Dr. Chas. Rice, then and now the able Chairman of the U.S. Pharmacopœia Revision Committee, had requested the writer to give some of his time and attention to questions of more direct practical import, viz., to the analysis of volatile oils. The apparent quantitative character of the carvoxime reaction, mentioned above, suggested the possibility of its application to the carvone determination in these oils. The attempt was made, and seemed to prove an unqualified success, for in four determinations the following results were obtained, viz., 50.22 per cent., 50.83 per cent., 50.41 per cent., and 50.00 per cent.

For an analysis of a complex organic mixture these results were remarkable indeed. When the preliminary experiments were repeated in Leipsic, the results there obtained seemed to throw considerable doubt upon the value of the method, which otherwise seemed almost ideal as to its chemical simplicity. It, therefore, became necessary to go over the ground repeatedly, so that the following papers on this subject have been published during the past five years. As in all analytical methods, great care must be given to details. This paper is to be a kind of *résumé* of the work done, the results of which are scattered and, therefore, not in a convenient form for anyone who wants to apply the method in actual practice or who may want to test it still further.

The first paper was published in April 1896 and bears the title "The Quantitative Estimation of Carvone in Volatile Oils" (Pharm. Rev. 14, p. 76). The experimental work was done by Mr. O. Schreiner. The paper contains a brief review and criticism of the various methods previously suggested for the analysis of the oils of caraway and spearmint, viz., the following:—

1. By fractional distillation.
2. By means of the crystalline hydrogen sulphide addition product.
3. By Huebl's iodine adsorption method.
4. By means of the specific gravity.
5. By means of the rotatory power.

The paper further describes the method of purification of the carvone and limonene for an artificial mixture, the preliminary methods of determination as carvoxime and the application of one of the three modifications tried to commercial oils.

The second paper was published in November of the same year, and is entitled, "Application of the Carvoxime Method for the Quantitative Estimation of Carvone to Adulterated Spearmint Oil" (Pharm. Rev. 14, p. 244). The experimental work of this is also by Mr. Schreiner. The method was put to a severe test, oil of spearmint, scientifically adulterated in such a manner as to defy detection by physical tests or even a combination of physical tests being used. The carvoxime method gave satisfactory results, revealing the low carvone content of the adulterated oils.

The third paper (Pharm. Arch. 2, p. 81) was published in May 1899, the experimental work having been done by Mr. F. W. Alden and Mr. S. Nolte.

The fourth paper (Pharm. Arch. 3, p. 9) appeared in January of this year, and the experimental work was done by Mr. Alden and Mr. F. G. Ehlerl.

The third and fourth papers contain reports on details of the method of determination, such as uniformity of results; volatility of carvoxime; moisture in air-dried carvoxime; volatility of carvoxime with water vapour; effect of alcohol and water vapour upon carvoxime; solubility, real and apparent, of carvoxime in water; time of reaction; influence of solvent; influence of resinous matter; influence of amount of hydroxylamine, of sodium bicarbonate, &c.

For the purpose of testing the method in its simplest form, a mixture of equal parts of carvone, regenerated from its crystalline hydrogen sulphide addition product, and of limonene, purified by repeated fractional distillation under diminished pressure, was made. To a solution of 10 grms. of this 50 per cent. carvone mixture, dissolved in 25 c.c. of alcohol, 5 grms. of hydroxylamine hydrochloride and 6.5 grms. of sodium bicarbonate were added. This mixture was boiled upon a water-bath in a flask connected with a reflux condenser for half an hour, 25 c.c. of water were then added, and the alcohol, which carries over a large quantity of limonene, was distilled off from a water-bath. Steam was then passed through the liquid until traces of carvoxime came over. The last portions of the distillate were collected separately in test-tubes, and, when traces of crystals of carvoxime appeared on the surface, the operation was interrupted. The tube of the condenser was then washed with a little hot water, and this, as well as the last collected distillate containing some carvoxime, was returned to the flask. The contents of the flask were then allowed to cool, and, after the carvoxime had completely solidified, it was removed from the sides of the flask by means of a loop of stiff wire, thrown upon a force filter, washed and dried by suction. The air-dried carvoxime was then transferred to a tared glass dish and heated for one hour on the water-bath, and when cool, weighed. To the weight thus obtained 0.100 gm. was added, as this is about the quantity lost during heating. From the weight of the carvoxime that of the carvone may be readily calculated:—

$$\begin{array}{l} C_{10}H_{14}NOH \quad C_{10}H_{14}O \\ 164.67 \quad : \quad 149.66 = 1.09088, \end{array}$$

or the weight of carvoxime expressed in grammes, when multiplied by 0.9088, gives the weight of the equivalent amount of carvone.

The 50 per cent. carvone mixture * gave, by this method, the following figures:—

	Per Cent.
I. 5.525 grms, carvoxime	= 50.22 carvone.
II. 5.592 " "	= 50.83 " "
III. 5.579 " "	= 50.71 " "
IV. 5.503 " "	= 50.00 " "

From these figures it will be seen that the results obtained by this method come within 1 per cent. of the true carvone content.

Two slight modifications of this method had been previously tried. The one gave results several per cent. too low (maximum, 2.40 per cent.), the other results too high (maximum, 4.27 per cent.). It is not necessary here to go into details about these modifications. They will be found in the first paper referred to above.

Applied to commercial caraway and spearmint oils, the method gave satisfactory results. In one instance spearmint oil was adulterated by way of test in such a manner with 50 per cent. of a mixture of $66\frac{2}{3}$ per cent. of cedarwood oil, and $33\frac{1}{3}$ per cent. of gurjun balsam oil that specific gravity and angle of rotation corresponded closely with the corresponding factors of genuine oil. The method revealed the low carvone content very nicely.

The method was then tested by the chemists of Schimmel and Co., of Leipsic, who reported rather unfavourably on the results obtained by them (Bericht, Schimmel and Co., October, 1896, p. 49). A careful perusal of their report, however, will reveal the fact that they did not apply the precautions specified as to details. If the distillation, *e.g.*,

* When more carvone is present a larger quantity of hydroxylamine must be used.



of the carvoxime-oil-alcohol mixture, is not conducted with due regard to small fractions, it will be difficult to learn when to stop. Carvoxime may be lost in the distillate, or oil be retained in the carvoxime residue, thus causing very appreciable differences in the results. In order to put the method to severer and more careful tests, it was studied in almost all of its details. The first question to be answered was whether uniform results could be obtained by a person or persons who had but a moderate experience in analytical work. The question whether the results were either too low or too high did not enter into consideration in this particular series of experiments.

Uniformity of Results. As stated, the first question to be investigated was to ascertain whether uniform results could be obtained with the exercise of the necessary precaution.

The following table gives the results obtained by two operators, each making five determinations under apparently the same conditions:—

No.	Grammes of Oil used.	Carvoxime weighed.*	Carvone Equivalent.	Percentage of Carvone.
1	10.0325	4.8818	4.5275	45.13
2	10.0081	4.8846	4.5300	45.26
3	10.0074	4.8900	4.4804	44.77
4	10.0118	4.7418	4.4002	43.95
5	10.0018	4.8704	4.5171	45.16
6	10.308	4.873	4.519	43.84
7	10.118	4.387	4.078	40.32
8	9.657	4.713	4.374	45.29
9	10.216	4.898	4.542	44.46
10	10.997	5.387	4.937	45.35

* From several of the tabulated series of results obtained in testing other details, the same conclusion as to uniformity of results can be drawn. It need not be concealed that in certain instances widely deviating results were obtained. But in almost every such case the product weighed showed that something had gone wrong. Thus, e.g., an oily oxime was several times obtained.

With but one exception (No. 7) these results vary but slightly, the highest being 45.35 per cent., the lowest 43.84 per cent., a difference of only 1.51 per cent. for the two extremes. For the analysis of so complex a substance as caraway oil such a result leaves little to be desired. In each case the oxime was firm and well crystallised. In but one instance was there more than a trace of colour.

Influence of Solvent.—In the preparation of the pulegone oxime of Beckmann and Pleissner it has been noticed repeatedly that with the use of the alcohol-ether mixture as solvent, as directed by them, a crystalline oxime does not always result even upon standing for days and weeks. This difficulty was overcome by the mere substitution of petroleum ether for alcohol ether as solvent and medium for reaction. Inasmuch as occasionally difficulty was encountered in obtaining a good crystallisable carvoxime, a few experiments in the change of solvent were made. When petroleum ether was substituted, although freshly rectified spearmint oil was employed, not a trace of crystalline oxime resulted. In another instance, chloroform was tried, to which, after heating for ten minutes, alcohol was added and the heating continued for forty minutes. This also resulted in a failure as far as crystalline oxime was concerned. In a third experiment a mixture of 20 parts alcohol and five parts chloroform was tried. 47.44 per cent. of oxime resulted, or about 3 per cent. less than in any of the other assays of the same oil. Besides, the oxime was soft and sticky. Methyl alcohol has also been tried, and it proved a failure as far as quantitative work is concerned. In addition, it has been considered worth while to study the influence of the amount of alcohol used, which, so far, proved the best medium in which to carry on the reaction. The following table (II.) gives the results of a number of experiments in this direction, from which it becomes apparent that no conclusions can be drawn as to any special effect attributable to the amount of alcohol used as solvent:—

TABLE II.

No.	Oil taken.		Alcohol.	Weight of Oxime.	Carvone Equivalent.	Melting Point of Oxime.	Percentages.		
	Kind.	Quantity.					Calculated.	Found.	Loss.
			C.c.						
1	Carvone and limonene taken in approximately equal quantities.	11.0230	25	4.5542	4.1387	49—56	45.41	37.55	7.86
2		10.0264	25	4.6755	4.2400	2—57	49.95	42.38	7.57
3		10.0457	25	4.6000	4.1805	39—51	50.00	41.61	8.39
4		10.0069	50	4.6401	4.2170	52—59	50.00	42.17	7.83
5		10.0185	50	4.7322	4.3003	2—52	49.98	42.93	7.05
6		9.9964	50	4.6914	4.2636	53—60	49.92	42.65	7.27
7	Oil of spearmint	10.0076	25	5.1625	4.6919	38—48	..	46.88	..
8		10.0193	25	5.2909	4.8084	2—48	..	47.99	..
9		10.0165	50	5.3536	4.8472	34—48	..	48.59	..
10		10.0241	50	5.7578	5.2328	35—46	..	52.20	..

Influence of Amount of Hydroxylamine.—It has been shown by Wallach and Schrader (Ann. 279, p. 368) that when an excess of hydroxylamine is employed under certain conditions, a compound, $C_{10}H_{14}NOH$.

is formed, and not the simple carvoxime, $C_{10}H_{14}NOH$, is formed. In the method of analysis as previously outlined sufficient oxime is directed to be used to theoretically convert all of the oil into carvoxime should it

TABLE III.

No.	Kind of Oil used.	Reagents sufficient for	Weight of Oil taken.	Oxime obtained.	Carvone Equivalent.	Description of Oxime.	Melting Point.	Carvone found.
		Per Cent. Carvone.					° C.	Per Cent.
1	Spearmint freshly rectified.	50	10.0058	3.5514	3.2275	Good	47—57	32.26
2		50	10.0043	3.5188	3.1979		42—55	31.97
3		60	10.0171	4.8079	4.3694		50—58	43.62
4		60	10.0112	4.5463	4.1317		43—57	41.27
5		70	10.0152	4.6623	4.2371	Poor	2—52	42.31
6		70	10.0969	4.2452	3.8581		40—52	38.55
7		100	10.0064	4.9110	4.4631		30—44	44.60
8		100	10.0032	5.3098	4.8254		25—45	48.24
9	Carvone and limonene in equal quantities.	50	9.9974	4.4315	4.0274	Good	45—57	40.28
10		50	9.9934	4.2179	3.8533		59—65	38.36
11		60	10.0109	4.7457	4.3129		50—58	43.08



be carvone. It seemed desirable, therefore, to ascertain in how far an excess of hydroxylamine might prove advantageous or disadvantageous. The amount of sodium bicarbonate was varied accordingly, but so that the ratio remained the same. The results of a series of eleven experiments are given in Table III. That the theoretical amount of hydroxylamine is not sufficient becomes fully apparent from the results, but the variation in the results for like amounts of hydroxylamine is too great to allow of anything more than a rather general conclusion to be drawn. The melting point of the oxime, however, clearly shows that the larger excess of hydroxylamine does not combine with the carvoxime to form the compound, $C_{10}H_{15}NOH.NH_2OH$, of Wallach and Schrader, for the latter melts at $174^{\circ}-175^{\circ}$. The quality of the oxime nevertheless suffers from an excess of hydroxylamine in some way or another, as shown by the grades marked "good" and "poor."

Influence of Amount of Sodium Bicarbonate.—In order to set the hydroxylamine free from the hydrochloride, sodium bicarbonate is employed. For 5 grms. of hydroxylamine, 6.5 grms. of sodium bicarbonate are directed to be used, an excess of about 0.5 grms. This renders the aqueous solution resulting after the distillation with water vapour decidedly alkaline. The effect of neutralising this excess of sodium bicarbonate and of avoiding it was, therefore, tried.

In experiments 1 and 2 (Table IV.) a mixture of equal parts of carvone and limonene was used. Experiment 1 was left alkaline, experiment 2 was rendered slightly acid with dilute hydrochloric acid. In experiments 3, 4, and 5, spearmint oil was used. Although the quality of the oxime from the acid solution is better than that from the alkaline solution, yet the results from experiments 4 and 5 vary considerably. Inasmuch as the neutralisation of the sodium bicarbonate with alcoholic hydrochloric acid—for the neutralisation should be effected while the mixture of reaction is still alcoholic—is somewhat troublesome, and inasmuch as an excess of acid may prove harmful, it was thought desirable to avoid the excess of bicarbonate from the beginning. In experiments 6, 7, and 8 the exact amount of sodium bicarbonate calculated to be necessary to liberate the hydroxylamine was taken. Freshly rectified spearmint oil was employed. In experiments 9 to 13 inclusive an insufficient amount of bicarbonate, only 5.5 grms. to 5 grms. of hydroxylamine hydrochloride was used. These proportions seem to give the most all round satisfactory results yet obtained, although there is still a difference of 4.18 per cent. between the minimum and maximum percentage. Attention should be called to the fact that spearmint oil does not give as good results as does caraway oil. With these modifications it may be expected that caraway oil will yield results with but slight variations. Furthermore, the oxime in these experiments was much better than that obtained previously.

TABLE IV.

No.	Amount of Oil taken.	Weight of Oxime.	Carvone Equivalent.	Description of Oxime.	M. Pt.	Per cent. Carvone found.
1	9.9933	4.7071	4.2778	Poor	Degrees. 42-52	42.81
2	10.0059	4.9171	4.4687	Good	53-56	44.66
3	10.0184	5.0799	4.6166	Poor	53-60	46.08
4	9.9951	5.1026	4.6372	Fair	48-59	46.40
5	10.0046	5.6395	5.1252	Good	50-63	51.23
6	10.0087	5.8420	5.3093	"	41-58	53.06
7	9.9983	6.0694	5.5150	"	47-57	55.16
8	10.0028	5.9877	5.4410	"	45-59	54.40
9	10.0059	6.1346	5.5770	"	44-59	55.72
10	10.0006	5.9004	5.3623	"	49-61	53.62
11	10.0128	6.3289	5.7499	"	48-59	57.43
12	10.0100	6.3661	5.7856	"	43-57	57.80
13	10.0008	6.0383	5.4876	"	39-56	54.87

Time of Reaction.—The effect produced by changing the time during which the reaction between the oil (carvone) and the reagents was allowed to take place was studied in two series of experiments. The first series was conducted

with spearmint oil, the results being recorded in the following table:—

No.	Grm. Oil taken.	Carvoxime obtained.	Carvone Equivalent.	Per Cent.	Time.	Quality of the Oxime.
1	10.0073	5.9303	5.3895	53.86	Mins. 30	Good
2	10.0041	5.5388	5.0337	50.32	30	Fair
3	10.0002	5.7771	5.2502	52.50	30	"
4	10.0007	5.5600	5.0529	50.53	30	"
5	10.0302	6.2472	5.6775	56.69	30	"
6	10.0033	6.3480	5.7691	57.67	20	Very good
7	10.0050	5.9082	5.3694	53.67	20	Good
8	10.0027	6.3799	5.7981	57.96	15	Very good

The second series was made with fraction 228° to 228.5° of Schimmel and Co.'s "extra-starkes Kuemmelöl," which is supposed to be pure carvone. This was mixed with an equal part of fraction 175° to 176° of "carvone." The results are recorded in the following table:—

No.	Grm. taken.	Grm. Carvoxime.	Carvone Equivalent.	Per Cent.	Time.	Quality of Oxime.
1	10.0304	4.9782	4.5242	45.10	Mins. 30	Excellent
2	10.0068	5.0455	4.5863	45.83	30	"
3	10.0276	5.0602	4.5937	45.86	16	"
4	10.0227	5.0633	4.6061	45.96	16	"
5	10.0198	4.9373	4.4870	44.78	10	"
6	9.9978	4.9509	4.4994	45.00	10	"
7	10.0188	4.5577	4.1420	41.34	5	"
8	9.9952	4.6930	4.2650	42.67	5	"

Whereas in the first series two of the results in the 30 minutes group are rather low, nevertheless the general conclusion that 15 minutes is sufficient for heating the mixture evidently can be drawn from the somewhat irregular figures. In the second table, the results are much better, and they strongly support the conclusion. Even 10 minutes seem to be almost long enough, whereas five minutes indicate a decided drop in the percentage of oxime obtained.

Solubility, Real and Apparent, of Carvoxime in Water.—Attention has been called to the fact that it is difficult to know just when to stop the distillation with water vapour, that not only non-carvone oil passes over, but that carvoxime is also volatile with water vapour; and, moreover, that the carvoxime does not always crystallise readily, and cannot be readily distinguished from the oil proper. Another objection might have been added, viz., that the carvoxime collected in the test tubes does not always readily solidify completely, but that some at times remains oily and passes through the filter when the oxime is washed with water. A record, therefore, was made in one instance. After distillation with water vapour, the mixture in the flask and the distillate were allowed to stand for 24 hours before being filtered. The aqueous filtrate was then set aside, and from it small crystals of carvoxime separated. These were collected, and their weight found to be 0.0129 gm., or 0.23 per cent. of the carvoxime employed.

The filtrate from assays *d* and *e* (see below) was distilled fractionally. The first fractions were very turbid, but the last ones were perfectly clear. After standing for some time, the turbid fractions separated fine crystals, which, after being dried, were weighed. In assay *d*, 0.0209, and in assay *e*, 0.0132 gm. of oxime were separated, corresponding to 0.379 per cent. and 0.240 per cent. respectively of the oxime employed.

Effect of Alcohol and Water Vapour upon Carvoxime.—In order to get some idea of how the solvents employed and the limonene of the oil might affect the oxime under the ordinary conditions of the assay, the following experiments were made:—

Experiment 1.—To the carvoxime equivalent of approximately 5 grms. of carvone, about 5 grms. of limonene were added, then 25 c.c. each of alcohol and water. This mixture, approximating to that obtained as the product of



reaction of the hydroxylamine on the alcoholic solution of the oil, to which 25 c.c. of water had been added, was heated in a flask on a water-bath to drive off the alcohol. Then steam was passed through the mixture, and the distillate collected as usual in the corresponding step of the assay. When crystals of carvoxime began to come over, the distillation was stopped, all of the oxime collected as directed in the process of the assay, air-dried, and heated in a tared capsule on a water-bath. To the weight of the oxime thus obtained, 0.100 grm. was added. The following table shows the results obtained in three experiments:—

	Quantities taken.			Quantities regained.		Percentage of Carvone.		
	Carvoxime.	Carvone Equiv.	Limonene.	Carvoxime.	Carvone Equiv.	Calculated.	Found.	Difference.
a.	5.5000	4.9984	5.1500	5.3806	4.9808	49.25	49.09	0.16
b.	5.5096	5.0071	5.0736	5.4006	4.9989	49.67	49.59	0.08
c.	5.5034	5.0015	4.9962	5.3134	4.8288	50.03	48.30	1.73

The carvoxime was the purified oxime obtained from spearmint oil; the limonene was the "carvene" obtained from Fritzsche Bros. The recovered oxime was nearly white before being heated on the water-bath. After heating, it was hard and crystalline, but of a brownish colour. The loss of carvoxime is therefore but slight, and the oxime seems to have changed but very little in this operation.

Experiment 2.—The limonene, fraction 174.5° to 175.5°, freshly distilled from Fritzsche Bros. "Carvene," was not weighed accurately, about 5 grms. being taken. Instead of driving off the alcohol at once, as was done in the foregoing experiment, the mixture was heated for 15 minutes in a flask connected with the reflux condenser, as is done in the assay. The oxime used was caraway carvoxime. The results are recorded in the following table:—

d.	5.5090	5.0066	5.0	5.1574	4.6870	50.03	46.84	3.19
e.	5.5022	5.0004	5.0	5.1563	4.6860	50.00	46.86	3.14

Experiment 3.—In order to ascertain whether this difference in the loss (average loss in Experiment 1 = 0.66 per cent., in Experiment 2 = 3.16 per cent.) was due to the additional heating, the same limonene was used, but the mixture was not heated 15 minutes previous to distillation.

f.	5.5034	5.0015	5.0	5.0768	4.6138	50.01	46.13	3.88
g.	5.5032	5.0013	5.0	5.1270	4.6594	50.01	46.59	3.42
h.	5.5025	5.0007	5.0	5.1446	4.6754	50.00	46.75	3.25

The average loss in this case is 3.52 per cent. of carvone, thus showing that the loss in Experiment 2 is not attributable to the additional heating.

Volatility of Carvoxime with Water Vapour.—In order to ascertain the volatility of carvoxime with water vapour, quantities of the oxime usually resulting in the reaction were distilled with water vapour for fifteen, thirty, forty-five, and sixty minutes respectively. The remaining oxime was collected and dried as usual, and weighed. The difference in weight before and after distillation gave the result sought. This result was checked by collecting the oxime that had distilled over, drying and weighing this also.

No.	Weight of Oxime in Distilling Flask.		Oxime Removed by Distillation.	
	Before Dist.	After Dist.	Weight.	Percentage.
1	5.072	4.010	1.062	20.94
2	4.765	2.399	2.366	49.65
3	4.772	0.408	4.364	91.45
4	5.375	0.379	4.996	92.95

No.	Oxime Distilled over and Collected.		Experimental Error due to Solubility in Water and other Loss.	
	Weight.	Percentage.	Weight.	Percentage.
1	0.824	16.24	0.238	4.69
2	2.106	44.20	0.260	5.46
3	4.059	85.06	0.305	6.39
4	4.702	87.48	0.294	5.47

Volatility of Carvoxime.—Mr. Schreiner had carefully weighed somewhat over 5 grms. of carvoxime, an approximation of the quantity generally obtained in the assay, in a glass capsule; heated the capsule on a boiling water-bath for an hour at a time, the time that seemed necessary for drying the oxime; and weighed after each period of heating to note the loss of weight due to volatilisation. He found that the average came near 0.100. These experiments were repeated, with the following results:—

Experiment I.—3.8671 grms. of caraway carvoxime were heated in a glass capsule on a boiling water-bath for an hour at a time, weighed, when cooled, in a desiccator, and the following losses recorded. (1) 0.0634; (2) 0.0693; (3) 0.0958; (4) 0.0907; (5) 0.0760; (6) 0.0958.

Experiment II.—5.5002 grms. of spearmint carvoxime, when treated in like manner, gave the following results: (1) 0.1127; (2) 0.1019; (3) 0.0582; (4) 0.1117; (5) 0.1067; (6) 0.583.

Experiment III.—4.470 grms. of spearmint carvoxime in a control experiment yielded the following data: (1) 0.103; (2) 0.180; (3) 0.160; (4) 0.156; (5) 0.145; (6) 0.141.

Experiment IV.—4.414 grms. of caraway carvoxime in a control experiment yielded the following data: (1) 0.109; (2) 0.177; (3) 0.162; (4) 0.161; (5) 0.152; (6) 0.165.

When compared, these results show rather surprising differences. These differences, however, are readily accounted for if the diameter of the opening of the water-bath is taken into consideration, as shown by the following tabular arrangement:—

Time.	Loss of Caraway Carvoxime.			Loss of Spearmint Carvoxime.		
	35 mm.	43 mm.	65 mm.	35 mm.	43 mm.	65 mm.
Hours.						
1	0.0634	..	0.109	..	0.1127	0.103
2	0.0693	..	0.177	..	0.1019	0.180
3	..	0.0958	0.162	0.0582	..	0.160
4	..	0.0907	0.161	..	0.1117	0.153
5	0.0760	..	0.152	..	0.1067	0.145
6	..	0.0958	0.165	0.0583	..	0.141

Moisture in Air-dried Carvoxime.—From the foregoing it becomes apparent that the loss of carvoxime due to volatility of the oxime itself is a fairly constant quantity for the same time and surface of exposure to heat. That this heating on the water-bath is a necessity is brought out by a series of experiments in which the oxime was weighed when air-dried and after drying on the water-bath for an hour. The results are recorded in the following table, which shows that the air-dried carvoxime evidently

No.	Weight of Air-dried Carvoxime.	After Drying on a Water-bath.	Total Loss.	Loss attributable to Moisture.
1	5.1807	4.9768	0.2039	0.1039
2	5.1912	5.0269	0.1643	0.0643
3	5.1825	5.0446	0.1379	0.0379
4	5.2103	4.9233	0.2870	0.1870
5	5.2925	5.1193	0.1732	0.0732
6	6.0294	5.7674	0.2620	0.1620
7	6.1717	5.7889	0.3828	0.2848
8	6.2256	5.7707	0.4549	0.3543



contains variable quantities of water, and that it would not do to weigh the air-dried oxime for purposes of assay.

Influence of Resinous Matter.—Attention has several times been called to the various ways in which non-volatile resinified matter in the oil may affect the reaction. If the oil has been badly "resinified" by continuous exposure to air and sunlight, the carvoxime resulting in the reaction may be so impure as to prevent its crystallisation. Such a result is not to be deplored, for it shows up at once the impurity of the oil and the necessity of its rectification

before it is put to use. In order to ascertain the percentage of carvone in such a resinified oil, it is but necessary to distil it with water vapour and to analyse the rectified oil according to the usual process.

As long as the amount of resin is not sufficient to prevent the oxime from crystallising, it is apparent that its presence in the carvoxime will add to the weight of the latter, and thus make the oil show up more favourably than it ought to. This was demonstrated experimentally by a series of three experiments each with pure carvoxime on the one hand and colourless "carvone" and "resinified

No.	Rosin in Limonene.	Quantities taken.			Quantities regained.		Percentage.		Melting Point of Oxime.
		Oxime.	Carvone Equivalent.	Limonene Containing Resin.	Oxime as Weighed (+ Resin).	Carvone Equivalent. ‡	Calculated.	Found.	
1	Per Cent. 0	5.5057	5.0036	5.0096	5.2346	4.8026	49.97	47.96	Degrees. 67-70
2	0	5.5014	4.9997	5.0000	5.2671	4.7867	50.00	47.87	69-69.5
3	1	5.5042	5.0022	5.0113	5.3032	4.8195	49.95	43.13	63-66
4	1	5.5000	4.9984	5.0069	5.3153	4.8305	49.96	43.23	64.5-68
5	1	5.5065	5.0043	5.0114	5.2786	4.7972	49.96	47.90	64.5-68
6	2	5.5065	5.0043	5.0090	5.3751	4.8849	49.93	48.78	..-67
7	2	5.5027	5.0009	5.0072	5.3899	4.8983	49.97	48.94	..-66
8	2	5.4991	4.9976	5.0034	5.4026	4.9099	49.97	49.09	63-68
9	2	5.5039	5.0019	5.0093	5.4088	4.9155	49.96	49.10	63-68
10	3	5.5024	5.0006	5.0083	5.2724	4.7916	49.96	47.87	62-67
11	3	5.5019	5.0001	5.0089	5.4235	4.9289	49.96	49.24	62-66.5
12	3	5.5032	5.0013	5.0092	5.3939	4.9020	49.96	48.97	62-67
13	3	5.5024	5.0006	5.0023	5.4075	4.9143	49.99	49.13	61-66
14	3	5.5025	5.0007	4.9964	5.4683	4.9696	50.02	49.71	61-67.5
15	4	5.5029	5.0010	5.0010	5.4524	4.9551	50.00	49.54	61-66.5
16	4	5.5054	5.0033	5.0015	5.5159	5.0128	50.01	50.10	61-67
17	4	5.5096	5.0071	5.0001	5.4417	4.9454	50.04	49.42	60-66.5
18	5	5.4999	4.9983	5.0006	5.5097	5.0072	49.99	50.03	62-68.5
19	5	5.5045	5.0025	4.9949	5.4983	4.9969	50.04	49.98	63-67
20	5	5.5044	5.0024	4.9989	5.5491	5.0430	50.02	50.42	62-67
21	1	5.500	4.9984	5.000	5.3010	4.81755	49.99	48.18	..
22	1	5.500	4.9984	5.000	5.2995	4.81619	49.99	48.16	..
23	2	5.500	4.9984	5.000	5.3215	4.8360	49.99	48.36	..
24	2	5.500	4.9984	5.000	5.2830	4.8011	49.99	48.00	..
25	3	5.500	4.9984	5.000	5.3550	4.8666	49.99	48.67	..
26	3	5.500	4.9984	5.000	5.3105	4.8261	49.99	48.25	..
27	4	5.500	4.9984	5.000	5.3640	4.8750	49.99	48.75	..
28	4	5.500	4.9984	5.000	5.3255	4.8398	49.99	48.40	..
29	5	5.500	4.9984	5.000	5.3100	4.8257	49.99	48.25	..
30	5	5.500	4.9984	5.000	5.3005	4.8170	49.99	48.17	..

† Corrected by adding 0.10.

‡ Including the resin.

TABLE XII.

No.	Weight of Resin present.	Weight of Oxime* (- Resin).	Carvone equivalent.	True Percentage of Carvone found.	Loss.
1	0.0000	5.2846	4.8026	47.96	2.01
2	0.0000	5.2671	4.7867	47.87	2.13
3	0.0501	5.2531	4.7740	47.68	2.27
4	0.0501	5.2652	4.7850	47.81	2.15
5	0.0501	5.2285	4.7517	47.44	2.52
6	0.1002	5.2749	4.7938	47.86	2.12
7	0.1001	5.2898	4.8074	48.04	1.93
8	0.1001	5.3025	4.8189	48.18	1.79
9	0.1002	5.3086	4.8245	48.19	1.77
10	0.1502	5.1222	4.6551	46.51	3.45
11	0.1503	5.2732	4.7923	47.87	2.09
12	0.1503	5.2436	4.7653	47.60	2.36
13	0.1501	5.2374	4.7779	47.77	2.22
14	0.1499	5.3184	4.8334	48.45	1.57
15	0.2000	5.2524	4.7734	47.72	2.28
16	0.2001	5.3158	4.8310	48.29	1.72
17	0.2009	5.2417	4.7636	47.60	2.44
18	0.2500	5.2597	4.7800	47.81	2.18
19	0.2497	5.2486	4.7699	47.70	2.34
20	0.2499	5.2992	4.8160	48.16	1.86
21	0.05	5.2510	4.7721	47.73	2.26
22	0.05	5.2405	4.7707	47.71	2.28
23	0.10	5.2215	4.7452	47.46	2.53
24	0.10	5.1830	4.7103	47.11	2.98
25	0.15	5.2050	4.7303	47.31	2.68
26	0.15	5.1605	4.6893	46.94	3.08
27	0.20	5.1640	4.6930	46.91	3.09
28	0.20	5.1255	4.6581	46.59	3.40
29	0.25	5.0900	4.5985	45.99	4.00
30	0.25	5.0505	4.5599	45.90	4.09

* Corrected by adding 0.10.

carvone" respectively on the other. The experiment with the colourless carvone yielded 49.09, 49.59, and 48.30 per cent. of carvone respectively, in place of 50 per cent. as calculated. The resinified carvone yielded 53.32, 53.47, and 53.34 per cent. respectively, in place of 50 per cent. as calculated. Thus the resin in the oil made it appear about 3 per cent. richer in carvone than it was in reality.

It also became necessary to pay more attention to the melting point of the carvoxime, and to learn how it would be influenced by the presence of this "resin." Two series of experiments were therefore made, the one with colophony or rosin, the other with so-called resin from resinified caraway oil.

I.—In the first series of experiments carvoxime was mixed with limonene to which a known quantity of rosin had been added, and the qualitative and quantitative effect of the rosin on the oxime, recovered according to the directions of the process of analysis, studied. The qualitative effect was judged by the change in melting point. The melting point of the pure recrystallised oxime is given as 71° by Goldschmidt and Zürrer (Ber. 18, p. 1730). The melting point of the oxime used in these experiments was determined, and found to be 70.5°-72°; 71°-72°; 71.5°-73°; 72°-73° in four different determinations. From the table given above it will be seen that the melting point of the oxime, after having been mixed with pure limonene, subjected to steam distillation, and to the heat of a water-bath for an hour, is lowered several degrees, even if no rosin is present. Whereas in a general way it may be stated that the melting point is lowered by the presence of rosin, and that the lowering is dependent on the amount of rosin present, yet the practical utility of this observation is impaired by two facts. First, it is



difficult to state where the impure oxime begins to melt. Different observers may well be of different opinion. Secondly, the point at which the mixture is completely liquid is sharper, but the difference here for different percentages of rosin present is but slight.

With regard to the increase in weight of the oxime produced by the presence of the resin, it will be seen that with the increase in the percentage of resin, the percentage of oxime found gradually increases to about 50 per cent., but in no case goes materially above the theoretical amount, even when 5 per cent. of resin are present.

The influence of the presence of the resin on the weight of the oxime is better demonstrated by the figures in Table XII. With but one exception, *viz.*, experiment 10, it will be seen that the actual loss of oxime in the series of experiments by Mr. Alden (1—20) is quite uniform, varying from 1.57 per cent. as minimum to

2.52 per cent. as maximum. The loss in the series by Mr. Ehlerl (21—30) who had no previous experience with this method was greater, the greatest loss being 4.09 per cent.

II.—The above experiments were supplemented by taking the so-called resin from resinified caraway oil. A badly resinified oil of caraway was distilled with water vapour and the residue heated on a water bath until it no longer lost weight. The non-volatile resin was dissolved in limonene, a 4.65 per cent. saturated solution resulting. Even upon the application of heat a stronger solution could not be obtained. From this concentrated solution the more dilute solutions were prepared. The results obtained in a series of 10 experiments are recorded in Table XIII. As will be seen upon comparison, much the same results were obtained as in the experiments with the colophony.

TABLE XIII.

No.	Per Cent. Resin in Limonene.	Quantities taken.			Quantities regained.		Percentages.		Melting Point of Oxime.
		Oxime.	Carvone equivalent.	Limonene containing Resin.	Oxime weighed* (+ Resin).	Carvone equivalent.	Calculated.	Found.	
1	1	5.5031	5.0012	4.9986	5.3235	4.8380	50.01	48.38	Degrees. 64—67.5
2	1	5.5040	5.0020	5.0004	5.2983	4.8151	50.01	48.14	66—69
3	2	5.5035	5.0116	4.9966	5.3233	4.8378	50.02	48.39	?—68
4	2	5.5039	5.0019	4.9946	5.2839	4.8020	50.04	48.04	65—67.5
5	3	5.5063	5.0041	5.0414	5.3236	4.8381	49.82	48.16	64—67
6	3	5.5041	5.0021	5.0405	5.3515	4.8634	49.81	48.42	61—66
7	4	5.5056	5.0035	5.0422	5.3729	4.8829	49.81	48.61	58—65
8	4	5.5051	5.0030	5.0376	5.4468	4.9500	49.83	49.30	?—66
9	4.65	5.5053	5.0032	5.0290	5.4985	4.9407	49.87	49.25	64—67.5
10	4.65	5.5057	5.0036	5.0376	5.4504	4.9533	49.83	49.33	64—66.5

* Corrected by adding 0.10.

Table XIV., like Table XII, shows the actual loss of oxime. Inasmuch as this method of analysis is still in the experimental stage, these figures should be worth recording.

III.—In the series of experiments reported under I. and II. the conditions were chosen as simple as possible by using carvoxime already formed, mixing it with limonene to which rosin or resin had been added, and recovering the contaminated carvoxime by steam distillation in the usual manner. A third series of experiments was undertaken in which the effect of the resin from caraway oil on the reaction between the carvone and hydroxylamine, as well as on the ultimate carvoxime was studied. The carvone employed was a fraction 228—229 of Schimmel and Co.'s "Carvol." The limonene used was a fraction 175° of "Carvene" from the same firm. The oxime of the eleven experiments recorded in Table XV. was soft and somewhat sticky, but could be manipulated without difficulty. It will be seen from this table that the melting point

is lower than in the previous experiments. Table XVI. also shows that the loss is much greater.

TABLE XIV.

No.	Weight of Resin present.	Weight of Carvoxime* (- Resin).	Carvone equivalent.	True Percentage of Carvone found.	Loss Per Cent.
1	0.0500	5.2735	4.7925	47.93	2.08
2	0.0500	5.2483	4.7697	47.69	2.32
3	0.0999	5.2334	4.7470	47.48	2.54
4	0.0999	5.1840	4.7112	47.13	2.91
5	0.1512	5.1724	4.7007	46.79	3.03
6	0.1512	5.2003	4.7260	47.06	2.75
7	0.2017	5.1712	4.6996	46.78	3.03
8	0.2015	5.2453	4.7669	47.48	2.35
9	0.2388	5.1977	4.7237	47.08	2.79
10	0.2342	5.2162	4.7405	47.20	2.63

* Corrected by adding 0.10.

TABLE XV.

No.	Percentage of Resin in Limonene.	Quantities taken.		Quantities regained.		Percentages.		Melting Point of Oxime.
		Carvone.	Limonene containing Resin.	Oxime.	Carvone equivalent.	Calculated.	Found.	
1	0	5.0058	6.0172	6.5542	4.1389	45.40	37.54	Degrees. 49—56
2	0	5.0078	5.0186	4.6755	4.2491	49.95	42.38	?—57
3	1	5.0090	5.0304	4.5997	4.1802	49.79	41.64	?—56
4	1	5.0276	5.0234	4.6134	4.1927	50.03	41.72	47—55
5	2	5.0180	5.0190	4.6751	4.2487	50.00	42.33	50—57
6	2	5.0037	5.0107	4.6696	4.3437	49.97	42.38	?—54
7	3	5.0193	4.9921	4.6570	4.2323	50.14	42.27	?—53
8	3	5.0715	4.9785	4.8794	4.4344	50.46	44.12	52—50
9	4	4.9920	5.0195	4.7744	4.3390	49.86	43.34	47—55
10	4	4.9894	4.9991	4.7003	4.2716	49.95	42.87	48—59
11	4	5.0192	4.9956	4.8710	4.4268	50.19	44.20	37—48



TABLE XVI.

No.	Weight of Resin present.	Weight of Carvoxime.	Carvone equivalent.	True Percentage of Carvone found.	Loss Per Cent.
1	0·0000	4·5542	4·1389	37·54	7·86
2	0·0000	4·6755	4·2461	42·38	7·57
3	0·0503	4·5494	4·1345	41·18	8·61
4	0·0502	4·5632	4·1470	41·26	8·77
5	0·1004	4·5747	4·1575	41·42	8·58
6	0·1002	4·5694	4·1527	41·47	8·50
7	0·1498	4·5072	4·0961	40·90	9·24
8	0·1494	4·7300	4·2986	42·77	7·69
9	0·2003	4·5736	4·1565	41·52	8·34
10	0·2000	4·5003	4·0899	40·94	9·01
11	0·1998	4·6712	4·2652	42·59	7·60

To conclude that these low results are due solely to the influence of the resin on the carvoxime while being formed, would not be correct, for other experiments have shown that the alkalinity of the reaction mixture during the steam distillation has much to do both with the yield and the quality of the carvoxime formed.

IV.—The highest percentage of resin in the experiments recorded under I., II., and III., is 2·5 per cent. (colophony) and 2·3 per cent. (resin from caraway oil) respectively. It requires but little experience with volatile oils, however, to know that resinification of oils may proceed much farther. Thus a commercial sample of caraway oil was found to contain as much as 11 per cent. of resin when rectified by steam distillation. The specific gravity of the oil before distillation was 0·957, after distillation 0·910. Before rectification it assayed 40·96 per cent. carvone (melting point of oxime 49°), after rectification 43·54 per cent. (melting point of oxime 55°). A sample of spearmint oil was found to contain 8·8 per cent. of resin when rectified in like manner. The specific gravity of the resinified oil was 0·9015, of the rectified oil 0·8953. Before rectification it assayed 46·88 per cent. (melting point of oxime 38°—48°) and 47·99 per cent. (melting point of oxime 2°—49°) respectively. After rectification the oil assayed 44·60 per cent. (melting point of oxime 30°—44°) and 48·33 per cent. (melting point of oxime 25°—45°) respectively. These data are not sufficiently accurate to admit of drawing any very definite conclusions.

Conclusion.—Although the method of determining the carvone content of volatile oils, containing this ketone, as carvoxime is by no means perfect, this method is unquestionably a step in the right direction. The more recent method of shaking out the carvone is subject to the same criticism which is applicable to the shaking out of phenols by alkali solutions. The one great advantage in the method proposed is that the analyst weighs a definite crystalline compound.

Meeting held on Friday, December 21st, 1900.

MR. CLIFFORD RICHARDSON IN THE CHAIR.

COLORIMETRIC DETERMINATION OF TITANIC ACID.

BY JAMES BRAKES.

IN the estimation of TiO_2 by the colour method, I have modified the method as used by Dr. Charles Baskerville (this Journal, 1900, 419) as follows:—

Fusing the residue left from the first filtrate with the mixed carbonates. Fusing the chemically pure TiO_2 with the above carbonates instead of $KHSO_4$ in preparing the standard solution. Also in standardising of the same.

The method is as follows:—

Fuse 5 grms of ore with an equal amount of NaF and ten times the weight of the ore of $KHSO_4$ in a platinum crucible at a low heat until the fusion is quiet, and finally heat 15 or 20 minutes at a low red heat to expel the last traces of fluorine. Cool crucible and lid, place in small beaker, and cover with 50 c.c. of 10 per cent. solution of

H_2SO_4 , and heat until dissolved. Filter into 500-c.c. flask, washing the filter and residue thoroughly with hot water, and fuse (if necessary) with a small quantity of the mixed carbonates. Cool and dissolve the mass in the crucible with strong H_2SO_4 . Heat carefully until the ore is decomposed, cool, place in beaker, cover with water, and heat until dissolved. Filter, allow the filtrate to run into the 500-c.c. flask, cool, dilute to 500-c.c. mark with water, and mix thoroughly.

Take 100 c.c. of the solution with pipette, place in 100-c.c. Nessler tube, add 5 c.c. of hydrogen peroxide, and mix thoroughly with mixing rod.

To a second Nessler tube add 100 c.c. of 10 per cent. solution of H_2SO_4 ; add the number of c.c. of $FeSO_4$ solution equivalent to the amount of iron present in 0·1 gm. of the ore; add now 5 c.c. of hydrogen peroxide, mix thoroughly, and add standard TiO_2 solution until the desired tint is obtained, comparing the colours by reflected light.

Standard TiO_2 Solution.

Fuse 1 gm. of chemically pure TiO_2 in platinum crucible with 8 grms. of the mixed carbonates ($Na_2CO_3 + K_2CO_3$), cool, place in beaker, add 100 c.c. of water, and add slowly 30 c.c. of concentrated H_2SO_4 , and heat until dissolved. Filter, and should the filtrate be turbid, refilter through the same filter until the filtrate is perfectly clear. Ignite the filter and contents, and fuse with 2 grms. of the above carbonates. Place in beaker as before, and add 100 c.c. of water and 20 c.c. of strong H_2SO_4 , and heat until dissolved. Filter, allowing the filtrate, if clear, to run into first filtrate, and, after the solution has become cold, dilute to 500 c.c. and mix.

To standardise the solution take 10 c.c. of the solution with pipette, place in 150-c.c. beaker, add 25 c.c. of water, add an excess of NH_4OH , filter, and wash thoroughly with hot water until free from sodium and potassium salts. Ignite, cool, and weigh.

To the crucible add one or two drops of water and the same amount of strong H_2SO_4 and a few c.c. of HF, and evaporate to dryness. Ignite and weigh, and calculate the TiO_2 contained in 1 c.c. of the solution.

$FeSO_4$ Solution.

Dissolve 50 grms. of $FeSO_4 \cdot 7H_2O$ in 500 c.c. of water, and add 100 c.c. of H_2SO_4 , and dilute to 1 litre, and standardise with $K_2Cr_2O_7$ solution.

The results obtained from a sample of iron ore by the above method were 0·738 per cent. TiO_2 and from the same sample Dr. Charles Baskerville's results were 0·740 per cent. TiO_2 (gravimetric).

Nottingham Section.

Meeting held at the Municipal Technical College, Derby, on Tuesday, November 20th, 1900.

PROF. STANLEY F. KIPPING, F.R.S., IN THE CHAIR.

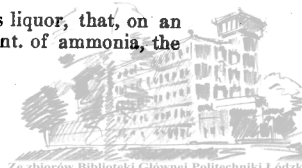
THE VALUATION OF GAS LIQUOR.

BY F. J. R. CARULLA.

ALTHOUGH ammoniacal liquors are being obtained in increasing quantities from the operations connected with coke ovens and blast furnaces, the large bulk of the make is still produced at the gas works. At one time it used to be worked up almost exclusively by chemical manufacturers, but gradually this process has become part of the gas manager's business.

The reasons for this change, and for the apparent encroachment, must interest this Society, representing, as it does, chemical manufacturers as distinguished from the gas industry.

Clearly, a raw material such as gas liquor, that, on an average, contains no more than 2 per cent. of ammonia, the



remaining 98 per cent. being practically waste, is not an article that can be dispatched to long distances. It will not stand heavy carriage charges, and, consequently, large gas works not conveniently situated in regard to chemical works are compelled to work the liquor up themselves. Occasionally, however, a chemical works close to a gas works is suddenly deprived of a commodity that is perhaps necessary to its very existence. Such a state of things can only be due to some serious misunderstanding, and the question is, How can it have occurred?

The chief cause of dissatisfaction is the system of sale and purchase that is generally adopted. The chemical manufacturer generally buys the liquor at a fixed price, but cannot sell his make of sulphate of ammonia ahead in the same way. As the price of sulphate varies enormously, without the manufacturer being able to influence it, the time is sure to come when he is selling at a loss. The gas company then has no cause to complain. On the other hand, sulphate prices may rise when the chemical manufacturer has a low-priced contract for gas liquor. The gas company—not unnaturally—regrets the loss of the considerable profits that it might be making, regardless, however, of the periods of low prices—sure to recur—when the chemical manufacturer has been losing money.

It is surprising that no great effort has ever been made by those manufacturers interested in this industry to bring about a change, making affairs more satisfactory to all concerned. It must be evident that a sliding scale instead of a fixed price would get over the difficulty.

The first consideration that arises, whatever the method of sale may be, is how the strength of the liquor is to be ascertained. The most usual method is to take the specific gravity by means of Twaddell's hydrometer.

Strange as it may appear, this is in many cases, especially with the low strengths, a perfectly fair estimate of the contents of ammonia in the liquor. It is not always so, but with the coals used in this district, and the strengths usually produced, the cases in which the indication is not a fairly true one are very rare indeed.

The Burton Gas Works, for instance, producing a liquor that seldom exceeded 4° Tw., yielded results accurate absolutely to the first decimal point.

The following are some tests made to check a certain lot of liquor:—

Tw. Degrees at 60° F. Actual.	Ounce Strength by Distillation.	Equivalent Tw.
3·3	6·73	3·36
3·9	7·93	3·96
3·9	7·83	3·91

Mr. F. L. Ramsden, the engineer and manager of the Burton Gas Works, informs the author that nearly all the coal and canal from which this liquor was obtained was from the North Derbyshire district.

These and other analyses referred to in this paper were made by Mr. E. M. Glover, who has had a very long experience in this particular test.

Considering that free ammonia lowers the specific gravity, it is a remarkable fact that as the density of gas liquor rises, the contents of ammonia also increase. The rate of increase is, however, not always even, and there is no doubt that, with strengths of 7° and 8° Tw., the hydrometer test is only an approximation, but as there is usually an increase of real strength over that indicated, it is a matter easy of adjustment when fixing the price, and does not prevent the use of the hydrometer, which is an immense convenience wherever this instrument can be employed. In some cases where the hydrometer is inapplicable or objected to, and where yet expedition has been desired, a method known as the "saturation test" has been applied. This test is only of interest as having given origin to the expression "ounce strength," for in reality it does not always yield reliable results. The test, conducted as it is by the direct saturation of 1 gallon of the gas liquor with sulphuric acid, the number of ounces used being noted, will fail to give the ammonia combined with strong acids.

An actual analysis becomes, therefore, the only alternative where the hydrometer is inapplicable, as, for instance, in liquor containing free ammonia, or in those from tarstills, &c., or where the liquor supplied is very variable. Such an analysis is always carried out by the well-known method of distillation.

By the kindness of Mr. John Phillips, secretary of the Bristol Gas Co., the author is able to give particulars of the modification they adopt. The description is of special interest, as it is issued to would-be contractors for the purchase of their gas liquor, with the forms of tender to be filled in with prices on a sliding scale based on the market value of sulphate of ammonia.

(The full description, with illustration of the apparatus, has been published in the Journal of Gas Lighting, of Dec. 4 and 11, 1900, pp. 1397 and 1462.)

Having fixed on the method for ascertaining the strength of the liquor, the next point is, what basis should be taken for the price of sulphate of ammonia. As this price is published weekly in the Chemical Trade Journal, the Journal of Gas Lighting, and a number of others, it is easy to agree upon some publication from which to take it. Then comes the question, What proportion of the current value of sulphate of ammonia shall be allocated to the chemical manufacturer, and what to the gas company? Whatever the price of sulphate may be, the cost of its manufacture from any particular strength of liquor, apart from the cost of the liquor itself, varies very little. Of course, it varies considerably when coal doubles in price, as has recently occurred, but one is speaking of normal times, disregarding accidents and abnormal occurrences, for which, nevertheless, some provision in the nature of insurance should be made.

It is unnecessary here to enter into the details that go to make up the cost. A fair sum where the gas liquor is close to the chemical manufacturer's works, or where it is delivered free, might be 5*l.* 5*s.* per ton of sulphate, and if this sum is deducted from the current price of sulphate, the remainder would fairly represent what the gas company should receive for the ammoniacal liquor used in the manufacture.

Having reached this agreement, it is easy to fix the price per ton for the various strengths of gas liquor that may be supplied.

The Twaddell scale is convenient, in that the number 60 divided by the strength in degrees Tw. gives the number of tons of liquor required to make 1 ton of sulphate of ammonia. Thus, of 6° liquor, 10 tons are required; of 5° liquor, 12 tons are required; of 4° liquor, 15 tons are required; of 3° liquor, 20 tons are required. The strength in Tw. degrees multiplied by the tons required always being 60.

Suppose that sulphate is at 11*l.* per ton. From these data it might appear that the price that the manufacturer should be able to pay for liquor delivered to his works would be—

$$\text{For } 6^\circ \frac{11\text{l.} - 5\text{l. } 5\text{s.}}{10} = 1\text{ } 1\text{s. } 6\text{d. per ton.}$$

$$\text{For } 5^\circ \frac{11\text{l.} - 5\text{l. } 5\text{s.}}{12} = 9\text{s. } 7\text{d. per ton.}$$

$$\text{For } 4^\circ \frac{11\text{l.} - 5\text{l. } 5\text{s.}}{15} = 7\text{s. } 8\text{d. per ton.}$$

$$\text{For } 3^\circ \frac{11\text{l.} - 5\text{l. } 5\text{s.}}{20} = 5\text{s. } 9\text{d. per ton.}$$

But it would really not be so, as, e.g., the cost of manufacture from 3° liquor is much greater than from 6°, in consequence of the much larger quantity that has to be dealt with—viz., double—to produce the 1 ton of sulphate. Obviously it cannot fairly be asked of him to pay one-half the price of 6° for 3°, although the latter yields one-half the quantity of sulphate.

The manufacturer can protect himself by making it a condition that no liquor shall be less than 4° Tw., or, what might be more convenient to both buyer and seller, to adjust the cost of manufacture to the varying strengths.

This may be done in the following manner:—

Let *a* = price of sulphate of ammonia.

Let *b* = cost of carriage of gas liquor per ton.



Let c = constant manufacturing charges, including acid, bags, carriage to port of shipment, &c., per ton of sulphate made.

Let d = variable manufacturing charges, including fuel, lime, wages, repairs, &c., also per ton of sulphate made, but their amount depending on the strength of the liquor. We will suppose that d = this value for 5° Tw.

Let T = strength of gas liquor in degrees Tw.

Let x = value per ton of gas liquor of any strength at the gas works.

A fair manufacturing profit should evidently be included in the value d , not in the value c , as otherwise the sulphate maker is not sufficiently protected in the event of deliveries of weak gas liquor, and, on the other hand, the gas company would not derive sufficient benefit when delivering strong liquor.

Remembering that 60 divided by the Twaddell strength of any liquor is equal to the number of tons of that liquor required for 1 ton of sulphate of ammonia, it will be evident that

$$x = \left\{ a - \left(\frac{60b}{T} + c + d \right) \right\} \times \frac{T}{60} \dots\dots\dots(1).$$

But we are supposing that the value d is for liquor of 5° Tw.; hence, as the equation stands, it would only be true for liquor of this strength. To make it applicable to liquor of any strength, it is necessary to consider that it will take just as long for, say, 100 tons of liquor to pass through the ammonia still if the strength is 4° Tw. as when it is 5°. The process can certainly be hastened or delayed in a certain measure, but this is not of sufficient importance to be taken into account in this calculation. We may therefore safely say that

$$\frac{5d}{T}$$

will represent the variable manufacturing charges per ton of sulphate made from liquor of any given strength.

Substituting this value for d , in equation (1), we get

$$x = \left\{ a - \left(\frac{60b}{T} + c + \frac{5d}{T} \right) \right\} \times \frac{T}{60} \dots\dots\dots(2),$$

and, simplifying, we obtain

$$x = \frac{T(a-c) - (60b + 5d)}{60} \dots\dots\dots(3).$$

Of course, there will be no two manufacturers who could give the same values to b , c , and d . Nevertheless, we may, for purposes of illustration, assign values to these factors, and easily construct a table to make the matter more clear.

Suppose b , the carriage per ton of liquor from the gas works, to be 2s.

Let c , the constant manufacturing charges per ton of sulphate, be 50s., and let d , the variable manufacturing charges, be 55s.

Using the formula (3), we get for x the prices given in the following table for liquor of different strengths at the various values of sulphate of ammonia indicated:—

x = Price per Ton of Liquor at Gas Works.

Tw. Strength of Liquor.	When Sulphate is valued at				
	8l.	9l.	10l.	11l.	12l.
3°	s. d.	s. d.	s. d.	s. d.	s. d.
4°	0 9	2 1	3 5	4 9	6 1
5°	2 7	4 3	5 11	7 7	9 3
6°	4 5	6 5	8 5	10 5	12 5
7°	6 3	8 7	10 11	13 3	15 7
8°	8 1	10 9	13 5	16 1	18 9

It will be evident from this table how unprofitable the working of low-strength liquor is to the manufacturer. At the low prices of 8l. and 9l. per ton for sulphate, the manufacturer might actually be losing money if liquor of 3° Tw. were given to him, and he had a carriage of 2s. per ton to

pay upon it. As low-strength liquor is frequently worked up, and considerably higher prices than those indicated by our table are paid for it, it is clear that the liquor must be passed as rapidly as possible through the still with probable loss of fixed ammonia in the spent liquor. At the same time, it must be added that low-strength liquor within reasonable limits commends itself to those who have to handle it many times, because any losses by leakage are not so serious as when the liquor is of a high strength.

A comparison may be made of the prices obtained in the earlier calculation for 6°, 5°, 4°, and 3° liquor, deducting the 2s. per ton supposed to be paid for carriage, and the prices in the table for the same strengths when the price of sulphate of ammonia is 11l. :—

Strengths Tw.	6°	5°	4°	3°
Price of liquor per ton, assuming 5l. 5s. as cost of making sulphate.	s. d. 9 6	s. d. 7 7	s. d. 5 8	s. d. 3 9
Price of liquor per ton, dividing the same cost into a constant and a variable portion ($c+d$) as per table.	10 5	7 7	4 9	1 11

The fairness of the suggested formula by which the table has been prepared will be seen from the comparison. The sellers would get 11d. more per ton for liquor of 6° strength by the table, whilst the buyer would pay 11d. less per ton for 4° strength. Of course 5° is not altered, as we have supposed d to represent the variable portion of the cost of manufacture for this strength of liquor.

In conclusion, the author would state that, although figures have been used for the sake of clearness and illustration, he only wishes to draw attention to a principle of valuation, that may be modified according to the circumstances of each case, but which he believes, when properly appreciated and understood, to be capable of introducing harmony amongst the contending interests of the gas and the chemical industries.

DISCUSSION.

The CHAIRMAN said he was surprised to hear that anyone used the hydrometer as a test for gas liquor. He understood that the liquor was bought and sold by the "ounce strength."

Mr. CARULLA remarked that the ounce strength obtained by saturation of the liquor with sulphuric acid also failed to give a true indication in many instances.

The CHAIRMAN said that the ascertainment of the ounce strength by the distillation test is what he referred to.

Mr. CARULLA said that he had experience of more than a dozen gas companies by whom the hydrometer was found a convenient and reliable instrument. Of course, when buying liquor from tar distillers, a distillation test was indispensable, as in that case the hydrometer gave no indication of the strength.

Obituary.

LORD ARMSTRONG.

By the death of Lord Armstrong, the Society of Chemical Industry loses one of its most distinguished members, and the world one of its greatest men. In whatever way the character of Lord Armstrong is regarded, whether as a scientific man and inventor, as a man of affairs, or as a public benefactor, he stands out among the great men of his time as a towering personality.

Lord Armstrong's father began life at Wreay, a small place near Carlisle, with no brilliant prospects, and was induced to remove to Newcastle, where he became partner in a firm of corn merchants, and eventually mayor of the town. His son at a very early age began to show a strong inclination to mechanics, but when he left



the Bishop Auckland Grammar School he was placed with the family solicitor as an articled clerk, and in due time became a partner in the firm. In 1834, he married Margaret, daughter of William Ramshaw, of Bishop Auckland. For thirteen years he adhered to the legal profession, but in his leisure he sedulously studied engineering problems; in fact, it was to mechanics rather than law that he gave his mind. One of the earliest of his mechanical inventions was the hydraulic crane, a type of hydraulic machine which has now become of world-wide utility. But what first drew the attention of the world to the ingenuity of this north-country solicitor with a mechanical genius was the successful and brilliant experiments he made in elucidation of a mysterious phenomenon reported to him as frequently occurring in connection with a steam engine at Seaton Delaval Colliery.

It was said that when the engineman was adjusting the safety valve while the steam was blowing off, sparks of fire darted out of his fingers. This strange phenomenon interested Mr. Armstrong; he carefully examined into it, found it to be new—the first instance known of the generation of electricity by effluent steam. This led him to the invention and construction of what was, at that time, by far the most powerful means known of generating high-tension electricity—the hydro-electric machine. Chiefly in recognition of the merit of this discovery, Mr. Armstrong, while still a young man, was elected to the fellowship of the Royal Society.

Between 1845 and 1850 Mr. Armstrong invented the "accumulator," by which an artificial "head" of water is substituted for the natural "head" gained by altitude only; and he extended the application of hydraulic power to hoists of every kind, dock-gates and swing-bridges, turntables, capstans, waggon-lifts, &c. For the manufacture of this machinery the Elswick Engine Works were started in 1847-8, the founders being Mr. Armstrong, Mr. Donkin, Mr. Potter, Mr. George Cruddas, and Mr. Richard Lambert. These gigantic works are monumental evidence of the great capacity of Lord Armstrong, not only as an inventor, but as the organiser of a great industrial enterprise—where, for the first time, was attempted the entire construction and armament of great ships of war as the product of one works, and that not a Government establishment. Lord Armstrong used to speak of Elswick as a national arsenal that might in time of war be of great importance in aid of the defence of the country, and recent history has shown the truth of his forecast. The modern cruiser class of fighting ship was evolved at Elswick. During the Crimean war, the difficulties of bringing up heavy artillery engaged Mr. Armstrong's attention. Lighter guns with a longer range, he saw, was the object to be attained. The work he had set himself to do was arduous; it was no less than to completely remodel the ordnance of the Army and Navy. Many details, of course, had to be worked out and trials to be conducted at remote spots on the moors or the shore. In 1856 the Armstrong rifled ordnance was ready for official inspection. A three-pounder was first submitted, then a five-pounder, afterwards heavier pieces. Finally, in 1858, the Rifled Cannon Committee recommended the Armstrong gun for special service in the field, and the Adjutant-General of Artillery pronounced it the best field-gun then known. Mr. Armstrong generously gave his invention to his country without fee or consideration. But such a service could not go unrewarded; he was knighted, made a C.B., and appointed Engineer of Rifled Ordnance with 2,000*l.* a year. Woolwich being unable to turn out the gun with the secrecy or rapidity desired, it was arranged that it should be made at Elswick.

In 1863 Sir William Armstrong was President of the British Association meeting at Newcastle, and drew attention to the increasing consumption and waste of coal, and the nearness of the time when our coal-fields will be exhausted. This resulted in a Royal Commission, of which Sir William was made a member.

He was president of the Institution of Mechanical Engineers in 1861, 1862, and 1869, and of the Institution of Civil Engineers in 1882.

Sir William Armstrong was raised to the peerage in 1887. LL.D. of Cambridge (1862), D.C.L. of Oxford (1870), and M. Inst. Eng. of Dublin; Grand Officer of the Order of San Maurizio e Lazzaro of Italy, Knight Commander of the Danish Order of the Dannebrog, of the Austrian Order of Francis Joseph, the Spanish Order of Charles III., the Brazilian Order of the Rose, and Second Class of the Rising Sun of Japan. His presidency of the Newcastle Literary and Philosophical Society extended over many years, and continued to the time of his death.

His public spirit and philanthropy were large and widespread. A lecture hall for the Literary and Philosophical Society, an operating theatre for the Infirmary, 10,000*l.* to the Natural History Museum, a Mechanics' Institute, schools for the Elswick men, and a banqueting hall and public parks—these were among his many gifts to Newcastle. He was a man who richly deserved his great popularity.

Lord Armstrong died in his ninety-first year, at Craigside, Rothbury, Northumberland, on Thursday, Dec. 27. The funeral took place on Dec. 31, 1900, and the burial, in the churchyard at Rothbury. All the principal learned and scientific societies were represented, the Society of Chemical Industry by its President, J. W. Swan, F.R.S., who in the name of the Society placed a wreath upon the grave.

Lord Armstrong has been a member of this Society since 1884, when he was elected as Sir W. G. Armstrong.

He leaves no heir, and his peerage dies with him.

Journal and Patent* Literature.

Class.	Page
I.—General Plant, Apparatus, and Machinery	27
II.—Fuel, Gas, and Light.....	28
III.—Destructive Distillation, Tar Products, Petroleum	32
IV.—Colouring Matters and Dyestuffs.....	33
V.—Textiles: Cotton, Wool, Silk, &c.	38
VI.—Dyeing, Calico Printing, Paper Staining, and Bleaching	39
VII.—Acids, Alkalis, and Salts, and Non-Metallic Elements	42
VIII.—Glass, Pottery, and Enamels.....	43
IX.—Building Materials, Clays, Mortars, and Cements.	43
X.—Metallurgy	44
XI.—Electro-Chemistry and Electro-Metallurgy	48
XII.—Fats, Fatty Oils, and Soap	50
XIII.—Pigments and Paints; Resins, Varnishes, &c.; India-Rubber, &c.	50
XIV.—Tanning, Leather, Glue, Size, Bone, and Horn; Ivory and Substitutes	52
XV.—Manures, &c.	53
XVI.—Sugar, Starch, Gum, &c.....	53
XVII.—Brewing, Wines, Spirits, &c.	55
XVIII.—Foods; Sanitation; Water Purification; and Disinfectants.....	58
XIX.—Paper, Pasteboard, Cellulose, Celluloid, &c.	61
XX.—Fine Chemicals, Alkaloids, Essences, and Extracts	62
XXI.—Photography	67
XXII.—Explosives, Matches, &c.....	68
XXIII.—Analytical Chemistry.....	69
XXIV.—Scientific and Technical Notes.....	75

* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to C. N. Dalton, Esq., Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.



I.—PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Solid Materials; Method of and Apparatus for Treating —; applicable to the Manufacture of Gas, Coke, and to other Purposes. P. Naef, New York, U.S.A. Eng. Pats. 23,415, also 23,415A, 23,415B, and 23,415C, Nov. 23, 1899. (Under Internat. Convent.)

HEAT is applied to (or abstracted from) the material to be treated, by circulating gases or vapours in heaters (or coolers) forming a part of the apparatus. The gases are passed through the material until they are cooled to a temperature at which the operation to be carried out ceases for practical purposes. Then the gases are again heated and brought into contact with the material. A continuous circulation of heated gas through the material is thus obtained, the material itself being preferably also moved through the apparatus. The excess of the gases or vapours produced during the operation is conducted through the material to be treated, and all the heat is abstracted from the same, and the reaction is completed. The invention also comprises improved means for charging the material to and for discharging it from the apparatus.

The claims, 25 in number, partly relate to applications of the method to such purposes as the distillation of bituminous fuel for the production of gas and coke, the manufacture of water-gas, the destruction of sewage matter and the recovery of ammonia therefrom, the calcination of limestone and cement, the production of carbonic oxide and carbonic acid, and to the carrying out of catalytic reactions requiring a constant temperature, such as the manufacture of sulphuric acid from sulphurous acid.

In specifications 23,415A, 23,415B, and 23,415C, which bear the same title and date as the above patent, the inventor describes some modifications in the processes of treatment, together with novel devices for effecting the same.—D. B.

Filtering Medium; Improved —. H. Nordtmeier, Germany. Eng. Pat. 2961, Feb. 14, 1900.

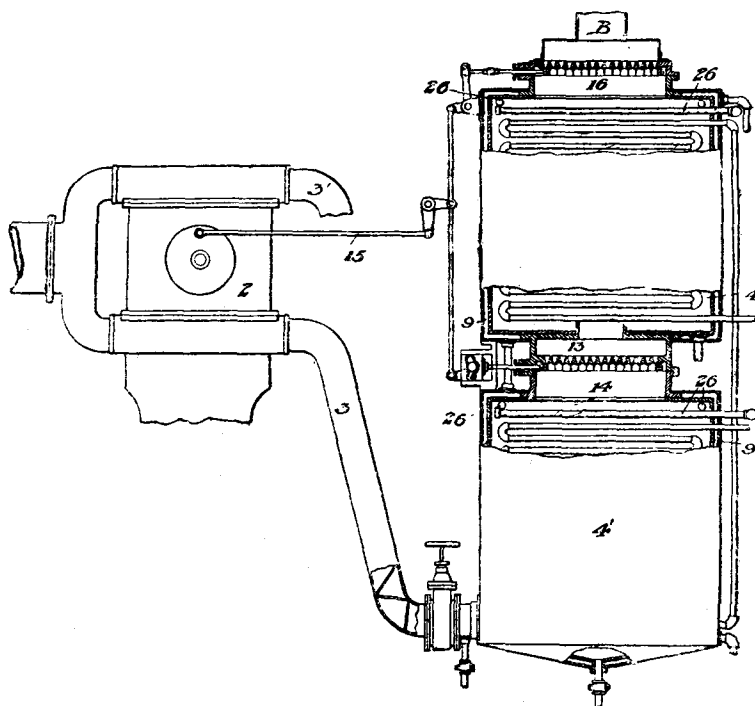
A CALCINED or baked filtering medium of fossil meal, "free from crazings" or surface cracks, "of a uniform porosity, and of the desired strength and solidity," is produced by mixing the fossil meal with asbestos, or asbestos-like minerals, such as asbestine or amianthus. The mixture, with or without the addition of organic substances, is moulded or shaped to form, and then baked or burnt.—R. A.

Linings for Protecting Vessels, Tubes, and the like from Corrosive Fluids. A. G. Bloxam, London. From R. Panzl and A. Troetscher, Waterville, Maine, U.S.A. Eng. Pat. 3975, March 1, 1900.

A PROTECTIVE lining is made of a mixture of hydraulic cement, pulverised chamotte, siliceous material (preferably pulverised quartz), water, and silicate of soda. Tanks, &c. may be provided with partitions, formed by applying the lining composition to a grate of bars or a strong wire netting, or they may be constructed entirely in this manner.—R. A.

Drying Air, and Apparatus therefor; applicable for Extracting Moisture from Air for Use in Blast Furnaces and Steel Converters, and other Purposes in the Arts for which Dry Air is Useful. J. Gayley, Pittsburg, U.S.A. Eng. Pat. 11,091, June 19, 1900.

THE air is dried by passing it through a cooling chamber and intermittently interrupting its flow therethrough, so that the air has alternate periods of rest and motion. The air is cooled by contact with the cooling surfaces of the chamber, and deposits its moisture thereon in the form of water or snow, after which it is delivered to the furnace, &c. By rarefying the air in the cooling chamber, the lowering of the temperature and the consequent deposit of the moisture are facilitated. The figure illustrates an apparatus for carrying out the drying process. The blast engine 2 is connected by pipes, 3, 3', to two or more cooling chambers, each of which consists of two or more sub-chambers, 4, 4', provided with a cooling jacket, 9, and cooling tubes or other cooling surfaces, 26. The two sub-chambers can be put in communication through the valve 14 in the neck 13, and the inlet B is controlled by the valve 16. The valves 14, 16 are operated by connections, 15, &c., synchronously with the stroke of the engine, so that one valve is opened when the other is closed, and vice versa. During one half-stroke of the engine, air is



drawn from the part 4' of one cooling chamber, while air enters the part 4 through the valve 16. Simultaneously, in the other cooling chamber, the valve 16 is closed and the valve 14 opened, and, after equalisation of pressure, the air in the parts 4', 4 remains stationary in contact with the cooling surfaces, the connection with the engine being closed.

On the return stroke of the engine, the conditions with respect to the two cooling chambers are reversed. By employing a third chamber, one or other of the three may be cut out for the removal of the products of condensation without interfering with the working. Each chamber may consist of more than two sub-chambers, arranged in multiple effect, and one or more of the valves between the sub-chambers may be kept open. If all the valves are kept open, the cooling is effected without the aid of rarefaction. In a modification, each chamber consists of only one part, in which rarefaction can be obtained by closing the inlet valve. In another arrangement, rarefaction is obtained without the use of valves, by making the outlet larger than the inlet. Deposited snow may be melted by heating, while the chamber is cut out, or, without interfering with the operation, by washing it off with cold brine.—R. A.

Treating Liquids with Gases, and Heating or Cooling Liquids for Distillatory and other Purposes; Method of and Apparatus for — P. Naef, New York, U.S.A. Eng. Pat. 23,404, Nov. 23, 1899. (Under Internat. Convent.)

ACCORDING to this invention it is proposed to supply heat to or abstract heat from the liquid to be treated, chiefly or partly by passing hot or cold gases through and directly in contact with the said liquid. For this purpose, apparatus is employed comprising one or more chambers having partitions provided with apertures, through which the liquid is passed, and which partitions serve to distribute the liquid or the gas. Means are provided for conducting gas or vapour through the chamber or chambers, and also through heating or heat-absorbing devices. The arrangement is preferably such that the gas is conducted out of the chamber, is reheated or cooled, and is returned to the chamber one or more times before it finally leaves the latter. The liquid is also preferably subjected to a preliminary heating or cooling by being passed through or around pipes, around or through which is conducted the gas from the chamber, or the fluid employed for heating or cooling the gas. In some cases the liquid may itself be passed through heaters or coolers.

The apparatus may be used for the distillation of ammonia liquor, for carrying out operations which require the abstraction of heat from a liquid, such as the precipitation of bicarbonate from brine saturated with ammonia by means of carbonic acid gas, and for the evaporation of liquids. 29 claims are made.—D. B.

Air Pyrometers. B. J. B. Mills, London. From The Bristol Company, Waterbury, Connecticut, U.S.A. Eng. Pat. 17,912, Oct. 9, 1900.

TWO tubes of flattened section are coiled in the same direction into spiral form, and are attached together at their free ends, without being in communication. The one end of one of the tubes is fixed, and is in connection with the pyrometer bulb, while the other end of the second tube is connected to the indicating or recording arm. The tubes are moved axially in opposite directions by barometric or thermometric changes, the second tube serving as a compensator for the first, so that corrections for barometer and thermometer are not required.—R. A.

Steam Boilers; Composition for the Prevention or Removal of Incrustation in — J. Garside, Ashton-under-Lyne; and G. J., and A. Saxon, all of Manchester. Eng. Pat. 19,734, Nov. 3, 1900.

ONE pound of palm oil is melted and mixed with $1\frac{1}{2}$ oz. of graphite. This product is to be put into the boiler through the manhole, or "may be dissolved by heat and fed in through the pump or injector." It is stated to float at first, but gradually to attract deposited solid matter until it becomes heavy enough to sink, when it lies quietly at the bottom of the boiler. It is claimed that all formation of scale is prevented, and that any existing scale is broken up and converted into removable flakes.—F. H. L.

II.—FUEL, GAS, AND LIGHT.

Coal Industry in Saghalien Island. F. F. Kleye. Chem. Zeit. Rep. 1900, 24, [94], 352.

KNOWLEDGE of the existence of coal-fields in the island of Saghalien dates from 1787. Coal from Due (air-dried) gave the following numbers on analysis:—Moisture, 1.71; ash, 1.56; sulphur, 0.17; carbon, 83.39; hydrogen, 5.60; oxygen and nitrogen, 7.57 per cent. This coal gave 65 per cent. of coke, whilst the volatile constituents amount to 35 per cent. The coal gives 8,249 cal., and belongs to the anthracite class. For factories and forge work it is the best coal in the East. Huge coal strata are also to be found on the west coast of the island, near the river Mgatsch. The coal is of large size, and is not lustrous. Mgatsch coal is only slightly inferior to Cardiff coal, and a mixture of Due and Mgatsch coals gives excellent results for heating purposes. The output of Due

coal amounted in 1899 to 1,500,000 pud (24,745 tons), and of Mgatsch and Sertunai coal to 800,000 pud (12,897 tons). Both classes of coal are certain to find a considerable market in Eastern harbours.—T. A. L.

Electric Furnace [Calcium Carbide]; Development of the. M. Keller.

See under XI. A., page 48.

Coal-Gas and Water-Gas; Supply of Mixtures of — H. Bunte. J. Gas Lighting, 1900, 76, [1959], 1332—1335.

IN England and America, carburetted water-gas is made from the residual oils obtained in the manufacture of lamp oil from crude petroleum, but in Germany the heavy import duty practically doubles the cost of such oils, and quite prohibits their use for gas-making. Illuminating water-gas can, however, now be produced by the Dellwik process by carburetting with benzol.

The author points out that, in view of the wide extension of the incandescent system of lighting, the illuminating power in flat-flame or Argand burners can no longer be regarded as the sole standard for the valuation of the gas. Von Oechelhaeuser has shown that coal-gas, of which the illuminating power has been reduced from 16 to 1 or 2 candles when consumed in flat-flame burners, will not have an appreciably lower efficiency in the incandescent burner. The author therefore proceeds to discuss the subject from the standpoint of the calorific power of the gas. Coal-gas has a calorific power of 136 to $141\frac{1}{2}$ calories per cubic foot, according to the quality of the coal used and the method of carbonising. Water-gas, with 10 per cent. of impurities—nitrogen and carbon dioxide—has a calorific power of 68 to $73\frac{1}{2}$ calories per cubic foot, or about half that of good coal-gas. If coal-gas be mixed with 20 per cent. of water-gas, the calorific power will be reduced by about 10 per cent., or from $141\frac{1}{2}$ to $127\frac{1}{2}$ calories per cubic foot, but there will be practically no change in the illuminating duty obtainable from the gas in the incandescent burner. The calorific power of the mixed gas may be considerably improved by addition of benzol, but this improvement is expensive compared with the cost of the gas, even when the price of benzol is low. Furthermore, a limit to the employment of benzol for carburetting is very soon reached, as in cold weather, the saturation point is easily passed, and then the benzol condenses in the mains. Enrichment with oil-gas is preferable, but it is pointed out that this method can only be economically adopted if the oil be duty-free. Oil-gas has, on the average, a calorific power of $277\frac{1}{2}$ calories per cubic foot, and a mixture of one-third oil-gas and two-thirds water-gas forms a product which has about the same calorific power as coal-gas, and which may be mixed with the latter without appreciably affecting its calorific power. The author points out that the water-gas process may also be regarded as a means of diminishing the coal requirements of a gasworks. A ton of coal yields, on carbonisation, about 10,250 cb. ft. of gas, which quantity of water-gas would be produced by a consumption of 0.115 to 0.170 ton of coke. Thus, every million cubic feet of water-gas made, means the setting free of about 100 tons of gas-coal.

The author finally discusses the question as to whether the carbonisation process or the water-gas process will predominate in the future. He concludes that the carbonisation system, which industrially and economically is by no means out of date, must be further developed, and the more recent oil-gas and water-gas systems accepted as useful auxiliary processes.—A. S.

Carbide and Acetylene Industries in Germany; Rise, Progress, and Present Condition of — F. Rose (Stuttgart). Consular Report. Foreign Office Miscellaneous Series, No. 540, Nov. 1900. (See also this Journal, 1900, 1158.)

AT the present time acetylene in Germany is a rather cheaper illuminant than petroleum, as the following figures indicate. Carbide is assumed to cost 32 pf. per kilo. (it now costs less, even in small quantities), and $3\frac{3}{4}$ kilos. yield 1 cb. m. net of acetylene. Other charges raise the



price of 1 cb. m. of acetylene to 1 mark 50 pf. In lighting power, 1 cb. m. of acetylene is equivalent to 16 cb. m. of coal-gas burnt in open-flame burners, or to 4 cb. m. burnt in an incandescent burner, or to 6 litres of petroleum, or to five 200-watt electric lamps. Coal-gas in Germany costs about 17 pf. per cb. m., and petroleum 25 pf. per litre. Hence, the equivalent in lighting power of 1 cb. m. of acetylene is obtained by petroleum for 1 mark 50 pf.; by coal-gas open burner for 2 marks 72 pf.; incandescent burner for 0 mark 68 pf., to which about 10 per cent. must be added for renewals of mantles, &c.; and by electric light for 3 marks 45 pf.

About 30 small towns in Germany are about to be, or are, lighted by means of acetylene. The works at Treptow-a.-d.-T. are typical of these town installations. They were constructed for a daily make of 200 cb. m., or for the simultaneous use of 2,000 flames of 32 candle-power. The generators are of the "carbide into water" type, and the gasholder has a capacity of 50 cb. m. Purification is effected by means of chromic acid dissolved in sulphuric or acetic acid (Ulmann's system). The gas passes from the generators through condensers and a washer with safety seal, to the gasholder, and thence through the purifiers, dryer, meter, and pressure regulator to the distributing system, of which the main pipes are of wrought-iron, 2 to 3 ins. in diameter. The total length of pipes is about five miles.

The insurance companies in Germany do not now demand increased premiums for premises lighted by acetylene, provided certain conditions are complied with, among which are the following:—(1) The gasholder must be provided with a safety valve. (2) The installation must be provided with a purifying apparatus. (3) Generators and gasholders must be isolated by walls of non-inflammable materials. (4) Inflammable substances must not be stored in the apparatus chambers, which must be always well ventilated. (5) Acetylene must not be prepared, stored, or used under a pressure of more than one atmosphere. (6) The piping must be of specified sizes, and the carbide stored and isolated according to regulations.

—J. A. B.

Acetylene Flame. E. L. Nichols. J. Franklin Inst. 1900, 150, [5], 356—387.

THE author has studied the acetylene flame with a view to utilising it as a standard source of light in photometrical and spectroscopical researches. He concludes that the acetylene must be used soon after generation, as it breaks down with age to such an extent that a sample stored over water for five months was found to contain only 25 per cent. of acetylene, and to give a flame having only 6 per cent. of the brightness of that from newly generated acetylene, though of similar colour. The process by which acetylene is generated from carbide also affects the illuminating power of the gas. Gas generated by the dry process, in which small quantities of water are dropped on large masses of carbide, has on the average only about 80 per cent. of the illuminating power of gas generated by the wet process, in which small masses of carbide are thrown into large quantities of water. The high temperatures which attend the reaction in the dry process appear to produce a mixture of acetylene and other gases instead of merely acetylene. Gas generated by the wet process only was employed in these researches on the acetylene flame.

As acetylene burns with a smoky flame unless mixed with air or a gas less rich in carbon, the flames of mixtures of acetylene and hydrogen were first investigated, but as their candle-power varied greatly with changes in the proportions of the components, and as acetylene was absorbed so rapidly when such a mixture was stored over water that the proportions became uncertain, the flame of a mixture of hydrogen and acetylene was finally deemed unsuitable for photometrical purposes. Certain characteristics of the flame of pure acetylene—viz., its great stability, its great intrinsic brightness, and its white colour—led the author to make further attempts to utilise it in photometry. Photographs of a flat flame viewed edgewise from acetylene under a pressure of more than 2 centimetres of water, showed that it consisted of a layer of heated gas, 0.005 cm. thick,

surrounded by a sheath or mantle of highly luminous material. The total thickness from one luminous mantle to the other, was found to be 0.065 cm. The intrinsic brightness was about twelve times that of an ordinary gas flame. This might be attributed either to the number of particles floating in the flame being greater in that proportion, or to the temperature or degree of incandescence being sufficiently higher. If the first were the only or principal cause, the transparency of the flame would be low, and consequently the horizontal distribution of intensity in the case of a flat flame would not be uniform, whereas it was found to be nearly uniform. The great intrinsic brightness of the acetylene flame must consequently be ascribed chiefly to the high incandescence of the carbon, which implies white colour, high temperature, and high radiant efficiency. Spectro-photometric tests showed that the acetylene flame in air is rather whiter than the lime-light, and in colour lies between that and the electric arc light. The acetylene flame in oxygen is whiter than the flame in air, and corresponds almost exactly with the light of an ordinary electric arc lamp. The temperature of the flame in air has been estimated by Le Chatelier at 2,000° C., and by Lewes at 1,517°. The author found, by the use of thermo-couples of various thicknesses, and by plotting curves from the results obtained therewith, that the temperature, which a junction of infinitesimal diameter would have when placed in the hottest region of the flame, would be, for the acetylene flame 1,900°, for an ordinary gas flame 1,780°, and for a candle flame 1,675°. The radiant efficiency of the acetylene flame, determined approximately by Melloni's method, was found to be 10.5 per cent. A comparison of the acetylene flame with other sources of light in the projecting lantern, showed that the light flux from four acetylene jets, placed one behind the other, with a reflector, was five times that from a round-wick petroleum flame with a 5-in. parabolic reflector. The light flux from limelight was four (old limes) to eight (fresh limes) times; that from an alternating current arc, ninety times; and that from direct current arcs, 120 to 200 times the light flux from the petroleum flame. The author concludes that the great intrinsic brightness, stability, steadiness, and great preponderance of rays of the shorter wave lengths render the acetylene flame specially valuable as a reference standard in spectro-photometry.

The flame of acetylene, burnt under a slight blast of air or mixed with oxygen, is useful as a source of high temperatures. Quartz and metals of the platinum group can be readily fused thereby. The temperature of the ordinary acetylene flame, from the luminous mantle outwards, exhibits a very sharp decline, the range extending over more than 1,000° in a distance of 4 or 5 mm. A thermo-junction, having a plane surface set parallel to the median plane of the flame, and moved towards it by means of a micrometer screw, gives a convenient means of observing the melting point of any metal which fuses without considerable oxidation. A tiny length of the metal is looped round the thermo-junction. Manometric flames, produced by burning acetylene within a mantle of pure oxygen, have been used by the author in collaboration with Merritt.

In conclusion, the author states that he has not yet found an acetylene flame the candle-power of which is constant. The most hopeful method of using the flame as a standard in photometry appears to consist in determining the candle-power of a specified area of the flame, and to use that as the source of light. The fluctuations in the radiation from a small area of the flame, were found to be comparable with the fluctuations from the flame of the Hefner lamp. The position of the area used would, however, have to be very carefully specified. The effects of purification of the acetylene, and of the degree of humidity of the air, on the flame have not yet been studied in this connection.

—J. A. B.

Illuminating Gas; Determination of Sulphuretted Hydrogen in —. A. Müller.
See under XXIII., page 73.

Coal-Gas; Determination of Sulphuretted Hydrogen in —. H. Leicester Greville.
See under XXIII., page 73.



Coal-Gas; New Method for the Volumetric Determination of Carbon Monoxide in — A. Smits, H. Raken, and P. C. E. Meerum Terwogt.

See under XXIII., page 73.

Gas Liquor; Valuation of — F. J. R. Carulla.

See page 23.

PATENTS.

Unconsumed Products of Combustion from Furnaces; Apparatus for Burning the — D. W. Stapp, Phillipsburg, Kansas, U.S.A. Eng. Pat. 1791, 1900. Date claimed under Internat. Convent., June 29, 1899.

THE claims are for the combination with an engine, of a receiver located in the smoke arch or chamber, and having its mouth directed towards, and located in advance of, the diaphragm of said smoke arch, and connected to the firebox by means of a conveyor pipe, an air feeder connected to the feeder or air-pipe of the said receiver, a second receiver connected to the firebox or furnace and located in the rear of the diaphragm, the second receiver having its mouth reversely arranged to the first-named receiver, and an air feeder for the second receiver. The first receiver is in the form of an extended bell mouth directed towards the point of flow of the smoke, &c., from the engine firebox, and the air feeders of both receivers have their outer ends arranged so as to create a suction and a forced draught to return to the firebox the matter taken up by the receivers.—C. S.

Artificial Fuel; Manufacture of — E. Springborn, Bow, E. Eng. Pat. 24,055, Dec. 2, 1899.

THE process is one for producing fuel from solid or semi-solid carbonaceous substances (e.g., sewage or other refuse matter, earths or rocks of a non-metallic or carbonaceous nature, such as certain clays containing a low percentage of silicate, and also those containing bituminous substances, the silt of rivers or lakes containing vegetable or bituminous matter, and other earths of vegetable origin) by treatment with saccharine matter (a $\frac{1}{4}$ to 1 per cent. aqueous solution of sugar) and inflammable hydrocarbon (e.g., coal tar with 10—15 per cent. of petroleum and 3—5 per cent. of tallow; or 90 per cent. of heavy petroleum and 10 per cent. of tallow), followed by an addition of an alkali carbonate, chloride, or nitrate ($\frac{1}{4}$ to 2 lb. per ton), the product being afterwards pressed into briquettes and dried. With materials poor in carbon an addition of 1—3 per cent. of soot, ground graphite, &c., may be made before the saccharine treatment, or a stronger solution of sugar may be used.

—C. S.

Solid Materials; Method of and Apparatus for Treating — Applicable to the Manufacture of Gas, Coke, and to other Purposes. P. Naef. Eng. Pats. 23,415, 23,415A, 23,415B, and 23,415C, Nov. 23, 1899.

See under I., page 27.

Briquette; Combustible — J. Paucheur, Brussels. Eng. Pat. 13,707, July 31, 1900.

A "COMBUSTIBLE briquette made on a foundation of coal by a scientific mixing of about 80 per cent. of coal dust, 17 per cent. of neat petroleum, and 3 per cent. of molasses to bind them."—C. S.

Fire-kindling Substances. H. H. Lake. From E. Jørgensen, Laugset, Norway. Eng. Pat. 15,018, Aug. 22, 1900.

THE substance is "composed of petroleum or other combustible oils, to which is added powdered or finely divided infusorial earth, so as to impart to the whole a pulpy consistency."—C. S.

Artificial Fuel. Dr. Clemens Dörr, Cologne, Germany. Eng. Pat. 15,476, Aug. 30, 1900.

THE claims are for: "A method of utilising carboniferous colliery waste, such as wash-heap waste, separated, i.e., hand-sorted, coal-streaked slate, and all other waste material, the said materials being granulated either when in the condition in which they are dumped at the mine, that is to say, containing non-carboniferous admixtures, such as sand, stone, and the like, or after partial or total removal

of the latter, and then being employed as combustibles, either each separately or mixed together, and after having previously been formed into cakes or not, as desired"; and for "the form of the method described in claim 1, in which coal slime, coal dust, small coal, or other waste material of small value are added to the materials mentioned."—C. S.

Chimney Chemical Cleansers. T. Huson, Liverpool. Eng. Pat. 24,375, Dec. 7, 1899.

THE chimney cleansers in use consist of a strongly oxidising salt, such as potassium nitrate, mixed with sulphur or its equivalent, and a volatilisable salt, such as sodium chloride, acting as a diluent. But it is found that sodium chloride, being hygroscopic, is objectionable, and in the present invention it is replaced, preferably, by sodium sulphate, though precipitated calcium carbonate or finely-divided earth or silica may be used. The mixture recommended is composed of potassium nitrate, 56 parts; sodium sulphate, 26 parts; and sulphur, 18 parts; all in fine powder and thoroughly mixed.—E. S.

Gas for Illuminating and Heating Purposes. H. H. Boehndel, London. Eng. Pat. 23,572, Nov. 25, 1899.

Carburetted Air.—The manufacture of a highly absorbent body is claimed, by mixing absorbent materials, such as chalk, lime, powdered pumice stone, peat moss, kieselguhr, and the like, with a substance, such as magnesia or silicate of soda, causing such absorbent materials to hold together in a porous mass, which mixture is, by the addition of water, formed into a paste, which, when divided into small lumps or pieces, is dried and afterwards calcined.

That improvement in the production of combustible gas is claimed, consisting in passing a blast of air through a sealed vessel containing a highly absorbent material impregnated with a suitable hydrocarbon.—R. S.

Gas; Apparatus for Washing and Scrubbing — S. Chandler, jun., and J. Chandler, both of Surrey; and Kirkham, Hulett, and Chandler, Ltd., Westminster. Eng. Pat. 24,383, Dec. 7, 1899.

COLUMNS for washing and scrubbing gas are claimed, wherein the plates, which are to be kept in a wet condition, are supported with their lower edges immersed in water, in such a manner that the gas to be treated, and which is admitted above the level of the water, has to pass downwards through the water and to pass upwards between the plates in order to escape, thereby producing a bubbling action, which maintains the plates in a wet condition. In apparatus for washing and scrubbing gas, the combination is further claimed of a casing, a pipe or pipes projecting up through the floor of the casing, a hood covering the pipe or pipes, and having its lower edges dipping into water, and bundles of plates arranged adjacent to the hood in such a manner that the gas, as it escapes from the hood through the water, will rise between the plates.—R. S.

Gas; Apparatus for the Production of — A. J. Boulton, London. From A. Perrier, Marseilles. Eng. Pat. 25,009, Dec. 16, 1899.

THE apparatus consists of (1) a carburetter, (2) an air-supply device, and (3) a gasholder. In apparatus for the production of gas, an air saturator is claimed, provided with several communicating chambers, arranged one above the other, to which liquid hydrocarbon is supplied from a reservoir, each of the chambers being further divided into several divisions, in order to compel the air, forced in by an air-bell, to take a zigzag or tortuous course through the liquid. In apparatus of the kind described, there is also claimed an air-supply device, consisting of an air-bell in a water receptacle, by the ascent and descent of which, automatically controlled, the air is drawn in and forced out respectively. The gasholder is of the usual form.—R. S.

Fire-Damp, Coal-Gas, Hydrogen, or other Gases; Improved Means for Indicating the Presence in the Atmosphere of — G. A. Lyncker and M. F. Mohr, Munich, Germany. Eng. Pat. 2094, Feb. 1, 1900.

A DEVICE is claimed for indicating the presence and accumulation of a gas, the specific gravity of which is not



above 0.6 (atmospheric air being = 1), such as methane, illuminating gas, hydrogen gas, &c., in which a porous cylinder, closed at the bottom, and made of clay or the like, is closed above gas-tight, by means of a corresponding thin metal foil membrane, which is conductively connected by means of two metal rings with one terminal, a second terminal being connected with a central contact screw screwed into a cross bar of one of the above rings, but insulated from the latter, the said contact screw, with its platinum point, being capable of adjustment above the centre of the membrane, in order that the sensibility of the apparatus may be varied according to the various conditions and kinds of gas.—R. S.

Gas; Enrichment of —. [*Carbureting Gas.*] F. W. C. Schniewind, New York, U.S.A. Eng. Pat. 10,588, June 9, 1900.

A gas of high illuminating power is obtained from coke ovens and other sources by drawing off separately the rich and the poor gases produced in a multiple series of ovens, scrubbing the poor gases with oil to eliminate and absorb the benzol contained in the gases, then distilling the oils to recover the absorbed benzol, and mixing the distillate, without further concentration, with the rich gases from the ovens, and finally subjecting the mixed rich gases and benzol distillate to a condensing and washing treatment, in order to remove ammonia and other impurities.—R. S.

Burners for Gas or other Combustible Vapours used in Furnaces. T. Fletcher, A. Neil, and Fletcher, Russell, and Co., Ltd., Warrington. Eng. Pat. 15,501, Aug. 31, 1900.

An improvement applicable to burners for gas or other combustible vapours used in connection with furnaces, consisting in the combination with such burners of a protecting hollow cone, the larger end or base of which rests against the back of the wire gauze, and the smaller end thereof projects into the furnace. The object of the cone is to protect the wire gauze when the blast is shut off, and to remove the flame from the surface of the gauze.—R. S.

Carburetted Air; Apparatus for the Cold Production of —, for Industrial and Domestic Purposes. F. J. Lothammer, Paris. Eng. Pat. 15,930, Sept. 7, 1900.

An apparatus is claimed for the production of carburetted air, so contrived as to ensure the formation of a combustible mixture of uniform composition and density throughout. The apparatus comprises an upright cylinder supported by legs, beneath which is a conical receiver, the latter forming the carburetter. The cylinder is divided into three chambers, one above the other, the upper one consisting of the pure air chamber, in which the pressure is regulated by a weighted valve, and from which air flows into the carburetter. The middle compartment forms the carburetted air chamber, and it is connected with the carburetter by means of a large central pipe, and with the "consuming apparatus" by an exit pipe. The lower chamber is the hydrocarbon reservoir, and the lower part of it is connected with the lower part of the carburetter by means of pipes, and its upper part is connected with the upper part of the carburetter by means of a bent tube, which ensures that the level of the liquid in the carburetter shall remain constant.

A carburetter virtually consisting of a conical receiver is also claimed, in which the level is maintained constant, the compressed air which has to be treated, flowing through to the bottom of the receiver (the area at the base being larger than the area at the top) across metal gauze or perforated plates, this air afterwards meeting, in the liquid, other plates of similar construction inclined in all directions. A heated air jacket surrounds the carburetter so as to compensate for the cold produced by the evaporation of the hydrocarbon used for carburetting.—R. S.

Explosive Gaseous Mixture; Device for Automatically Detecting and Indicating the Presence of an —. J. G. A. Rhodin, Manchester. Eng. Pat. 1122, Jan. 18, 1900.

A DEVICE for automatically detecting and indicating the presence of an explosive gaseous mixture, comprising in its

essential features a vessel through which a sample of the gas to be tested is caused to flow, and in which it is exposed to an electric spark. A by-passage from this vessel is kept normally closed by a valve carried by a pivoted tube or arm, which is overbalanced when an explosion in the vessel takes place, and thereby closes an electric circuit.—J. C. R.

Acetylene or other Hydrocarbons; Manufacture of —, from Carbide, and By-Products thereof. G. J. Atkin, Tottenham. Eng. Pat. 22,425, Nov. 9, 1899.

CALCIUM or other carbide is decomposed by admixture with solids containing water or the elements thereof, either in unstable combination or as water of crystallisation. Calcium carbide is stated thus to yield acetylene gradually, together with useful by-products, which vary according to the nature of the solid employed. For instance, the hydrated mon carbonate or monosulphate of an alkali yields an alkaline residue, which with oil or grease may be employed to produce soap; beet, potato, or other starchy matter gives a residue from which solid starch and a solution of the albuminous and gelatinous matters may be obtained. The acetylene formed is stored in ordinary gasholders, which, however, are sealed in solution of silicate of soda to avoid the gradual diffusion of the gas, which occurs when water is used as the sealing liquid.—J. A. B.

Acetylene Gas; Generators for the Production of —. A. L. Kiény, St. Denis, France. Eng. Pat. 23,432, Nov. 24, 1899.

A COVERED reservoir is divided into two compartments, in one of which is inserted a carbide receptacle to which water is supplied, while the gas thereby evolved passes through water in the lower part of the other compartment, the upper part of which serves to store the gas for the supply of burners, &c. The pressure of gas in this compartment is caused to control the flow of water to the carbide receptacle.—J. A. B.

Acetylene Gas for Street Lamps, Gate Posts, Carriage, and ordinary Illumination; Apparatus for the Production of —. J. W. Edmundson, Dublin. Eng. Pat. 23, Jan. 1, 1900.

WITHIN a cylinder containing water is a cylindrical bell, with detachable base, containing perforated trays, supporting carbide, traversed by a central pipe through which the generated gas passes to a purifier, comprising a washer and two superposed chambers containing sieves supporting purifying material.—J. A. B.

Acetylene Gas; Apparatus for the Production of —. C. Meissner, Hornberg, Germany. Eng. Pat. 14,034, Aug. 4, 1900.

CARBIDE, contained in a funnel, drops into water in a generating tank until the pressure of the evolved gas raises a conical hood, which closes the nozzle of the funnel and interrupts the supply of carbide. The funnel is mounted on a cover, with downwardly extended walls sealed in an annular tank containing glycerin.—J. A. B.

Acetylene Gas; Generator for —. J. Fazan, Apples/Morges, Switzerland. Eng. Pat. 16,979, Sept. 24, 1900.

THE crown of a bell, floating in a tank of water, supports a perforated cylinder in which is a cylinder containing baskets of carbide and having an orifice near its top, by which water gains access to the carbide. The gas evolved passes through a pipe, with cock, to the bell. Several generating cylinders may be combined with one bell.

—J. A. B.

Acetylene Gas Generating Apparatus. A. E. Adolffson, Stockholm. Eng. Pat. 17,466, Oct. 2, 1900.

BETWEEN a carbide receptacle and a subjacent tank containing water is a closed vessel in which is operated, according to the movements of the gasholder into which the gas evolved passes, an oscillating vessel which is so constructed that when the opening from the carbide receptacle is open, that into the tank is closed, and vice



versa. An oscillation of the vessel thus conveys a given quantity of carbide into the generating tank.—J. A. B.

Mixtures of Carbide of Calcium which are free from any Danger of Explosion in Generating Gas; Process to Manufacture —. F. L. Toby and O. S. Borch, both of London. Eng. Pat. 23,874, Nov. 30, 1899.

FIVE to 15 lb. of dried calcium chloride or other hygroscopic salt, and 90 lb. of calcium carbide, are ground together with the addition of a little oil, and to the mixture 2 lb. of tar are added. The whole is mixed, heated to about 120°, and, after cooling and standing for a few days, is compressed into briquettes of suitable size. The briquettes are stated to afford a more uniform generation of gas than calcium carbide alone, and the rapidity of generation may be increased by increasing the proportion of calcium chloride in the mixture. The briquettes are intended for use in generators in which the carbide is in excess of the water.—J. A. B.

Incandescent Gas Lighting; Impts. in connection with Burners used for —. C. S. Snell, Saltash. Eng. Pat. 24,096, Dec. 4, 1899.

THIS relates to a burner suitable for high-pressure gas, which can automatically adapt itself to low-pressure gas should the pressure be reduced inadvertently or otherwise. At the mouth of the burner is provided a series of gas apertures, collectively large enough to maintain an effective flame within the mantle at ordinary low gas-pressure, but the central hole is of larger bore than the others, and, when closed, leaves sufficient aperture area in the remaining holes to pass enough gas when the latter is at high pressure. A disc, ball, diaphragm, or other convenient form of float valve is arranged below the gas apertures, and is so adjusted that at a certain degree of gas pressure it closes the central exit, leaving the maintenance of the light entirely to the remaining high-pressure apertures. A number of devices for applying this principle are described.—H. B.

Incandescence Bodies suitable for Use with Gas and like Burners. J. H. H. Duncan and The New Sunlight Incandescent Company, Ltd., London. Eng. Pat. 25,359, Dec. 21, 1899.

THERE are claimed mantles of the following composition:—alumina, 48 to 60 per cent.; chromic oxide, 5 to 10 per cent.; and thoria, 42 to 35 per cent. In preparing the mantles, either the usual impregnation process is employed, or solutions of the substances may be mixed with collodion, the mixture being afterwards extruded into threads in the known manner.—H. B.

Lamps; Manufacture of Vacuum Osmium —. C. Auer von Welsbach, Vienna. Eng. Pat. 7211, April 18, 1900.

"I HAVE found that the presence of traces of oxidising gases, such as water vapour, as well as of reducing dissociable gases or vapours containing a large proportion of carbon, such as, for example, vapour of fatty acids, is in a high degree prejudicial both to the durability as well as to the economy of osmium vacuum lamps. The agents first named are mostly developed from the glass of the bulb; the others come from the india-rubber and from the packings of the mercury pumps." The traces of hydrogen gas which are liberated during use by an osmium filament which has not been too highly heated in the process of manufacture, prevent the action of the oxidising gases on the filament; it is therefore important that the glass of the bulb should contain no reducible oxides capable of oxidising this hydrogen to water vapour. The substance of the invention will be seen from the claims:—(1) For an osmium vacuum lamp, a bulb consisting of glass fusible with difficulty, e.g., potash-soda-glass, containing no oxides, such as oxide of lead, which when heated are reduced by hydrogen. (2) In the process of making lamps of this kind, preventing the presence of deleterious gases by connecting together by soldering, or by molten shellac, those parts of the vacuum-pump which communicate directly with the bulb, and avoiding any kind of fat in the packings of the pump. (3) An osmium lamp constructed in accordance with these two claims.—H. B.

Vapour Burners. A. Lecomte, Paris. Eng. Pat. 10,556, June 9, 1900.

A SPIRIT burner in which a metallic body projects into the flame, conducting heat to the vaporising chamber, a spiral of wire gauze being arranged within the latter to promote the volatilisation of the spirit.—H. B.

Illuminating Power of [Incandescence] Gas Burners; Device for Increasing the —. W. Theobald, Lee, and G. Theobald, Catford. Eng. Pat. 18,208, Oct. 12, 1900.

THE device consists of a hollow or cup-shaped cap, placed upon the top of the lamp chimney, so that the passage for the draught is considerably lessened. With incandescent mantles the device "is effective especially when the gas is only partly turned on."—H. B.

Hydrocarbon Vapour Burners. A. E. Hartel, Philadelphia. Eng. Pat. 18,474, Oct. 16, 1900.

THIS relates to devices for preventing unvaporised hydrocarbon from passing to the burner from the vaporising chamber, for obviating the transmission of heat to the oil supply, and for effecting the preliminary heating of the vaporising chamber.—H. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, PETROLEUM.

Brown-Coal Tar Purification; Chemical Function of Sulphuric Acid in —, and its Physical Significance. R. Pauli. Chem. Zeit. 1900, 24, [89], 969—970.

THE separation of brown-coal tar into its components (light and heavy oils, and soft and hard paraffin wax) by distillation, is regarded as a physical process, the removal of creosote and resin by alkalis and sulphuric acid being considered chemical operations. In the absence of sufficient resin, the excess of acid attacks the valuable constituents, the term resin as used in this industry, being strictly definable as "loss from tar and oil by the action of sulphuric acid." As sulphurous acid is evolved in the operation, it seems probable than an oxidising action takes place. This was experimentally investigated in the following manner:—100 grms. of tar were placed in a flask on a water-bath, and so arranged that water-vapour could be led in at one end, gaseous products collected at the other by the help of an aspirator in a wash-bottle containing standard iodine solution, and a known amount of acid could be added to the flask when desired. About 3 grms. of concentrated sulphuric acid were so added when the tar had assumed a temperature of 50° C.; the flask was then well shaken for half an hour with the aspirator working freely. The amount of sulphuric acid consumed was estimated by titration, and found to be 1.123 gm. of which 0.81 gm. was represented by sulphurous acid retained in the wash-bottle. The loss of tar and the amount of resin obtained under these conditions were separately determined in a beaker as a more convenient vessel. The difference between 1.123 and 0.81 gm. of H₂SO₄ (0.313 gm.) represents acid spent in forming resin by sulphonation, so that the greater proportion was spent in oxidation. It was also noticed that the total weight of resin was less than the loss of tar by 2—3 per cent. Oxidation by iodine and chlorine was then attempted, only the former agent being found suitable. 8 grms. of iodine caused a tar loss of 8.02 grms., corresponding to the total amount of active oxygen in 3 grms. of H₂SO₄, fatty acids and olefines being attacked as well as aromatic hydrocarbons, and a specially dense and compact resin being obtained. The iodine value of the tar was 40 per cent.

The author experimented with 20 samples of brown-coal tar from different sources, and tabulated the specific gravity before and after addition of 3 per cent. of sulphuric acid, and the weight of resin formed. The specific gravity of the constituents removed (P) was calculated from the formula—

$$\frac{\text{Wt. of raw tar} \times \text{its sp. gr.} - \text{wt. of clean tar} \times \text{its sp. gr.}}{\text{Weight of resin (i.e., tar loss)}} = P$$



This varied from 1.049 to 0.889, the lower limit denoting removal of light constituents owing to excess of acid relative to the amount of heavy constituents. The practical optimum value, he considers, is 0.930, and recommends that any batch of tar or oil should be tested and the proportion of acid adjusted so that the specific gravity of the constituents removed (P), calculated by the above formula, agrees with this value, thus avoiding waste of acid and the conversion of valuable constituents into worthless resin.

—R. L. J.

Metacresol in Mixtures of Cresols; Determination of — H. Ditz.

See under XXIII., page 73.

PATENT.

Mineral Oils, Liquid; Solidification of — H. B. Helbing and F. W. Passmore. Eng. Pat. 23,978.

See under XII., page 50.

IV.—COLOURING MATTERS AND DYE STUFFS.

Indigo; Oxidation of — G. v. Georgievics and L. Springer. *Monatsh. für Chem.* 21, [5], 1900, 413—421.

In order to obtain a discharge pattern on Indigo-dyed goods, the material is printed with an alkali chromate and passed through a bath containing sulphuric and oxalic acid. The chromic acid liberated, oxidises and discharges the Indigo where printed. The oxidation proceeds rapidly in presence of oxalic acid, but very slowly with chromic acid and sulphuric acid alone. The rate at which the oxidation proceeds is proportional to the amount of oxalic acid present, and hence the action is a catalytic one. The oxalic acid can be replaced by citric, tartaric, salicylic, benzoic, succinic, malonic, acetic, or formic acid, glycerin or alcohol, but these substances are much less active.

Oxalic Acid; Oxidation by Permanganate of — It is observed, in titrating oxalic acid with permanganate, that the first drops of the latter are only decolorised slowly at the beginning of the operation, but more rapidly subsequently. This is due, according to the authors, to the presence of manganese sulphate, and the decoloration is accelerated from the commencement by adding a trace of this reagent. They assume that the potassium permanganate acts on the manganese sulphate, forming manganese peroxide, and that this, in presence of sulphuric acid, is the oxidising agent. A peroxide could be detected in all stages of the oxidation by the liberation of iodine from potassium iodide, and the yellow coloration with titanium solutions. The peroxide can hardly be hydrogen peroxide, and is probably an organic peroxide, which the authors hope to isolate.

—T. A. L.

Indigo Carmine and Indigotin; Explanation of the Decrease in the Use of — W. Zänker. *Leipziger Färber- u. Zeugdr.-Zeit.* 1900, 49, [12], 503—504.

INDIGO carmine and other forms of sulphonated indigo, e.g., the so-called Indigotin, have been largely displaced in recent years by the coal-tar dyestuffs. The chief advantages of Indigo Carmine depend on its property of level dyeing; even when the colour is unlevel, owing to the initial temperature of the dye-bath being too high, it becomes level on long boiling. The colour is also readily stripped from the fibre should the shade be too full. These advantages are not fully shared by any coal-tar dyestuff, but dark shades dyed with certain coal-tar dyestuffs are considerably faster to light than when Indigo Carmine is employed. This is not the case with pale shades, for not only is it difficult to find a level-dyeing dyestuff giving the same pale shades as Indigo Carmine and exceeding it in fastness, but also the tone of a faded Indigo Carmine colour is not nearly so unpleasant as that, for instance, of

a faded Sulphonyaniline or Patent Blue colour, the Indigo still showing a pale pure greenish-blue tint, while the coal-tar blue has become an objectionable dull green.

The decrease in the amount of Indigo Extract used in dyeing, which the author considers undeserved, may, however, be to a great extent attributed to the fact that it is so often sent into the market in an impure condition—the result of hasty and incomplete manufacture. Indigo carmine should consist entirely of the sodium salt of indigotin disulphonic acid, but the commercial extracts frequently contain more or less of the monosulphonate and even insoluble unchanged indigo, these impurities being due to imperfect sulphonation. Many of the disadvantages ascribed to the use of Indigo Extract are caused by the presence of these substances, since indigotin monosulphonate is not a good dyestuff for wool, the colours produced by it being pale, dull, and extremely fugitive.

This defect of commercial extracts is now well known to the chemists in several works, and in some cases the indigo is so thoroughly sulphonated that there is danger of falling into the opposite error, and by over-sulphonation destroying the colouring matter or producing an extract yielding colours which rub off very readily. Indigotin trisulphonate does not possess the same useful properties as the disulphonate; in weak solutions the dyestuff is attracted too quickly and in strong solutions too slowly, with the result in the former case of unlevel dyeing, while in the latter matching is rendered very difficult.

It is certain that very great care must be taken in the manufacture of Indigo Extract if this product is ever partly or wholly to regain the position which it formerly occupied.

—R. B. B.

Triphenylmethane; Relation between the Chemical Constitution of Dyestuffs derived from —, and the Absorption Spectra of their Aqueous Solutions. P. Lemoult. *Comptes Rend.* 131, [21], 839—842.

WHEN solutions of the various dyestuffs containing 1 gram-molecule per 1,000 litres are compared in layers of equal thickness, all show a band in the red, and most another band towards the violet. The middle of the red band is situated, for all those which contain an atom of tertiary nitrogen in the para position with regard to the central carbon atom in two of the phenyl nuclei, about wave-length 6,860, and for all those which contain such a nitrogen atom in the three nuclei, about wave-length 6,660. These positions seem quite independent of the nature and positions of other substituting groups in the molecule.

—J. T. D.

Triphenylchloromethane; Preparation of —

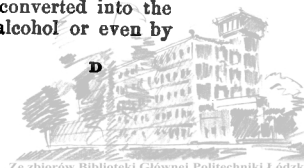
M. Gomberg. *J. Amer. Chem. Soc.* 22, [11], 752—757.

CARBON tetrachloride (1 part) and benzene (3.5 parts), thoroughly dried, are mixed in a round-bottomed flask, provided with a reflux condenser, and aluminium chloride (1.25 parts) is gradually added. After reaction, the mixture is heated for an hour on the water-bath, thoroughly cooled, and very slowly poured upon ice and water, avoiding all rise of temperature; benzene is also added, to dissolve the triphenylchloromethane. The benzene solution is separated, washed, dried over calcium chloride, and concentrated on the water-bath. On cooling, triphenylchloromethane crystallises out; the crystals are separated and washed with ether. The mother-liquor is concentrated by distillation under diminished pressure, and ether added, when a further portion of triphenylchloromethane separates, and a third portion is obtainable by a repetition of this treatment. The final mother liquors contain triphenylmethane carbinol, but no triphenylmethane. The yield of the chloro-compound is 70—85 per cent. of the theoretical.

The author prepares his aluminium chloride, very conveniently, by acting on aluminium in a combustion tube with a rapid stream of chlorine.—J. T. D.

Triphenylcarbinols by Alcohol [Malachite Green]; Etherification of — O. Fischer. *Ber.* 33, [18], 3356—3357.

MALACHITE Green base is very readily converted into the corresponding ether by boiling with an alcohol or even by



allowing the alcoholic solution to stand. The methyl ether is obtained by dissolving Malachite Green base in boiling methyl alcohol, and allowing the concentrated solution to stand. The ether separates in white plates, which easily turn green. The product is very readily soluble in benzene, sparingly soluble in petroleum spirit and in ether. It melts at 151°C . The ethyl ether is always produced when the base is heated with ethyl alcohol to 80° – 170°C ., and preferably under pressure at 110° – 120°C . It forms colourless prisms, melting at 162°C . The benzyl ether is formed by heating the base with 3–4 times its weight of benzyl alcohol for about one hour to 170°C . The melt solidifies to a mass of crystals, and after washing with methyl alcohol the product is crystallised from a mixture of benzene and methyl alcohol, free from acid. It forms silky white needles, softening at 195° and melting at 198°C . The crystals remain colourless in an atmosphere free from acid, but turn green immediately in contact with acids. When treated with dilute sulphuric acid and distilled with steam, benzyl alcohol passes over, whilst the sulphate of the Malachite Green base remains behind.

—T. A. L.

Rosaniline Bases. G. v. Georgievics. Monatsh. für Chem. 21, [5], 407–412.

THE views expressed by the author (Monatsh. 17, 4) as to the formation of a coloured base from pararosaniline have been controverted by H. Weil (Ber. 29, 2677; this Journal, 1897, 131). The author, however, considers that they receive fresh support from the work of Hantzsch and Osswald (Ber. 33, 285; this Journal, 1900, 236), who have shown the existence of *p*-rosaniline ammonium base, and he brings forward some further evidence in support of his view. When a cold magenta solution is treated with a large excess of soda lye, a red amorphous precipitate is obtained, which soon becomes crystalline, and yields quantitatively the carbinol base of rosaniline. When this is shaken with ether the latter remains colourless. If, however, only a very small excess of soda lye be employed, the red precipitate is only converted after some time, and incompletely, into the carbinol base, and on shaking with ether or, preferably, with chloroform about 10 times the quantity of ammonium base (weighed as hydrochloride) as of the carbinol, dissolves with an orange-yellow colour in the solvent. When a pararosaniline solution of known strength is titrated with soda lye, the solution only turns red litmus paper blue when a considerable excess of the latter reagent has been added. This indicates that part of the soda lye is neutralised by the carbinol base, which behaves like an acid towards strong bases. This view is confirmed by the following consideration. The rosaniline carbinol base separates even from very dilute solutions of the filtrate from the red precipitate, and hence the carbinol base, which is insoluble in cold water, must be dissolved by the excess of soda lye, since none of the base crystallises out when the magenta solution is neutralised with ammonia. The author is unable to confirm Weil's statement that rosaniline carbonate solution is decomposed by salt into rosaniline hydrochloride and sodium carbonate, which turns red litmus paper blue (*loc. cit.*). The base obtained by using a small excess of soda lye when freshly precipitated, dissolves completely in ether, but soon loses this property. The soluble portion must consist of the rosaniline ammonium base, although Hantzsch and Osswald doubt the existence in the solid state of such ammonium hydrates. The rosaniline ammonium bases decompose in aqueous solution even more rapidly than in the solid state, and assume the character of salts even in the total absence of carbonic acid. This is due to a combination between the ammonium and carbinol bases and the red colour which the carbinol base gradually assumes, and the coloration on filter paper produced by a solution of Rosaniline in ether is due to the formation of a "rosaniline rosanilate." It is suggested that a similar isomerisation takes place in the case of the bases of Safranin and Methylene Blue. Hantzsch and Osswald point out that the solid so-called free Phenosafranine possesses the conductivity of a salt.

—T. A. L.

Auramine from Tetramethyldiamidodiphenylmethane. J. Walter. Chem. Zeit. 1900, 24, [94], 1031–1032.

THE original method by which Auramine was obtained—heating tetramethyldiamidobenzophenone with sal-ammoniac and zinc chloride—has been entirely superseded by the present process, which, according to the author, is due to him and Sandmeyer. The former had, in fact, deposited a sealed communication in May 1887, which was read in 1895 (this Journal, 1895, 744), and in which the production of Auramine was described, by heating tetramethyldiamidodiphenylmethane with sulphur and subsequently adding sal-ammoniac and zinc chloride. The present process consists in heating tetramethyldiamidodiphenylmethane with sulphur in a current of ammonia gas, and the author lays claim to having devised the plant for this purpose. The melt still gives 80–100 kilos. of commercial Auramine O containing about 8–10 per cent. of dextrin or sugar, and two such charges can be worked through in 24 hours. Excluding the production of the methylene base—from formaldehyde and dimethylaniline—the operation requires eight men by day and two at night, both charges being finished off in the daytime. Further reference is made in the paper to the synthetic production of pararosaniline from diamidodiphenylmethane already mentioned in the abstract quoted above.—T. A. L.

Azo Dyestuffs from β -Naphthol and α -Naphthylamine Sulphonic Acids to Wool; Behaviour of —. G. v. Georgievics and L. Springer. Chem. Zeit. Rep. 1900, 24, [94], 352.

WOOL dyed with the dyestuffs referred to is not a chemical compound of the dyestuff-acid with the keratin of the wool, although hitherto this has been assumed to be the case. The authors' experiments also show that some relation exists between the solubility and absorption of the dyestuffs. The colour acids are scarcely taken up at all from their aqueous solutions by the wool fibre, and only become so in presence of acetic acid, an increase in this acid producing a heavier shade. In fact, the colour acids are less soluble in dilute acetic acid than in pure water. No relation could be observed between solubility and affinity, but hitherto it has not been possible to determine whether there is not a relation between the strength of a colour acid and its affinity. With regard to the shades obtained, those from the 1·4 acid are the fastest to light, whilst those from the 1·1', 1·2', and 1·3' acids are the most fugitive.—T. A. L.

Azo Dyestuffs from β -Naphthol and α -Naphthylamine Sulphonic Acids. G. v. Georgievics. Chem. Zeit. Rep. 1900, 24, [94], 351–352.

OF the seven possible dyestuffs having the formula $\text{HO}_2\text{S}\cdot\text{C}_{10}\text{H}_6(\alpha)\text{N}:\text{N}\cdot\text{C}_{10}\text{H}_6\cdot\text{OH}(\beta)$ only Fast Red A from naphthionic acid and β -naphthol has been described. Investigation shows that the position of the sulphonic acid group has an important bearing on the properties of the dyestuffs, and similarities in the naphthylamine sulphonic acids are also present in the dyestuff derivatives of these acids. For instance, the dyestuffs from the acids 1·3' and 1·2' ($\text{NH}_2\cdot\text{SO}_3\text{H}$) are almost undistinguishable, whilst the 1·2 and 1·1' and the 1·4 and 1·4' derivatives also exhibit a great similarity. In the face of this, Erdmann's statement that the 1·2 naphthylamine sulphonic acid has a conductivity about 2,000 times greater than the peri compound is somewhat strange. The proximity of the sulphonic acid group to the chromophoric azo group in the 1·2 and 1·1' dyestuffs manifests itself in the yellow shade given by these compounds on wool, all the other dyestuffs giving red shades. On spectroscopical examination, all the dyestuffs transmit red and part of the orange-red almost unchanged, and none of the dyestuffs have any appreciable action on a photographic plate.—T. A. L.

Millon's Reagent. W. Vaubel.
See under XXIII., page 71.

Xanthorhammin and Quercitrin; Sugar Constituents of —. E. Votocek and V. Fric.
See under XXIV., page 76.



PATENTS.

Indigo Leuco Compounds and other Indigo Products, and Materials for Use therein; Manufacture and Production of — J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 23,123, Nov. 20, 1899. (Second Edition.)

The dialkyl esters of phenylglycocoll-*o*-carboxylic acid readily form formyl, carbethoxyl, or benzoyl derivatives, which can be converted into indoxyl compounds, and subsequently into Indigo. The conversion may be effected not only by the action of caustic alkalis, but also by heating, or on standing at the ordinary temperature with dilute alkaline solutions. For this purpose the alkaline earths (except magnesia), the alkali alcoholates, sodium, ammonia, hot sodium carbonate solution, and sulphuric acid of various strengths may be employed. The resulting product is indoxyl or indoxyllic acid, or in the presence of alcohol an ester is obtained. With concentrated sulphuric acid, indigo sulphonic acids are obtained. As an example of the method employed, 1 kilo. of phenylglycocoll-*o*-carboxylic acid diethyl ester is heated with 2 kilos. of formic acid (90 per cent.) for two hours to 150° C. After cooling, the solution is filtered, and evaporated *in vacuo*. The residue is then dissolved in ether and extracted with sodium carbonate solution. The formyl compound is obtained by distilling off the ether, and in order to convert it into indoxyl it is boiled with 10 kilos. of a 20 per cent. caustic soda solution out of contact with the air. From this solution, after cooling, the indoxyl may be precipitated, or Indigo may be obtained from it directly. The formyl ester prepared above may be converted into Indigo sulphonic acid by heating it on the water-bath with five times its weight of sulphuric acid, containing 4 per cent. of free sulphuric anhydride. When no further increase in the blue colour formed can be observed, the melt is poured on to ice, and the Indigo sulphonic acid is salted out.—T. A. L.

Indigo Leuco Compounds and other Indigo Products; Impts. in the Manufacture and Production of — J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 23,123A, Nov. 20, 1899. (Second Edition.)

In place of the acetyl derivatives mentioned in the foregoing specification the patentees state that the acetyl-derivative of the dialkyl esters of phenylglycocoll-*o*-carboxylic acid can in the same manner be readily converted into indoxyl compounds (which are easily oxidised to Indigo). For instance, 1 kilo. of the acetyl ester is heated with 5 kilos. of a sodium carbonate solution (8 per cent. Na₂CO₃) until all is dissolved. The solution is then diluted, mixed with 2 kilos. of caustic soda lye (20 per cent. NaOH), and air is blown through the solution, when Indigo separates out.—T. A. L.

New Colouring Matters [Black], and of Products for Use therein; The Manufacture and Production of — J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 25,288, Dec. 20, 1899. (Second Edition.)

By treating dinitrochlorobenzene with *p*-aminophenol in equimolecular proportions in presence of sodium acetate, it yields *p*-hydroxy-*o*-*p*-dinitrodiphenylamine, and the corresponding derivative can be obtained from *p*-aminophenol-*o*-sulphonic acid. The patentees now find that this compound or its sulphonic acid will condense with a further proportion of dinitrochlorobenzene, yielding a phenol ether or sulphonic acid thereof. The condensation can be effected in one operation, and it is unnecessary to isolate the intermediate compound. These new products, on heating with sulphur and sodium sulphide, yield substantive cotton dyestuffs, giving greenish-black shades. On subsequent treatment with sulphuric acid and bichromate they give bluish-black shades. For example, about 19 kilos. of *p*-aminophenol-*o*-sulphonic acid and 5.5 kilos. of calcined soda are dissolved in 140 litres of water, mixed with 10.5 kilos. of calcined soda and 41 kilos. of dinitrochlorobenzene, and cohobated for about three hours, until the latter product has practically disappeared. The product of the reaction

separates out on cooling as sodium salt in brilliant light yellow flakes, and may be recrystallised from water or alcohol. For the preparation of a dyestuff, about 40 kilos. of this sodium salt of *p*-dinitrophenoxy-*o*-*p*-dinitrodiphenylamine-*m*-sulphonic acid, 80 kilos. of sulphur, and 200 kilos. of crystallised sodium sulphide are heated together in an iron vessel provided with an agitator to 140° C. When the melt becomes solid at this temperature it is allowed to cool, and the mass is powdered, when it can be employed directly for dyeing. It dissolves readily in water to a bluish-green solution, from which the dyestuff can be precipitated by salt or ammonium chloride, whilst hydrochloric acid yields a yellowish-brown flocculent precipitate. The dyestuff gives greenish-black shades on unmordanted cotton fast to acids, alkalis, and soap. When the dyed fabrics are treated with bichromate and sulphuric acid, bluish-black shades are obtained fast to soap, chlorine, and sulphur. A further series of condensation products is also claimed, resulting in the formation of other nitrated phenol ethers by treating *p*-hydroxy-*o*-*p*-dinitrodiphenylamine with *o*-nitrochlorobenzene-*p*-sulphonic acid or with *p*-nitrochlorobenzene-*o*-sulphonic acid.—T. A. L.

Black Colouring Matter; Manufacture and Production of New — J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 890, Jan. 15, 1900. (Second Edition.)

ACCORDING to Eng. Pat. 3828 of 1894 (this Journal, 1895, 147), a process is described for obtaining Naphthazarin or Alizarin Black from 1.1'-dinitronaphthalene. In the present specification the same initial material is employed for the production of a new black dyestuff differing from Naphthazarin. The method consists in treating 1.1'-dinitronaphthalene in concentrated sulphuric acid at a high temperature with sulphuretted hydrogen or with sulphides. A Naphthazarin intermediate product is formed during this operation, which is converted into the new dyestuff. It can be rendered more soluble by treatment with sulphites or bisulphites, and in this condition can be used with a chromium acetate mordant for printing cotton fabrics, giving grey to deep black lakes. The new dyestuff can be produced at a price to replace logwood. About 100 kilos. of 1.1'-dinitronaphthalene are dissolved in 1,000 to 2,000 kilos. of sulphuric acid (96 per cent. H₂SO₄) at 130° C. A current of sulphuretted hydrogen is then passed through the solution until no unaltered dinitronaphthalene remains, which usually takes from 6—8 hours. After cooling, the melt is poured into 500 litres of water, boiled, and filtered. The residue contains some Naphthazarin, which can be removed by means of a solution of alum. The product dyes unmordanted wool violet-black, which becomes deep black on subsequent treatment with a chrome salt. In order to obtain the more soluble bisulphite compound, 200 kilos. of a 25 per cent. paste of the new dyestuff and 75 kilos. of sodium bisulphite solution (40 per cent. NaHSO₃) are heated from 4—5 hours at 95° C. The paste so obtained is standardised by adding water. The product is completely soluble in boiling water, and can be used for cotton printing.—T. A. L.

New Azo Colouring Matter [Red], and Lakes therefrom; The Manufacture and Production of — B. Willcox, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 25,511, Dec. 22, 1899. (Second Edition.)

HITHERTO 2.1-naphthylamine sulphonic acid has found no technical application. It has, however, been discovered that when diazotised and combined with β -naphthol it yields a dyestuff which even in the form of its alkali salts is almost insoluble in cold water and very sparingly soluble in hot water. This property renders it a valuable product for the preparation of lakes. For example, a paste containing 1.1 kilo. of the sodium salt in 100 litres of water is mixed with a solution of 1 kilo. of crystallised barium chloride in 10 litres of water. After boiling, 100 kilos. of an aluminium hydroxide paste (containing 2½ per cent. of aluminium hydroxide) are added, and the lake is filtered off, washed, and dried.—T. A. L.



Azo Colouring Matters [Yellow], and Materials for Use therein; The Manufacture and Production of New — J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 1227, Jan. 19, 1900. (Second Edition.)

THE specification relates to the production of a new nitro-*m*-phenylene diamine sulphonic acid by sulphonating and nitrating *m*-dichlorobenzene in one operation. The product so obtained is treated with ammonia under pressure, yielding the new derivative, which, when combined with diazotised Primuline, gives a yellow dyestuff fast to washing, acid, and chlorine. About 1,500 grms. of *m*-dichlorobenzene are stirred into 4,150 grms. of fuming sulphuric acid (23 per cent. free SO₂) at a temperature below 70° C. The melt is then heated for two hours on the boiling water-bath, until a sample dissolves to a clear solution in water. After cooling to the ordinary temperature, a mixture of 2,050 grms. of fuming sulphuric acid (13 per cent. free SO₂) and 725 grms. of nitric acid (94 per cent. HNO₃) is added with constant agitation. The temperature rises to 70°–80° C., and the reaction is completed by heating for about two hours on the water-bath. The melt is then cooled and diluted with 10 litres of water, and the aqueous solution is treated with potassium chloride, which precipitates the potassium salt. About 350 grms. of this salt and 1,200 grms. of ammonia (30 per cent. NH₃) are heated in an autoclave to 150° C. for about six hours. On cooling, long reddish-yellow crystals of the potassium nitro-*m*-phenylene diamine sulphonate separate out. The free acid crystallises in silky yellowish needles. For the preparation of a dyestuff, about 66 grms. of Primuline are dissolved in 2 litres of boiling water. About 7 grms. of sodium nitrite are added, and the solution, when cold, is run into 43 grms. of hydrochloric acid (37 per cent. HCl) and 150 c.c. of water. When the diazotisation is complete, the diazo compound is run into a solution of 25 grms. of the new nitro-*m*-phenylene diamine sulphonic acid in 750 c.c. of water kept alkaline by means of sodium carbonate. The mixture is then heated to 60°–65° C. until a clear solution is obtained, which requires from 4–5 hours. The new dyestuff is ultimately salted out, filter-pressed, and dried. The product so obtained is readily soluble in water, and dyes brilliant yellow shades showing great fastness to washing, acids, and chlorine.—T. A. L.

Colouring Matters; Manufacture and Production of Products Useful in the Manufacture of — J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 1387, Jan. 22, 1900.

THE action of certain sulphites—preferably bisulphites—on certain aromatic hydroxy and amino compounds, especially those of the naphthalene series, yields characteristic products, apparently ester-like compounds of hydroxyl derivatives with sulphurous acid. These substances, compared with the corresponding free naphthols or other naphthalene derivatives from which they are obtained, are more easily soluble in water. Those of the monohydroxy derivatives do not combine with diazo or tetrazo compounds, whilst the dihydroxy and aminohydroxy derivatives still possess this property, although in a less degree than the dihydroxy naphthalenes and aminonaphthols themselves. Certain of the aminonaphthol esters can be diazotised and employed for the manufacture of azo dyestuffs. The esters in general are tolerably stable to dilute hydrochloric and sulphuric acids. They are, however, hydrolysed by heating with concentrated sulphuric acid, solutions of the fixed alkalis, alkaline earths, and the like, yielding the corresponding hydroxy compounds. By heating with ammonia they are converted into amino derivatives. Hence it is possible, by employing this invention, to pass from hydroxy to amino compounds, and, on the other hand, from certain amino to certain hydroxy derivatives. The patentees, however, disclaim the process described in Eng. Pat. 16,807 of 1899 (this Journal, 1900, 732). The α -naphthol and α -naphthylamine derivatives with a free ortho and meta position, and β -naphthol or β -naphthylamine derivatives with a free *m*-position, are most readily acted upon, and certain rules hold good with regard to the di-derivatives. Of the benzene

compounds those most suitable are *m*-derivatives, such as resorcinol, *m*-phenylene diamine, *m*-aminophenol, and the like. For example, in order to obtain the sulphurous acid ester of a naphthol sulphonic acid, 246 grms. of 1.4-naphthol sulphonic acid and 1 kilo. of bisulphite (40 per cent. NaHSO₃) are heated on the water-bath for one hour, until a test portion, after acidifying with hydrochloric acid and driving off the sulphurous acid, contains only a small quantity of the initial material. The whole melt is then treated in a similar manner, yielding a solution of the easily soluble sulphurous ester of 1.4-naphthol sulphonic acid. On heating with ammonia it is converted into naphthionic acid. As an example of the conversion of a naphthol into a naphthylamine, 144 grms. of β -naphthol, 116 grms. of ammonium sulphite [(NH₄)₂SO₃], 500 c.c. of water, and 120 grms. of ammonia solution (20 per cent. NH₃) are heated together in a closed vessel, with agitation, to 100°–150° C. until all the β -naphthol has disappeared. The β -naphthylamine, which separates out, is then filtered off, and the mother-liquor is employed for a subsequent operation. For the purpose of obtaining *m*-aminophenol from resorcinol, 110 grms. of resorcinol, 116 grms. of ammonium sulphite, 500 c.c. of water, and 100 grms. of ammonia solution are heated at 100°–125° C. until the resorcinol has practically disappeared. The aminophenol formed is extracted, and purified by shaking its acid and caustic alkaline solution respectively with ether. If in this example the ammonia solution be increased to 250 grms. and the temperature be maintained at 125°–150° C. until the whole of the resorcinol has practically disappeared, the product of the reaction is *m*-phenylene diamine. In this case it is necessary to boil the solution resulting from the reaction with sulphuric acid in slight excess until free from sulphurous acid, and to filter from any insoluble matter. Any aminophenol formed may be removed.

—T. A. L.

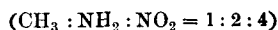
Antraquinone Dyestuffs; Manufacture or Production of New — H. E. Newton, London. From The Farbenfabriken vorm. F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 23,637, Nov. 27, 1899.

By treating mono- or diamino-antraquinone sulphonic acids or their hydroxy derivatives with benzyl chloride they are converted into benzylated products of great technical value. The new products dye unmordanted wool from acid baths bluer or greener shades than the original materials. For instance, a solution of 10 kilos. of diamino-anthraquinone disulphonic acid (Eng. Pat. 12,011 of 1897; this Journal, 1898, 572) in 500 litres of hot water has slowly added to it, at 80°–90° C., 8 kilos. of benzyl chloride with constant agitation. The temperature is maintained until a sample dissolved in concentrated sulphuric acid and mixed with boric acid no longer exhibits the characteristic absorption spectrum of the boric ether of diamino-anthraquinone disulphonic acid. The new dyestuff is precipitated by cooling and adding concentrated brine. It forms, when dry, a blue powder soluble with a blue colour in water, and is precipitated unchanged by adding hydrochloric acid. It dissolves with a yellow colour in concentrated sulphuric acid, which turns green on adding boric acid. The new dyestuff gives bright blue shades on unmordanted wool from an acid bath, and greenish-blue shades on chrome-mordanted wool.

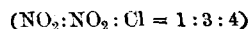
—T. A. L.

Indazol, and Dyestuffs [Brown] therefrom; Production of Derivatives of — R. B. Ransford, Norwood. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 23,657, Nov. 27, 1899.

THE amino-indazol obtained from nitrotoluidine—



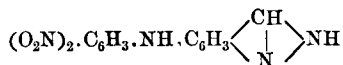
readily condenses with dinitrochlorobenzene—



yielding a new indazol derivative, which may be used directly or after further nitration, for the production of dyestuffs by heating with sulphur and alkaline sulphides. For example, 13.3 kilos. of amino-indazol, 20.3 kilos. of dinitrochloro-



benzene, and 25 kilos. of sodium acetate are boiled together in dilute alcohol for several hours. The alcohol is then distilled off, and the dinitrophenylamino-indazol—



separates as a brown powder. After recrystallisation from alcohol it forms reddish-brown crystals melting at 261° C. In order to convert it into a dyestuff, 15 kilos. of the product are heated with 30 kilos. of sulphur and 75 kilos. of sodium sulphide for several hours to about 130° C. The melt may be used directly for dyeing, and the product gives olive shades on cotton from a bath containing salt and sodium sulphide. A brown dyestuff is formed if the dinitrophenylamino-indazol be treated in sulphuric acid solution with nitro sulphuric acid before heating with sulphur and sodium sulphide.—T. A. L.

Colouring Matters [Brown]; Impts. in the Manufacture of —. R. B. Ransford, Norwood. From L. Cassella and Co., Frankfurt-on-the-Maine, Germany. Eng. Pat. 25,754, Dec. 30, 1899.

On heating the dinitro-oxydiphenylamine obtained from 1.3.4 - dinitrochlorobenzene and 1.4 - aminophenol with caustic alkalis in aqueous solution, it is transformed into a brown dyestuff which differs considerably from the initial material, since this latter, on heating with sulphur and alkaline sulphides, yields Immedial Black, whilst the transformed product when similarly treated gives a characteristic yellowish brown dyestuff. The dinitrophenoxytolylamine from dinitrochlorobenzene and amino-*o*-cresol behaves in the same way. For instance, 40 kilos. of dinitro-oxydiphenylamine are dissolved in 80 kilos. of caustic soda lye (40° B.) and 240 litres of water, and boiled for 3—4 hours until no more ammonia is evolved. After diluting, the new product is precipitated with hydrochloric acid, and forms, when dry, a black amorphous powder. It dissolves readily in presence of alkalis, and dyes unmordanted cotton intense brown shades. 25 kilos. of the substance, 52 kilos. of sodium sulphide, and 13 kilos. of sulphur, together with a little water, are gradually heated to 160° C. and maintained at this temperature until the melt becomes solid. It can be used directly for dyeing, and dissolves readily in water, giving intense yellowish-brown shades on cotton from a warm bath containing salt. A subsequent chromate treatment turns the shade yellow and increases the fastness.

—T. A. L.

Blue Mordant Dyestuffs of the Anthraquinone Series; Manufacture of —. O. Imray, London. From The Farbwerke vorm. Meister, Lucius und Brüning, Hoechst a/Main, Germany. Eng. Pat. 24,954, Dec. 15, 1899.

ACCORDING to Ger. Pat. 6526 (lapsed), sulphonic acids are obtained by the action of fuming sulphuric acid on dinitroanthraquinone or its reduction products, but these acids are practically valueless. A method is described in Ger. Pat. 75,490 by which they are heated with dilute alkalis under moderate pressure, when they yield blue mordant dyestuffs soluble in water. In the present specification this method is further improved by heating the products of Ger. Pat. 6526 in the form of their lime lakes with aqueous alkalis, with or without the presence of an oxidising agent, such as saltpetre, until they become insoluble in water. Under these conditions the sulphonic acid groups are removed, and the amino groups are replaced by hydroxyl. A mixture of 100 grms. of the product of Ger. Pat. 6526, 50 grms. of lime, 100 grms. of sodium hydroxide, 20 grms. of saltpetre, and 9 litres of water is heated in a closed vessel provided with an agitator for about 20 hours to 180° C., until a sample, when treated with hydrochloric acid, yields an insoluble dyestuff. The whole melt is then boiled with dilute hydrochloric acid, and the hexahydroxyanthraquinones are filtered off. When dissolved in dilute sodium carbonate or alkali, or by washing with sulphuric acid, these products yield pure blue mordant dyestuffs.—T. A. L.

Blue-Violet Dyestuffs; Manufacture of —. O. Imray, London. From The Farbwerke vormals Meister, Lucius und Brüning, Hoechst a/Main, Germany. Eng. Pat. 1761, Jan. 27, 1900.

DYESTUFFS of the *o*-tolylidiphenylmethane series are obtained, according to this invention, from dibenzyl-*m*-toluidine. The products formed differ from those obtained from dibenzylaniline in being faster to alkali and bluer in shade. The dyestuffs are obtained either by oxidising the leuco-sulphonic acids of dibenzylamino-*o*-tolyltetramethyl- (or ethyl-) diaminodiphenylmethane, or by sulphonating the basic dyestuffs of the above-mentioned *o*-tolylidiphenylmethane derivatives. The leuco-sulphonic acids may be obtained by condensing tetramethyl- (or ethyl-) diaminodiphenylcarbinol with *m*-toluidine (Ger. Pat. 27,032), benzylating, and then sulphonating with fuming sulphuric acid (25 per cent. SO₃); secondly, by condensing the said diphenylcarbinols with dibenzyl-*m*-toluidine, and then sulphonating; or, thirdly, by condensing the diphenylcarbinols with dibenzyl-*m*-toluidine disulphonic acid (Ger. Pat. 69,654). The basic dyestuffs employed for sulphonation may be obtained by condensing the above-mentioned carbinols with dibenzyl-*m*-toluidine and subsequent oxidation (Ger. Pat. 27,032), or by direct oxidation of the ketone corresponding to the said carbinols with dibenzyl-*m*-toluidine (Ger. Pat. 27,789). *Dibenzyl-*m*-toluidine* is readily obtained by adding a slight excess of benzylchloride to a hot mixture of *m*-toluidine and a concentrated solution of sodium carbonate. When the reaction is complete, the excess of benzyl chloride is driven off with steam, leaving *dibenzyl-*m*-toluidine* as a thick oil, which crystallises on cooling. On recrystallisation from alcohol, it melts at 72° C. Its disulphonic acid is formed by treating the base, dissolved in sulphuric acid monohydrate, with fuming sulphuric acid (25 per cent. SO₃). The acid yields salts readily soluble in water, which may be separated and purified in the usual manner. For the production of a dyestuff, the leuco-sulphonic acid of *dibenzylamino-*o*-tolyltetramethyldiaminodiphenylmethane*, obtained according to one of the methods instanced above, is dissolved in water in the form of its sodium salt. To this solution, made acid, is added, with constant agitation, the calculated quantity of lead peroxide paste. After making alkaline the solution is filtered hot, and the dyestuff is precipitated by adding salt to the filtrate at about 50° C. The product dyes wool bluish-violet shades.—T. A. L.

Indigo into an easily Reducible Form in Paste and in Powder; Process for transforming difficultly Reducible Crystalline —. T. R. Shillito, London. From J. R. Geigy and Co., Basle, Switzerland. Eng. Pat. 1293, Jan. 20, 1900.

IN some of the technical processes for the production of artificial Indigo, the product is obtained in a crystalline condition, which can only be reduced in the vat with difficulty. By dissolving such Indigo in cold concentrated sulphuric acid, it can be precipitated unchanged by adding water at a low temperature, and it is then in such a condition that the addition of a sufficient quantity of hydrosulphite reduces it in a few minutes to Indigo White, the operation being conducted out of contact with air. One kilo. of crystalline Indigo is slowly stirred into 4 kilos. of well-cooled concentrated sulphuric acid. After a short time the green paste is poured on to water and ice. The Indigo is precipitated in an exceedingly fine condition, and, after filtering and washing, may be at once employed for dyeing purposes. It still remains easily reducible after drying and grinding. (See also Eng. Pat. 23,122 of 1899; this Journal, 1900, 1009.)—T. A. L.

Orange-Yellow Dyestuffs belonging to the Acridine Series; Manufacture of —. C. D. Abel, London. From The Actengesellschaft für Anilinfabrikation, Berlin, Germany. Eng. Pat. 1820, Jan. 29, 1900.

NEW orange dyestuffs of the acridine series are obtained by alkylating the naphthacridine derivatives described in Eng. Pat. 16,474 of 1898 (this Journal, 1899, 826). The alkylation can be effected by heating with alkyl haloids or



with alcohols and mineral acids. For instance, 10 kilos. of aminotolunaphthacridine, 24 kilos. of methyl alcohol, and 12 kilos. of concentrated hydrochloric acid are heated under pressure for several hours at 160°–170° C. After cooling, the excess of alcohol is distilled off, the residue is dissolved in water, and the dyestuff is salted out. It forms an orange powder, very easily soluble in hot water to an orange-yellow solution exhibiting, when dilute, a yellowish-green fluorescence. The solution is precipitated by adding sodium carbonate, caustic alkali lye, or ammonia. This base is scarcely soluble in water or benzene, but dissolves readily in alcohol or ether, and the solutions have a similar yellowish-green fluorescence. The dyestuff gives orange-yellow shades on tannin-mordanted cotton.—T. A. L.

Black Colouring Matter directly Dyeing Cotton; Manufacture of a —. C. D. Abel, London. From The Actiengesellschaft für Anilinfabrikation, Berlin, Germany. Eng. Pat. 2531, Feb. 8, 1900.

DINITRO-CHLORO-OXYDIPHENYLAMINE, having the formula $[1,3,4], (\text{NO}_2)_2 \cdot \text{C}_6\text{H}_3 \cdot \text{NH} \cdot \text{C}_6\text{H}_3 \cdot (\text{OH}) \cdot \text{Cl}$, 1.2.4, when heated with sulphur and alkaline sulphides, yields a black cotton dyestuff. For the manufacture of the initial product, 15 kilos. of *o*-amino-*p*-chlorophenol are dissolved in 750 litres of hot water, mixed with 11 kilos. of sodium carbonate and 20.5 kilos. of dinitrochlorobenzene, the whole being then boiled for several hours. On cooling, the condensation product separates in red needles. In order to obtain the dyestuff, 50 kilos. of sodium sulphide, 20 kilos. of sulphur, and 15 litres of water are heated together, and 10 kilos. of the dinitro-chloro-oxydiphenylamine, produced as above, are added at about 80° C. The temperature is then raised and maintained for several hours at 140°–150° C. The heating is then continued at a somewhat higher temperature until the melt is quite dry and may be powdered, or else the mass is dissolved in water and the dyestuff precipitated from the aqueous solution by a mineral acid or by means of a current of air. The product so obtained readily dissolves in a dilute sodium sulphide solution, with an intense bluish-green coloration.—T. A. L.

Extraction; Method or Process of —. P. Gulden, Leipsic, Germany. Eng. Pat. 16,716, Sept. 19, 1900.

An improvement in the method of extracting dyeing and tanning materials, fruits, leather, &c., which consists in carrying out the extraction and the evaporation simultaneously and *in vacuo*. The material to be extracted is placed in the digesters, together with a suitable quantity of the liquid solvent to be employed. The mixture is then heated, by means of steam coils or other suitable method, to a temperature not exceeding 60° C. At the same time a vacuum is obtained by means of an air-pump. Thus the surplus liquor is evaporated *in vacuo* after having penetrated the material under treatment, the juices thus obtained being allowed to pass over from one digester to another filled with new material until sufficiently concentrated.—M. C. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Yarn and Cloth Testing Machines. G. R. Smith, Osssett, near Leeds. Proc. New England Cotton Manufacturers' Assoc., Washington Meeting, No. 69, Oct. 1900.

THE author has designed four machines which are suitable for testing any textile fibre, either as yarn or cloth. All the machines consist essentially of a beam which is balanced by suitable means before introducing the yarn or cloth to be tested.

The beam is provided with a jaw to fix one end of the yarn or cloth, the other end of the material being attached to another jaw, which is placed at a suitable distance away and connected with an arrangement which is moved by clockwork. When the material under test is stretched by the motion of this clockwork arrangement, the beam is tilted upwards sufficiently to allow water to flow into a graduated cylinder placed at one end of the beam; equilibrium is thus restored, and this action continues until the material breaks.

The amount of water in the cylinder is a measure of the tension to which the material under test has been subjected.

—J. E. H.

Impregnation of Fibrous Materials with Substances of Low Melting Point; Process for the —. J. Rudolf. Leipziger Färber- u. Zeugdr.-Zeit. 1900, 49, [12], 496.

The two methods hitherto employed for waterproofing fabrics with paraffin, stearates, or wax are: (1) A hot roller is made to rotate in contact with the solid substance and the fibrous material is then led over this roller; (2) The paraffin, &c. is dissolved in benzene or petroleum spirit and the material steeped in the solution.

According to the new process (Ger. Pat. 1900, 112,943), the substance is emulsified in water by means of a centrifugal machine. Paraffin, ozokerite, vegetable wax, beeswax, and stearine or palmitine and their metallic compounds are the waterproofing substances employed; one of these is melted and revolved in a heated centrifugal machine with boiling water, by which treatment it becomes so finely divided that it will remain suspended for a long period without separation.

The goods are impregnated with the emulsion and in the drying process which follows the water evaporates, and the emulsified substance melts and penetrates the fabric, thus rendering it waterproof. Only small quantities of the substance are required, and the appearance of the fabric is not affected.—R. B. B.

Cuprammonium Solutions; Preparation of —. M. Fremery, E. Bronnert, and J. Urban. Amer. Pat. 658,632, Sept. 25, 1900. Chem. Zeit. 1900, 24, [83], 906.

A MIXTURE of copper and 16 per cent. ammonia solution is treated with air, the temperature being maintained below 5° C.—A. S.

Artificial Leather; Process for the Manufacture of —. Leipziger Färber- u. Zeugdr.-Zeit.

See under XIV., page 52.

PATENTS.

Fibre applicable to all sorts of Weaving and Spinning, and Processes for the Treatment or Separation of Same; Improved —. G. C. Dymond, Liverpool. From L. Cruz - Pasqual - de - Bonanza, J. Selva-Javaloyes, Diego Quilez-Quilez, M. Gomez-Valdivia, and A. Alonso-Blasco, Elche, Alicante, Spain. Eng. Pat. 16,811, Aug. 18, 1899.

THE fibre from palm limbs is extracted in three ways. (1) The limbs are digested for five hours in boiling water or soda-lye (sp. gr. 1.045) at 90° C., and then passed, when dried, through rollers to squeeze out gummy matters. The fibres are then treated in the usual way to prepare them for spinning, &c. (2) The chemical method consists in first drying the limb, and then digesting it for 48 hours in soda-lye of 8° B. The fibres are now separable, and are washed well with water for 24 hours and then treated with a mixture of equal parts of coconut-oil and colophony. They are then treated for four hours in a bath of dilute sulphuric acid of 5° B. (3) The third process consists in first combing or hackling the limb and afterwards digesting in soda-lye.—C. M.

Retting or Steeping Flax; Method of and Apparatus for —. A. Badoil, Marseille. Eng. Pat. 20,907, Oct. 19 1899. (Foreign Application, April 15, 1899.)

BUNDLES of flax are placed in a series of tanks, which latter are divided into compartments, horizontally and vertically. The horizontal divisions are made by perforated grid-plates. Each division is arranged so that a cage can fit into it. The whole is covered by a non-perforated plate and a lid. The bundles are first digested in a soap solution at 70° to 80° C. for two hours, 8 kilos. of soap to 100 kilos. of stalks is the proportion. The fibres are then removed, passed through fluted rollers and then digested with hydrochloric acid solution (3 litres of acid to 30 litres of water for each 100 kilos. of stalks) at 60° C. for one hour. After draining and



washing, the stalks are bleached in a solution obtained by mixing 10 kilos. of chloride of lime, and 10 kilos. of sodium carbonate in 1,000 litres of water, this process being carried on at 30° C. for three hours. The flax is afterwards washed well with water, and dried in a hydro-extractor.

—C. M.

Mercerising, Scouring, or Dyeing Yarns; Apparatus for — W. Macconel, Netherlee, Renfrewshire. Eng. Pat. 1736, Jan. 27, 1900.

An apparatus consisting of a series of tanks containing the various liquids and an overhead rail. This rail is undulated, and carries on frames the yarn to be treated. As the pulley travels, the yarn dips alternately into the liquids, and is then raised to clear the tank before going on to the next.

The frames are arranged so that the yarn may either be stretched or remain unstretched.—C. M.

Textile Fabrics; Manufacture of — E. Marty, Riberac, France. Eng. Pat. 13,084, July 20, 1900.

FABRICS are made by spinning camels' hair, and then weaving alone or weaving with other materials, such as cotton, hemp, &c., according to the quality required. It is claimed that fabrics made with camels' hair resist heat, water, sugar, acids, &c.—C. M.

Impermeable Threads and Fabrics; Production of — W. G. Heys, Manchester. From E. Sénéchal de la Grange, Paris. Eng. Pat. 16,332, Sept. 14, 1900.

It is claimed that the following mixture can be made into perfect threads by any process by which artificial silk is made:—100 kilos. of dry nitrated cellulose is mixed with 15 kilos. of indiarubber solution, and 5 kilos. of stannous chloride.—C. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Stains and Unevenness in Dyed Woollen Tissues; Some Causes of — G. Robrecht. *Färber-Zeit.* 1900, 11, [22], 349—352.

STAINS and cloudy patches in woollen tissues are sometimes caused by imperfect wetting-out of the latter when they have been sent into the dyehouse in the dry state. The tissues should be passed through boiling water to ensure complete saturation before being dyed. Tissues which are received in the dyehouse in the wet state are better not so treated, provided that they have been well washed after milling, as the water is apt to produce stains in them. This is especially the case when pale colours are dyed.

Unevenness in dyeing is often caused by defective construction and defective heating of the dyeing machines. Stains are due to dirty dye vessels and winches, dirty barrows or trucks (used in carrying the pieces to and from the dyehouse), soot from the works' chimneys, rusty iron nails (wooden pegs should be used) in the winches, resin in the wood of new dyeing machines, frothy dye-liquors, scum on the surface of the dyebath (frequently from the dyestuffs), oil drops from overhead shafting, dyestuff-dust blown about the dyehouse by draughts of air (due to faulty arrangement of the dyehouse), presence in the tissue of oxalic acid left after removing iron stains, drops from the roof or overhead beams (the last is a prolific source of stains).

In removing stains, not only the stained part, but the tissue for some distance about it, should be treated. The reagent, for instance, soap, must also be thoroughly removed before dyeing or redyeing.—E. B.

Aniline Black, over-dyed with Basic Dyestuffs; The Bronzing of — F. A. Roesler and H. Hackl. *Färber-Zeit.* 1900, 11, [22], 357—358.

THE bronze-like appearance of Aniline Black, which has been printed upon cotton tissues and dyed over or "topped" with basic dyestuffs, is principally due to the colour-lakes being superficially deposited upon the printed parts, but is partly

due to the nature of the Aniline Black and of the dyestuff employed. The defect is strongly shown with Magenta, Methyl Violet, Crystal Violet, Victoria Blue, and Brilliant Green, less so with Methylene Blue, New Methylene Blue, Capri Blue, Nile Blue, Safranin, and Methylene Violet 3 R A extra. To prevent it to some extent, the following method of dyeing is recommended:—Mordant the printed tissue with an acetic acid solution of tannic acid, fix with tartar emetic, thoroughly rinse to remove the imperfectly fixed mordant, dye for some time in the cold with the basic dyestuff, next raise the temperature to 38° C., and maintain this temperature till the bath is exhausted, then add acetic acid and carry the temperature to the boiling point. The tissue is afterwards well washed and dried. Dyeing at the ordinary temperature has the effect of causing the dyestuff chiefly to become fixed upon the unprinted parts of the tissue. The object of the addition of acetic acid, and of the boiling of the dyebath, is to remove the loosely fixed colour-lake.—E. B.

Unions with Diamine Dyestuffs; Dyeing of — W. E. Fearnside. *J. Soc. Dyers and Colourists*, 16, [12], 258—263.

FOR drabs, fawns, &c., Diamine Catechin B is an ideal dyestuff, being fast to light, stoving and hot-pressing; in conjunction with Diamine Fast Yellow B and Diaminogen B, varied shades are obtained, which are level and fast to light.

In the dyeing of light shades, it is important to keep on the light side of the pattern, since, if the shade be too dark, it is very difficult to strip the wool, which indeed can only be done effectively by means of potassium permanganate and sodium bisulphite.

Again, in dyeing shoddy unions which have been stripped with potassium bichromate and sulphuric acid, it is best to neutralise the goods thoroughly with alkali previous to dyeing, otherwise uneven results will be obtained.

Dress goods and crépons containing mercerised cotton, are dyed with less sodium sulphate than usual, the material being entered into the dye-bath at or near the boil, and the boiling continued during the whole of the dyeing process in order to cover the wool. (The ordinary process consists in dyeing for a considerable time below the boil.) In this connection, avoid dyestuffs which have a greater affinity for cotton than wool. In the case of dark shades, the mercerised cotton has a tendency to dry up "bronzey," but this appearance can be removed by running the goods for 15 minutes in a fresh hot bath containing sodium sulphate. In all cases, the addition of a small amount of acetic acid in washing is recommended.

Two-coloured ("shot") effects upon crépons are obtained by dyeing the wool with acid dyestuffs, washing and dyeing the cotton in a cold concentrated bath containing sodium sulphate and carbonate and substantive dyestuffs; Diamine Black R M W, Diamine Black B H, Diamine Sky Blue, Diamine Fast Yellow A, and Diamine Orange D, are largely used in this connection.

However, where the cotton is to be dyed black, the following process is employed:—Dye the cotton with Diamine Black B H at 100° F. (if higher temperature, the wool will be stained), diazotise and develop with phenylene diamine, and finally dye the wool in acid bath.

Quite recently a new method of dyeing, by a combination of the dyeing and milling process, has been adopted, chiefly for the production of black. A full black is obtained by adding 1—1½ per cent. of Milling Black B to the soap solution and milling for at least 60 minutes; the wool, which is only slightly but uniformly tinted, is dyed in acid bath with 2—5 per cent. sulphuric acid, and the boiling is reduced to a minimum in order to diminish the bleeding effect of the cotton.

The addition of sodium sulphate in the milling yields a more intense black, but this advantage is more than counter-balanced by the increased scouring which is necessary to remove the soap in the presence of a salt, and which consequently diminishes the intensity of the black. In all cases, scouring must not be done at a temperature above hand-warmth nor for too long a time.

Generally, most substantive dyestuffs can be applied in the manner described, only they are not fast enough to acids



to withstand cross-dyeing. However, for mixtures in which the wool has been dyed either in the loose state or as yarn, the cotton is advantageously stained or even dyed to shade, by adding the dyestuff to the soap solution in the milling process; moreover, this procedure is more economical than the older process of dyeing the cotton cold in the washing machine.—J. E. H.

Linen Dyeing; Some Notes on —. *Textile Colorist*, 22, [262], 291—292.

In dyeing with the basic colours, if full shades be required, it is necessary to mordant the linen before dyeing, by steeping it in a solution of tannic acid, varying in strength from 1 lb. for pale shades to 3 lb. for deep shades, allowing the linen to remain in this mordanting solution from 6 to 12 hours, according to the depth of shade required.

When dyeing bright colours, the best tannic acid should be employed; for dark shades, sumach may be used with advantage. After mordanting, the tannin is fixed on the linen fibre by steeping the goods for half an hour in a solution of tartar emetic, the amount employed being equal in weight to that of the tannin used. If only pale shades are required, it is not necessary to mordant the linen before dyeing. The dyeing is best effected by working the goods for 20 minutes in a cold solution of the dyestuff, then gradually raising the temperature to a boil, and finally working the goods for half an hour at this temperature. The goods are then washed in water and dried.

The Rosaniline Blues require the addition of 5—8 lb. of alum to each 100 galls. of the dye-bath, in order to thoroughly fix the dye on the linen fibre, and the temperature of the dye-bath should not exceed 180° F. or the colour is liable to be injured; it is recommended to allow the linen to remain in the bath until the latter has cooled down to 100° F. before removing the goods.

In dyeing with the direct cotton dyes, the most economical results are obtained by making the dye bath as strong as possible, and dyeing at a boil; about 10—20 lb. of Glauber's salt or common salt are added to the dye-bath for each 100 lb. of linen to be dyed. The dye-bath is seldom exhausted of colour; it is therefore economical to retain it for future use, adding from two-fourths to three-fourths of the original amount of dyestuff used for each succeeding lot of goods to be dyed. Some of the direct dyestuffs may be treated with chromium chloride, chromium fluoride, chromium sulphate, potassium bichromate, or copper sulphate, in order to increase the fastness of the colour to washing and light, and in some cases to increase the depth of shade; the quantities recommended are 7—9 oz. for medium shades and 2—3 lb. for deep shades.

Many of the direct dyes may be diazotised and developed after dyeing by treatment in a cold solution of sodium nitrite and hydrochloric acid for 15—20 minutes, using 1—3 lb. of sodium nitrite according to the depth of shade required, together with three times this amount of acid; the goods are now transferred for 15—20 minutes to the developing bath, which contains β -naphthol, resorcinol, phenylene-diamine or some other developer.

The "Sulphyl dyestuffs" are useful for dyeing linen. Among these are the Immedial Blacks, Blues, and Browns, &c., &c. In using these colours the linen is dyed in a very strong dye-bath at a boiling temperature, keeping the goods underneath the surface of the liquor during the dyeing. The dye-bath may be used over again by strengthening it with 50—70 per cent. of the original quantity of the dyestuff used. After dyeing, the excess of liquor is squeezed out of the goods and returned to the dye-bath, the linen being then well washed and treated with a solution of potassium bichromate or copper sulphate in order to develop and fix the colour on the fibre.—M. C. L.

Lactic Acid in Calico Printing; Some Applications of —. F. Oswald. *Bull. Soc. Ind. Mulhouse*, Sept.—Oct. 1900, 343—346.

Of the two isomeric modifications of lactic acid, only the α -hydroxypropionic acid is of interest to the calico printer. Its chief value depends on the fact that a solution of considerable strength, *viz.*, 16° B. can be prepared containing the lactates of aluminium, tin, and calcium, whereas it is

not possible to prepare any other solution suitable for use in printing containing these three metals in combination with the same acid. The solution is made from 600 grms. of aluminium sulphate, 300 grms. of stannous chloride, 100 grms. of quicklime, and 1,000 grms. of lactic acid, these ingredients are heated together until dissolved, and yield about three litres of solution at 16° B. The printing colour is prepared with starch thickening, olive oil, Alizarin, and the above solution of lactates, or the last may be replaced by aluminium and calcium acetates, stannic oxide, and lactic acid. The colours are considerably brighter than when no lactic acid or lactate is used, and good results are also obtained with Alizarin Orange, Alizarin Bordeaux, &c.

The author's experiments point to the possibility of dyeing a Turkey-Red with only two paddings, the probable sequence of operations being as follows:—Pad with Alizarin and Turkey-Red oil with or without the addition of ammonia, dry, pad in solution of mixed lactates, dry, and steam.

Chromium lactate also possesses features of interest and is best prepared by dissolving chromic oxide in lactic acid. When this is used in printing with Alizarins, the shades are brighter than those obtained with the acetate or nitroacetate.

Lactic acid is useful in printing basic colours with tannin and tartar emetic, and especially in conjunction with Indulines.

Stannous lactate owing to its reducing properties can serve as a discharge for direct colours. If basic colours are added, coloured discharges are produced, but for a white discharge, stannous chloride is added to the thickened lactic acid. In either case printing of the discharge must be followed by steaming.

Finally, lactic acid may be employed in preparing a thickening to replace "acid starch thickening." For this purpose the starch is heated with water, and while still hot, the lactic acid is added and the mixture cooled.—R. B. B.

Irisamine in Calico-Printing; Application of —.

W. Hofacker. *Färber-Zeit.* 11, [21], 337.

IRISAMINE G (Cassella) is a new dyestuff of the Rhodamine series, and yields brilliant rose shades.

In addition to the usual mode of application with tannic acid and antimony, it may be fixed by means of a salt of chromium oxide (Cr_2O_3), in which case the shades are quite as fast to light and washing, and, if possible, more brilliant, than those obtained with tannic acid.

The fixation with chromium should be especially serviceable for the production of brilliant rose shades in combination with steam colours. The quantity of chromium acetate (18° B.) employed, must not exceed 50—75 c.c. per litre of printing colour.—J. E. H.

Colouring Matters [Blacks on Cotton] on the Fibre; Method for the Detection of Certain —. *Leipziger Färber- u. Zeugdr.-Zeit.* 1900, 49, [12], 487.

To determine whether black cotton has been dyed with the sulphur dyestuffs (Vidal, Immedial, Katigen, Sulphogen colours, &c.), the fibre is boiled with a solution of stannous chloride in hydrochloric acid. A strip of paper moistened with lead acetate solution is held in the steam from the boiling solution, and is coloured brown or black if sulphur colours be present.

Aniline Black is identified by treating the cotton for a short time with cold hydrochloric acid, when fibre and solution both become green. Aniline Black dyed by the one bath process, is distinguished from an oxidation black by the green colour of the ash in the former case, due to the presence of a large amount of chromic oxide; the one bath black also rubs off much more readily than the oxidation black.

In order to ascertain if Direct Blacks have been used in combination with Aniline Black, the cotton is boiled for some time together with white cotton in water containing a little soda; if Direct Blacks are present, the white cotton is stained. Should the dyed cotton bleed very strongly, and the reactions for Aniline and Sulphur Blacks be not given, the colour has been produced by means of direct dyestuffs alone.



Logwood may be detected by the red colour of solution and fibre when the latter is boiled with dilute sulphuric acid: on neutralising with soda, the red changes to a yellow. By repeated extraction with sulphuric acid, the logwood may be completely removed, and the fibre then tested for the presence of other colouring matters.

If tannic acid has been employed in conjunction with iron, the ash will contain a considerable amount of ferric oxide, and if this is the case, the presence or absence of logwood should also be determined.

Basic colours which are employed for topping or "blooming" blacks on cotton, may be extracted by cold concentrated alcohol, to which a few drops of hydrochloric acid have been added.—R. B. B.

Leather; Dyeing, Staining, and Finishing of —.

M. C. Lamb. *Leather Trades' Rev.* 33, [764], 871.

Continental Methods of Dyeing: The Two-Tray Method.—The skins to be dyed are divided into packs—say, for example, four packs. A strong solution of the dyestuff to be used is prepared, a quantity being dissolved sufficient to dye all the skins. This stock liquor is conveniently made up into four times as many pints of dye-liquor as there are packs to be dyed—in this case 16 pints. Two dye-trays are provided similar to English dye-trays, but not so deep, and three separate dye liquors are prepared with hot water, each sufficient to take one pack of skins, the skins being paired flesh to flesh. One of the liquors should contain one pint of the strong stock solution, the second two pints of the same, and the third one quarter of the solution that remains. These liquors may be termed respectively 1, or weak liquor; 2, or medium liquor; and 3, or strong liquor. The first liquor is poured into one of the trays, and a pack of skins worked in it, these being turned, just as is customary in the English tray method. The second, or medium liquor, is placed in the second tray, and the pack of skins is removed from the weak liquor and worked in the medium. By the passing of the pack of skins through the weak liquor, this becomes exhausted of its dye, and may be thrown away, and into the empty tray the strong liquor is poured, and in this strong liquor, the dyeing of the pack of skins is completed.

These two remaining liquors now form the weak and medium liquor for the next pack. The pack of skins is successively passed through the first, and then on to the second, the spent liquor is thrown away, and a fresh liquor is prepared with one-third of the remaining stock solution, poured into the empty tray, and in this strong liquor, the second pack goes through its final working. These two liquors now form the weak and medium liquor for the third pack. To finish this third pack of skins, one-half of the remaining stock liquor is used; and for the finishing of the fourth pack, the remaining stock liquor is put into the bath.

The temperature of the several baths should be between 45° and 50° C., and the packs should be worked in each bath from 5 to 10 minutes.

By the above process each pack of skins goes through three separate baths, commencing with a weak bath, when the skins are naturally greedy for the dye, and finishing with a strong hot liquor, which may be much stronger than the bath used in the ordinary English tray method. This finishing liquor produces a fullness and evenness of shade unobtainable by the English process, and the method is extremely economical in the use of dyestuffs.

The Dip Method.—A wooden vat or tray, 3 ft. in length, 1½ ft. in width, and 1 ft. deep, is tilted up lengthwise at an angle of about 45°, so that the dye liquor in the tray runs to its lower end. The skins to be dyed are paired, and are dyed pair by pair. About half the quantity of the concentrated dye solution usually required to dye a pair of skins is placed in the tray, together with hot water enough to make 1½ gall. The skins are worked up and down five or six times, being lifted out of the liquor each time. The remainder of the concentrated dye solution is now added, and the process repeated until the requisite depth of shade is acquired.

By this process only one pair of skins is dyed at a time, consequently, out of a pack of about four dozen skins at least half a dozen shades can be sorted out.

This method, usually adopted on the Continent, even ignoring its other disadvantages, is quite unsuitable for this country on account of the great amount of labour required for it, and the quantity of dyestuff wasted.

—J. G. P.

PATENTS.

Sulphur Dyestuffs; Method of Dyeing with —. O. Imray, London. From The Faröwerke vorm. Meister, Lucius und Brüning, Hoechst a/Main. Eng. Pat. 24,455, Dec. 8, 1899.

In this patent the application of the sulphur dyestuffs is described, after the manner employed in the hydrosulphite indigo vat, by first transforming them by means of hydrosulphites into their leuco derivatives, then dyeing with them in this form, and finally developing the colour by oxidation. The method of carrying out the process is exactly the same as with indigo, and indigo may be used in combination with the sulphur colours in this way. Other indigo vats, e.g., the lime and copperas vat, do not give similar useful results. The oxidation may be brought about either by exposure to air or by treatment with metallic salts or other oxidising agents.

Among the most suitable dyestuffs for this vat-dyeing process are Immedial Blue C, Immedial Black G, and V extra, Katigen Blue, Vidal Black, Clayton Fast Black D, and the dyestuffs obtained according to Eng. Pat. 24,538, of 1898 (this Journal, 1899, 1012).—R. B. B.

Dyeing or Printing with Azo Colouring Matters; Process for the Production of Grounds on Cotton in —. T. R. Shillito, London. From J. R. Geigy and Co., Basle, Switzerland. Eng. Pat. 25,618, Dec. 28, 1899.

In the production of grounds for azo-colours, e.g., Paratraniline Red, on the cotton fibre by means of phenols, naphthols, and their derivatives, a rosin soap, made from rosin and alkali, is added to the padding solution instead of Turkey-red oil, olive oil, or any of the additions hitherto employed. Or, the rosin soap may be separately applied previous to the application of the grounding solution.—R. B. B.

Discharging Indigo-dyed Silk Goods; Impts. in —. J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen a/Rhein, Germany. Eng. Pat. 2689, Feb. 10, 1900.

THE Indigo-dyed silk goods are first discharged in the usual or any suitable manner, e.g., with bichromate followed by sulphuric and oxalic acids, and subsequently submitted to the bleaching action of reducing or oxidising agents, such as sulphurous acid, in the gaseous or liquid condition, or as bisulphite, hydrogen peroxide, or other bleaching agent.—R. B. B.

Dyeing, Bleaching, and other Liquids and Gases, through the Materia contained therein; Sliver Cans or Receptacles to Permit of the Circulation of —. H. Honegger, Duisburg a/Rhein, Germany. Eng. Pat. 7214, April 18, 1900.

CANS for the reception of slivers during the bleaching and dyeing processes, &c. are furnished with a removable perforated cover, a perforated false bottom, and a solid real bottom with a hollow seating. This seating fits on a projecting hollow pin attached to the false bottom of the vessel containing the dye or other liquor, and the liquor is made to circulate through the slivers from below, returning to the outer vessel through the perforated lid of the sliver cans.

For the purpose of making the can in a smaller and more convenient form, it may be composed of two parts, the upper of which is a removable extension of the lower or actual can, and serves as a guiding arrangement when the slivers are laid on the drawing frame, as well as when they are compressed by the movable cover.—R. B. B.



VII.—ACIDS, ALKALIS, AND SALTS.

Potassium Chlorate; Electrolytic —. A. Bröchet. *Ind. Electrochim.* 1900, 4, 41—43. Through *Science Abstr.* 3, [11], 893.

CONTINUING previous investigations the author now concludes that in cold and only slightly alkaline or acid solutions of potassium chlorate, the only primary electrolytic product is hypochlorite, the reduction of which can be prevented by adding bichromate as proposed by Müller, some of this hypochlorite is then oxidised to chlorate in a manner not yet ascertained, but probably in part through the agency of bichromate, as there seems to be no electrolysis of water. In hot alkaline solutions the conversion into chlorate is more rapid, but not complete. The question of the direct formation of chlorate in more strongly alkaline solutions remains undecided, but the author agrees with Oettel.—W. G. M.

Chlorates; Decomposition of —. Part III. *Calcium Chlorate and Silver Chlorate*. W. H. Sodeau. *Proc. Chem. Soc.* 16, [229], 209.

WHEN calcium chlorate is decomposed slowly, about 0.6 per cent. of its total chlorine is evolved, whether the pressure be 760 mm. or 4 mm., but the proportion exceeds 2 per cent. when the decomposition under atmospheric pressure is rendered violent. As the proportion of free chlorine is independent of the pressure of the gaseous products, the calcium chloride in the residue is not produced by the action of chlorine upon oxide first formed.

When silver chlorate is heated to about 350° C. it explodes with a yellow flash, about 7 per cent. of its chlorine accompanying the oxygen. When slowly decomposed, the influence of pressure is even greater than in the case of lead chlorate. At atmospheric pressure, only 0.2 per cent. of its chlorine remains free, but 22.6 per cent. is obtained at 2½ mm. pressure, and more than 36 per cent. should be obtained if the action between chlorine and silver oxide could be completely eliminated.

It is concluded that oxygen and chlorine are produced during the slow decomposition of either chlorate by two simultaneous independent reactions represented by the equations $2M(ClO_3)_2 = 2MCl_2 + 6O_2$ and $2M(ClO_3)_2 = 2MO + 2Cl_2 + 5O_2$ (where M = Ca or Ag₂). With calcium chlorate the "chloride" decomposition proceeds at about 180 times the rate of the "oxide" decomposition, whilst with silver chlorate the ratio is less than 1.8 : 1.

The probability of the "oxide" decomposition being endothermic suggests an explanation of the increase of chlorine in rapid decomposition at high temperature.

Silver chlorate differs from the chlorates of potassium, barium, and calcium in its highly explosive nature and in the occurrence of an extremely strong secondary action between chlorine and the oxide, but resembles the chlorates of potassium, barium, calcium and lead, in that no free chlorine is produced by displacement from the chloride.

Iron Nitride. G. J. Fowler.

See under XXIV., page 77.

Electro-Chemical Industry in France. I. Guillet.

See under XI. A., page 48.

Sulphuric and Nitric Acid; Early Manufacture of —. Oscar Guttman.

See page 5.

PATENTS.

Acetic Acid of High Percentage and on a Large Scale, by means of Fractional Distillation; Process and Apparatus for the Production of —. E. Edwards, London. From The Krauschwitzer Thonwaarenfabrik für Chemische Industrie (vormals Ludwig Rohrmann) Company, Krauschwitz, Germany. *Eng. Pat.* 25,297, Dec. 20, 1899.

THE acetic acid vapour coming from the generating vessel is condensed in a long and capacious horizontal cooler,

whence the acid is led to three storing tanks, from any one of which it may flow through suitable valved pipes, by gravity, into a stone chamber of cubical form, lined externally with lead, heated by a steam coil, and provided at the top with a pipe leading to a stoneware condensing arrangement, whence the acid flows into a tank below. In connection with this there are two more stone retorts, each successively smaller than the preceding one, and similarly provided with condensing and storing adjuncts. The crude acetic acid received from the cooler into one of the storage tanks is of about 70 per cent. strength, and contains sulphurous acid; it is allowed to rest for 24 hours, when it is run into the first and largest of the stone retorts, till the retort is two-thirds full. The acid is then carefully heated, and the sulphurous acid which comes off first is allowed to escape. The weak acetic acid of the early part of the distillation is collected separately; apart from this, the first third of the distillate is of 56 per cent., the second of 70 per cent., and the last third of 85 per cent. strength. The first third condensed, is sold as 56 per cent. acid, whilst the other portions are oxidised by addition of 2 per cent. of sodium chromate, and, after rectifying, an acid is obtained of 90 per cent., which is oxidised by potassium permanganate, pure glacial acid being ultimately obtained, besides acid of intermediate strength.—E. S.

Sulphuric Acid by the Catalytic Process; Manufacture of —. E. Raynaud, Spy, Belgium, and L. Pierron, Jette Saint Pierre, Belgium. *Eng. Pat.* 16,254, Sept. 12, 1900. (Under Internat. Convent.)

IN case the temperature be kept uniform, at which combination of sulphurous acid with oxygen is effected by catalytic bodies, the gases are first brought into contact with such bodies containing but a small proportion of platinum (say about 5 per cent.), and next with bodies containing about 40 per cent. of platinum, and finally with such as contain about 10 per cent. A portion of the gaseous mixture while rich is thus "first converted by the substance of slight richness, and, as it becomes impoverished, it is subjected to the action of substances of greater richness which complete the conversion." The final contact with the poorer bodies causes the re-formation of any sulphuric acid first formed, which may, through excessive action, have become decomposed. Or catalytic bodies of uniform richness may be used, by such regulation of the temperature in the successive parts reached by the gases, that the reaction may begin at about 300° C., advancing to 500°, and then declining to about 400°, the variation of temperature acting similarly to the variation in the first example of the richness in platinum of the catalytic bodies employed. Hydrogen sulphide may, after purification, replace sulphurous acid in the process.—E. S.

Sulphurous Acid; Process for the Purification of —. E. Raynaud and L. Pierron, both of Belgium. *Eng. Pat.* 16,253, Sept. 12, 1900. (Under Internat. Convent.)

CRUDE sulphurous acid gas is passed through one or more towers charged with porous material, such as Kieselguhr, by which it is absorbed. The material is then heated by a suitable device, whereby the gas is said to be liberated in a pure state. Several towers or columns may be arranged to form a circuit, so that those in which the porous material is saturated may be cut off temporarily, and the gas set free.—E. S.

Hydrates of the Peroxides of Lime, Baryta, Magnesia, and the like; Manufacture of —. G. F. Jaubert, Paris, France. *Eng. Pat.* 17,460, Oct. 2, 1900.

TO obtain calcium peroxide hydrate, 78 parts of sodium peroxide is intimately mixed with 74 parts of dry hydrated lime, and the mixture is strongly compressed into cylinders of 500 grms. each. Such a cylinder is immersed in 5 litres of water with 1 kilo. of ice, in an enamelled iron vat, which is itself cooled. The temperature is kept below 10° C. After an hour or two, the cylinder is disintegrated, and the calcium peroxide may be separated by filtration, washed, and dried, first at ordinary temperature in a closed vessel,



and lastly at 100° C. or above. The filtrate consists of caustic soda solution. Barium peroxide and magnesium peroxide, and the like, may be similarly obtained.—E. S.

Peroxide of Sodium, either alone or with the addition of other Salts; Preparing Compressed —. G. F. Jaubert, Paris, France. Eng. Pat. 17,461, Oct. 2, 1900.

SODIUM peroxide is compressed in a steel pastille mould formed of a cylinder closed at one end and into which a punch is forced, giving a pressure of 7,000 kilos. on a surface of about 25 sq. cm., the cylinder being charged with 500 grms. of the powder. Such compressed peroxide is stated to have great advantages in use over the uncompressed peroxide, especially in respect to liability to explosive decomposition in presence of water, and dangers of fire. For some purposes, it is preferred to compress an intimate mixture of the peroxide with potassium bisulphate, for which latter the sodium salt, or oxalic or tartaric acid may be substituted.—E. S.

Solid Hydrosulphites; Manufacture and Production of —. J. Y. Johnson, London. From The Badische Anilin und Soda Fabrik, Ludwigshafen-on-Rhine, Germany. Eng. Pat. 901, Jan. 15, 1900.

FIRST example: zinc dust is added to a sodium bisulphate solution of stated density, and the solution, after filtering, is heated to 50°–60° C., and sodium chloride is stirred in; on cooling, solid sodium hydrosulphite separates in crystals. Second example: a strong, hot solution of zinc hydrosulphite is treated with sodium chloride to obtain crystals of a "new zinc-sodium double salt." If solid zinc chloride be dissolved in the zinc hydrosulphite solution, zinc hydrosulphite is obtained as a solid salt. Magnesium hydrosulphite solution, treated with sodium chloride, yields a magnesium-sodium hydrosulphite. Third example: sodium hydrosulphite solution, in which zinc chloride is dissolved, gives a precipitate, separable by filtration, of a "new zinc-sodium double salt." Fourth example: solid calcium chloride, or magnesium chloride, is dissolved in zinc hydrosulphite solution to obtain the zinc-calcium or the zinc-magnesium double salt. Fifth example: the paste from the filter or cake from the filter-press, obtained by the process described in the first example, is washed with acetone or alcohol or the like, until water is removed, and is then dried, preferably *in vacuo*. The same washing process is generally applicable. Reference is made to Eng. Pat. 19,762, 1899 (this Journal, 1900, 900).—E. S.

Alkaline-Earth Silicides, and a Combination of Silicon and Hydrogen, and Process for their Manufacture. B. J. B. Mills, London. From The International Chemical Company, New Jersey, U.S.A. Eng. Pat. 14,124, Aug. 7, 1900.

ALKALINE earth silicides are formed by reducing a compound containing the alkaline earth metal combined with oxygen and mixed with silica by heating with carbon in an electric furnace. A compound of silicon and hydrogen combined in equal molecular proportions, is made by reducing a mixture containing the alkaline earth metal and the siliceous material by heating with carbon in an electric furnace, and treating the resulting silicide with dilute acid. This yellow, crystalline, non-explosive compound is insoluble in water and in acids, and is decomposed by caustic alkaline solutions. Chemical compounds are claimed consisting of silicon combined with an alkaline earth metal in the proportions represented by the formula RSi_2 , R indicating the alkaline earth metal; and of silicon combined with barium in the proportion represented by the formula $BaSi_2$, these compounds being white, or bluish white substances of metallic appearance, having a crystalline fracture, and oxidising slowly in the air to silicon dioxide and an alkaline earth metal oxide, or to silicon dioxide and barium oxide and are decomposed by pure water, with the formation of the alkaline earth metal hydrate, silica, and free hydrogen or of barium hydrate, silica, and free hydrogen respectively.—G. H. R.

VIII.—GLASS, POTTERY, ENAMELS.

Pottery Glazes; Solubility of Certain Lead Glasses or Frits used in the Preparation of —. W. Jackson and E. M. Rich. Paper read before the Manchester Lit. and Phil. Soc. Chem. Trade J. 1900, 27, [702], 331.

THE authors carried out experiments to determine what factors, apart from chemical composition, affect the amount of lead oxide dissolved on treating lead frits with dilute hydrochloric acid. The results show that the solubility is increased in a very marked manner by increase of fineness, the solubility of the same frit, reduced to different degrees of fineness, varying from 1 to 15 per cent. of the material used. After the action of the acid has proceeded for a short time, the whole of the soluble lead appears to have been extracted. It was found, however, that this was not due to the absolute insolubility of the remainder, but to the formation of an insoluble layer on the surfaces exposed to the action of the acid, which protects the enclosed particles from further action. When this layer was removed by chemical or physical means, it was found possible to extract more lead oxide from the frit, and by continually removing this insoluble layer, practically the whole of the lead oxide could be extracted.—A. S.

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

Timber; Preservation of —. O. Chanute. Eng. and Mining J. 1900, 70, [21], 606.

THE more important of the new methods for the preservation of timber are as follows:—

The Creo-Resinate Process.—In this process it is proposed to use creosote and resin, together with a small percentage of formaldehyde.

The Water-Creosote Process.—An emulsion of creosote and water is forced into the wood.

The Hasselman Process.—The wood is boiled in a solution of the sulphates of copper and iron with alumina and kainite.

The Allardyce Process.—The wood is treated first with a solution of chloride of zinc and then with tar oil.

The Naphthenic Acid Process.—This consists in "injecting into the wood a solution of a copper salt of naphthenic acid, the naphthenic acid being obtained from Russian petroleum.

The author recommends the adoption in the United States of the following three features of European practice:—

(1) The careful testing, chemically, of the antiseptics to be injected.

(2) The uniform injection of the wood with stated and liberal quantities of the antiseptics.

(3) The adequate seasoning of the wood before treatment. This is stated to be essential, if good results are to be obtained; otherwise the antiseptic will not be uniformly distributed, and some portions of the wood will decay before others.

The author concludes from his experience that if "the ties (wood) are injected with reasonable uniformity, and with the equivalent of $\frac{1}{2}$ lb. of dry zinc chloride to the cubic foot, as is done in Germany, "Burnettizing" makes them last 10 to 12 years in the track, with ordinary exposure; while perhaps half that quantity will produce the same result in the more arid regions of the United States; that the zinc-tannin process will impart to them a life of 12 to 14 years, and the zinc-creosote process may extend this to 14 or 16 years."—A. S.

Mortars [Cement]; Injurious Action of Saline Liquids on —. Deval. Bull. Soc. d'Encouragement, 1900, 6, [11], 669.

TABLETS, 2 mm. in thickness, cut from briquettes made from pure Portland cement, were immersed in water for periods of seven days, three months, and six months respectively, after which they were placed in solutions of



magnesium sulphate and calcium sulphate, and the time noted of the first appearance of disintegration and their final destruction. The results obtained, confirm the observations of Vicat, *viz.*, that old mortars better withstand the action of sea-water than freshly made ones.—H. H. B. S.

Portland Cement; Manufacture of —, from Blast-Furnace Slag by the Forell Process. C. Steffens. Chem. Zeit. Rep. 1900, 24, 359.

THIS process has been working satisfactorily for several years in the Lollar Portland Cement Works. The raw materials, consisting of wet granulated slag and hard limestone, are broken, mixed, and passed through a drying chamber heated by the hot gases from the kiln. The dried mixture is finely ground, and is then mechanically conveyed to the revolving kiln, which is a special feature of the process. The clinker, on leaving the kiln, is white hot, and only loosely balled together. The usual operations of making into balls and drying are entirely dispensed with. The total consumption of coal amounts to from 18 to 20 per cent. of the clinker produced. The cement is of good quality, and the process is expected to be put in operation at other works when the prejudice at present existing against slag cements has disappeared.—H. H. B. S.

X.—METALLURGY.

Iron and Steel Production; Direct —. C. Otto. Chem. Zeit. 1900, 24, 1033—1034.

BLAST-FURNACE practice in America has shown that the coal consumption in the Leadville furnaces is higher than in those of Pueblo, which are at an elevation 5,000 ft. lower. This is due to the lower atmospheric pressure at the higher level. By working under pressure several advantages would be gained, and notably an economy in time. Although a good ore mixed with carbon is readily reduced in the earlier stages of the reduction, six hours is necessary to complete the reaction. But by invoking the assistance of mechanical energy the time may be shortened. By thermal calculations it is shown that if the reduction be effected at a pressure of one atmosphere above the normal, the time of reduction may be reduced by one-half, the external heat applied being, of course, increased in correspondence with the reduction in the time, and the ore being sufficiently finely crushed to allow of the reaction being completed in the shorter period. By doubling the difference of temperature between the inside and the outside of the reduction vessel, the time of reduction may be again reduced by one-half. Such a pressure-furnace (working at +1 atmosphere pressure) has been tried by Bessemer. Cast steel has been made experimentally in a similar way by a Westphalian works. 1.5 kilo. of scrap-steel with 5 kilos. of ore and 1.25 kilo. of wood-charcoal dust were placed (in a crucible) first in an ordinary wind furnace, and then in a special blast furnace, with the result that 4.575 kilos. of cast steel were produced, containing, per cent., 0.46 C., 0.07 Si, 0.07 Mn, and 0.014 S.—W. G. M.

Soft Steel and Wrought Iron; Influence of Copper in Retarding Corrosion of —. F. H. Williams. Proc. Eng. Soc. Western Pennsylvania, 16, Sept. 1900, 231—232.

THREE pieces of soft Bessemer steel containing 0.078, 0.145, and 0.263 per cent. of copper, and one piece without copper, were dipped simultaneously into water and hung up to dry many times a day for a month, and were then cleaned from corrosion, and the loss in weight determined. Whilst the loss in the steel was 1.85 per cent., the losses in the copper steels were respectively 0.89, 0.75, and 0.74 per cent. only. Similarly, whilst a soft steel lost 1.65 per cent., and three samples of wrought iron lost 0.76, 0.80, and 0.87 per cent., a wrought-iron containing 0.393 per cent. of copper lost only 0.53 per cent. Consequently copper not only reduces the corrosion of soft steel to within that of wrought-iron, but reduces the corrosive susceptibility of the latter metal as well.—A. W.

Iron and Alloys of Iron; Effect of Temperature on Magnetic Properties of —. R. L. Wills. Phil. Mag. 1900, 50, 1—37; through Science Abstr. 3, [11], 879.

EWING has divided the process of magnetising magnetic metals into three stages: (1) where there is low permeability and almost no retentiveness; (2) where the magnetisation curve rises rapidly and permeability is high; and (3) where permeability decreases and the saturation point is approached. Heat causes the transition from stage to stage to occur under a lower magnetising force, and the author now reports the effect of temperature on the permeability for low magnetising force. Rings of iron and of Fe—W, Fe—Al, and Fe—Ni, and of a steel containing Cr and Mn, non-magnetic when unannealed, but magnetic after annealing, were wound with the magnetising coils, and the induction was measured ballistically on reversing the magnetising current. By raising the temperature gradually under constant magnetising force, permeability-temperature curves were obtained for different values of the magnetising force. These are now published, together with μ -H curves for constant temperatures up to 800° C.

—W. G. M.

Gold Ores at Cripple Creek, Colorado; Sampling and Milling of —. S. F. Hazlehurst. Eng. and Mining J. 1900, 70, [19], 545.

THERE are five samplers now in active operation in the Cripple Creek district, whilst another one will be ready about the beginning of 1901. The sampler of the National Gold Extraction Company has a capacity of about 200 tons a day. The ore is first passed through a Blake crusher, 9 by 15 ins.; then through a set of rolls, 14 by 24 ins.; after which it is screened through a $\frac{1}{4}$ -in. mesh, and passed into a "Vezin cut-out," by which it is reduced to $\frac{2}{3}$ of its bulk. It is then "coned" and quartered, passed through an Engelbach grinder, and dried over steam pipes. The method of sampling employed by the other companies is essentially the same as the foregoing, but the Rio Grande Sampling Company can deal with 400 tons, the Eagle Ore Sampling Company with 450 tons, and the Taylor and Brunton and Cripple Creek Sampling and Ore Companies with 600 tons a day. In the milling establishment of the Colorado Ore Reduction Company there are a cylindrical drier of the White-Howell pattern, a system of fine-crushing rolls consisting of three sets of Davis rolls, 14 by 27 ins., with six sets of revolving screens, and a Ropp roaster. The ore is crushed to $\frac{1}{2}$ -in. mesh, dried, reduced to a No. 24 mesh in the fine-crushing apparatus, and then roasted. The roasted ore is treated either by the cyanide process or by chlorination, according to its character. For the cyanide process, there are four tanks of 50 tons capacity each, two of 65 tons each, and two of 150 tons each; all the tanks are provided with filter bottoms. After the ore-pulp has remained a sufficient time in contact with the cyanide solution, the latter is drawn off, the pulp is washed with water, and the residual tailings are sluiced over a system of riffles, in order to obtain as complete an extraction as possible. The gold is recovered from the cyanide solution by precipitation with zinc, and is worked up in the usual manner.

For the chlorination process, there are three barrels, two of 10 tons capacity each, and one of five tons; they are lined with sheet lead, and are provided with filter bottoms of hard wood and lead, and with covers which can be screwed on; they are mounted on trunnions. The roasted ore-pulp is introduced, together with the requisite quantities of bleaching powder, sulphuric acid, and water, into the barrels, and the latter are set in motion. After a sufficient time, the chloride of gold solution is drawn off, the pulp washed with water, and the gold precipitated from the solution by sulphuretted hydrogen. The solution is allowed to settle, and any slime which may be held in suspension is recovered by passing the supernatant liquid through a filter-press. The sulphide of gold is roasted in a muffle until free from sulphur, and is then melted and cast into bars.

The Economic Gold Extraction Company's mill has a capacity of 300 tons a day, and comprises six rolls, 16 by 36 ins., each of which is fed from a 5-ton hopper; inclined screens; seven roasters of the Argall type; and an "economic ore cooler," of which the following is a brief



description:—"It is a shell, 18 ft. in length by 6 ft. in diameter, a continuous channel 360 ft. long being made inside by pieces 2 by 4 ins., riveted to the shell, 12 ins. apart. It is raised at the far end, where it is furnished with discharge spouts; the cylinder revolves under water, which is constantly cooled by a sprayer." The capacity of the cooler is about 60 tons in 24 hours, and the temperature is reduced from 1,600° F. to 150° or 200° F.

The ore is crushed by the rolls, and, after passing over the screens, has become reduced to from No. 16 to 20 mesh. The crushed ore is roasted, cooled, and then treated by chlorination in the usual manner. The mill tailings are subjected to further treatment on Wilfley tables.—A. S.

Telluride Gold Ores of Cripple Creek, Colo., and Kalgoorlie, West Australia. T. A. Rickard. Eng. and Mining J. 1900, 70, [21], 611.

In the Cripple Creek district, Colorado, the lodes partake of the composition of the prevailing rocks, which is mainly andesitic breccia, lying upon granite, with bodies of phonolite, trachytic phonolite, nepheline basalt, &c., penetrating both the granite and the breccia. At Kalgoorlie the prevailing rock is schistose, and the lodes are generally bands more highly schistose than the encasing rock, and impregnated to a notable degree with disseminated pyrites and secondary calcite.

The ores from Cripple Creek and Kalgoorlie present appreciable differences in chemical composition. The Cripple Creek ore contains a high proportion of alumina, ranging from 15 per cent. in the granitic ores to 25 per cent. in those occurring with phonolite and allied rocks; a trace of magnesia; up to 4 per cent. of lime; from 55 to 70 per cent. of silica, the amount being highest in the granitic ores; and from 1.5 to 2 per cent. of sulphur. The Kalgoorlie ore contains from 2 to 12 per cent. of alumina; from 5 to 15 per cent. of secondary carbonates of lime and magnesia; from 45 to 60 per cent. of silica; 1—2.5 per cent. of titanate acid; and from 4 to 8 per cent. of sulphur. In both ores the percentage of iron is a little higher than that of sulphur, but in about the same ratio.

The Kalgoorlie ore is the better from the smelters' standpoint, being less silicious and containing a much smaller percentage of alumina. The Cripple Creek ore can only be smelted satisfactorily when mixed with other ores, so as not to impair the fusibility of the slag.

The Cripple Creek ore can be satisfactorily treated by either the cyanide or chlorination process. The Kalgoorlie ore is not suitable for chlorination, on account of its high percentage of lime and magnesia, but is very amenable to cyanidation.

The Kalgoorlie ore yields the finest specimens of the telluride of gold, calaverite; samples analysed had a specific gravity of 9.377, and contained nearly 42 per cent. of gold, with less than 1 per cent. of silver. In the Cripple Creek ore, the calaverite is generally finely disseminated, and somewhat obscured by the presence of sylvanite; it has a specific gravity of 9, and contains 38—40 per cent. of gold, and about 3 per cent. of silver.—A. S.

Gold Ores at Mount Morgan, Queensland; Chlorination of —. E. W. Nardin. Proc. Inst. Civil Eng. 142, [4].

The lower-grade ore, containing about 11 dwt. of gold per ton, is treated with a solution of chlorine gas in water, and the gold precipitated with charcoal. The plant at the new West Works, which is capable of treating 100,000 tons of ore annually, consists of 16 vats, each of 100 tons capacity, four chlorine stills, one set of four towers in which the gas is absorbed by trickling water, four closed-in storage tanks for the chlorine solution, four similar gold-liquor storage tanks, 12 charcoal filters, three vacuum and three force pumps. The chlorinating vats have each a false bottom of wood, upon which are layers of gravel and sand of decreasing size. The finely ground ore is thrown in on the top of this, and the chlorine solution run in above and withdrawn below by the aid of a vacuum of about 5 lb. per square inch. The escaping liquors from each vat are tested until they contain plenty of free chlorine, when washing water is run through.

The parts of the plant are built at different levels, to avoid pumping as much as possible. The stills are made of flags, 5 ins. thick, jointed with india-rubber, like ordinary chlorine stills for the making of bleaching powder. The joints of all the pipes carrying chlorine gas or solution are also "grouted" with tar and fireclay, &c. The gold-liquor pipes, pumps, &c., are made of the usual cast-lead, hardened with a small percentage of antimony. The filtering vats have a wooden false bottom covered with cheese cloth, on which is put about 2 ft. of finely crushed charcoal, which is afterwards burnt and the ash smelted. The sulphuric acid for making the chlorine is manufactured at the Company's works from imported sulphur. The cost for chlorine alone amounts to a trifle over 5½d. per lb., and the total cost for chlorinating and precipitating is about 4s. 4½d. per ton of low-grade ore, with an extraction of 92.06 per cent., leaving 22 grains in the residue.

The treatment of the richer ore, of an average of about 4 oz. of gold per ton, at the top works, is exactly the same, after the ore has been roasted to get rid of the 11 per cent. of sulphur which it contains. The extraction in this case is 95 per cent., leaving about 4 dwt. 6 grains in the residue. The chlorinating period, however, is much longer, with a consumption of 11.47 lb. of chlorine per ton of ore, as compared with 2.51 lb. for the low-grade material.—A. W.

Platinum; New Method of Separation of the Metals accompanying —. E. Leidié. Comptes Rend. 131, [22], 888—891.

1. *Elimination of Foreign Metals.*—The residues from the extraction of platinum and iridium are roasted in the air, reduced in hydrogen, washed with hydrochloric acid, and again reduced in hydrogen. They are then mixed with twice their weight of common salt, and heated to redness in a stream of chlorine, any volatile products being collected. These products and the residue are extracted with water, and the process is repeated with the insoluble portion. The aqueous solution is allowed to stand for a day, filtered from any insoluble chlorides, heated to 100° C., and a slight excess of sodium nitrite added, when any iron falls as ferric hydroxide, and any gold as metal. On now adding sodium carbonate, all the other metals are precipitated, while the platinum, palladium, iridium, rhodium, and ruthenium remain in solution as sodio-nitrites, the osmium as sodium chloro-osmite. The liquid is heated to boiling, and filtered.

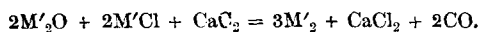
2. *Separation of the Platinum Metals.*—(a) Excess of sodium hydroxide is added, and a stream of chlorine passed through the liquid contained in a distilling apparatus entirely of glass, at first in the cold, afterwards at 50°—60° C. The distillate of perosmic and per-ruthenic anhydrides is received in dilute alcohol, which reduces the anhydrides to the metallic state. The two metals are separated by the method of Deville and Debray. (b) The alkaline liquid is now saturated whilst hot with hydrochloric acid, enough sodium nitrite added to convert the chlorides again into the double nitrites, and ammonium chloride added to saturation. Iridium and rhodium are precipitated as ammonio-nitrites. These are dissolved in hot hydrochloric acid, the solution evaporated and treated with water, and the solution saturated with ammonium chloride; the rhodium remains dissolved, while ammonium chloro-iridate is precipitated. This is collected, dried, and heated to 450° C. with sodium chloride; the sodium chloro-iridate formed is soluble in water, and is thus separated from any double rhodium salt it may have contained. The solution is precipitated with ammonium chloride as ammonium chloro-iridate, which gives the metal as reduction in hydrogen. The rhodium salt from which the iridium has been separated is concentrated to crystallisation; the crystals are redissolved, transformed into sodio-nitrite, then into ammonio-nitrite, which is precipitated (any iridium present remaining in the solution, provided that it be not saturated with sal-ammoniac); this precipitate is converted into double chloride, which is then reduced by hydrogen. (c) The liquid from which the rhodium and iridium have been precipitated is evaporated to dryness, the residue heated with hydrochloric acid, dried, and calcined. From the residue, the alkali



salts are dissolved out by water, and the remaining metals dissolved in aqua regia; the excess of acid is evaporated, the residue dissolved in water, and a reducing gas (preferably nitric oxide) passed through. On now saturating with ammonium chloride, ammonium chloroplatinate falls, which is collected, recrystallised, and reduced in hydrogen. To the mother-liquor, mercuric cyanide is added, when palladium cyanide is precipitated. This is decomposed by heat, the palladium dissolved in nitric acid, and converted into ammonium chloro-palladate, which is reduced in hydrogen at a red heat, and the metal cooled in carbon dioxide.—J. T. D.

Calcium Carbide and Silicon Carbide as Reducing Agents for Metallic Oxides, Salts, and Earths. B. Neumann. Chem. Zeit. 1900, 24, 1013—1014.

MOISSAN, Warren, and Frölich have, at different times, described the use of calcium carbide as a reducing agent for metallic oxides. This reduction takes place in accordance with the equation $3M'_2O + CaC_2 = CaO + 3M'_2 + 2CO$, where M' is a monovalent metal; it is readily effected, but leaves the reduced metal mixed with lime, which is only fluxed with difficulty. The author uses salts, and preferably haloid salts, a certain (sufficient) amount of oxide being added to allow of the removal of carbon as carbon monoxide, according to the general equation—



By this means, using salt or $NaCl + KCl$ as a flux, and heating the whole mixture in a crucible, Ag, Cu, Ni, and Pb are readily reduced and recovered in quantity; Sn and Zn are for the most part volatilised; Fe, Cr, and Mn do not yield a regulus of metal. Alloys also, such as bronze, brass, and German silver, can be produced from mixed chlorides. In all these reductions carefully dehydrated chlorides should be employed. If $NaCl$ be substituted for part of the metal chloride, sodium is reduced, but is distilled off, an attempt to prepare a lead-sodium alloy having proved unsuccessful.

Sulphates are also reduced ($M'_2SO_4 + 2M'_2O + CaC_2 = 3M'_2 + CaSO_4 + 2CO$), but fluorspar or other flux is required for the $CaSO_4$ produced. Ni and Pb were thus reduced, but Fe, Cr, and Mn gave no regulus. Mixtures of $CuSO_4$ and SnO_2 , and $ZnSO_4$ and CuO , gave bad results. Sulphates mixed with CaC_2 , without the addition of oxide, yielded sulphides (as, for example, Cu_2S).

Carbonates behaved, in the main, like sulphates, white-lead ores and malachite giving good results. Roasted *erubescite* gave a black copper, owing to the iron present; roasted $PbS + ZnS$ gave a brittle crystalline mixture of zinc and lead. Tinstone and raw calamine each gave a low yield of metal. Mixtures of tinstone and copper ores produced an inferior ferruginous alloy; copper ore, with calamine was, however, more satisfactory. Molybdenum glance gave minute grains of metal. Spathic iron ores, hematite, and garnierite were not reduced.

Other carbides, such as silicon carbide, gave similar results, soda being added in this case to flux the silica produced. Even, however, with calcium carbide at its present low price (other carbides are excluded by their cost), the process is not likely to find an application on a large scale. The use of oxides and chlorides alone need be considered; but chlorides require an expensive dehydrating process, whilst oxides from roasted ores are usually too impure. Hence, for the ordinary metals, reduction by carbon is cheaper, whilst for the more valuable metals the method of reduction with the aid of aluminium (requiring as it does no extraneous heat) is preferable. Frölich has stated that about $\frac{1}{10}$ — $\frac{1}{4}$ ton of CaC_2 is required to reduce 1 ton of Cu; but, according to the author's figures, 342 kilos. of the pure carbide—much more, therefore, of the commercial carbide—would be used per 1,000 kilos. of copper.—W. G. M.

Uranium and Vanadium Ores; Analysis of —. O. P. Fritchie.

See under XXIII., page 70.

Ferrochrome; Determination of Carbon in —.

A. A. Blair.

See under XXIII., page 70.

PATENTS.

Iron and Steel Wire, Rods, and the like Articles; Forming a Protective Coating on —. O. G. Moseley, Manchester. Eng. Pat. 24,496, Dec. 9, 1899.

THE coating is produced by enclosing the article within a tube or chamber, heating it by a current of electricity passing through it, and surrounding it with a "barfing" agent, which may be the usual hot producer-gas of the Bower-Barff process, or preferably the hot products of combustion of gas or oil mixed with, and injected into the chamber by dry steam under pressure, in such a manner that little or no air is drawn in at the same time.

An apparatus is claimed for this purpose illustrated for the treatment of wire. It consists of a tube closed at both ends except for small central holes to allow the wire to be drawn through from one drum on to another. Close to the entering end is a side tube connected with the dry steam injector, the latter being conveniently arranged between the fuel burners, which are under a small hood, so that the injection of the steam draws in with it the hot products of combustion direct from the flames and without any appreciable quantity of air. An exit is provided for them near the other end of the barfing tube. At the ends of the tube are electric terminals, which are attached to the wire so that the portion travelling through the barfing agent in the tube can be heated.—A. W.

Tool Steel; Making of —. R. W. James, London. From The Bethlehem Steel Co., South Bethlehem, Pa., U.S.A. Eng. Pat. 10,738, June 12, 1900.

A metal-cutting tool is formed of air-hardening tool steel containing not less than one-half per cent. of chromium and not less than one per cent. of tungsten or molybdenum, or a mixture of these substances, the said tool or its cutting portion being heated prior to use to a temperature of not less than $1,725^\circ F.$, in order to make it capable of efficient use and adapted to retain its efficiency at high temperatures. The thermal treatment may be varied, and a separate claim is made for each variation in the method of producing the metal of this composition as follows: heating to a temperature of or over $1,725^\circ F.$; to a temperature of or over $1,850^\circ F.$; and, after heating to $1,725^\circ$ or over, to the following fluctuations,—cooling rapidly to below $1,550^\circ$; cooling the tool and reheating to above 450° and below $1,350^\circ$; cooling and reheating to above 700° and below $1,240^\circ$; cooling to a temperature not over $1,240^\circ$, and afterwards maintaining for several minutes between $1,240^\circ$ and 450° ; cooling to below $1,550^\circ$ and maintaining for several minutes between $1,350^\circ$ and 450° ; cooling to below $1,550^\circ$ and maintaining for several minutes between $1,240^\circ$ and 700° ; and, lastly, coating the portion of the tool to be treated, with fusible slag previous to heating to $1,725^\circ F.$ or over until the slag is melted.

In addition to the 10 claims three others are made: one for a similar steel-cutting tool containing not less than 1 per cent. of chromium and not less than 4 per cent. of tungsten or its equivalent, heated to $1,725^\circ$; another for the method of producing the same; and the third for a similar metal tool containing not less than 3 per cent. of chromium and not less than 6 per cent. of tungsten or its equivalent, heated to $1725^\circ F.$ —A. W.

Moulding Material for Use in Casting Steel. E. Sarg, Malstatt-Burbach, Prussia. Eng. Pat. 18,120, Oct. 11, 1900.

IN place of the fire-clay in the usual moulding material which necessitates a long drying and burning process before use, coal-slate is added to the silver sand and coke, and the mixture air-dried at a moderate temperature, the innermost parts not necessarily being dried. A convenient mixture consists of three parts of silver sand, six parts of coal-slate (black-batt or bituminous shale), and one half part of coke.

—A. W.



Lead from Zinc; an Improved Process for Separating —, when both Metals exist together in Solution as Nitrates, Chlorides, or partly as Nitrates and partly as Chlorides. G. E. Davis and A. R. Davis, both of Manchester. Eng. Pat. 253, Jan. 4, 1900.

ZINC oxide is added to the solution of the mixed lead and zinc salts, and carbonic acid gas is passed through, whereby lead carbonate is precipitated, zinc replacing lead in the solution. It is preferred to conduct the process in two stages; in the first stage less than the theoretical quantity of zinc oxide is used, mixed with the lead precipitate of a previous second stage operation; in the second stage an excess of zinc oxide is used.—E. S.

Ores [Lead, Zinc, Silver, &c.]; Treatment of Complex and Refractory —. F. Ellershausen, London. Eng. Pat. 483, Jan. 8, 1900.

THE raw ores are smelted in a blast furnace or cupola, with plenty of lime, so as to leave very little zinc in the slag, and the fumes generated at the throat of the furnace are drawn off by means of a fan or exhauster which rapidly mixes them with water, so as to obtain them in chemical and mechanical combination. The water absorbs the sulphur dioxide, which in turn dissolves part of the zinc, leaving an insoluble portion containing sulphides of lead and zinc with varying proportions of zinc sulphide and oxide. The whole is conveyed to settling tanks, the clear liquor, when cooled, is used again in the fan, and the deposited material is treated with boiling crude caustic liquor, which decomposes the lead compounds, forming a deposit of metallic lead, containing the volatilised silver, whilst the insoluble zinc compounds suspended in the liquid soda are recovered by removing and diluting with water, and afterwards suitably treated. The soluble zinc in the fan water, when sufficiently concentrated, is recovered by treating it with the alkali solution remaining after the deposition of the metallic lead.

A claim is made for the apparatus for this process constructed in accordance with a diagrammatic illustration. The inlet opening of the fan is in connection with the throat of the furnace, and the outlet connected to a pipe leading to a trough or launder, contained in a closed chamber, and running to the settling tanks. Water is supplied through an opening in the top of the fan casing on to the revolving blades. If the mixing be incomplete with one fan, the fumes are drawn through and washed in a second one. This is done by nearly closing a valve in the exit pipe, so that the water can pass along, but without the fumes, which are withdrawn through a side pipe between the first fan and the valve, to the inlet of the second fan, and so on, the exit tube leading to the same launder.—A. W.

Sulphide Ores [Lead, Zinc, Gold, &c.]; Treatment of certain Mixed —, for the Recovery of their Valuable Constituents. G. E. Davis and A. R. Davis, both of Manchester. Eng. Pat. 710, Jan. 11, 1900.

THE treatment is a combination of operations in which the mixed sulphide ores are attacked by dilute nitric acid, eliminating impurities from the resulting solution of nitrates of zinc, lead, iron, &c., by the addition of a regulated quantity of zinc oxide with agitation and heat to remove the iron, &c., separating the lead from the purified solution by a further regulated quantity of zinc oxide and then passing through it carbonic acid gas, evaporating the residual solution of zinc nitrate to a suitable strength, specific gravity of about 1.5, and furnacing the same for the production of zinc oxide and gaseous nitrogen compounds, and the recovery of the latter as nitric acid, together with the nitrous fumes from the original operation of the nitric acid on the ore. The ore residue containing silica, sulphur, and sulphate of lead, together with gold and silver, may be treated in any convenient manner.

A separate claim is made for the use of the nitrate of zinc solution for diluting the nitric acid to be used for attacking the ore, so as to obtain a stronger ultimate solution of the same for evaporation.—A. W.

Zinc Ores; Treatment of Complex —. G. de Bechi, Paris, and The General Metal Reduction Company, Ltd., London. Eng. Pat. 985, Jan. 16, 1900.

ZINC-BEARING sulphide ores are mixed and roasted with 15 to 30 per cent. of silica, silicious sand or other silicious matter, whereby the zinc is rendered more completely soluble in acids than when the ore is roasted by itself, and consequently the residue, after leaching, is in a condition more suitable for further metallurgical treatment (this Journal, 1899, 1026).—A. W.

Aluminium Alloys. L. G. Baudelot, Arques-la-Bataille, France. Eng. Pat. 873, Jan. 15, 1900.

THE claims are for the addition of cobalt to alloys of aluminium with copper, German silver, or other analogous metals, with the production of the alloys, aluminium-copper-cobalt and aluminium-German silver-cobalt, and a method for obtaining the same as follows:—A rich alloy, of copper or German silver, 800 parts by weight, with cobalt 200 parts, and aluminium 3,000 parts, is first prepared, and 200 parts of it are added to 800 parts of molten pure aluminium at a bright red heat to obtain the final alloy.

—A. W.

Aluminium with other Metals; Manufacture of Composite Articles of Cast —. L. G. Baudelot, Arques-la-Bataille, France. Eng. Pat. 874, Jan. 15, 1900.

THE cast aluminium is attached to cores or strengthening pieces of other metals, such as steel, &c., by covering or coating the said cores or pieces with an alloy or a metal, such as tin, brazing metal or the like, which will enable the aluminium to afterwards adhere to the same. In the case of steel the metal is first coated with brazing metal and then with tin to prepare it for the aluminium.—A. W.

Aluminium; Process of Soldering —. J. Novel, Geneva. Eng. Pat. 8518, May 8, 1900.

IN soldering aluminium to itself or to other metals, the parts are first tinned in conjunction with a flux consisting of a mixture of stearic acid, oleic acid and resin, or stearic acid with oleic acid or resin, in suitable proportions, and are then soldered in the ordinary way, using a soldering flux composed of the same materials.—A. W.

Crucibles and Crucible Furnaces. A. Reynolds, Sheffield. Eng. Pat. 1004, Jan. 16, 1900.

THE crucible is built up on a supporting plate or frame having a large free air space below, and consists of a thick bed of refractory material with a circular sunken recess on its upper surface into which the wall of the crucible, consisting of a tube of refractory material open at both ends, is placed and packed with fire-clay. The bed is perforated with a large conical hole which is filled by a plug of refractory material, held up in its place from underneath by a plate secured by bolts and cotters. The upper truncated surface of the plug, forming the central part of the bottom of the crucible, is partly hollowed out so as to slope to the centre, from whence a vertical tapping hole runs right through the middle of the plug to the air space underneath. The tapping hole is closed at its lower end by a small plug of refractory material supported on a swinging plate held up by a cotter. A number of crucibles may be built on the same hearth, each one with a separate tapping hole accessible from the air space below, the object being to tap the contents without removing or disturbing the crucible, which can then be made of larger size.—A. W.

Metallic Alloys; Production of Nickel Coloured and Silver Coloured —. M. Ekker, Erzsebetfalva, and J. Krajcsics, Budapest, both in Hungary. Eng. Pat. 17,390, Oct. 1, 1900.

TO produce nickel-coloured alloys, the following materials are placed in layers in the smelting pot in the order given, commencing at the bottom with 3,750 parts by weight of old copper, then 20 of phosphor bronze, 7,000 of nickel, 80 of pulverised magnesium, a further 3,750 parts of old copper, 20 of aluminium, 8,000 of zinc, 150 of cadmium, 20 of zinc ash, and, finally, 7,500 parts of old copper on the top. The



whole is then melted, stirred, mixed with about 20 parts by weight of sal-ammoniac powder, and the alloy cast in moulds.

Similarly, for the silver-coloured alloys, the following materials are arranged in layers in the same order and melted and mixed with 10 parts of sal-ammoniac powder, *viz.*, 6,000 parts by weight of nickel, 20,000 of copper, 4,000 of zinc, 100 of pulverised magnesium, 300 of cadmium, 20 of zinc ash, and 10 of aluminium.

Compositions for the manufacture of alloys according to these formulæ are specially claimed.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

(A.)—ELECTRO-CHEMISTRY.

Electro-Chemical Industry in France. L. Guillet. Génie Civ. 1900, **37**, 146—149, 172—173, 186—190, 219—220, 229—231, 254—256. Through Science Abstr. **3**, [11], 894—895.

THIS is a review of the whole chemical industry of France. With regard to the electro-chemical portion of the papers, caustic soda is produced in works at Lamothe and Montiers, by two companies using respectively the Griesheim and Outhenin-Chalandre processes respectively, the annual output at Lamothe being 2,500 tons. Alkalis and bleaching powder are made by the Société Fives-Lille at Bozel, in Savoy, where 8,000 h.p. is available. At St. Michel, the Société d'Électro-chimie manufactures potassium permanganate, ammonium persulphate (made from the sulphate, and used in bleaching and photography) chlorates and perchlorates; the last two compounds are also made by Berges, Corbin, and Co., at Chedde (Savoy), the two companies producing 3,000 out of the 3,850 tons of chlorate made in France. Ammonium perchlorate is now being made for use in the manufacture of mining explosives; and the electro-thermal reduction of phosphorus is about to be used for the first time in France. Eight factories, situated respectively at Sechillienne, Epierre, St. Michel, Giffre, N.D. de Briançon, Bellegarde, Froges, and St. Beron, manufacture calcium carbide, but though they have, in all, 14,400 h.p. available, it is not all used for the purpose.

—W. G. M.

Electric Furnace [Calcium Carbide]; Development of the — M. Keller. Paper read before the International Congress of Electricity, Paris. Eng. and Mining J. 1900, **70**, [19], 549.

THE author divides electric furnaces, designed for the manufacture of calcium carbide, into three classes:— (1) Arc furnaces, based on the Moissan and Siemens type. (2) Resistance furnaces, based on the Héroult type. (3) Incandescence furnaces, based on the Cowles type (see this Journal, 1889, 678). Arc furnaces may be further subdivided into three classes:—(a) furnaces with both electrodes movable; (b) furnaces with one electrode fixed, forming usually the floor or hearth; (c) multiple arc furnaces, in which the floor of the furnace generally acts as the common secondary electrode for the arcs, which form between it and the three or more primary electrodes fixed around it; polyphase currents are mostly used with these furnaces.

Arc furnaces are not suitable for the manufacture of carbide, because of the loss of energy occasioned by the temperature of the arc being considerably above that required; and loss of material owing to the finer particles of the charge being carried away by the "blowing" of the furnace.

In resistance furnaces the temperature attained is directly related to the sectional area of the electrodes. For the production of carbide, an E.M.F. of 20—25 volts is sufficient, but "heavier" currents are required than with arc furnaces, and conductors of larger sectional area must therefore be provided.

The incandescence type of furnace permits the utilisation, within a limited area, of the greatest amount of energy, and

avoids the most serious defect of the second type, namely, that the currents must always traverse the whole depth of the layer of materials already fused.

Electric furnaces may also be classified according to the kind of current employed. Furnaces heated by means of alternating currents have recently been widely adopted, because the dynamos yielding monophase or polyphase currents are better adapted to stand the resistance variations incidental to electric furnace operations. Furnaces employing monophase currents are best arranged in series, but with arc-heating, it is better to connect the furnaces in parallel. In the furnace designed by Bertolus in 1897, triphase current was used, and three carbon electrodes were connected to the three terminals of the dynamo, whilst the hearth of the furnace itself provided the common return electrode. In later forms the three different phases of the current have been utilised in separate furnaces, and these, therefore, each operate as though worked with monophase current.

The carbon for the electrodes is subjected to special treatment in order to increase its conductivity. For furnaces in which vertical electrodes are used, the latter are generally formed square or rectangular in section, whilst for other types of furnace, cylindrical carbons are mostly used.

With arc furnaces the E.M.F. required, varies considerably, and depends upon the conductivity of the gases which are emitted from the heated substances. For the production of calcium carbide, an E.M.F. of 50—60 volts is required; for corundum, 50 volts; and for the production of iron by the electro-thermal method, 20 volts. In resistance furnaces, a lower E.M.F. is generally sufficient. With incandescence furnaces practically any E.M.F. up to 80 or 100 volts can be used, for the resistance increases with the increase of the length of the bed of materials through which the current has to pass, and this may be varied at will.

According to recent estimates the total energy employed in electric furnace operations is 230,000 h.p., of which total, 185,000 h.p. are used in the production of calcium carbide, 27,000 h.p. for aluminium, 11,000 h.p. for copper, and 2,000 h.p. for carborundum. It is stated that in the latest form of the Gin and Leleux furnace, it is possible to obtain 6·20 kilos. of carbide per kilowatt day of 24 hours, or, in other words, a thermal efficiency of 75 per cent.—A. S.

Sulphuric Acid Solution; Electrolytic Reduction of Substances Reducible with Difficulty in — J. Tafel. Zeits. Phys. Chem. 1900, **34**, 187—228. Through Science Abstr. **3**, [11], 893—894.

THE author seeks for a general method for the preparation of organic compounds by electrolytic reduction, and has experimented with caffeine. This substance can only be reduced in sulphuric acid solution when the cathode is of a material (lead or mercury) showing a high cathode-potential. The surface of the cathode should be coated electrolytically with spongy lead to prevent the disturbances in reduction due to the contamination of the cathode by traces of foreign metals. Reduction is slightly hastened by a rise of temperature. Within certain limits the current-yield is nearly proportional to the current. For equal strengths of solution and equal current concentration per litre of liquid at the cathode, the current density is without any great influence on the reaction, but the reduction increases slightly as the current density diminishes. With equal strength of solution and current concentration, and with the same relation between cathode-area and volume of cathode liquid, the reaction is the same for all sizes of apparatus of similar construction.—W. G. M.

Sulphuric Acid containing Iron; Electrolysis of Dilute — [Effect of Iron in Sulphuric Acid for Secondary Batteries.] K. Elbs. Zeits. für Elektrochem. 1900, **7**, [19], 261—262.

Two similar gas (H-O) voltmeters with bright platinum electrodes were placed in series. In one voltmeter pure sulphuric acid (sp. gr. 1·175) was employed, whilst small



quantities of iron were added to the acid in the other. The results are given in the following table:—

Amount of Iron in Acid.		Current Density.	Loss of H-O Gas.
Per Cent.		Per Sq. Dm.	Per Cent.
1	}	2.230	48.3
		0.920	64.3
		0.228	97.4
0.1	}	6.4	3.0
		4.9	3.6
		2.27	7.2
		1.123	11.9
		0.366	24.1
0.01	}	0.355	25.1
		2.217	1.7
		1.150	1.9
		0.360	6.3

If formed lead plates are substituted for the bright platinum electrodes the values are scarcely altered. The bad results which would be obtained if the sulphuric acid in secondary batteries contained iron are obvious from the above table. Not only iron and manganese, but all metals which have a changing valency produce the same effect. It is now usual to specify that the acid for secondary batteries shall be free from iron. The question arises as to how far this must be complied with, especially if it be remembered that iron gives very pronounced reactions, and that traces are easily detected.

The author considers that if the amount of iron present in the acid be less than 0.01 per cent. it will practically have no injurious effect. In order to ascertain whether the amount of iron lies below this limit he employs the following rapid tests. About 10–15 c.c. of the acid are supersaturated with aqueous ammonia. If no turbidity, due to ferric hydroxide, be produced after standing a few minutes, the acid contains at most only 0.008 per cent. of iron. Acid containing 0.005 per cent. of iron is immediately coloured blue on adding potassium ferrocyanide, or red on adding potassium thiocyanate.

If therefore an acid shows the presence of iron when tested with potassium ferrocyanide or potassium thiocyanate, but not when tested with ammonia, it may safely be used for secondary batteries.—J. S.

Manganous Salts at the Anode; Behaviour of —.

K. Elbs. Zeits. für Elektrochem. 1900, 7, [19], 260–261.

The products obtained at the anode during the electrolysis of manganous salts may contain manganic salts, *Braunstein*, or permanganic acid, according to the nature and quantity of the acid employed, and to other conditions of experiment. The term "*Braunstein*" is employed as a collective name to denote all brown precipitates, consisting of hydroxides or other derivatives of manganese peroxide.

For the exclusive production of permanganic acid the conditions are:—The manganous salt of a strong acid in very dilute solution, a large excess of the acid, and a temperature not exceeding 80° C. Several difficulties occur in the case of manganous sulphate. Although the conditions of experiment are varied within wide limits, manganic sulphate, *Braunstein*, and permanganic acid or two of these products are usually formed. Manganic sulphate and permanganic acid both produce a deep violet-red coloration, which, however, can be distinguished by the absorption spectrum. Manganic sulphate absorbs the yellow and green portion of the spectrum uniformly, whilst permanganic acid at sufficient dilution shows the five well-known absorption bands.—J. S.

Potassium Chlorate; Electrolytic —. A. Brochet.

See under VII., page 42.

Ampère-Manometer. G. Bredig.

See under XXIII., page 69.

PATENTS.

Gases Generated in Electrolytic Apparatus; Improved Means for Carrying off the —. W. Bein, Berlin, Germany. Eng. Pat. 24,058, Dec. 2, 1899.

THE electrolytic apparatus described is an improvement on that claimed for in Eng. Pat. 21,838, 1894 (this Journal, 509, 1895), and provides means for leading off the gases generated at the lower electrode without disturbing by ebullition the layer formation of the cell. The electrodes are substantially horizontally arranged at the top and bottom of the electrolytic cell in so far as a layer of the electrolyte is provided between the electrodes, which is to be kept undisturbed and serves as a diaphragm. Each lower electrode is covered with a frame or box provided with a slanting cover of osmotic pervious material, and having recesses at its side to enable the liquid to enter the frame, the latter causing the gases generated at the lower electrode to escape beyond the impervious partition to a compartment from which they are drawn off.—G. H. R.

Electrical Accumulators; Method of Producing Electrodes for —. C. Luckow, jun., Cologne, Germany. Eng. Pat. 24,960, Dec. 15, 1899.

THE claim is for a method of rendering metals capable of storing electricity by subjecting them in shapes suitable for electrodes to the electrolysis of aqueous solutions of the alkali and alkaline earth hydroxides, such solutions being strongly diluted, so that a very high degree of electrolytic dissociation of the dissolved constituents takes place.

—J. C. R.

Electrolytic Apparatus. W. Barnes, Massachusetts, U.S.A. Eng. Pat. 1457, Jan. 23, 1900.

THE apparatus comprises a hermetically sealed electrolytic cell containing a diaphragm, which divides it into two compartments, the one containing an anode, and the other the cathode, and both electrically connected with an electrical generator. An hermetically sealed feed regulator connected by pipe to the cell, is actuated by the level of the liquid in the latter, and there are conduit connections from it to the cell, and also between it and the intermediate feed reservoir, which has an inlet, whilst the main feed reservoir has an outlet which discharges into the inlet without being in contact with it. There is a vacuum-creating device for, and operatively connected with, at least one compartment, comprising a conduit which is both a vacuum and a gas-escape conduit. A vacuum chamber on a lower level than the cell is connected with at least one compartment of it, and with the feed reservoir, between which and the vacuum chamber is a testing device with a conduit to the feed regulator. Various modifications are described and illustrated.—G. H. R.

Electrodes for use in Electro-chemical Processes. O. Lanckner, London. From A. Vogelsang, Dresden. Eng. Pat. 14,104, Aug. 7, 1900.

RELATES to the construction of electrodes of platinum foil, or other metal which is not acted upon by the electrolyte. The examples shown are intended for the production of bleaching liquors from common salt solutions.—J. C. R.

Electrolytic Meters. A. Wright and The Mutual Electric Trust, Ltd., both of Brighton. Eng. Pats. 23,315 and 23,316, Nov. 22, 1900.

THESE inventions relate to methods of measuring electric current by means of electrolytic meters. According to the specifications the meter may be placed in a circuit forming a shunt or by-pass to the main current. This, it appears, has hitherto not been practicable, on account of the polarisation in the electrolytic cell. By the present arrangements these drawbacks are overcome by means of an extraneous source of electricity, like a primary or secondary battery, or thermopile, placed in circuit with, and opposed to the electrolytic cell.—J. C. R.



(B.)—ELECTRO-METALLURGY.

Iron and Nickel; Electro-Deposition of —, from a Solution of the Sulphates. F. W. Küster. *Zeits. für Elektrochem.* 1900, 7, [19], 257—259.

REFERENCE is made to the experiments of Töpffer (this Journal, 1900, 156), who found that the alloy obtained on electrolysing the mixed sulphates of iron and nickel, was relatively richer in iron the lower the current density used. Exterpolation of the curves showed that for zero current density, iron free from nickel should be deposited.

This result was quite unexpected, since nickel is a nobler metal than iron, the decomposition point of nickel solutions being about 0·1 volt lower than that of iron solutions.

The author has, by a novel method, re-determined the potentials necessary for the liberation of iron and nickel from solutions of their sulphates, and confirms the fact that nickel is deposited at about 0·1 volt lower than iron. As a possible explanation of the anomaly he suggests that, although nickel is deposited first, the ratio:—*liberated* H₂ | deposited Ni, may for a given E.M.F. be greater than the ratio:—*liberated* H₂ | deposited Fe.—J. S.

Metals; Electrolytic Cleansing of —. J. Reyval. *Écl. Electr.* 1900, 24, 91—92. *Through Science Abstr.* 3, [11], 897.

IN the process patented by the Vereinigte Elektrizitäts Aktien Gesellschaft of Vienna (French Pat. 292,333 of 1899) an alkali-metal salt is used as electrolyte; the metal to be cleansed forms one electrode (aluminium or zinc would be made cathodes, but iron, copper, or copper alloys would be anodes), and carbon, or a metal not attackable by the solution, or by the ions present, forms the other electrode. With Al or Zn the aluminate or zincate formed at the cathode diffuses through the solution until, meeting the free acid from the anode, hydroxide is deposited. Similarly, iron or copper salts, formed at the anode in cleansing these metals, are ultimately precipitated by the alkaline solution flowing from the insoluble cathode. Thus, the electrolyte is always regenerated, and the dissolved metal is deposited as a hydroxide, which may be recovered. To cleanse steel sheets for galvanising, they are, as anodes, opposed to thicker sheets of iron as cathodes, in a solution of sodium sulphate. In this process, which is said to be rapid and economical, an E.M.F. of from 4 to 8 volts suffices to produce a current density of 140 ampères per square metre [13 ampères per square foot].—W. G. M.

PATENT.

Electro-Deposition of Metals upon Iron and Steel. H. M. Punnett, and H. M. Punnett, jun., Birmingham. Eng. Pat. 24,668, Dec. 12, 1899.

(1) THE articles to be coated are suspended through the medium of a permanent magnet or magnets, so arranged within the electrical circuit as to constitute a return-current conductor; and (2) the same, but with the said magnets energised by a separate current.—J. C. R.

XII.—FATS, OILS, AND SOAP.

Wax; Acid and Saponification Values of —. Modification of Hübl's Method of Determining them. O. Eichhorn.

See under XXIII., page 74.

PATENTS.

Mineral Oils, Liquid; Solidification of —. H. B. Helbing and F. W. Passmore, London. Eng. Pat. 23,978, Dec. 1, 1899.

PETROLEUM is converted into a solid mass by mixing it with a concentrated aqueous solution of a salt of casein, preferably the sodium salt, in the proportion of, say, 20 parts of casein dissolved in 100 parts of decinormal caustic soda

solution to 1,000 parts of petroleum. The emulsion is poured into moulds and allowed to stand, when it gradually thickens.—D. B.

Mineral Oils, Liquid; Solidification of —. H. B. Helbing and F. W. Passmore, London. Eng. Pat. 23,979, Dec. 1, 1899.

To every 1,000 parts of the freshly-made emulsion, prepared in accordance with the method described in the previous specification, there is then added 10 parts of ordinary commercial 40 per cent. formaldehyde solution. The product is at once poured into moulds and left to harden. The relative proportions of the ingredients may vary according to the particular kind of product which it is desired to obtain.—D. B.

Oil from Dirty Waste; Extracting —. J. Heywood, Clayton, Manchester. Eng. Pat. 25,228, Dec. 20, 1899.

THE oily waste is placed in a closed receiver between two perforated plates, where it is extracted with a stream of carbon bisulphide, made to travel in an upward direction by means of a pump. From the outlet of the receiver the liquid passes to a steam-heated still, the oil remaining, and the solvent travelling through a condenser to a storage well, into which the pump suction dips. From the lowest point of the condensing coil an escape pipe conducts any vapours and gases beneath the level of water in a small tank, whence they pass away through a vertical shaft provided with a descending current of water. At the end of each extraction, steam is admitted to the base of the receiver, which drives into the condenser all the remaining solvent. The oils recovered are drawn off from the still at proper intervals.—F. H. L.

Oil-yielding Seeds; Process for Treating —. [Linoleum, &c. Manufacture.] M. Bärwinkel, Hamburg. Eng. Pat. 11,860, June 30, 1900.

IN this process, oil-cake or crushed oleaginous seeds are mixed with metallic oxides, such as manganese peroxide, lead monoxide, zinc oxide, or the like, or else with sulphur or metallic sulphides, such as those of antimony or lead. The product is then brought into a revolving drum, heated to a temperature ranging between 80° and 168° C. for several hours, and submitted to the action of oxidising gases, such as air or oxygen. In the case of linseed, 9 parts thereof may be mixed with 1 part of sulphur, and treated as above; and the result is a homogeneous substance, closely resembling linoleum, and capable of being rolled into sheets. Cork or similar filling materials may be added if desired; but by this process the natural solid matter of the seeds remains in the "linoleum." The claims are for the employment either of the oxides or sulphides, or of oxidising gases, or for both together.—F. H. L.

XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.**(B.)—RESINS, VARNISHES.**

Exudation Resins. M. Bamberger and E. Vischner. *Monatsh. für Chem.* 21, 564—570.

LARICRESINOL (chiefly the isomeride of m. pt. 95° C.; see this Journal, 1899, 1134) was subjected to destructive distillation. From 427 grms. there were collected 257 grms. of distillate, consisting of a watery layer (about 80 grms.) and an oily layer; while uncondensable gases, containing carbon dioxide and hydrocarbons, were also formed, and a hard, bright charcoal remained in the retort. The watery layer was slightly acid, and from it there was separated, after neutralisation, an aldehyde, but in quantity too small for further examination. The oily layer partly solidified, and by filtration there was separated from it a crystalline substance, which, after repeated solution and crystallisation from alcohol, proved to be pyroguaiacin, C₂H₁₀.OCH₃.OH. The alcoholic mother-liquors yielded a second crystalline substance, but not in quantity sufficient for identification. The oil was distilled under 33—35 mm. pressure, and chiefly yielded two fractions, one at 90°—



110° C., principally guaiacol, the other at 200°–230° C., containing much pyroguaiacin, and a second substance, probably a methoxy-derivative of pyrogallol. About 40 grms. of guaiacol and about 25 grms. of pyroguaiacin were obtained.—J. T. D.

Resins of the Conifers; Recent Researches on —. A. Tschirch. *J. Pharm. Chim.*, 6th ser. 12, [9], 409–413.

The author divides the resins into three groups:—(1) *Tannol resins*, which contain esters of resin alcohols, resino-tannols, which afford reactions analogous to those of tannins. These resino-tannols form benzoic or cinnamic esters. (2) *Resene resins*, which contain no tannol esters, but consist mainly of resenes, a group of bodies which are indifferent to alkalis and to other reagents. (3) *Terpino-resins*, or acid resins, analogous to resinolic acid.

Tannol Resins.—This group comprises the benzoresins, containing esters of benzoic or cinnamic acid, such as benzoin, Peru and Tolu balsams, acaroid resin, dragon's blood, resin of aloes, and storax, and the umbelliferous gum resins, ammoniacum, galbanum, sagapenum, asafetida, and umbelliferous opopanax.

Resene Resins include the burseraceous oleoresins, myrrh, olibanum, burseraceous opopanax, Mecca balsam, elemi, bdellium, tacamahaca, mastice, diptercarpous dammar, Doona resin, and Manilla copal.

Terpinoresins.—This group includes coniferous resins, the resin of *Polypus officinalis*, and the resins of the Cæsalpinæ, copaiba balsam, and Zanzibar copal.

Method of Examination.—The resinous product is dissolved in ether, and agitated successively with (1) a 1 per cent. solution of ammonium carbonate; (2) a 1 per cent. solution of sodium carbonate; (3) solutions of potassium hydrate, 0.1 per cent. and 1 per cent.

Resinolic acids are dissolved by these solutions; resenes remain in the ether, with any essential oil present, which may be subsequently removed by steam distillation. All coniferous resins, except amber, contain no esters, but consist solely of resinolic acids, resenes, and essential oil. The majority of these acids are amorphous, and are removed by the sodium carbonate solvent; only a few are soluble in the solution of ammonium carbonate. The former may be separated by crystallisation, or by precipitation with lead acetate. The following are the constituents of the chief coniferous oleoresins examined:—

Venice Turpentine.—Laricinolic acid, $C_{20}H_{30}O_2$; α - and β -larinolic acids, $C_{18}H_{26}O_2$; and laricoresene.

Strasburg Turpentine.—Abienic acid, $C_{13}H_{20}O_2$, soluble in ammonium carbonate; abietolic acid, $C_{20}H_{28}O_2$; α - and β -abietinotic acids, $C_{16}H_{24}O_2$; and abietoresene, $C_{19}H_{30}O$.

Canada Balsam.—Canadinic acid, $C_{19}H_{34}O_2$, soluble in ammonium carbonate solution; canadolic acid, $C_{19}H_{30}O_2$; α - and β -canadinolic acids, $C_{19}H_{30}O_2$; and canadoresene, $C_{21}H_{40}O$.

Jura Turpentine.—Picea-pimaric acid, $C_{13}H_{20}O_2$, soluble in ammonium carbonate; picea-pimaric acid, $C_{20}H_{30}O_2$; α - and β -picea-pimarolic acids, $C_{25}H_{44}O_2$; and juroresene, $C_{21}H_{36}O$.

Bordeaux Turpentine.—Pimaric acid [pimaric?], $C_{14}H_{22}O_2$, soluble in ammonium carbonate; pimaric acid, $C_{20}H_{30}O_2$; α - and β -pimarolic acids, $C_{18}H_{26}O_2$; and bordo-resene.

Sandarac.—Sandaraelic acid, $C_{45}H_{66}O_7$ or $C_{13}H_{20}O_2$; callitrotic acid, $C_{65}H_{84}O_8$ or $C_{13}H_{20}O_2$.

Amber.—Succino-abietic acid, $C_{30}H_{120}O_5$ or $C_{32}H_{125}O_5$; and succinilvinic acid, $C_{24}H_{36}O_2$.

The following constituents, noted by others, have been confirmed by the author:—

American Colophony.—Abietic acid, $C_{19}H_{28}O_2$.

Galipot.—Pimaric acid, $C_{20}H_{30}O_2$.

Comparison of these figures shows several homologous formulae. Thus, pimaric acid is the homologue of abietic acid, laricinolic acid of larinolic acid, pimaric acid of pimarolic acid. The acids of Canada balsam only differ in the number of their hydrogen atoms; pimaric, picea-pimaric, and laricinolic acids have a common formula. The author does not accept the theory that resins are formed by the oxidation of terpenes. Having allowed oil of turpentine to resinify in the air, only traces of resinolic acids were found

to have been formed. The products of oxidation were chiefly resenes. The formation of the resenes of the terpenes, or terpinoresenes in this manner seems, therefore, possible. Resinolic acids do not appear to be derived from terpenes, but to possess some bonds in common with them. On submitting abietic acid to dry-distillation with zinc dust, naphthalene and methyl-naphthalene are among the products obtained; naphthalene is also among the bodies obtained on heating colophony. If, however, colophony be distilled with slaked lime, no naphthalene results, but terpenes are formed, and if pimaric acid be heated with hydriodic acid and phosphorus, terpenes are also produced. These results establish the fact that the coniferous resins contain both a naphthalene group and a terpene nucleus.

A peculiar hydrocarbon, fichtelite, which possesses this structure, is already known; it seems probable that pimaric and abietic acids may be derivatives of this body.—J. O. B.

(C.)—INDIA-RUBBER, &c.

India-Rubber from Different Species of Sapium. Pharm. J. 1900, 65, [1585], 511.

R. THOMSON has recently exhibited some leaves of a species of *sapium* from the United States of Colombia, and stated that the plant yielded a very valuable india-rubber. Hemsley, in the "Icones Plantarum," pl. 2647, gives a description of *Sapium verum*, from which the best, or "Colombian Virgen," rubber is obtained. Another species, *S. jenmani*, Hemsley, is described in the same work, pl. 2649. According to Thomson, it yields an abundance of rubber of inferior quality. The leaves of *S. verum* are elliptic, oblong, leathery, with many lateral veins, and are rounded at both base and apex. The leaves of *S. jenmani* are thinner and narrower, and the apex is acuminate with an obtuse point.—A. S.

Balata and Gutta-Percha; Purification of —. Arends. Chem. Zeit. 1900, 24, [83], 897.

THE author has carried out experiments to ascertain the suitability of balata as a substitute for gutta-percha, and also as to the use of the cheaper carbon tetrachloride in place of chloroform for the purification of the two substances. The following method for the purification of balata is given:—Commercial balata is cut into small pieces, boiled with acidulated water, washed, and dried. The dry substance is dissolved in a mixture of equal parts of petroleum spirit and carbon tetrachloride, the liquid allowed to settle, the clear portion decanted, and, after the addition of some water, the solvent distilled off. The residual purified balata is freed from any traces of the solvent still present, then well beaten and rolled out. Gutta-percha can be purified in a similar manner, except that the purified product frequently requires to be bleached, if a white preparation be desired.

The author considers that balata can satisfactorily replace gutta-percha in the preparation of traumaticin, gutta-percha-plaster mulls, &c. He also draws attention to the various directions in which carbon tetrachloride can be applied in analytical practice.—A. S.

PATENTS.

Gutta-Percha; Manufacture of —. Siemens Bros. and Co., Ltd., Westminster, and W. Dieselhorst, Old Charlton, Kent. Eng. Pat. 25,494, Dec. 23, 1899.

It has hitherto been found somewhat difficult to dry gutta-percha after the preliminary washing without the use of so elevated a temperature that the material is liable to be injured. To overcome this inconvenience, the gutta-percha is masticated at a more moderate temperature in a vessel where a partial vacuum is maintained by means of a pump, the vapours passing first through a surface condenser. In order to prevent any accidental contamination of the gutta-percha with the lubricating oil of the masticator-shaft bearings, each shaft, between its stuffing box and the masticator proper, passes through a catch vessel, and has a circumferential groove cut upon it. By this device the oil escaping from the gland collects in the catch pit, for it cannot pass the groove; while any gutta-percha working its



way along the shaft also falls into the pit, and cannot be drawn back into the apparatus by the vacuum.—F. H. L.

India-Rubber and Gutta-Percha; Process for Producing a Substitute for —. E. Zühl, Berlin. Eng. Pat. 18,536, Oct. 17, 1900.

To imitate gutta-percha (A) 2 kilos. of paraffin, 6 kilos. of pitch, and 2.5 kilos. of Chinese wood-oil are melted and mixed together. 1.1 kilo. of sulphur chloride and afterwards 100 grms. of powdered sulphur are next added, and the whole is heated for an hour to 160° C. (B) 2 kilos. of pitch and 1 kilo. of wood-oil are heated together under cover for eight hours at 280°, then vulcanised with 150 grms. of sulphur chloride as above. The material obtained resembles india-rubber in respect of durability and insulating power, but is less elastic, and is weak under torsion. To obviate these defects, (C) 100 grms. of india-rubber are dissolved in 300 grms. of molten naphthalene at the lowest possible temperature, and incorporated with 400 grms. of wood-oil and 700 grms. of pitch, asphalt, or the like; the naphthalene is volatilised by a current of steam, and the residue is vulcanised as before. (D) 1 kilo. of A is dissolved in 3 kilos. of naphthalene, mixed with 100 grms. of india-rubber in the same quantity of solvent, and the naphthalene removed with steam.—F. H. L.

XIV.—TANNING, LEATHER, GLUE, SIZE.

Raw and Tanned Hides; Use of Spirit in the Removal of Fat from —. A. Wünsch. Ledermarkt, 1900, [75]; through Zeits. Spiritusind. 1900, 23, [47], 429.

RAW hides always contain a large proportion of fat, which ought to be removed before tanning, since the mordanting and tanning liquors penetrate better, and are more easily removed afterwards, if the fat be previously extracted. When benzene is used alone for this purpose with wet or dry hides, the penetration is less uniform and the removal of fat is less complete than when a mixture of alcohol and benzene is employed. In this case, not only is fat recovered which would otherwise be saponified by the alkaline depilatory, but the leather also is softer and more valuable.

The soaked hides, after having been pressed and allowed to drip, are placed in a wooden drum, which is mounted in a somewhat larger stationary cylinder, which can be hermetically closed, and in which, by means of tooth gearing, the inside of the cylinder may be made to rotate. When the interior is filled with a pack of hides, the cylinder is closed and the drum rotated. At first, dilute alcohol is brought into contact with the skins. This liquor, by suitable pipes, is then drawn off and replaced by a mixture of benzene and strong alcohol, which may be further strengthened with more benzene if required. After treatment the mixture is run off, and the hides rinsed with a little alcohol.

The cylinder is now opened, and the hides, deprived of fat, are taken out, and replaced by a fresh pack to be treated. The apparatus is fitted with the necessary feeding pipes from the alcohol and benzene reservoirs, as also waste pipes and pressure valves. The benzene, alcohol, and fat can be recovered from the solutions, the former being used in subsequent packs.—J. F. B.

Brown Shoe Calf; Manufacture of —. Leather Trades Rev. 33, [764], 869.

Treatment of Fresh Market Calf.—The skins are thoroughly soaked in two or three changes of clean water, and are then limed, after which they are unhaired and fleshed, and may be run through a washing tumbler in soft water for about an hour. After leaving the washing tumbler, they are then put into a weak puer at a temperature of about 35° C., and are then passed on to a strong puer. When sufficiently reduced, they are scudded and then drenched, the object of the drench being to remove all traces of lime salts, to clean the skin, and to open it up into proper condition to receive the tan. They are then ready to be tanned in a weak gambier liquor of about 5° Bk. [Barkometer].

In starting new liquors, one pint of acetic acid should be added to the paddle for every five dozen medium calf skins, the object of this acid being to keep the fibres open.

The skins are kept in motion in the paddle till coloured off, and are then put on a horse to drip overnight. They are then placed in a similar liquor of 10° Bk., and the process repeated until a strength of 20° or 25° Bk. is reached, when the goods should be thoroughly struck through. They are now introduced into a fresh paddle containing a gambier liquor of 25° Bk., to which about 2 galls. of good oakwood extract have been added; and the process of tanning continued until, by the addition of oakwood extract, the strength registers 35° Bk. The time taken depends upon the substance of the skin. After tanning, the skins should be laid in pile to drain, and then oiled with best Newfoundland cod oil, laid in pile for a day, and then hung in the sheds to dry.

Splitting, Shaving, Sumaching, &c.—The tanned skins are wet back, sammied until in condition for shaving, or, if stout enough, split with a band-knife splitting machine, the splits being used for waxing linings, &c. After shaving, they are soaked in water, brushed over on the grain with a soap solution (made up of 2 lb. of soft soap and 3 galls. of hot water), then rinsed in a tub of hot water, soured in sulphuric acid, and afterwards sumached. The sumaching may be done in a drum taking 2½–3 buckets of sumach with 7–8 pails of water, at a temperature of 50° C. The skins are run in this for about three hours, washed up in warm water, allowed to drain, and then dried to fix the tannin.

Dyeing and Finishing.—The skins are now wetted back, put into a paddle and dyed, the dyeing generally being done with acid dyestuffs. Suitable shades of brown can be produced from Cuba and Indian Yellow R and East Brown R, toned down with blue or green. A little sulphuric acid is added to the dye-bath to develop the shade. After dyeing, the skins are washed up, struck out on the grain side, strained on boards, and dried. When dry, they are removed from the boards, flamed to pattern, set out on flesh and grain, and hung up in a warm room or shed until thoroughly dry; they are then stuffed, the first stuffing being made by boiling two medium sized cow-heels for three hours in water, to which are added ½ lb. of Irish moss, 1 pint of linseed oil, ¼ lb. of Castile soap; when cool the liquid is strained through calico. This should make from 3 to 3½ galls. The stuffing is put on with a flannel cloth, rubbed well in, and smoothed with the hand. The goods are hung up, and afterwards receive a second coat, consisting of the same solution diluted to half strength with water. The skins are finished by perching with a moon knife, after which they receive another coat of stuffing in the dry state, are hung up, brushed up with a stiff brush or brushing machine, and finished by rolling with a plain roller.—J. G. P.

Artificial Leather; Process for the Manufacture of —. Leipziger Färber- u. Zeugdr.-Zeit. 1900, 49, [12], 497.

EQUAL parts of grey wool and Italian hemp are felted together, and the sheets of felt thus obtained are washed and dried and then impregnated with a specially prepared mixture. This mixture contains boiled linseed oil, colophony, turpentine, glycerin, and vegetable wax, these ingredients being heated together on the water-bath with the addition of ammonia, until a homogeneous mass results; a solution of gum and a casein solution containing sodium bichromate are then added, also an antiseptic, and mineral colours according to the shade required. The mixture is heated until it is viscous, and is employed in this condition for impregnating the felt, after which treatment the material is dried at the ordinary temperature, steeped in a solution of aluminium acetate, and finally dried by pressure between heated rollers. The product is stated to be especially suitable for the manufacture of boot soles.—R. B. B.

Leather; The Dyeing, Staining, and Finishing of —. M. C. Lamb.

See under VI., page 41.



PATENTS.

Leather; Improved Process and Composition for Tawing Skins in the Manufacture of — G. W. Adler, Philadelphia, U.S.A. Eng. Pat. 24,680, Dec. 12, 1899.

THE skins are first treated with a solution of aluminium sulphate and sodium chloride; after which they are subjected to treatment with sodium thiosulphate if a fine grain be required; the goods are now resolved for one hour in the drum, in a solution made by dissolving 6 lb. of chrome alum, 3 lb. of sodium sulphate, 3 lb. of sodium chloride, and $\frac{1}{2}$ lb. of potassium or sodium acetate in 3–6 gallons of water; these quantities being sufficient for 100 lb. of skins prepared for tanning.

It is claimed that by this method it is possible to produce a material which possesses the qualities of a chrome-tanned leather together with the characteristics of an alum-tawed skin.—M. C. L.

Extraction [Tanning or Dyeing Materials, &c.]; Method or Process of — P. Gulden. Eng. Pat. 16,716, Sept. 19, 1900.

See under IV., page 38.

Hides and Fibrous Materials; Apparatus for Treating — J. F. Lester, Atlanta, U.S.A. Eng. Pat. 17,480, Oct. 2, 1900.

THE claim of this invention is that the tanning or cleaning may be accomplished without removing the material under treatment from the chamber in which it is placed. For the apparatus used for such treatment, the combination is claimed of "a suitable chamber for containing the material, one or more independently-controlled fluid tanks, a supply pipe for creating a pressure within the chamber, a valve regulating the supply of fluid to the pump, and a valve-controlled discharge-pipe."—M. C. L.

XV.—MANURES, Etc.

Thomas Slag; Detection of Mineral Phosphate in — N. von Lorenz.

See under XXIII., page 69.

XVI.—SUGAR, STARCH, GUM, Etc.

Beetroot Juice; Krause's Method for Determining the Purity of — H. Claassen. Bull. de l'Assoc. des Chim. de Sucre et de Dist. 1900, 18, [4], 250–251. From *Centralbl. Zuckerind.* 1900, [41], 809.

THE hydrometer used by Krause is graduated in two ways, one giving the actual degree Brix of the digestion juice, the other, that of the original juice of the beetroot. The calculation has been established as follows:—Since 104.2 grms. of pulp contain 4.2 grms. of marc, the dilution of the juice is 100 grms. to 400 c.c. If the beetroot juice be 11° Brix, the diffusion juice is 2.715. The polarisation found, relates not to 25 grms. of beetroot juice, but to 26.048 grms. of pulp. Krause calculates thus:— $2.715 \times 26.048 \div 25 = 2.8288^\circ$ Brix, which corresponds to 11° Brix of the original beetroot juice. The figure 11 of the Brix scale is therefore placed opposite the figure 2.8288 of the Brix scale of digestion juice.

The author, however, pronounces strongly against the use of too fine a pulp, for it is difficult to weigh exactly, and gives trouble from froth.

It remains to be determined if the duration of the digestion has an influence on the result, if the solid constituents of beetroot marc may not gradually dissolve, and thus influence the readings of the hydrometer, and if there is inversion of sugar. Further, it remains to be proved that digestion without acetate of lead gives the same polarisation as the ordinary method with acetate of lead. These various points should be definitely fixed before the new method is allowed to make its way into practice.—L. J. de W.

Diffusion Juice by the Separation Process; Purification of — A. V. Bull. de l'Assoc. des Chim. de Sucre et de Dist. 1900, 18, [4], 252. From *Die deutsche Zuckerind.* 1900, [29], 1166.

IN a preceding number of the same journal, Szyfer has drawn attention to the purification of raw juice by the process elaborated by Steffen for desaccharifying molasses. In laboratory tests a sucrate was obtained of 96.70 purity, leaving 0.65 of sugar in the waste liquors. On the large scale, after evaporating the juice obtained by decomposing the sucrate with carbonic acid, a syrup of purity 96 was obtained. In another case, on treating a diffusion juice of purity 88.30, a syrup was obtained of purity 96.61, and saline quotient 53.13; the exhaustion of the beetroots had been pushed to the extreme, and the scums of the decomposition of the sucrate still contained 1.90 per cent. of sugar.

In criticising Szyfer's experiments, the author states that the separation of sugar as saccharate is difficult in solutions containing more than 7 per cent. of sugar. The idea of applying the separation process to diffusion juice has already been entertained by Stammer, but the cost, considering the considerable quantity of lime necessary, prohibited its application industrially. Desaccharifying molasses by separation is practised in factories where the tri-saccharate is used in place of lime in defecating diffusion juice at the first saturation, so that there is no longer an excessive consumption of lime. The conditions for properly carrying out the separation have been indicated by Steffen in his patents and still hold good.

Szyfer thinks that only 7 to 8 of lime should be used per 100 of beetroots, but this quantity would be too small for roots containing 14 to 16 per cent. of sugar, for hitherto it has been considered that 80 of lime per 100 of sugar is necessary to give a satisfactory result in separation. In any case 8 per cent. is already three times the amount actually required. The cost of manufacture would be considerably increased, and the present plant insufficient.—L. J. de W.

Sugar Liquors; Influence of Alkalinity on — Zscheye. Bull. de l'Assoc. des Chim. de Sucre et de Dist. 1900, 18, [4], 254. From *Die deutsche Zuckerind.* 1900, [30], 1194.

THE principal cause of the grey colour of sugars is the solubility of salts of iron in sacro-calcic solutions. It is advisable to saturate at the second carbonating to about 0.03 of alkalinity, calculated as lime, so as to decompose all the sacro-calcic compounds formed during defecation, and to precipitate the iron salts which have entered into solution. It must also be noted that the organic acids set free by sulphurous acid, likewise dissolve the iron in the juice, and the presence of small quantities of invert sugar may have the same effect. In any case a certain alkalinity must be maintained at every stage. These observations have been confirmed by Strandes. In a new factory no sulphurous acid is used, but the lime is allowed time to act on the juice, and by boiling and agitation, the defecation is effected under conditions favourable to a full purification. The sugars obtained are always of a fine yellow colour.

—L. J. de W.

Third-Jet Sugar and Molasses; Composition of the Insoluble Matter of — H. Pellet. Bull. de l'Assoc. des Chim. de Sucre et de Dist. 1900, 18, [4], 193–194.

WHEN molasses and solutions of certain sugars of low quality are examined, they are found not to be absolutely clear, but the turbidity persists and does not collect rapidly at the bottom of the vessel. This insoluble matter was collected by filtration and analysed.

Third jet sugar gave 0.264 gm. of insoluble matter per 100 grms. of sugar. After ignition there remained 0.130 gm., or about 50 per cent. of organic matter as loss.

Molasses gave a total residue of 0.0467 gm. per 100 grms. of sugar, containing 42 per cent. of organic matter.



The mineral residues gave the following results:—

	3rd Jet Sugar.	Molasses.
Silica soluble in alkalis	74.7	97.9
Sand	5.7	Nil.
Alumina and peroxide of iron..	7.6	0.6
Lime	9.1	1.5
Sulphuric acid.....	2.6	Traces.
Copper	Traces	..
Various (phosphoric acid, nil)..	0.3	..
	100.0	100.0

It appears that these insoluble substances, apart from organic matter, consist of silica soluble in alkalis, which is found in the products as gelatinous silica. The composition will evidently vary with the method of working adopted in the sugar factories, and the study of these deposits may serve to explain many obscure facts in manufacture.—L. J. de W.

Sugar; Action of Ozone in the Manufacture of—
Herzog. Bull. de l'Assoc. des Chim. de Sucre et de Dist.
1900, 18, [4], 252—254. From Die deutsche Zuckerind.
1900 [30], 1197.

FROM an examination of recent publications on the action of ozone on sugar and beetroot and factory juice, the following conclusions are drawn, viz.:—that the subject requires a more thorough study before it can be proved that there is no danger of destruction of sugar; that the influence of ozone on beetroot juice appears to be directed to the destruction of those constituents which give it its characteristic odour and taste; and that there has been no proof of an increase in the quotient of purity or of a strong decolorisation by the action of ozone alone.—L. J. de W.

Beetroot Diffusion Juice; Warm Diffusion and Warming
— M. Meliehar. Zeits. Zuckerind. Böhmen, 1900,
25, [1], 8—15.

In criticising Claassen's views on diffusion, the author divides the heat into the useful portion which is carried by the diffusion juice, and the lost heat which is left in the spent pulp and waste waters.

With the high price of fuel at the present time, it is desirable to consider whether diffusion shall be carried out in the old costly way as hitherto, or the so-called hot diffusion shall be adopted, in which the highest diffusion temperature is given to the first diffuser which is filled with fresh chips.

With regard to the proposal to heat cooled diffusion juice with open spent steam from the quadruple effect, it is pointed out that there exist heaters with high transmission coefficient, which are capable of readily heating the juice without dilution; moreover, diluted juice necessitates an increase of surface of evaporation in addition to the direct disadvantage.—L. J. de W.

Diffusion Juice and Masecutes; Organic Acids Extracted by Ether from— K. Andrlík, K. Urban,
and V. Stanek. Zeits. Zuckerind. in Böhmen, 1900, 25,
[2], 83—89.

In diffusion juices organic acids extractible by ether vary greatly in quantity; their acidity ranged from 24.5 to 39.4 c.c. of normal alkali per 100 grms. of sugar, mean 29.1 c.c. The above figures, however, are not to be considered as limits. Of this acidity, oxalic acid accounts for from 7.6 to 15.3 c.c., mean 10.77 c.c., of normal alkali. Acids volatile with steam were only present in small quantities, equivalent to from 1.4 to 3.3 c.c., mean 1.9 c.c., of normal alkali per 100 grms. of sugar. Only a portion of the organic acids gets through into the masecuite, numbers corresponding to from 6.1 to 14.2 c.c., mean 9.3 c.c., of normal alkali were obtained. Including the oxalic acid, 68 per cent., or about two-thirds, of the organic acids are removed by the saturation processes; excluding the oxalic acid, of which only very small traces remain after saturation, 49.3 per cent., or about one half, of the other acids are removed.

The quantity of organic acids extractible with ether, varies with the season; the mean difference between the organic acids of the masecutes of two seasons corresponded to 3.8 c.c. of normal alkali per 100 grms. of sugar. Apparently the quantity of organic acids extractible with ether increases during the boiling of the syrups; the increase observed up to the final molasses, corresponded on an average to 0.52 c.c. of normal alkali per 1 per cent. of ash. The quantity of volatile acids increases during saturation and evaporation up to the first masecuite; this increase amounted to 51 per cent. of the volatile acids originally present in the diffusion juice.—J. F. B.

Filtration [Sugar] through Animal Charcoal. F. Stolle.
Zeits. Ver. deutsch. Zucker-Ind. 1900, 50, [537], 872
—883.

AN attempt is made to determine the quantity of the constituents of revived char which are dissolved by varied treatment in the filter. Revivified char was preferred, since the employment of new char for refined liquor is exceptional. 35 kilos. of the char are put into a malleable iron filter, 6 ft. long, and washed with water at 30°, 50°, and 80°—90° C. for two days, samples being taken every few hours, the water having a head of 6 ft., and being run at the rate of 1 litre in 7 minutes. In each case both water and char are analysed. Previous to each experiment the char, after fermentation, is treated with caustic soda, then with the calculated quantity of hydrochloric acid, and with frequently renewed boiling water until the washing water is neutral. It is then passed through a Klusemann washing machine, dried thoroughly, and carefully burned at a temperature of 500° to 550° C., and finally packed in the filter for the experimental washing.

With water at 30° C., 28 hours elapse before the water is free from calcium and sodium sulphates; sodium chloride and carbonate show for some time afterwards. Calcium carbonate begins to appear when the sulphate is absent. Calcium sulphide could not be detected; iron, only in the first sample.

With water at 50° C., sodium sulphate disappears after 8 hours washing, calcium sulphate after 12 hours, sodium carbonate after 17 hours, and sodium chloride after 22 hours. Calcium carbonate begins to show at the eighth hour and before the sulphate is absent. Ammonia, even after 12 hours, can be quantitatively determined, and traces of iron show throughout.

When water at 80°—90° C. is used, calcium sulphate, sodium chloride, and sodium sulphate disappear after 8 hours, and sodium carbonate after 12 hours. The solution of calcium carbonate begins after 4 hours, while the sulphate is still present. Iron is present in traces throughout, and ammonia in measureable quantities for 12 hours.

When steam was passed through, the condensed water showed the same percentage of calcium sulphate throughout the experiment, but calcium carbonate was not dissolved. The following table shows the composition of the char:—

Temperature of Water.	A.	B.	30°	50°	80°—90°	Steam.
Carbon	8.140	6.138	7.086	7.032	7.150	6.984
Sand and clay ..	0.308	0.466	0.519	0.330	0.234	0.416
Calcium carbonate.	10.28	7.187	6.590	6.590	6.570	7.100
Calcium sulphate.	0.0717	0.058	0.009	0.016	0.0105	0.0433
Calcium sulphide.	0.132	0.040	0.0014	0.0783	0.121	0.0634
Nitrogen (Kjeldahl).	1.044	0.549	0.5233	0.6003	0.678	0.636

Column A. is new char before use. B. the revived char after being frequently used; this was the char taken for the experiments.—L. J. de W.

Beet-Molasses; Presence of Lactic Acid in— A. Schöne and B. Tollens. Zeits. Vereins deutsch. Zucker-Ind. 1900, [538], 980—981.

SINCE lactic acid is formed by the action of lime or strontia on aqueous solutions of cane sugar at 100°—125° C., the



probability exists that the acid will be present in beet-molasses, and this supposition the authors confirm. Of 13 samples of molasses examined, eight contained lactic acid in such a quantity that it could be separated and converted into zinc lactate, identified by analysis; in the others, the acid was detected qualitatively. The authors conclude, therefore, that lactic acid is a constant constituent of beet-molasses—H. T. P.

Cane Sugar; Action of Strontia upon Solutions at 125°—128° C., of —. A. Schöne and B. Tollens. Zeits. Vereins deutsch. Zucker-Ind. 1900, [538], 978—979.

THE authors have carefully examined the changes occurring when a saccharose solution is heated with strontia, under pressure at 125°—128° C., and find, that although small proportions of lactic acid and other decomposition products are formed, no trace of raffinose is produced. The same result has already been shown to obtain when cane sugar solutions are heated to 100° C. with lime or strontia. It is concluded, therefore, that the raffinose present in beet-molasses, pre-exists in and is wholly derived from the beet, and is not formed during the manufacturing process.

—H. T. P.

PATENTS.

Sugar; Method and Apparatus for Refining —. J. Robin-Langlois, Paris. Eng. Pat. 23,134, Nov. 20, 1899.

THIS invention consists of devices for quickly refining sugars by taking them in the raw and crystallised state and then washing, turbinng, drying, and grinding, for the purpose of agglomeration into a pasty mass. The claims are for apparatus for carrying out the different processes.

—J. L. B.

Saccharine and other Crystallisable Liquids; Concentration and Crystallisation of —. Process and Apparatus for —. J. McNeil and C. McNeil, Govan, Lanarkshire. Eng. Pat. 23,598, Nov. 27, 1899.

THE crystallisation of saccharine and other crystallisable solutions is carried out in a series of vessels all working under diminished atmospheric pressure and heated by exhaust or low pressure steam. The first vessel works intermittently by drawing in charge after charge of the liquid to be treated, bringing each to a hot saturated condition, then forming the grain and dropping it into a vessel placed underneath. From this receiver the mass is drawn up to the second vessel in the series and some syrup or thick juice is run in to increase the size of the grain. The mass then passes into the third vessel where more syrup is added, this process being continued throughout the series.

—J. L. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

Glycogen in Yeast; Appearance and Disappearance of —. R. Meissner. Centralbl. Bakteriol. (II. Abth.), 1900, 6, 517; through Woch. für Brau. 1900, 17, [45], 669—670.

WORTMANN observed in certain cases of fermentation of wine musts that the carbonic acid evolved, was in excess of the amount calculated from the sugar consumed. This was noticed especially in the later stages when the fermentation was of protracted duration. He attributed it to the consumption by respiration of the reserve materials of the yeast: glycogen and fat. In 1895, Will studied the formation of glycogen in the yeast cell under favourable nutrition and its disappearance during auto-fermentation. Laurent found that the glycogen might amount to 32.58 per cent. of the dry substance of the yeast. Lindner has observed the formation of glycogen at the expense of other dead cells. The author finds that the dilute solution of iodine often only gives a yellow coloration, and recommends a solution containing 20 parts of potassium iodide and 7 parts of iodine in 100 of water; this gives a sharp and rapid coloration. The reaction was obtainable in the case of yeast from must cultures 22 hours old, even with daughter cells having a diameter one-fifth of that of the mother cells; younger

buds only showed a yellow coloration. Some races only gave the brown reaction after some time; others showed it immediately after the first yellow coloration. The author confirms the observation of Will and Lindner that the distribution of glycogen is very irregular. During the secondary fermentation, glycogen was still detected after some time, both in quiescent and fermenting cells. In wine fermentation the quantity of glycogen is greatest at the end of the primary fermentation, after which it gradually decreases. Whilst still a fair amount of sugar is unfermented a number of the cells pass into the quiescent stage and lose some of their glycogen; this change is recognised by the granular structure of the cell contents and the shrinkage of the cells; the quiescent cells are less resistant to iodine, and give the glycogen reaction at once. The rate of disappearance of glycogen varies with different races; some cells containing glycogen are found even in starved deposits. It does not do to wait for the disappearance of all the glycogen before separating the yeast from the wine. The production and consumption of glycogen in the cells may proceed simultaneously. The author regards the glycogen as a "transitory" reserve material which secures a constant supply of sugar for the yeast, and aids it in its struggle for existence.—J. F. B.

Zymase from Sterilised Yeast. E. Buchner. Ber. 1900, 33, [17], 3307—3310.

THE author has amplified his previous observations on the preparation of active zymase extracts from yeast previously dried and sterilised. Bottom-fermentation beer yeasts were carefully dried at a pressure of 30 mm. at temperatures ranging from 35° to 100° C. The dried yeasts were then subjected to the action of dry heat in a current of hydrogen for a considerable time, namely, for from 8 to 10 hours, at temperatures ranging from 95° to 110° C. To meet possible objections, all the preparations were then tested for sterility by careful observation of their behaviour in beer wort for three weeks. All the preparations having been proved sterile, they were then extracted by trituration with a 10 per cent. solution of glycerin in water, with the aid of sand and kieselguhr. After pressing, extracts were obtained which were still active to an extent varying from one quarter to one half of the activity of the extracts prepared from the fresh yeast. Thus a considerable quantity of active zymase was recovered in spite of the high temperature and the loss of zymase attendant on the manipulations and imperfect solubility in the dry state. To the author's mind, the above results conclusively dispose of the theory advanced to explain the fermentative activity of his extracts by the presence of living protoplasmic residues.—J. F. B.

"Zymase, Buchner's"; Remarks on the Paper by Macfadyen, Morris, and Rowland on —. E. Buchner. Ber. 1900, 33, [17], 3311—3315.

THE author considers that several points in the paper by Macfadyen, Morris, and Rowland (this Journal, 1900, 1127), dealing with the preparation and properties of expressed extracts from English top-fermentation beer yeasts, are open to criticism. In the first place, the bibliography of the English authors is not quite complete, no notice being taken of Lange's work on top-fermentation distillery yeasts (this Journal, 1898, 779), amongst others. Certain apparent discrepancies are found in regard to the relative effect of the extracts on different sugars. In some cases glucose is fermented twice as strongly as maltose, and in other cases the relations are exactly reversed; the only difference in the extracts producing these results lies in the age of the yeast before extracting. Again, in regard to the action of antiseptics, discrepancies of a similar nature are noticed; in some cases toluene has a greater retarding effect than thymol; in others, thymol is more inhibitive than toluene. Buchner comments on the general weakness of the fermentative power of the extracts prepared by the English authors; very few samples were as active as Buchner's extracts, whilst many possessed less than half the normal activity. It is also pointed out that with concentrations of sugar below 20 per cent., such as were largely used by the English authors, the mere addition of thymol is not sufficient



to suppress the activity of micro-organisms. Top-fermentation yeasts are always more or less impure, and with such low concentrations of sugar, the authors' results are vitiated in the absence of proof of the sterility of their liquids. Finally, Buchner refers to one of his former papers (this Journal, 1899, 778) on the question of the so-called "auto-fermentation" of the extracts. In that case he had determined the "auto-fermentation" in extracts of Munich yeast, and he now gives results of experiments with Berlin yeast. The quantity of gas evolved by the latter without addition of sugar is somewhat higher than in the case of the Munich extracts, probably owing to a higher content of glyco-gen, but it never exceeds 10 per cent. of the total quantity of gas evolved when sugar is added. The very large quantities of gas evolved by the extracts from the English yeasts without sugar may be due to glyco-gen, or very probably to the activity of bacteria.—J. F. B.

"Zymase; Buchner's —"; *Enzyme Theory versus Plasma Theory*. Windisch. Woch. für Brau. 1900, 17, [46], 681—682.

CONTRIBUTING to the discussion on the paper of Macfadyen, Morris, and Rowland (this Journal, 1900, 1127), the author first remarks on the extreme difficulty at first experienced in preparing active yeast extracts. The very erratic results might be explained by assuming that zymase is not secreted and stored up in large quantities, but is only formed when there is work for it, that is, under the stimulative influence of the presence of sugar. When the yeast is removed from the fermenting liquid, the small quantity of zymase would be rapidly digested, and no more would be formed. Bottom-fermentation yeasts are always fully immersed in the saccharine medium, and are kept at low temperatures. Top-fermentation yeasts are exposed to the air, and, owing to their position at the surface of the liquid, they are not in constant contact with saccharine wort; moreover, at the high temperatures employed in English breweries, they are far more susceptible to the action of the proteolytic enzyme. The author quotes numerous instances in nature where the secretion of an enzyme is determined by excitement due to the presence of the particular substance which it attacks, e.g., the animal digestive enzymes, &c. Lange's work showed that the extracts from top-fermentation distillery yeasts were less active than those from bottom-fermentation brewery yeasts, and also contained less nitrogen. How far the weaker activity of the extracts from top-fermentation yeast depends on the particular conditions of growth outlined above remains to be investigated.—J. F. B.

Aspergillus Niger; The Proteolase of—. II. G. Malfitano. Ann. de l'Inst. Pasteur, 1900, 14, 60; through Woch. für Brau. 1900, 17, [46], 690.

THE enzyme has the character of a proteolytic diastase, very similar to papaïn and the proteolytic enzyme of malt. It acts upon gelatin, nucleoproteins, globulins, and albuminates, but it only attacks albumin if the latter has undergone a previous decomposition, since it cannot dissolve coagulated albumin. The particular reaction of the medium most favourable to its activity is that of neutrality towards Methyl Orange, that is, acidity due to acid phosphates.

—J. F. B.

Fermentation Vats [Distillery]; Tar Coating for—. G. Heinzelmann. Zeits. Spiritusind. 1900, 23, [48], 438. (Compare also this Journal, 1900, 839 and 761.)

FURTHER evidence is now to hand that the tarring of the vats inside can be effected without any damage to the course of fermentation, and to the use of the more solid matter of the spent wash as fodder. A good way of applying the tar, so as to avoid any subsequent ill effects, is to use it boiling. At the end of the season, when the vats have dried, a coat of boiling coal-tar is given; it is allowed to remain a fortnight before applying a second coat. In this way sufficient time is afforded before the next season for the coating of tar to become perfectly hard and harmless.

Tar should certainly never be applied shortly before the vats are required for use. The removal and oxidation of the objectionable volatile constituents of the tar are considerably facilitated by its application whilst boiling; the boiling tar also penetrates the wood more readily.

The main object in tarring the vats is to dispense with the trouble of having to lime them every time after emptying, and it is sufficient to wash them with warm water, finishing up with a thorough brushing. But this latter operation is sometimes omitted by the workmen, and, since it is absolutely essential, it is best to sprinkle the tarred vats with lime, and then insist on its being brushed off. The use of lime is an additional safeguard, as growths of moulds can occur even on tarred surfaces. Moreover, the use of lime destroys the organisms which have lodged on the copper cooling worms, and which are not removable by the hose alone.—J. F. B.

Potato Spirit from the Mashing Space; High Yields of—. Schirmann. Zeits. Spiritusind. 1900, 23, [48], 438.

THE author complains of the large number of fraudulent processes purporting to give higher yields of spirit per cent. of the mashing capacity. Whilst not denying that yields of 12 per cent. and more can be obtained with good materials and up-to-date plant, he holds that those people who state that high yields should be the rule and not the exception, do so out of ignorance.

In obtaining a high yield, the first question that arises is whether it is obtained economically, and without a great waste of starch. Whilst frequently obtaining a yield of 12 per cent. from his mashing space with good potatoes, the author also very often has the greatest trouble in getting 9.5 per cent. with potatoes poor in starch.

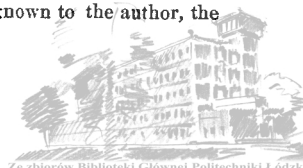
It is more important to utilise the whole of the raw material efficiently than to obtain high yields at a loss. Concentrated mashes are frequently difficult to attenuate down to the lowest gravity (less than 1° Balling is often demanded), on account of certain properties and constituents of some kinds of potatoes.—J. F. B.

Fermentation Gases; Utilisation in the United States of—. H. Medinger. Woch. für Brau. 1900, 17, 701—702.

IN the Milwaukee breweries the methods of Schlitz and Pabst are in use. Fermentation is carried out in the settling tank (capacity, 320 hectolitres) and in fermenting vats (capacity, 110—120 hectolitres). The vats are provided with two openings, one carrying a pipe for conducting the gas to a receiver, and the other for introducing the yeast and other manipulations; sometimes an observation glass is also provided.

The wort is made from malt, with maize or rice adjuncts; it comes from the brewing house into a collecting tank; it then passes through the coolers into the settling tank. Here it is pitched with yeast and aerated four times in 36—48 hours for five minutes with filtered air. The further fermentation is conducted in the fermenting vats, in which the wort is cooled, sometimes as low as 1.5° C., and remains 10—14 days without aeration. The gas is collected from both the settling tank and the fermenting vats. The covers of the vats are kept saturated with water to prevent shrinkage of the wood. In some New England breweries the gas is freed from bad-smelling impurities and pumped into the Lager vats under pressure, whereby, it is said, the ripening of the beer is considerably hastened.

Witte-mann, of New York, has introduced a process which is said to work very well: the gas flows at a pressure of about $\frac{1}{2}$ lb. per sq. in. into a carbonic acid factory, where it is treated by a special process and compressed. In a Californian brewery the gas is used without purification for gassing the beer, but the latter has not a good flavour. The collection of the gases of fermentation is especially advantageous to those breweries which cask their beer under pressure before bottling. The cost of the American method is not great; in one case known to the author, the



alteration cost 525*l.*, and was borne by the carbonic acid factory, the cost of the gas to the brewery being reduced to one-twentieth.—J. F. B.

Melitriose [Raffinose]; Is a Special Enzyme required for the Hydrolysis, by Micro-organisms of — A. Bau. Woch. für Brau. 1900, 17, [47], 698.

In their paper on certain species of Amylomyces (this Journal, 1900, 1128), Sitnikoff and Rommel suggest that, since glucose is fermented but raffinose is not hydrolysed by some of the species, this sugar may require the presence of a special enzyme for its hydrolysis. The author points out that those species which did not hydrolyse raffinose also had no effect upon cane sugar. He lays great stress on the close analogy between the nature of the attachment of the fructose group to the melibiose residue in raffinose and that of the fructose and glucose groups in cane sugar. Both sugars are non-reducing, and both are very easily split up by weak acids into reducing sugars; and, since Fischer proposed the formula $C_6H_{11}O_5-O-C_6H_{11}O_5$ for cane sugar, the author thinks that a similar argument will apply for the connection of fructose to melibiose to form raffinose, i.e., $C_6H_{11}O_5-O-C_{12}H_{21}O_{10}$. The author grants that the anhydride linkage between the glucose and galactose groups of melibiose is of quite a different nature; melibiose is only split by strong acids (mineral acids and oxalic), and requires the presence of a special enzyme, melibiase, for its hydrolysis before fermentation. But he holds that the ordinary cane-sugar enzyme, invertase, is sufficient for the resolution of the simple $-O-$ connection, and that, whenever invertase is present, raffinose [melitriose] is split up into fructose and melibiose.—J. F. B.

Invertin or Invertase in Grapes; Presence of — V. Martinand. Comptes Rend. 131, [20], 808—810.

THE must of grapes, made after careful cleansing and sterilising of their outer surface, was found to contain invertase, which was identified by the temperature of its maximum activity, and by the influence of acetic acid on that activity. Unit quantity (that capable of inverting 0.2 gm. of sucrose in an hour, at 56° C., in presence of 1 per cent. of acetic acid) was contained in from $\frac{1}{10}$ to $\frac{1}{10}$ c.c. of the must of various grapes. The same amount was found in the extract from 2.5 grms. of fresh vine leaves. The amount in the grape is more than enough to invert all the sugar it contains. When the invertase in the must is destroyed by heat, the wine formed from it contains practically no invertase, while that made from the fresh must contains it in considerable quantity. Invertase in wine, then, comes as a rule from that in the must, not from the fermenting yeast. This diastase does not oxidise so readily as some others, for it is contained in considerable amount in the must made from currants which have been allowed to take up again their natural water by soaking, while the oxidising diastase contained in the fruit is oxidised and destroyed in the drying process. Invertase disappears altogether, however, in the oxidising disease of "casse," as well as in the microbial diseases known as "tourne" and "pousse."—J. T. D.

American Wines; Composition of — W. D. Bigelow. U.S. Dept. Agric. 1900, Bulletin No. 59.

THIS bulletin contains tables giving the results of analyses of 845 samples of American wines of known origin from the various wine-producing States. The largest number of analyses relate to the wines of California, the material from the other States being as yet rather meagre. For purposes of comparison, the reports of the German "Weinstatistik Commission" are quoted on the subject of European wines.

Alcohol.—The American wines generally contain a higher percentage of alcohol than the European; this is especially the case with the wines produced in the warmer parts of California. Fermentation does not yield more than 14.5 grms. of alcohol per 100 c.c.

Glycerin.—Unfortunately many of the analyses of American wines do not include determinations of the

glycerin; the results obtained ranged from 0.163 to 1.083 gm. per 100 c.c. The German authorities quote limits from 0.4 to 1.0 gm. per 100 c.c., with extreme cases of 0.2 and 1.39 in rare instances. The glycerin content of American wines, so far as has been determined, is lower than that of European wines.

Glycerin to Alcohol Ratio.—This ratio is considered of great importance in judging the purity of wine. The later German statistics put this ratio at from 6 to 14 parts of glycerin per 100 of alcohol. The glycerin-alcohol ratio of American wines of known purity often falls below the minimum limit of 6 per cent.

Sugar-free Extract.—This is got by subtracting the sugar, —0.1 gm., and, in the case of plastered wines, the potassium sulphate, —0.1 gm., from the grms. of total extract per 100 c.c. According to the later opinions, the minimum limit should be 1.6 gm. per 100 c.c. for white wines and 1.8 for red wines in Europe. For Californian wines, Curtis puts the average extract at 2.90 for red wines and 2.0 for white (six months old), or 2.65 for red and 1.75 for white (two or three years old). He regards with suspicion a red wine lying outside the limits 2.4—3.25 and a white wine outside 1.5—2.4 grms. of sugar-free extract per 100 c.c.

Ash.—The German commission puts the limits of ash between 0.44 and 0.11 gm. per 100 c.c., regarding with suspicion anything less than 0.14 or more than 0.35. The American wines answer to this specification, and the same standards may be applied. Curtis gives the average ash contents of American wines as 0.28 gm. per 100 c.c. for red and 0.21 for white wines.

Extract to Alcohol Ratio.—This ratio is used as a test for the fortification of wine by added alcohol or its dilution with water. This ratio is not included in the tables for American wines in this bulletin.

Total Acid.—The acidity of European wines lies between 0.4 and 1.5 gm. per 100 c.c., calculated as tartaric. The acidity may vary during ageing. The acidity of Californian wines (six months old) averages 0.525 gm. per 100 c.c. for red and 0.570 for white; less than 0.450 is suspicious.

Volatile Acid.—The high volatile acidity of American wines is undoubtedly largely due to imperfections in the methods of fermentation. But it is very probable that with equal perfection, the volatile acids of American wines would still be higher than in European wines. For Californian wines up to three years old, Curtis proposes a volatile acidity of 0.14 per cent., as against the German maximum of 0.12 per cent. There has been a great improvement as regards volatile acids in American wines in recent years.

Reducing Sugar.—Imperfect fermentation also accounts for a high percentage of reducing sugar; for this reason American dry wines often exceed the 0.1 gm. per 100 c.c. which is regarded as the standard for European wines.

Plastering is of rare occurrence in American wines.

The remainder of the bulletin contains full descriptions of the analytical methods employed and the tests for the detection of various preservatives.—J. F. B.

"Saccharin" in Wine and Beer in the Absence of Salicylic Acid; Detection of — F. Wirthle.

See under XXIII., page 72.

Yeast from Grain Distilleries; Classification as a Food-stuff and Examination of — S. Rohn.

See under XVIII. A., page 58.

Methyl Alcohol in Mixtures; Detection of — S. P. Mulliken and H. Scudder.

See under XXIII., page 71.



XVIII.—FOODS; SANITATION; WATER PURIFICATION, & DISINFECTANTS.

(A.)—FOODS.

Meat Extracts; The Food Value of — L. Fürst. Chem. Zeit. 1900, 24, 994—995.

AFTER reviewing the various statements made by Bremer, König, Bömer, and others, concerning the true nutritive constituents of meat extracts, the author comes to the conclusion, already generally accepted, that the proportion of albumoses, peptones, and albumins in the extracts is too small to give any food value to the same.

The amount of extract usually taken is too small to have any but a stimulative effect.—W. P. S.

Yeast from Grain Distilleries; Classification as a Food-stuff and Examination of — S. Rohn. Zeits. Unters. Nahr. und Genussmittel, 1900, 3, [11], 756—763.

By a recent enactment, pressed yeast for bakers' use has been brought under the foodstuff laws in Germany. It must be the pure product of the fermentation of grain, and must not be mixed with potato flour nor with beer yeast.

Detection of Potato Flour.—For small quantities, up to 2 per cent., the best means of detection and estimation is the microscope. With higher proportions, the granules cannot be counted with sufficient accuracy to give reliable results. One or two per cent. of potato flour does not necessarily indicate wilful adulteration, as the yeast may become contaminated to this extent by using the presses, vessels, and pipes for other purposes. There is as yet no really good method for the quantitative estimation of starch in yeast; the author suggests that an iodine colorimetric method or a saccharification method might be worked out successfully.

Detection of Beer Yeast.—An expert has no difficulty in distinguishing grain-fermentation yeast from beer yeast when both are pure, either by taste or by the small black specks of hop resins present in the latter. But to determine the composition of mixtures is a very difficult matter, especially when the proportion of beer yeast is less than 25—30 per cent. The only chemical test is the behaviour towards raffinose (Bau, this Journal, 1898, 937). Beer yeasts of the bottom-fermentation type ferment this sugar completely, whilst the top-fermentation distillery yeasts convert it into melibiose. By this test the detection of less than 20 per cent. of beer yeast could only be effected by very careful comparative fermentations; moreover, the author has often met with distillery yeasts which ferment raffinose completely but slowly. Microscopic examination is useless for the detection of beer yeast in distillery yeast, owing to the numerous variations of both kinds.

Detection of Molasses Yeast.—The detection of yeast derived from molasses fermentation, when mixed with that of grain fermentation, is practically impossible. Even experts are unable to distinguish with certainty between the two kinds in the unmixed state. Since the number of pressed yeast factories working molasses is very small, the Government must resort to official supervision if it desires to control the sale of this kind of yeast.

Testing the Fermentative or Working Power of Yeast.—There is no absolute measure of the fermentative power of yeast; the most general method of testing is that of Hayduck and Meissl. The tests vary in different factories and have only a relative value, depending entirely on the conditions of manufacture and employment.

The yeasts of highest fermentative power are not always those most suitable for bakery purposes, and official tests are hardly called for.

The annual production of pressed yeast in Germany is 21 million kilos. from 954 distilleries.—J. F. B.

Oranges; Artificial Colouring of — Pum and Micko. Zeits. Unters. Nahr. und Genussmittel, 1900, 3, [11], 729—735.

THE authors contradict a statement made by Hotter of Graz, that "blood" oranges are often made artificially by

injecting colouring matters under the skins of ordinary yellow oranges.

Extensive experimental trials showed that in no case could any staining of the orange be effected with natural or artificial dyestuffs which could possibly deceive the simplest purchaser after the orange was peeled.—J. F. B.

Tea; Theine in — J. Kochs. Rev. Cult. Colon. 7, 494. Pharm. J. 1900, 65, [1586], 537.

THE author has determined the percentage of theine in several varieties of Chinese tea. The samples were all pure, and had preserved their aroma owing to the packages having been hermetically sealed. The results of the analyses were:—Souchong, 2.83; Flower Pekoe, 4.36; Scented Tea, 3.08; Pouchong, 3.44; Congou, 3.23; and Oolong, 3.66 per cent. of theine. A Brazilian tea, Chà Morumbi, contained 3.11 per cent. of theine. The market value of a sample of tea and its suitability for use depend not only upon composition, but also upon the appearance, aroma, and taste of both leaf and infusion. Tea from Assam, Ceylon, and Java is better packed, and consequently has more aroma than that from China and Japan. According to W. Krohn, formerly German Consul at Futschau, only the Chinese, scented Orange Pekoe tea is artificially flavoured. The author states that this tea is of excellent quality, and that the flavouring is in no wise an attempt to adulterate the article.—A. S.

Maize in Wheat Flour; Detection of — G. Embrey. See under XXIII., page 72.

Maize in Wheat Flour; Detection of — E. J. Bevan. See under XXIII., page 72.

Dulcine (Phenetol-Carbamide) in Foods and Beverages; Detection of — See under XXIII., page 72.

PATENTS.

Foodstuffs; Process and Apparatus for Preserving — J. J. Möller, Flensburg, Germany. Eng. Pat. 24,801, Dec. 13, 1899.

THE apparatus for preserving foodstuffs or for disinfecting any articles consists of an inner vessel fitting loosely in an outer containing vessel. On the upper periphery of the outer vessel, two troughs or grooves are made, corresponding with two projecting flanges on the periphery of the lid, in such a manner that a double "liquid seal" is produced. The inner trough, which is in communication with the interior of the vessel, is filled with a readily volatile antiseptic, whilst the outer groove is filled with oil to prevent evaporation of the antiseptic into the air. A further receptacle also containing the antiseptic is suspended inside the vessel by a flange or lips from the top. In this way the vapours of the antiseptic come into contact with the contents of the vessel and efficiently preserve them from the action of bacteria.—J. F. B.

Milk, &c.; Pasteurising and Sterilising — E. von Bühler, Charlottenburg, Germany. Eng. Pat. 25,329, Dec. 21, 1899.

THE milk or liquid to be treated is gradually heated in two batteries joined together according to the counter-current principle, each battery being composed of two or more pasteurising or sterilising apparatus connected together. In one of the two batteries the previously heated liquid is further heated by an independent heating medium; it is then passed to the other battery where its heat is utilised for the preliminary heating of a fresh supply of liquid.

—J. F. B.

Milk; Production of Condensed — A. Gürber, Würzburg, Germany. Eng. Pat. 25,484, Dec. 23, 1899.

SKIMMED milk is concentrated by freezing out the water in the form of ice whilst rotating in a centrifugal machine. Freezing is effected by introducing a refrigerator cooled by



brine into the rotating machine; as the ice accumulates, it is separated from the heavier concentrated milk by the centrifugal action. The cream may then be added to the condensed milk.—J. F. B.

Blood, Milk, &c. in the Form of Dry Powder; Obtaining the Solid Constituents of—. R. Stauf, Posen, Germany. Eng. Pat. 14,724, Aug. 16, 1900.

The process claimed is carried out by converting the liquid into a fine spray, bringing the spray of atomised liquid into contact with an ascending current of hot air, so that the liquid constituents are completely vaporised and the dry powder produced is collected. The apparatus consists of spray producing jets supplied with air under pressure, and a shaft through which a current of heated air passes into a spacious chamber in which the dry powder is deposited.—J. F. B.

Rennet Ferment; Preparation of—. J. R. Hatmaker, London, from J. A. Just, New York. Eng. Pat. 877, Jan. 15, 1900.

A LIQUID extract of rennet is prepared by digesting the stomachs in a relatively weak solution of calcium chloride, afterwards adding additional calcium chloride to the extract in order to precipitate the mucus, which is then removed. For the extraction of the rennet, the inventor prefers an 8 per cent. solution of calcium chloride; this is then made up to 10–18 per cent. for the separation of the mucus; more than 18 per cent. of calcium chloride would precipitate the ferment. The calcium chloride solutions must be made perfectly neutral to litmus. Both the product and the process for making the same are claimed.—J. F. B.

Brewers' Spent Grains; Manufacture of a Food from—. J. Schroeder and L. Diefenthal, Osnabrück, Germany. Eng. Pat. 11,639, June 27, 1900.

The inventors claim the process for the manufacture of a food product, possessing many advantages, by mixing the spent grains from breweries or distilleries with substances containing gluten or other nitrogenous proteid bodies and then submitting the product to a baking process as in the manufacture of bread. The use of crude molasses in the mixture is also claimed. Crushed rye with a small proportion of flour, is mentioned as giving good results.

—J. F. B.

Carbonating Apparatus. E. E. Murphy, Boston, U.S.A. Eng. Pat. 14,136, Aug. 7, 1900.

IN a carbonating apparatus there are claimed, an inlet pipe for supplying liquid under pressure, a gas-inlet pipe for supplying gas under less pressure than that on the liquid, a mixing chamber for the gas and liquid in constant open communication with the liquid supply under initial liquid pressure, and normally filled with gas and liquid, a valve normally closing said gas inlet pipe by the pressure in said mixing chamber, and adapted to open automatically by the pressure of the gas, upon a reduction of pressure in the mixing chamber below the gas pressure to admit the gas which flows into the mixing chamber by its own pressure, independently of the flow of the liquid, means for subdividing and combining the gas and liquid," (a metallic sponge composed of layers of wire cloth), "means for retarding the flow of the liquid from the liquid supply pipe into the mixing chamber to allow the gas to fill the mixing chamber before it is filled with the liquid, a passage establishing communication between the mixing chamber and the storage reservoir, a valve controlling said passage, an outlet for the carbonated liquid from the storage reservoir, and a valve controlling said outlet." The liquid is admitted under a pressure of from 175 to 200 lb., and the gas at from 125 to 150 lb.—E. S.

Albumin and Meat Extract; Preparation of—. G. Deycke, Constantinople. Eng. Pat. 16,060, Sept. 10, 1900.

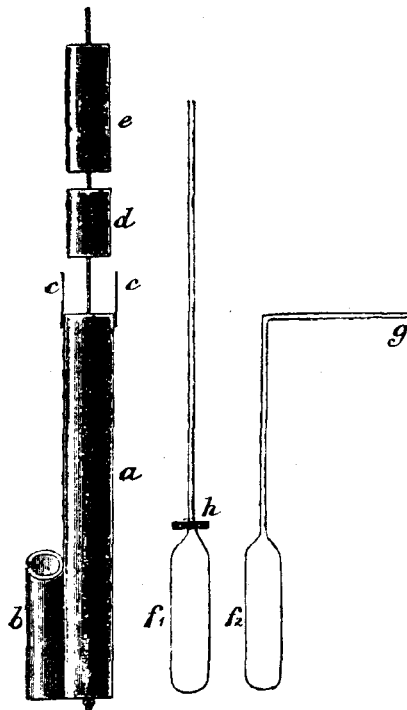
THE process for obtaining albumin from flesh, fish, &c., consists in finely chopping the material, treating it with a 2–3 per cent. soda lye at about 37° C., filtering, shaking the filtrate with ether, precipitating the albumin by means of dilute acid, freeing it from liquid, washing with alcohol

and drying. The meat extract is prepared by mixing the liquid which was filtered from the albumin with alkali until it has only a slight acid reaction, concentrating, dialysing, and evaporating to dryness.—J. F. B.

(B.)—SANITATION; WATER PURIFICATION.

Water; Apparatus for taking Samples of—, for Bacteriological Examination. H. Röttger. Chem. Zeit. 1900, 24, 873.

THE glass test-tube f_1 , of 10–15 c.c. capacity, is drawn out to a capillary at the end. The capillary is bent at right angles in the middle, as in f_2 ; and after the apparatus has been sterilised by boiling water, it is sealed up vacuum. It is



then rested in a brass case b , soldered to a lead cylinder a , about 2 cm. wide and 20 cm. long, bored throughout its length to pass a cord by which the whole is suspended. At the upper end of the lead cylinder are soldered two brass wires, c c . In use, the bulb of the test-tube rests in b , and the bent capillary passes between c and c , which prevent it from twisting round; the loose lead cylinder d , threaded on to the cord, and the lead disc h resting on the glass portion of the apparatus, serve to keep it in place. The whole is then lowered by means of the cord to any desired depth, the depth being indicated by indicating strings attached to the cord at intervals of 1 metre. As soon as the capillary has reached the position from which the sample is to be taken, the lead cylinder e , hitherto held in the hand, is allowed to fall down the cord, the force of impact on reaching d serving to break the capillary. The vacuous bulb at once fills with water, and the whole is drawn up to the surface, whereupon the capillary is again sealed up to preserve the sample until it is required for examination.

—W. G. M.

Ferruginous Waters; Purification and Rapid Filtration of—. O. Kröhnke. Zeits. angew. Chem. 1900, [46], 1154–1161.

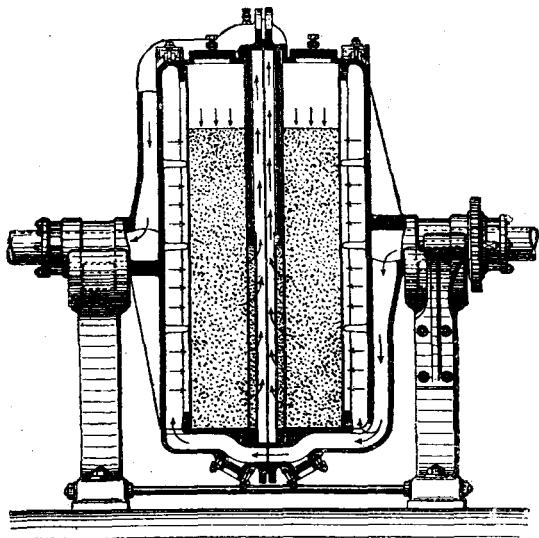
WATER largely depends for its purity on the amount of natural filtration it undergoes, and this is proportional to the depth from which it is drawn. The water found in low-lying districts often contains iron, which, if present in a greater amount than 1 mgrm. per litre, seriously impairs the industrial value of the water.



The methods of removing iron, however, are now so efficient, that the question of purification should always be considered before costly and uncertain borings are commenced for fresh sources. Iron is usually present as ferrous carbonate or bicarbonate, which on oxidation is converted into insoluble ferric hydrate with liberation of carbon dioxide. The mechanical shock of contact with angular particles, for example, with quartz sand, withdraws an appreciable amount of iron from solution, as laboratory experiments show. If the iron occur as sulphate, its removal is more difficult; chemical means must be employed, such as the addition of lime, magnesite, &c. The purification of potable waters requires extreme care and meets with little favour in Germany. The author reviews the methods of treatment applied to ordinary ferruginous waters, which all depend on oxidation followed by filtration. This may be attained by showering the water through the air and passing it through a surface filter.

A better method is to allow it to percolate through a bed of coke or brick, which after a time still further improves in efficiency, owing to the iron-mud which deposits in its lower layers, and the accumulation of organic matter which exerts a fermentative action. Various types of plant are referred to, including the common household expedients (the animal-charcoal filter and the "Leckfässer," common in some districts). The special advantages claimed for the Linde-Hess filter, consisting of wood-shavings impregnated with tin-oxide as an oxygen carrier, are considered illusory.

The filtering apparatus itself as distinguished from the oxidising portion, requires special consideration owing to the difficulty of effectually cleansing it. Surface filters are cleaned by raking over their contents with or without the aid of a stream of water or high pressure steam. Drum filters, which can be agitated, have many advantages. An American type, illustrated in the original paper, is rotated on a vertical axis, water under pressure being driven through in a reverse direction to that of filtration. The author exhibits a side elevation of the system adopted by the "Allgem. Städtereinigungsgesellschaft" in Hamburg, which consists of a large coke percolator made in sections, so that repairs can be effected without stopping the whole plant, and through which the water passes into a special filter, patented by himself. This is formed of a series of drums, any number of which can be coupled up as desired, mounted on a horizontal shaft. The internal arrangement will be seen from the annexed diagram:—



The water flows in at one end through the hollow axis, passes through the metallic sieve diaphragms into the chambers which are only partially filled with sand, and out again by the axis.

The special advantages claimed are the very large filtering surface and the rapid and effectual method of cleaning. For this, the drum or drums are whirled by the aid of a windlass, the loose sand scours itself thoroughly clean, and the dirt is washed out through the sides again by a current of water, the whole operation being automatic and occupying but a few minutes.—R. L. J.

Alga; Soluble Colouring Matter of Blue-Green —
R. Kolkwitz.

See under XXIV., page 77.

PATENTS.

Refuse Destructors. A. J. Liversedge, London. Eng. Pat. 23,209, Nov. 21, 1899.

THE combinations claimed include: two or more cells, separated from each other so far as the ash-pits and fire-grates are concerned, but communicating in their upper portions; a separate supplementary combustion chamber; a special supplementary air duct in the bridge, communicating with a source of air supply under pressure; special clinkering or charging doors with small supplementary openings and doors on their faces; a refuse-storage bunker with distributing and charging trucks, the bottoms of all being on the same level as each other and as the fire-grates of the cells; and an overhead railway with elevating apparatus and clinker trucks or barrows provided with means of attachment to the elevator.—C. S.

Refuse Consuming Furnaces or "Destructors." W. J. Glen, Leyton, Essex. Eng. Pat. 1743, Jan. 27, 1900.

THE opening through which the refuse is introduced is arranged so as to deliver the same direct on to the hearth, which latter, and the openings provided for stoking the charge, are placed at such a distance above the level of the fire-bars, that a body of incandescent fuel is always left ready to fire the next supply of refuse and maintain the combustion there.—C. S.

Disease Germs; Improved Means for Destroying —
C. M. Johnson, Redhill, Surrey. Eng. Pat. 22,862, Nov. 16, 1899.

DISEASE germs are destroyed or expelled from the animal system by means of "an electric current of high voltage and low ampère, producing the violet or ultra-violet ray," which may be used alone or "in combination with medicines, drugs, and chemicals."—L. A.

Sewage to Filters or on to Land; Apparatus for Regulating the Delivery of Liquids, especially in connection with the Delivery of —
D. Cameron, J. F. Commin, and A. J. Martin, Exeter. Eng. Pat. 18,322, Sept. 11, 1899.

REFERRING to previous specifications, Nos. 3003 of 1896 and 5671 of 1898 (this Journal, 1897, 459; and 1899, 511), a check-valve is placed in the siphon by which the actuating bucket is emptied, so that the filtered effluent from the filter previously filled, which fills the siphon, may not pass into the bucket thereby. The filling of the previous filter will, therefore, have no immediate effect on the filter under consideration, but when such previous filter is discharged, such discharge will cause the return, through the siphon, of the contents of the actuating bucket, which will then rise and permit the opening of the valve admitting sewage to the next filter in rotation.

Means are described for definitely storing sufficient liquid to fill a filter. These consist substantially of a valve actuated by a pair of floats immersed, respectively, in the liquid on the up-stream and down-stream side of the valve. A proper opening of the valve is secured by means of a weighted lever, connected with the floats in such a manner that it opposes their motion, but that such opposition becomes less as soon as such motion has commenced. The connection of the valve with the floats is made by means of a slotted link, in such manner that the motion of the float which opens the valve is not communicated to the latter until the float has risen sufficiently to cause the weighted

lever to become overbalanced. The valve is then lifted right off its seat, and cannot again close until the liquid on the upper side of the valve, has fallen sufficiently to cause the buoyancy of the second float, added to the weight of the first, to again overbalance the lever in the reverse direction.

In order to facilitate the opening of the admission valve to a filter, a cylindrical counterweight is suspended from the valve lever within the discharge well of the filter supplied by such admission valve. When the discharge well fills, the weight of the cylinder will be wholly or partially neutralized, and will therefore not oppose the closing of the admission valve to the same extent as it would if the cylinder were still suspended in air.

An improved inlet for admitting crude sewage to a septic tank, furnished with a flap-valve for closing the opening if desired, is also described.—L. A.

Bacterial Treatment of Sewage Effluent and the Like.

R. F. W. Smith and the Pioneer Investment Trust, Ltd., London. Eng. Pat. 550, Jan. 9, 1900.

SEWAGE effluent which has undergone treatment in a bacteria bed or septic tank is sterilised and aerated by forcing into it ozonised air or oxygen, in order to destroy pathogenic microbes.—L. A.

Sewage or other Liquid; Apparatus for the Automatic Intermittent Discharge of —, to and Withdrawal from Filter Beds.

H. B. Killon, Manchester. Eng. Pat. 2647, Feb. 10, 1900.

A SERIES of siphons, floats, and valves is so arranged, in connection with a corresponding series of filter beds and a central chamber, that, upon the collection of a regulated quantity of liquid in the central chamber, such liquid is automatically discharged by one or other of the siphons on to one or other of the filter beds. Another series of floats and valves connects the filter beds in such a manner that as each filter bed, in rotation, becomes full, the liquid standing in the previously filled filter bed is automatically discharged.—L. A.

Sewage and other Effluents, especially of Municipal Draining Systems; Method of and Apparatus for Purifying —.

O. Freysoldt, Stettin, Germany. Eng. Pat. 13,752, July 31, 1900.

THE strained sewage passes into the hollow walls of a series of heated evaporation chambers, into which it is sprayed. The steam or other vapours are exhausted into the air through scrubbers, and the mud flows into a collecting chamber, or on to a bed of soil.—L. A.

Water; Production of Reagents, specially designed for Purifying —.

H. H. Lake, London. From The Jewell Export Filter Co., New York, U.S.A. Eng. Pat. 12,862, July 17, 1900.

A SOLUTION of ferric sulphate is prepared by generating SO_2 , passing the gas into water, forming ferrous bisulphite by leading the solution of sulphurous acid over iron, and oxidising it by means of a current of air.—L. A.

(C).—DISINFECTANTS.

Fluorescent Bodies; Antiseptic Action of —.

A. Raab. Zeits. für Biologie; through Pharm. Zeit. 45, [59], 569.

STRONGLY fluorescent bodies, such as acridine, act as powerful antiseptics in sunlight, while they show but slight action in the dark. Thus, a 1 : 20,000 solution of that body was found to kill infusoria, when exposed to sunlight, in six minutes, whereas, in the dark, the same organisms resisted its action for 24 hours. Similar results were obtained with solutions of quinine sulphate and of Eosine. It would therefore appear that these bodies act as antiseptics, not directly from their inherent chemical properties, but indirectly by the chemical activity of the fluorescent light rays of their solutions.—J. O. B.

PATENTS.

Disinfectant or Deodorising Composition; Manufacture of a New or Improved —.

R. H. Gordon, Glasgow. Eng. Pat. 15,979, Sept. 8, 1900.

THE following ingredients—sulphate of lime, 16 drachms; carbolate of camphor, 1 dr.; carbonate of ammonia, 2 drs.; carmine, 1 grain; strong ammonia solution, 2 fluid drs.; water, 8 fluid drs.—are mixed, and the paste, before it has set, is moulded into tablets or poured into small metal boxes, which can be carried about the person or placed in an apartment or elsewhere.—L. A.

Disinfectant Compound; Improved —.

D. McClellan Kelsey, Saratoga Springs, New York, U.S.A. Eng. Pat. 17,713, Oct. 5, 1900.

THE following ingredients, when mixed together, form a dry powder or flour, which is adapted for sprinkling wherever an effective disinfectant and deodoriser is required:—Hydrated calcium sulphate, 17 parts; charcoal, 2 parts; dried peat, 1 part; sublimed sulphur, 0.3 part; ferric oxide, 0.1 part; crude carbolic acid, 0.04 part.—L. A.

XIX.—PAPER, PASTEBOARD, Etc.

Russian Paper Industry. Papier Zeit. 1900, 25, [93], 3487—3488.

ACCORDING to a report issued by the Russian Department of Commerce and Industry, on the position of the paper industry up to the end of 1897, paper and the allied industries comprise 558 factories, with an annual production of 51.7 million roubles and employing 39,363 hands.

Paper-making has been established in Russia for 200 years; the principal raw material is still old linen rags, since linen is very plentiful, being worn by the peasant classes. Russia exports large quantities of linen rags, on which there has been for some time an export duty of 0.3 rouble per pood; there is no import duty. The introduction of mechanical woodpulp has caused a considerable lowering of the cost of paper. The grinding of wood has become established in districts where forests and water-power are available. In Finland, especially, this industry has reached large proportions and considerable quantities are exported; Finnish wood cellulose, also, is exported to Russia and other countries. In spite of extensive forests and pyrites deposits, the manufacture of wood pulp in Russia proper (excluding Finland) is not very great, on account of the dearth of fuel, and the greater part of the wood material employed is imported. Roofing boards, made with mill-board soaked in pitch, are very largely used in Russia; the home production is not sufficient, and these boards are still subject to a duty of 0.6 rouble per pood. In Russia the production of mechanical wood pulp is estimated at 10,000 tons, and of wood cellulose at 16,000 tons; the imports of wood materials in 1897 amounted to 35,000 tons. Finland is the main source of the mechanical pulp, and most of the cellulose comes from Germany and Belgium.

The most important paper works are in the district of St. Petersburg. Mechanical and chemical wood pulps are used principally in the north and west; in the other parts of the country, linen rags are the chief material. Cotton rags only constitute about 10 per cent. of the total quantity of rags employed. Most of the paper made is of medium and low grade; the demand for high qualities is small and is supplied from abroad. Only three or four factories manufacture products equal to the German standard or "normal paper." The papers containing wood stuff are weaker than German paper of the same class.

Amongst the allied industries, the manufacture of wall paper takes the first place; this industry has attained a high development and the products are exceptionally good.

—J. F. B.

Paper; Detecting Forgeries on —. G. Bruylants and L. Gody. Paper read before the Belgian Academy of Medicine. Scientific American Supplement, 1900, 50, [1300], 20,833.

THE authors communicate a method for the detection of frauds and alterations on business papers. They found that



if the paper under examination be subjected to the action of iodine vapour, any irregular wetting or rubbing is plainly indicated. The erased surfaces assume a yellow or brownish tint. If, after being subjected to the action of the iodine, the paper on which an erasure has been made be moistened, it becomes of a blue colour, the intensity of which varies with the length of time of contact between the paper and the iodine vapour, whilst, after again drying, the erased portions are more or less darker than the remainder of the sheet. When the erasure has been so rough as to remove a considerable portion of the material, exposure to iodine vapour, wetting, and drying, result in less intensity of coloration on the parts erased. The action of the iodine also differs according to the quality of the paper. It is stated that irregular wetting and rubbing can be detected by this process after the lapse of three months. More characteristic, but considerably weaker, reactions are obtained if the paper, before examination, be immersed in a water-bath for 3–6 hours.—A. S.

PATENTS.

Material resembling Celluloid, and for other Purposes; Glazing, Covering, and Moulding of Surfaces for Producing — C. Hellriegel, London. Eng. Pat. 22,186, Nov. 6, 1899.

INSTEAD of making articles entirely of celluloid, a foundation of pasteboard, paper, or similar material, shaped, coloured, and printed as required, is coated with a thin layer of collodion in a centrifugal machine; it is then placed in a machine of special design, and first hot- and then cold-pressed under moulds or forms. The working table rotates round a vertical axis in such a manner that the action of the press is continuous. The process and the machine are claimed.—R. L. J.

Material suitable for Wrapping Purposes, also for the Manufacture of Envelopes as well as Bags for the Reception of Various kinds of Produce, such as Bacon, Hams, Flour, Frozen or Chilled Meat, and the Like; Manufacture of — W. J. Ward, Longsight, Manchester. Eng. Pat. 23,603, Nov. 27, 1899.

CALICO, muslin, or the like is placed on rollers and run on the surface of the endless wire of a paper-making machine. The prepared pulp is run on the material and wire. The whole goes through the various rollers and drying cylinders and can afterwards, if required, be run through a bath of melted wax, the excess of wax being afterwards squeezed out.—C. M.

Celluloid in Films, Pellicles, and other Forms; Manufacture of — O. Imray, London. From The Farbwerke vorm. Meister, Lucius und Brüning, Hoechst a/Main, Germany. Eng. Pat. 25,434, Dec. 22, 1899.

CERTAIN aromatic sulphonic acids, either separately or mixed, of the general formula, $R \cdot SO_2 \cdot A$, where R denotes an aromatic radical or its substitution product, and A is an aliphatic or "aromatic ether residue," or a substituted NH_2 group (e.g., glyceryl paratoluene sulphonate, paratoluene sulphonamide, or paratoluene alkyl amide), may be used as substitutes for camphor in the manufacture of celluloid. Films or pellicles may be also produced, on photographic paper, for example, by adding one or more of these compounds in small quantity to the ordinary solution of nitro-cellulose. Cloth may be similarly impregnated. The substitutes, and films made in the way described, are claimed.—R. L. J.

Fireproof Wood-Pulp for use in the Manufacture of Boards and other Articles; Making — F. E. Keyes, New York, U.S.A. Eng. Pat. 4309, March 6, 1900.

THE fireproofing solution itself is used in the grinding machine instead of water only, thus avoiding the expense of drying the screened pulp, and mixing it with the solution in a special beater. The impregnated pulp is pressed and dried in the usual manner.—R. L. J.

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

Cerite Earths of Monazite Sand; Separation of the — R. J. Meyer and E. Marekwald. Ber. 33, [16], 3003–3013.

THE raw material used consisted of a mixture of the oxalates of cerium, didymium, and lanthanum, with small quantities of yttrium earth oxalates. It contained 25 per cent. of water, as determined by combustion, it being impracticable to dry the oxalates at a sufficiently high temperature, owing to the risk of decomposition.

Conversion of Oxalates into Soluble Nitrates.—The oxalates are boiled with KOH solution, with the addition of hydrogen peroxide. The oxalic acid is completely decomposed, and a yellowish, crystalline precipitate is obtained, containing the Ce as a mixture of ceric hydroxide and peroxides. The precipitate is sucked off by a filter pump, washed, dried at $120^\circ C.$, and it then dissolves readily in concentrated nitric acid to a dull-red solution. Drying the precipitate for some time at $120^\circ C.$ is necessary for destroying the peroxides; otherwise, on subsequently dissolving in HNO_3 , these would act like H_2O_2 , causing partial reduction of the ceric solution.

If it is not desired to obtain the Ce at once in the ceric form, the oxalates are added gradually to twice their weight of nitric acid (1.4 sp. gr.), and the liquid is kept boiling, with the occasional addition of a few drops of fuming nitric acid, till the development of gas ceases, the oxalic acid being thus destroyed. If not boiled long enough, oxal-nitrates are formed, which would separate out on cooling.

To the brownish nitric-acid solution, ammonium nitrate is added (80 grms. per 100 grms. of the original oxalates), and on evaporating the solution to about one-third of its volume and cooling, the double nitrates crystallise out almost quantitatively.

Separation and Purification of the Ceria.—Witt and Theel's process (this Journal, 1900, 766) is recommended for this purpose: it consists in oxidising the Ce by means of ammonium persulphate, in a solution of the nitrates which is kept neutral by the addition of $CaCO_3$. This precipitates the Ce to the last trace, but the precipitate (consisting of basic ceric sulphate and $CaSO_4$, with small quantities of Di and La salts) cannot be completely freed from Di and La by a reasonable amount of washing. It is dried at $120^\circ C.$, powdered, and dissolved in 10 times its weight of warm, boiled-out nitric acid (1.4 sp. gr.); ammonium nitrate, dissolved in a small quantity of water, is added in amount equal to $1\frac{1}{2}$ times the weight of the dried precipitate; and the double nitrate $(NH_4)_2Ce(NO_3)_6$ crystallises out quickly in a fairly pure condition. It is purified by recrystallising once or twice from concentrated nitric acid; the crystals are sucked off on a platinum cone, and are dried over H_2SO_4 and KOH. The pure ceria obtained on igniting some of the double nitrate will have a very pale yellow tint, which does not disappear on further purification of any kind. In making this test the salt should be ignited on porcelain and not on platinum, as the latter is distinctly attacked and colours the oxide.

Separation of the Yttrium Earths.—In the present case, where the proportion of yttrium earths is small, precipitation by K_2SO_4 is good enough. The filtrate from the cerium separation is heated to boiling, and while a strong current of steam is passed through it, finely ground K_2SO_4 is added in small portions till the Di absorption lines have almost disappeared from the solution. The fractionation should not be carried further, to avoid precipitation of yttrium earths; the loss of Di and La is trifling. The hot liquid is decanted from the crystalline precipitate, which is sucked off and washed with cold saturated K_2SO_4 solution.

Conversion of the Double Sulphates into Nitrates.—The sulphates are boiled for a short time with five times their weight of concentrated nitric acid, and the mixture is poured into boiling water (1,500 c.c. per 100 grms. of double sulphates), complete solution ensuing. Ammonium oxalate is added (75 grms. per 100 grms.), and strong ammonia to saturation; the precipitated oxalates are sucked



off and converted into nitrates by boiling with nitric acid as above described. The liquid is evaporated on a water-bath till no more HNO_3 is given off, and the syrup is diluted with hot water.

Separation of Didymium and Lanthanum.—The authors consider the method consisting in the fractional precipitation of the boiling, nearly neutral, nitrate solution with finely sifted magnesia (Muthmann and Rölzig's process; this Journal, 1898, 789) is the best in every respect for this purpose. The material should be subjected twice to this treatment.—H. B.

Rare Earths; Combination of Hydrogen with the Metals of the —. C. Matignon. Comptes Rend. 131, [22], 891—892.

By reducing the metals from their oxides by means of magnesium, in an atmosphere of hydrogen (see next abstract), the author has shown that thorium, cerium, and lanthanum (in the case of these three confirming Winkler's work), praseodymium, neodymium, and samarium all combine rapidly with hydrogen, producing when cold a barometric vacuum in the apparatus. These hydrides dissociate at high temperatures; and the same apparatus in which they are prepared allows of the measurement of their dissociation pressures at various temperatures.

—J. T. D.

Rare Earths, Metals; Direct Combination of Nitrogen with —. C. Matignon. Comptes Rend. 131, [21], 887—889.

When the oxides of these metals are heated with slight excess of magnesium powder, in sealed tubes containing nitrogen, the magnesium reduces them to the metals, which then combine directly with the nitrogen, producing a vacuum in the tube. If the tube contains atmospheric air, a mixture of oxide and nitride of the metal is formed, and the argon contained in the original air is left. Nitrogen thus unites with thorium, cerium, lanthanum, praseodymium, neodymium, and samarium. Winkler had already proved that the first three of these are reducible from their oxides by magnesium; these experiments establish the fact for the last three. The heats of formation of thorium and cerium oxides are greater than those of the other oxides; samarium oxide seems to have the smallest heat of formation. By separating the mixture in the tube into two portions, exhausting the nitrogen by heating one portion, and then applying heat to the other, the pure metal is obtained, mixed with excess of magnesium, which can be distilled off by a longer application of heat.—J. T. D.

Cinchona Alkaloids. W. v. Miller and G. Rohde. Ber. 1900, 33, [17], 3214—3237.

Cinchotoxine is an isomeride of cinchonine, obtained by heating that alkaloid in acetic acid solution for 36 hours under a reflux condenser. The differences in crystallographic form between cinchotoxine and the cinchonine, obtained by Pasteur by heating cinchonine and cinchonidine salts, are now found to be due to dimorphism; the two substances are thus identical.

Isonitrosocinchotoxine, $\text{C}_{19}\text{H}_{21}\text{N}_3\text{O}_2$, is obtained by the action of amyl nitrite (1 mol.) upon cinchotoxine in the presence of sodium ethylate (1 mol.). By the action of methyl iodide in chloroform solution, it gives an addition compound, from which the hydriodic acid is not removed by caustic alkalis, but only by the prolonged action of excess of sodium ethylate. The separated base is probably identical with the isonitroso compound of Claus's so-called methylcinchonine. The action of excess of amyl nitrite upon cinchotoxine produces a substance identical with nitroso-isonitrosocinchotoxine (Ber. 28, 1070).

Quinotoxine is the isomeride of quinine corresponding to cinchotoxine, and is obtained in a similar manner. It is identical with Pasteur's quinicine. The simplest method of preparation is as follows:—Quinine is dissolved in the proper quantity of dilute sulphuric acid; the solution of the bisulphate is evaporated in a dish until a pellicle forms, and is then further evaporated in a large conical flask in an oil-bath at 140° — 150° C., the water vapour being aspirated away. The crystalline cake melts to a brown mass, and is then transformed into the isomeric quinicine bisulphate

after 1—2 hours. The base is set free by caustic soda, dissolved in ether, the solution dried over potash, filtered from unchanged quinine, and the solvent removed. The base may be purified by recrystallisation of the oxalate or tartrate, but cannot itself be obtained crystalline.

Quinotoxine unites with *p*-bromphenyl-hydrazine, forming a hydrazone. Nitrous acid converts quinotoxine into the nitroso-compound $\text{C}_{20}\text{H}_{23}\text{N}_3\text{O}_2$, and the nitroso-isonitroso-compound $\text{C}_{20}\text{H}_{22}\text{N}_4\text{O}_4$. The former gives a crystalline hydrazone, melting at 140° C., with phenylhydrazine. Methyl iodide converts quinotoxine into methylquinine and its idiomethylate. Isonitrosocinchotoxine is obtained in a similar manner to isonitrosocinchotoxine; its compound with methyl iodide is similar to the corresponding derivative of cinchotoxine.—A. C. W.

α - and β -Isocinchonine. Z. H. Skraup and R. Zwerger. Monatsh. für Chem. 21, 535—563. **β -Isocinchonine; Constitution of —.** Z. K. Skraup, H. Copony, and G. Medanich. Monatsh. für Chem. 21, 512—534.

BOTH of these alkaloids are obtained from cinchonine by heating it on the water-bath with sulphuric acid of sp. gr. 1.7; the α -compound is formed first, and on further heating is transformed into the β -compound. To obtain the latter, 15 grms. of cinchonine bisulphate are heated with 60 c.c. of sulphuric acid for about 40 minutes, the mixture quickly cooled and poured on ice. The acid is then nearly neutralised with ammonia, ether and excess of ammonia are added, and the alkaloid is thoroughly extracted with more ether. After distilling off the ether, the residue is treated with hot hydrochloric acid (about 5 \times normal) till just acid; on cooling, the bulk of the alkaloid separates as hydrochloride, and a second crop can be obtained from the mother-liquors. A single recrystallisation yields a perfectly pure product.

Both α - and β -isocinchonine agree with cinchonine in forming addition compounds with hydriodic acid; and as they also, like cinchonine, yield on oxidation formic, as the only volatile acid, they probably contain the same viny group as cinchonine. Moreover, β -isocinchonine, like cinchonine, yields, with methyl iodide, two isomeric quaternary iodethyl compounds; one white and stable, the other yellow and unstable.

But while cinchonine contains a hydroxyl group, the authors could not obtain evidence of a hydroxyl group in α - or β -isocinchonine, nor of a ketonic group.

Cinchonine, when its acid sulphate is heated, is converted into the isomeric cinchonine, which is ketonic. Both α - and β -isocinchonine also undergo isomeric change when similarly treated; but while the α -compound yields two isomers, that chiefly formed being ketonic, the other not, the β -compound yields but one, which has no ketonic group.

Both α - and β -isocinchonine yield, on oxidation with chromic acid, products similar to those from cinchonine; that is to say, not only cinchoninic acid, but also meroquinine or analogous substances.

Both from their mode of preparation, and from the action of heat on the acid sulphates, it would seem that the α -compound is constitutionally nearer to cinchonine than is the β -compound.—J. T. D.

Alkaloids; Precipitation of —, by Picric Acid. T. Chandelon. Assoc. belge des Chim. Through Chem. Zeit. 1900, 24, [89], 974.

THE author has previously described the separation of certain alkaloids from the viscera of animals, and the identification of the former by precipitation with oxalic acid (see this Journal, 1885, 554). He has now investigated the utility of picric acid for the same purpose, employing pure alkaloids in the following manner:—

0.01 gm. of alkaloid was placed in 15 c.c. of dry ether and allowed to stand for 48 hours. 3—4 c.c. of the clear liquid was then mixed with an equal volume of a concentrated solution of picric acid in cold dry ether. Three degrees of solubility were thus observed, the alkaloids marked with an asterisk being only partially soluble in the given amount of ether:—

(a) **Entirely Precipitated.**—Cocaine (crystalline), quinine (amorphous), *atropine (crystalline), pilocarpine, and *strychnine.



(b) *Entirely Unprecipitated*.—Coniine, veratrine, *solanine, narcotine, *colchicine, *aconitine (crystalline), *caffeine, and *theobromine.

(c) *Partially Precipitated*.—Quinine (amorphous), *codeine, brucine (crystalline), *cinchonine, nicotine, thebaine, and papaverine.

Of the first and last series, quinine, quinidine, nicotine, strychnine, and brucine separated immediately; the others in the course of 24 hours. From weaker solutions, the crystals grow larger, but more slowly. Each alkaloid (except brucine) has, from a given solvent, a single characteristic crystalline form, which may be readily recognised and distinguished under the microscope, if the crystals are protected from evaporation of the solvent on the object glass, by flooding them with paraffin oil, after decanting the mother liquor. Brucine crystallises in two ways, either as large rectangular prisms truncated on two sides of the ground line (basal pinakoids), or as spherical conglomerates with a polarising effect like that of starch grains; but these never appear together from the same solution. The alkaloids may be recovered from the picrates in the usual manner.

The above results are only true when precipitation is effected from ether. If chloroform is substituted, the change may affect (1) the solubility of the alkaloidal salt, coniine picrate, for example, being insoluble in chloroform; (2) the crystalline form, e.g., nicotine picrate crystallises better from chloroform than from ether, and with a different habit.

Contrasting these observations on the picrates with those previously made on the oxalates, it appears that the two derivatives of a given alkaloid may differ (1) as to solubility; coniine, for instance, is precipitated by oxalic and not by picric acid; and (2) as to crystalline habit in a marked manner in cases where both are insoluble. Thus, strychnine oxalate forms needles, and the picrate rhombic tablets with saw-like markings.—R. L. J.

Strychnine and Brucine; Action of Bromine on —. C. Kippenberger. Zeits. anal. Chem. 1900, **39**, [10], 609—627.

Action of Bromine Water containing Bromine Salts.—On mixing a solution of a strychnine salt with bromine water containing, e.g., 50 grms. of KBr per litre, the nearly insoluble hydrobromic acid monobromstrychnine superbromide is formed ($C_{21}H_{21}BrN_2O_2 \cdot HBr \cdot Br_2$); but when there is a large excess of bromine, the corresponding dibrom-superbromide is produced in slight amount.

If, in the reaction, large quantities of a bromine salt be present, and the strychnine salt solution contain some free acid, the superbromide ($C_{21}H_{22}N_2O_2 \cdot HBr \cdot Br_2$) is formed, together with some of the superbromide ($C_{21}H_{22}BrN_2O_2 \cdot HBr \cdot Br_2$). The production of the latter is favoured by the addition of sodium chloride. These compounds are slightly soluble in water, and the solubility is increased by acids.

Brucine under analogous conditions forms corresponding compounds, but its hydrobromic acid superbromides are much more soluble than the strychnine compounds.

From the results of his experiments the author concludes that no exact analytical method for the quantitative estimation of strychnine and brucine can be based on the reaction between these alkaloids and bromine.—C. A. M.

Terpenes and Essential Oils. O. Wallach. XLIX. Annalen, 1900, **313**, [3], 345—370.

Phellandrene.—In preparing the nitrosite, the mixture of phellandrene and sulphuric acid should be stirred continuously whilst the sodium nitrite solution is being dropped in; the temperature should not exceed 4° C. The crude product is very unstable, and should be rapidly purified; it is dissolved in the least quantity of chloroform, a little alcohol and ether added, and the clear liquid cooled in ice for 3—4 hours, when crystallisation occurs. The freezing-point method indicates the double formula ($C_{10}H_{16}N_2O_2$).

On oxidation by strong nitric acid, phellandrene nitrosite gives two isomeric compounds $C_7H_{10}N_2O_4$, terephthalic acid, isopropylsuccinic acid, and an isomeride of the last

named. Oxidation by permanganate produces isopropyl succinic and isobutyric acids.

Reduction of Terpinene Nitrosite.—The nitrosite was rapidly reduced in alcoholic solution by sodium. The products were distilled in steam, the distillate was caught in an aqueous solution of oxalic acid, from which, after removal of the alcohol, ether extracted neutral products. The basic products were obtained by adding alkali, and were then purified by distillation *in vacuo*. The base, $C_{10}H_{17}NH_2$, boils at 209°—210° C.; its camamide melts at 171° C. after recrystallisation from methyl alcohol. It is not identical with any compound hitherto known. By the action of nitrous acid, followed by oxidation with chromic acid, it was converted into an unknown ketone of carvone-like odour, which forms an oxime melting at 96°—98° C. The non-basic products of the reduction contained cymene and a ketone, $C_{10}H_{16}O$, which forms an oxime melting at 83°—84° C. When the oxime is warmed with sulphuric acid it regenerates a ketone of pure carvone odour.

Oxidation of Pinene.—When oil of turpentine has been oxidised by means of potassium permanganate in order to obtain α -pinonic acid (Ber. **29**, 22), a camphoraceous smell is noticed on evaporating the liquid. The volatile substance was obtained by distilling and fractionating the oily distillate. The fractions boiling between 170°—200° and 200°—215° C. reacted with semicarbazide solution. The semicarbazone is derived from a ketone, $C_9H_{14}O$, boiling at 209°—211° C., and identical with the nopinone obtained by Villiger by the oxidation of nopinic acid (Ber. **29**, 1927). The oxime could not be obtained crystalline, but the ketone forms a very characteristic compound with benzaldehyde, $C_9H_{12}O : CH \cdot C_6H_5$. It is obtained by allowing a mixture of equal mols. of the two substances to stand with sodium ethylate for some time, and then diluting with water; the compound crystallises from methyl alcohol in colourless transparent crystals, which melt at 106° C.

Pinocamphone, $C_{10}H_{16}O$, is a ketone obtained, together with pinylamine, by the reduction of nitrosopinene. Its oxime melts at 86°—87° C.; on reduction by sodium in alcoholic solution it yields pinocamphylamine, $C_{10}H_{17}NH_2$, a liquid base which combines with carbonic acid.—A. C. W.

Geranium; Development of Terpene Compounds in the —. E. Charabot. Comptes Rend. **131**, [20], 806—808.

The author has examined geranium oil prepared from the green plants in July and in August, and from the completely matured plants in September. (Compare, for lavender and mint, this Journal, 1900, 272 and 372.) He finds that, as the plant matures (1) the acidity diminishes; (2) the oil becomes richer in esters; (3) the amount of total alcohol slightly increases, but that of free alcohol diminishes; (4) the proportion of rhodinol to geraniol increases. He finds that before maturity there exist mere traces of a ketonic constituent (menthone) or none at all; also that this is formed at or after maturity, when the plant possesses its maximum respiratory activity. The rhodinol is possibly formed by hydrogenation of the geraniol (Tiemann has already realised this reaction in the laboratory), but the author will not yet commit himself to this hypothesis; while the menthone is very probably formed from the rhodinol by its oxidation to rhodinol, which (this Journal, 1900, 769) is then converted by isomeric change into menthone.—J. T. D.

Sandal Wood [Amyrol], West Indian —. H. v. Soden and W. Rojahn. Chem. Zeit. Rep. 1900, **24**, [94], 349.

It has already been shown (this Journal, 1900, 464) that West Indian sandal wood contains a new sesquiterpene alcohol, $C_{15}H_{24}OH$, termed amyrol. According to later investigations this amyrol contains mixed with it an isomeric alcohol. Amyrol boils at 299° C., has a rotation +36° and a specific gravity at 15° C. of 0.987. It is converted by dehydrating agents into a sesquiterpene, $C_{15}H_{24}$. Sandal wood contains another compound, *Amyrolin*, $C_{22}H_{32}O_3$, which separates from alcohol in colourless slightly fluorescent crystals, melting at 117° C. Amyrolin dissolves in alcoholic potash with a yellowish-green fluorescence; on prolonged boiling, the potassium salt of an acid is formed, which has not yet been obtained in a pure state.—T. A. L.



Thujene, a New Tricyclic Terpene. L. Tschugaeff.
Ber. 1900, **33**, [16], 3118—3126.

SEMMLER, who discovered thujene, could not obtain thujene from thujyl chloride (Ber. **25**, 3343). Also Wallach (Annalen, **272**, 111; **286**, 107) and Semmler, by the dry distillation of thujylamine hydrochloride, obtained a terpene, "thujene or tanacetene." It is apparently a monocyclic compound. Wallach has found that isothujylamine hydrochloride yields a terpene on dry distillation, which is most probably identical with the above thujene. This compound, in view of its relationship to isothujone, should be called isothujene. The true tricyclic thujene has now been prepared by the author.

Thujene was reduced to thujyl alcohol by boiling with sodium in absolute alcohol. Thujyl alcohol was boiled with sodium and toluene or xylene on the sand-bath, the solution was poured off from the sodium and treated with carbon bisulphide and methyl iodide, in order to obtain thujylxanthogenic methyl ester. After distilling off volatile matters in steam, the residue was taken up in ether, the solution dried, ether driven off, and the residue subjected to dry distillation. The distillate was rectified and boiled over sodium; it then forms a limpid liquid of slight odour, boiling at 151° — 152° .5 C., and with the specific gravity $d_{4}^{20^{\circ}} = 0.8275$. It thus differs in physical properties from all terpenes hitherto known; it also differs in chemical properties. It produces no nitrosochloride. The action of two atoms of bromine gives, with evolution of hydrobromic acid, a reddish-brown syrup, soluble in alcohol to a deep-red solution. Thujene is rapidly oxidised in the air; it instantly decolorises permanganate. Thujene, as also pinene and limonene, when shaken with a hot strong solution of mercuric acetate containing free acid, gives in a few minutes a fine pearly crystalline substance, insoluble in most organic solvents and in water. The author has not yet been able to regenerate unaltered thujene from this compound.—A. C. W.

Rose Oils; Occurrence of Phenylethyl Alcohol in —.
H. von Soden and W. Rojahn. Ber. 1900, **33**, [16], 3063—3065. (See also this Journal, 1900, 768—769; 1036 and 1037.)

THE small proportion of phenylethyl alcohol in rose oils distilled by steam, as compared with the large percentage in extracted oils, is due to the considerable solubility of the alcohol in water; it is contained in the distilled water, from which it may be extracted by ether. The hypothesis of Walbaum, that the alcohol is not developed in the rose petals until they are dry, is therefore unnecessary. Stephan and Walbaum obtained mere traces of phenylethyl alcohol in working up 11 kilos. of German rose oil; the authors obtained larger quantities (though still a small percentage) by extraction with dilute caustic soda. Thus it is possible that the alcohol is present partly in the form of esters. Rose preparations obtained by extraction should contain a larger proportion of the alcohol; two technical products have now been examined:—

Rose Pomade, prepared by the maceration of fresh roses with warm fat. By the method of Hesse (this Journal, 1899, 396) 0.56 per cent. of volatile oil was obtained from the pomade. That portion of the volatile oil which was extracted from the water coming over in the steam distillation was several times shaken with 4 per cent. caustic soda solution. The phenylethyl alcohol dissolved was then extracted by ether; it constituted 46.5 per cent. of the total volatile oil.

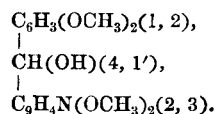
"*Rose Pure*," a brownish-yellow viscous oil, obtained by the extraction of free rose petals by means of a volatile solvent. This oil was distilled with steam until the distillate was almost odorless. The phenylethyl alcohol, obtained as before, was 25 per cent. of the total volatile oil.

This alcohol is thus a normal and important constituent of the essential oil of roses. Small quantities were also found in Bulgarian (Turkish) rose oil.—A. C. W.

Papaverinol. L. Stuchlik. Monatsh. für Chem. 1900, **21**, [8], 813—830.

ACCORDING to Goldschmidt, papaverine is a tetramethoxybenzylisoquinoline; on oxidation by potassium perman-

ganate it forms a ketone, which, on reduction, should yield the alcohol, papaverinol—



The best yield is obtained by adding a slight excess of zinc dust in small quantities at a time to a solution of papaveraldine in glacial acetic acid, heated on the water-bath. After diluting and removing zinc as sulphide, sodium carbonate was added almost to neutralisation, and the solution then precipitated by ammonia. The precipitate was dissolved in dilute hydrochloric acid, the solution filtered from unreduced papaveraldine, decolorised by animal charcoal, the base precipitated by ammonia, and recrystallised from methyl alcohol. The small, almost white, needles melted at 137° C. Papaverinol is readily soluble in organic solvents, but very slightly soluble in water. The hydrochloride is very soluble and difficult to crystallise; it was obtained crystalline by dissolving the base in dry ether, passing in dry hydrochloric acid gas, dissolving the precipitate in alcohol, and adding ether to incipient turbidity. After some hours the salt then separates in fine yellowish needles, forming star-shaped groups. It begins to darken at 180° C., and melts at 200° — 202° C.

Papaverinol hydrochloride is similar as regards physiological effect to papaverine.—A. C. W.

Nitrosalicylic Acid and Nitrosulphonic-salicylic Acid.

R. Hirsch, Ber. 1900, **33**, [17], 3238—3241.

AN almost quantitative yield of nitrosalicylic acid is obtained by the following process:—100 grms. of salicylic acid are dissolved in 300 grms. of cold strong sulphuric acid. The mixture is cooled to 0° C., and a mixture of 90 grms. of nitric acid and 270 grms. of sulphuric acid then added in portions. The temperature must not exceed 10° C. The excess of acid is drained off, and the residue twice boiled with 2 litres of water. Nearly pure α -(*m*)-nitrosalicylic acid remains.

Nitrosulphonic-salicylic acid is obtained by heating 100 grms. of salicylic acid for 30 minutes on the water-bath with 500 grms. of sulphuric acid, allowing to cool to 30° C., and adding a mixture of 90 grms. of nitric acid and 270 grms. of sulphuric acid in portions of 10 c.c., the temperature being kept between 30° and 40° C. Excess of acid is drained off, the residue dissolved in water, and the solution neutralised by barium hydrate. On cooling, the neutral salt separates in fine yellowish-red needles.—A. C. W.

Poisonous Boraginaceæ. K. Greimer. Archiv. **238**, 505. Pharm. J. 1900, **65**, [1584], 490.

THE author found that *Anchusa officinalis*, *Cynoglossum officinalis*, and *Echium vulgare* all contain a poisonous alkaloid, cynoglossine. The physiological action of this alkaloid is similar to that of curare. *Symphytum officinalis* also contains a toxic alkaloid, *symphyto-cynoglossine*, similar in chemical constitution to cynoglossine, but differing in its physiological action. The above-mentioned plants also contain a notable quantity of choline, and a toxic glucoside, *consolidin*, which, when hydrolysed with acids, splits up into glucose, and an alkaloid, *consolicine*. The latter is three times as powerful, as regards its physiological action, as the glucoside, *consolidin*, from which it is derived.—A. S.

Angophora; New Species of —. R. T. Baker. Proc. Linn. Soc. N.S.W. 1900, **84**. Pharm. J. 1900, **65**, [1584], 489.

THE New South Wales tree, popularly known as "Coolabah," appears to constitute a new species, and is named by the authors *Angophora melanoxylo*. It is a medium-sized tree, from 40 to 50 ft. high, and with a diameter up to 3 ft.; the bark is somewhat similar to a "Box" bark, and is much less fibrous than that of *A. subvelutina*, F. v. M., or *A. intermedia*, D.C. The botanical characters of the tree are described in detail. The kino obtained from the tree forms brownish-coloured, very friable masses, having a dull frac-



ture. It is but little soluble in cold water, forming a whitish turbid solution; the turbidity disappears on boiling, but again appears when the hot solution is cooled. The substance causing the turbidity was extracted with ether, and was found to be aromadendrin. No eudesmin is present. The presence of that substance in the kinos of some *Angophoras* indicates a chemical connection between those trees and the *Eucalypts*. Eudesmin appears to be the more common in the *Eucalypts*, but in the kinos of some species, both eudesmin and aromadendrin are present; up to the present, aromadendrin alone has only been found in one species, *E. calophylla* of Western Australia. The tannin present in the kino of *Angophora melanoxylon* gives a green coloration in a very dilute aqueous solution, with one drop of ferric chloride solution, and in that respect differs from the kino of *E. calophylla*, which gives a blue coloration under similar conditions.—A. S.

Aloin; Oxidation of —, by means of Potassium Persulphate and Caro's Acid. E. Seel. Ber. 1900, **33**, [17], 3212—3214.

The author has examined the products of the oxidation of aloin from Barbados aloes. The action of potassium persulphate yields different products according to the quantity of the reagent, excess of which produces a pale-red compound in almost quantitative yield. It appears to be an unstable oxygen addition compound. It is also formed by the electrolytic oxidation of aloin in dilute sulphuric acid, or by means of potassium percarbonate. Caro's reagent, obtained from potassium persulphate and sulphuric acid (this Journal, 1900, 172), or Baeyer's mixture of hydrogen peroxide and sulphuric acid (Ber. **33**, 124), produces a brownish-red powder, from which chloroform extracts tetrahydroxymethyl-antraquinone, $C_{15}H_{10}O_6$.

—A. C. W.

Erysimin; New Glucoside from Erysimum Seeds. Schlagdenhauffen and Reeb. Comptes Rend. **131**, [19], 753—755.

The seeds of various species of *Erysimum*, freed from fatty matters by extraction with petroleum spirit, are lixiviated with alcohol; the residue, after evaporating the alcoholic solution, is dissolved in water, precipitated by sodium sulphate, and the precipitate redissolved and reprecipitated by sodium sulphate two or three times. The crude glucoside is dissolved in alcohol, the solution filtered and evaporated, the residue dissolved in water and precipitated by lead acetate. After removal of the lead by sulphuric acid and neutralisation by ammonia, the solution is evaporated to dryness and the residue extracted with alcohol. Evaporation of the alcoholic solution yields the pure substance. This is a pale-yellow amorphous mass, slightly hygroscopic, soluble in water or alcohol, not in ether, chloroform, benzene, or carbon bisulphide. It melts at $190^{\circ}C$, and begins to decompose at a slightly higher temperature. It gives the reactions of a glucoside, and the results of analysis are expressed by the empirical formula $C_8H_{12}O_5$. It is a violent poison to warm-blooded animals and to frogs.

The seeds appear also to contain an alkaloid, which, however, the authors have not yet obtained in a pure state.

—J. T. D.

Frangula, Sagrada and Rhubarb, Soluble Active Glucosides of —. E. Aweng. Apoth.-Zeit. **15**, 537. Chem. Centr. 1900, **2**, [14], 766.

The author has before shown that the above-mentioned drugs contain two groups of active constituents; the primary glucosides easily soluble in water, and the secondary glucosides slightly soluble in water. Both groups are completely extracted by 70 per cent. alcohol.

Frangula Bark.—If the alcoholic (70 per cent.) extract be evaporated to expel the alcohol, then treated with dilute ammonia, and the solution faintly acidified with acetic acid, the secondary glucosides separate in large flocks, and can be easily filtered off, whilst the primary glucosides remain in the filtrate. The latter contains Kubly's "frangula acid." This may be obtained in a crystalline form from a mixture of equal parts of benzene and absolute alcohol; if it be heated in aqueous solution for a long time, the acid becomes insoluble, but again becomes soluble if dissolved in ammonia

and reprecipitated with acetic acid. Baryta water does not produce a precipitate in the aqueous solution of the acid, although the foreign substances that are contained, together with "frangula acid" in the aqueous percolate of the bark, and are also present in Kubly's red acid, are precipitated by this reagent. The pure acid reddens blue litmus paper. It is a secondary glucoside, and on hydrolysis yields, besides the sugar, frangularhamnetin, which dissolves in concentrated alkali to a yellowish-red solution, changing to golden-yellow on dilution, and is probably a decomposition product of rhamnetin.

The secondary glucosides of frangula bark contain emodin, chrysophanic acid and frangulin, soluble in benzene; a glucoside soluble in a mixture of benzene and absolute alcohol, which yields emodin on heating with dilute sulphuric acid; and another glucoside, insoluble in the solvents mentioned, but which dissolves in caustic soda to a violet solution, and corresponds to the "eisenemodin" described by the author.

Sagrada.—The secondary glucosides have not yet been examined. The primary glucosides contain "frangula acid" and a glucoside, which on hydrolysis yields emodin. The two glucosides may be separated by 96 per cent. alcohol. The emodin glucoside is almost completely precipitated from its aqueous solution by baryta, gelatin solution, and formalin.

Rhubarb.—Only the primary glucosides were examined. They contain the same compounds as those of sagrada. With ammonia, "frangula acid" (from all three drugs) gives yellow, emodingleucoside (from sagrada and rhubarb), bright raspberry-red solutions. Emodingleucoside appears to be more active than "frangula acid," and this fact becomes important in connection with the valuation of rhubarb.—A. S.

Corybulbine into Corydaline; The Conversion of —. Alkaloids of *Corydalis Cava*. J. J. Dobbie, A. Lauder, and P. G. Paliatseas. Proc. Chem. Soc. **16**, [229], 205. (See also this Journal, 1896, 125—826.)

CORYDALINE, $C_{18}H_{15}NO(OCH_3)_4$, differs from corybulbine, $C_{18}H_{16}NO(OCH_3)_3$, by CH_2 , and contains four methoxyl groups, whilst the latter alkaloid contains only three. The authors have now proved that corybulbine contains a hydroxyl group and forms a mon-acetyl derivative, $C_{18}H_{15}N(OCH_2)_3O.C_2H_5O$. By treatment with concentrated hydrogen iodide the two alkaloids yield the same phenolic derivative, $C_{18}H_{15}N(OH)_4HI$. Corybulbine can be readily converted into corydaline by treatment with equivalent quantities of methyl iodide and potassium hydroxide in methyl alcohol solution. The artificial corydaline agrees in melting point, solubility in various reagents, and specific rotation with the natural alkaloid. The platinumchloride, ethyl sulphate, and hydroiodide of the natural and artificial substances have been compared and found to be identical.

Hyoscyamus Muticus, and of Datura Stramonium grown in Egypt; The Alkaloids of —. W. R. Dunstan and H. Brown. Proc. Chem. Soc. **16**, [229], 207.

In a previous paper (this Journal, 1891, 1177) the authors showed that *Hyoscyamus Muticus* grown in India contained 0.1 per cent. of hyoscyamine, which is readily isolated in a pure state. Subsequently Gadamer (see this Journal, 1899, 171) in a brief note recorded the fact that the same plant grown in Egypt contains more than ten times this quantity. Through the kindness of Mr. E. A. Floyer, the authors have been enabled to examine a specimen of the plant from Egypt. They find it to be much richer in hyoscyamine than the sample of Indian growth previously examined. The seeds furnished 0.87 per cent. and the stems and leaves 0.59 per cent. It remains to be determined whether the Indian plant is always poorer in alkaloid, or whether it was a peculiarity of the sample examined.

The authors call attention to the Egyptian plant as an important source of the alkaloid hyoscyamine.

Datura Stramonium grown in the Egyptian desert also contains hyoscyamine, unaccompanied by other atropaceous alkaloids, to the extent of 0.35 per cent.

An abundant supply of either plant could be obtained from Egypt.



"Tutu." Part I. T. H. Easterfield and B. C. Aston. Proc. Chem. Soc. 16, [229], 211.

THE authors have examined three varieties of tutu—*Coriaria ruscifolia*, *C. thymifolia*, *C. angustissima*—which cause serious loss of stock in New Zealand, and have isolated from them a glucoside, *tutin*, $C_{17}H_{20}O_7$, along with acetic, gallic, succinic, and other acids. From *C. thymifolia* quercetin or an isomeric compound was obtained; and from *C. angustissima* a volatile acid, $C_8H_8O_4$, which has not been identified.

Tutin was obtained in colourless crystals melting at 208° – 209° C. (uncorr.), and is perceptibly volatile at 120° – 130° C. Its solubility is 1.9 grms. in 100 grms. of water at 10° ; 1.5 grms. in 100 grms. of ether at 10° ; 8.2 grms. in 100 grms. of alcohol at 16° C. It is very soluble in acetone, sparingly soluble in chloroform, insoluble in benzene and carbon bisulphide. Its optical rotation was determined, and gives $[\alpha]_D^{19} = +9.25^{\circ}$.

The authors also discussed the formula for coriamyrtin, and conclude that the formula $C_{15}H_{18}O_5$, which is half that usually accepted, harmonises better with the facts. A comparison of the chemical and physical characters of *tutin* and *coriamyrtin* proved that these substances are not identical.

A note by Prof. Marshall on the pharmacology of *tutin* states that its action is similar to that of *coriamyrtin*, but is more slowly produced, and it is much less toxic. Its action is exerted mainly on the medulla oblongata, and the basal ganglia of the brain.

Nux Vomica; Determination of —. F. C. J. Bird.

See under XXIII., page 75.

Alkaloids; Use of Tannin in Purifying Residues containing —. C. Kippenberger.

See under XXIII., page 74.

Lemon Oil; Determination of Citral in —. Schimmel's Semi-ann. Rep., Oct. 1900, 25.

See under XXIII., page 75.

Lemon Oil; Determination of Citral in —. E. J. Parry.

See under XXIII., page 75.

Lichens; Constitution of —. VI. W. Zopf.

See under XXIV., page 77.

Carvone; Analysis of Oils containing —. E. Kremers.

See page 16.

PATENT.

Camphor; Pinyll Oxalate and Pinyll Formate; Process for the Production of —. C. K. Mills, London. From The Ampère Electro-Chemical Company, Jersey City, U.S.A. Eng. Pat. 14,754, Aug. 17, 1900.

TURPENTINE (5 parts) from any recognised source, if containing sufficient pinene, is heated with anhydrous oxalic acid (1 part) to 120° – 130° C., the resulting product is treated with caustic alkalis in excess, and the mixture of camphor and borneol so obtained is steam-distilled to remove impurities.

The borneol is then oxidised to camphor. The inventor claims this process in its various stages, and also the intermediate products, pinyll formate and pinyll oxalate.

—R. L. J.

XXI.—PHOTOGRAPHY.

Light; its Influence on the Action of Chlorine on Metallic Silver.—II. V. v. Cordier. Monatsh. für Chem. 21, [7], 655.

THE author gives an account of his further experiments on this subject. The formation of silver chloride is not increased under the influence of red light; whilst it is under the influence of violet and blue light, although the reducing action, which takes place at the same time, is also increased. Light filtered through a sufficiently thick layer of chlorine gas, behaves, generally like red light. Filtration

of the light through dry chlorine weakens its influence on the reaction very little or not at all; with moist chlorine, however, there is a considerable weakening, which may be increased by the addition of small quantities of hydrogen.

Röntgen rays have practically no influence on the reaction.—J. W. H.

Sensitiveness of Photographic Plates; Increasing the —. R. Neuhauss. Phot. Rundsch. 1900, 14, 233. From Chem. Zeit. Rep. 1900, 24, [90], 336.

PHOTOGRAPHIC plates may be rendered more sensitive by a preliminary very short exposure to light. The author recommends that the plates should be exposed in the dark room, before the red lamp, until on development a very slight fog appears. The time required for this preliminary exposure should be ascertained once for all, and is then applicable to all plates made from the same emulsion.

—J. S.

Absorption Spectra; Plates for Photographing —.

A. Miethe. Zeits. angew. Chem. 1900, 1199.

THE method which Formánek has already described (this Journal, 1899, 611) for differentiating colouring matters and for examining mixtures thereof, becomes still more useful if the absorption spectra can be photographed and preserved for reference. Ordinary photographic plates are not suitable for this purpose, as the characteristic absorption bands of the dyestuffs lie principally in the less refrangible part of the spectrum; and even commercial colour-sensitive (ortho-chromatic) plates are not completely satisfactory, for their sensitiveness stops at about the wave-length 590. The author publishes two formulæ for the preparation of either slow or rapid plates, which have given good results, and which permit an impression of the spectrum to be obtained up to the Fraunhofer line A.

Rapid Plates.—The bath is made by dissolving 1 gm. each of Glycin Red (Kinzelberger), Quinoline Red, and Quinoline Blue (with a little ammonia) separately in 500 c.c. of 93 per cent. alcohol, filtering after a few days. 20 c.c. each of the red dye solutions are then poured into 150 c.c. of water, 50 c.c. of alcohol are added, and the mixture is allowed to rest for two hours. 2 c.c. of the blue solution are next introduced; and after another two hours' standing, the liquid is carefully filtered. Finally, 3 c.c. of ammonia and 1 c.c. of the Quinoline Blue are added, and the whole is diluted with 150 c.c. of water and the same quantity of alcohol.

Slow Plates.—The bath consists of 100 c.c. each of 1:5,700 aqueous solutions of Diazo Black (Bayer), and Iodoesine, with 3 c.c. of ammonia.

Bromide plates, which are as free as possible from fog, are thoroughly cleaned and dusted, and immersed for two minutes in either of the baths; they are then held under a rose, soaked for two minutes in distilled water, and dried as quickly as possible, preferably in a cupboard with artificial draught.

The rapid plates are sensitive from the ultra violet to the wave-length 680. If they are required to photograph bands in the green, yellow, and red, they are used behind a screen of Tartrazin or Martius Yellow. If bands in the blue also are to be recorded, the screen should be a very weak aqueous solution of Neutral Red, when the plates give an uniform image from B to the violet. The slow plates are sensitive even to less refrangible light; their range extends to the extreme end of the visible red. As their sensitiveness is uniform beyond the line 500μ , for work at the red end of the spectrum, they should be protected by a somewhat stronger screen of Martius Yellow; for an image of the whole spectrum, a stronger filter of Neutral Red should be used. They require about three times the exposure of the rapid plates. Both kinds keep for at least five or six days, but they are advisedly used before they are four days old. All manipulations should be carried out in absolute darkness, especially with the slow plates. Development is rather prolonged. The author recommends the Welsbach mantle as a source of light for observing the absorption bands of colouring matters; for it contains a large proportion of the less refrangible rays, and therefore easily gives an uniform spectrum with a comparatively translucent colour screen.

—F. H. L.



Photographic Fixing Baths. Brit. Jour. Phot. **47**, [2116], 741.

EDER first suggested the addition of an acid to the ordinary fixing bath to prevent staining, but, unfortunately a decomposition takes place which may be injurious to both plates and papers. Briefly, the addition of an acid to excess of sodium thiosulphate results in the formation of sulphurous acid, sulphuretted hydrogen, a sodium salt of the acid used, sodium sulphate, sulphur, sodium bisulphite, pentathionate, and acid sulphide. The addition of alum to prevent "frilling" has a similar effect. Lainer states that if the acid be added to a solution of sodium sulphite, and the mixture then poured into the solution of sodium thiosulphate, no deposition of sulphur takes place. He suggests the addition of 50--100 parts of acid sulphite lye to every 1,000 parts of thiosulphate solution (1:4). As a substitute for the lye he recommends: solution of sodium sulphite (1:4), 60 parts; tartaric acid solution (1:2), 20 parts. His alum bath contains saturated solution of alum, 1,000 parts; saturated solution of sodium sulphite, 300 parts; solution of thiosulphate (1:4), 1,250 parts. Mercier showed that on using an organic acid in the fixing bath, the addition of an acetate, citrate, or tartrate prevented any deposition of sulphur, and that the plate could be safely transferred to the fixing bath after development without washing. The following is his formula:—

	Parts.
Anhydrous sodium thiosulphate.....	100
Potassium metabisulphite.....	20
Sodium citrate.....	5
Sodium chloride.....	20
Potash alum.....	20
Water.....	1,000

The acid fixing bath, when properly made, preferably with an organic acid, the acid being added to the sodium sulphite solution and the mixture then added to the thiosulphate solution, gives results remarkably free from stain or deposit, and is far superior to the ordinary bath.

—J. W. H.

Photographic "Reducer"; Ammonium Persulphate as a — D. Myblin. *Atelier des Phot.* 1900, **7**, 108; through *Chem. Zeit. Rep.* 1900, **24**, 344.

THE author is unable to accept either of the theories advanced by Lumière Bros. (this *Journal*, 1898, 870; 1899, 856) and Namias to explain the "reducing" action of ammonium persulphate upon negatives. His own idea is as follows:—The solution penetrates the gelatin film where most silver is congregated (i.e., the high lights of the positive picture), attacks the metal, and converts it into silver sulphate, which partly dissolves. The persulphate is (chemically) reduced to sulphate, oxygen being liberated. By the action of the water, free sulphuric acid is also formed, which dissolves the gelatin, chiefly that which surrounds the disappearing image. The process will continue until the deepest particles of silver are reached, that is, until the whole picture is ruined. Nevertheless, the image is not wholly destroyed, for the negative still retains a faint blue colour, which is probably due to the undissolved silver sulphate that resists the action of washing with water. In the fixing bath, the blue colour disappears; but by mechanical intensification, the remaining image can be somewhat strengthened.—F. H. L.

Trichromatic Photography; Optics of — F. E. Ives. *Brit. Jour. Phot.* **47**, [2116], 742.

FOR the correct reproduction in colour by photographic methods, the obtaining of the three colour records must involve a strictly quantitative photographic analysis, for no other will admit of the correct synthetical reproduction of the spectrum itself, the only test for any trichromatic process. By positive synthesis of the colour records, the image is built up by adding light to light, red, green, and blue, but in the production of paper prints the picture is obtained by superposing coloured shadows. It will be clear that since red, green, and blue are the colours in positive synthesis, their complementary colours, or minus red (cyan blue), minus green (bright crimson), and minus blue (yellow), are the printing colours; the white printing

surface, however, not being illuminated by a mixture of red, green, and blue light only, but by all the spectrum rays, makes it necessary to consider the absorption of the colours in the intermediate spectrum regions; on this account the absorption of the printing colours should not conform to the Maxwell curves, but should be greatest for the pure colours, and fall gradually to the next "primary" in the spectrum. In any case, however, a slight but perceptible degradation of colour takes place unless the prints be viewed in a mixture of pure red, green, and blue light.

—J. W. H.

PATENTS.

Transparent Photographic Films. J. E. Thornton, Altrincham, and O. F. S. Rothwell, Hulme, Manchester. Eng. Pat. 17,165, Aug. 24, 1899.

THE invention consists of a stripping film mounted on a transparent paper base. The paper is made transparent by any suitable method, and rolled and glazed (without this treatment the grain of the paper would appear in the image obtained); the stripping medium, preferably consisting of aluminium or zinc salts of fatty or resin acids, is then applied, and, after drying, the coating with sensitive emulsion takes place in the ordinary way. Such a film, although quite adherent to the base, can be stripped dry, and needs neither heat nor solvent to facilitate the operation.

—J. W. H.

Photo-Printing and Developing; Apparatus for — J. W. Vickers and H. W. Rumsey, London. Eng. Pat. 1530, Jan. 24, 1900.

THE invention relates to means of reproduction of engineers' and other drawings by photography. Exposure is made by incandescent gas light; arrangements are described for moving the series of lights to different parts of the flat printing frame used; development is carried out in a cylindrical vessel, the print being clamped to a frame capable of rotation.—J. W. H.

XXII.—EXPLOSIVES, MATCHES, Etc.

Nitrogen Iodide. O. Ruff. Ber. 1900, **33**, [16], 3025.

CHATTAWAY has shown that "nitrogen iodide," prepared in aqueous solution, has the composition NH_3, NI_3 (*Proc. Chem. Soc.* 1898, **15**, 17—22). Recently C. Hugot, by the action of iodine on liquid ammonia, has obtained the compounds $\text{NI}_3, 3\text{NH}_3$, and $\text{NI}_3, 2\text{NH}_3$ (*Ann. Chim. Phys.* [7], **21**, 5). At the low temperatures attained by the use of liquid air and alcohol, the author has prepared similar compounds with different amounts of ammonia of crystallisation. At -60°C . a substance is obtained having the composition $\text{NI}_3, 12\text{NH}_3$, and crystallising in brownish-red leaflets. At -35° to -40°C . $\text{NI}_3, 3\text{NH}_3$ is produced, crystallising in olive-green needles. These, when dried *in vacuo* at -35° , turn a light brownish-green colour, and then have the composition $\text{NI}_3, 2\text{NH}_3$. Dried *in vacuo* at -25° they are converted into the ordinary "nitrogen iodide" NH_3, NI_3 , in the form of reddish-violet needles.

Sodium amide, iodine and liquid ammonia react together to form a substance of the composition $\text{Na}_2 \text{NI}_3$.—A. M.

Chlorates; Decomposition of — Part III. Calcium Chlorate and Silver Chlorate. W. H. Sodeau.

See under VII., page 42.

Explosives; Heat Test for — W. Cullen.

See page 8.

PATENTS.

Explosives. J. Fuehrer, Vienna. Eng. Pat. 16,277, Sept. 13, 1900.

THE inventor claims the use of aluminium or other light metal mixed with material which will convert it into oxide on firing. This oxidation sets free a large amount of heat. A suitable mixture may, for instance, be made of ammonium nitrate, aluminium, and charcoal in the proportions $4\text{NH}_4\text{NO}_3 + 2\text{Al} + \text{C}$.—A. M.

Explosives; Manufacture of — E. Gathmann, Washington, U.S.A. Eng. Pat. 18,920, Oct. 23, 1900.

THE invention relates to propulsive explosives made in the form of rods having a number of longitudinal perforations.



In rods thus constructed, but without any provision other than the longitudinal apertures for permitting the ignition flames to communicate with the more distant portions of the rods, the gases are generated within these perforations in such great volume, that these passages cannot accommodate their flow, and the rods are therefore burst open and broken into fragments, thereby causing a sudden and dangerous rise of pressure in the bore of the gun. In order to obviate this difficulty, the inventor makes a number of V-shaped cuts half through the rods, these cuts being made alternately on opposite sides of the rods. He claims "a longitudinally multi-perforated powder rod having alternate cuts or grooves on its opposite sides, each pair of said cuts or grooves intercepting the several longitudinal perforations."—A. M.

Explosives; Manufacture of — E. Gathmann.
Washington, U.S.A. Eng. Pat. 18,923, Oct. 23, 1900.

THE invention described is similar to that of Eng. Pat. 18,920 (preceding abstract), except that in this case the transverse cuts are of different form, each cut intercepting all the longitudinal perforations. Diagrams and descriptions are given of a number of ways in which this may be carried out.—A. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS, ETC.

Ampère-Manometer. G. Bredig. Zeits. für Elektrochem. 1900, 7, [19], 259—260.

THE ampère-manometer devised by the author is shown in the accompanying figure. The bottle *a* is nearly filled with a 2 per cent. solution of sodium hydroxide, and contains two concentric cylindrical nickel electrodes *b* and *c*, which are insulated from each other by means of several glass rods. The oxygen and hydrogen given off are conveyed through the bent tube *d* to the wider portion *e*, which is loosely plugged with cotton-wool. After being filtered by the cotton-wool (which must be renewed from time to time)

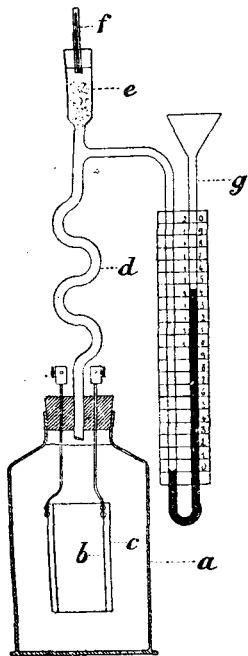
the gases escape through the capillary tube *f*. A manometer *g* attached to the tube *d* registers the excess pressure within the apparatus. This excess pressure, for a capillary tube of given length and bore, will rise as the rate of evolution of the gases increases, and, for not too large excess pressures, will be approximately proportioned to the rate of evolution of the gases according to the Poiseuille formula.

The rate of evolution of the gases is, however, proportional to the current strength, and hence small internal excess pressures (above that of the atmosphere) will be very nearly proportional to the current strength. The current strength in ampères can thus be measured as a pressure.

The author employs several capillary tubes which are so adjusted that 1 ampère produces a deflection of, e.g., 1 cm., 10 cm., &c., on the water manometer; so that by simply interchanging the

capillary tubes the range and sensitiveness of the instrument can be altered at will.

The temperature coefficient is about + 0.56 per cent., so that for the ordinary variations in the temperature of the laboratory, the instrument is liable to an error of about 5 per cent. An E.M.F. of 1.6—2.0 volts is required.



If dew becomes deposited inside the capillary tubes, it can easily be removed by washing with water, alcohol, and ether.

The ampère-manometer is not a precision instrument, but it has been found very useful in analytical and synthetical electrolysis.—J. S.

INORGANIC CHEMISTRY.—QUALITATIVE.

Thomas Slag; Detection of Mineral Phosphate in —
N. von Lorenz. Chem. Zeit. Rep. 1900, 24, 355.

THE process depends upon the detection of fluorine, which is assumed to be always present in mineral phosphates, and always absent in Thomas slag. The slag is treated with concentrated sulphuric acid in a beaker covered with a large watch-glass, upon the under side of which, and therefore exposed to the fumes generated, a small filter paper moistened with a dilute solution of soda is caused to adhere. After exposure to the fumes for about five minutes, the paper is washed with a few c.c. of water, and the wash-water is then acidified with acetic acid and tested by the addition of a solution of calcium chloride acidified with acetic acid. The production of a white precipitate or turbidity on or before boiling indicates the presence of fluorine, and indirectly of mineral phosphate.—H. H. B. S.

INORGANIC CHEMISTRY.— QUANTITATIVE.

Chromic Acid; The Iodometric Estimation of — K. Seubert. Zeits. angew. Chem. 1900, [46], 1147.

THIS paper is virtually an introduction to the one following.

Potassium Bichromate on Potassium Iodide in the presence of Sulphuric Acid; Action of — K. Seubert and A. Henke. Zeits. angew. Chem. 1900, [46], 1147—1154.

AFTER a series of experiments on the influence of time on the completeness of the reaction, of mass on its speed, on the influence of dilution, the author concludes that, for perfect safety, the molecular ratio—



should be adopted, under which conditions the reaction proceeds so rapidly that titration can be at once proceeded with. This ratio converted to parts by weight is = 1 : 10 : 36 in a total volume of 2,000. The following practical points are mentioned: 0.15 gm. $K_2Cr_2O_7$ (= 0.05 gm. Cr), requiring about 30 c.c. N/10 thiosulphate, is a convenient quantity to use when determining chromium. The chromate should be placed in a 500 c.c. stoppered flask, neutralised if necessary, the reagents added in the above ratio, avoiding concentrated H_2SO_4 , and diluted before titration with 200—300 c.c. of water.—R. L. J.

Tungsten Trioxide; Separation of —, from Molybdenum Trioxide. M. J. Ruegenberg and E. F. Smith. J. Amer. Chem. Soc. 22, [11], 772—773.

WHEN the two metals are both present as trioxides, they are readily and completely separated by sulphuric acid of sp. gr. 1.378, in which tungsten trioxide is completely insoluble. The analytical figures were equally accurate, both in the case of mixtures in various proportions of the two oxides alone and in the case of mixtures of the two with a large excess of ferric hydroxide.—J. T. D.

Arsenic; New Method of Determining — O. Ducru. Comptes Rend. 131, [22], 886—888.

THE solution containing the arsenic in the form of arsenic acid, is concentrated, or is evaporated to dryness and redissolved in the least possible amount of water; any alkali carbonates are decomposed by hydrochloric acid, and ammonia is added, just to alkaline reaction. Into a conical flask is put, in the proportion of 10 c.c. per 100 mgrms. of expected arsenic, a solution of cobaltous chloride containing 75 grms. of the crystallised salt per litre. To this is added ammonium acetate solution, made by saturating 40 per cent. acetic acid with 20 per cent. ammonia, so as to form about one-fourth of the whole bulk of the liquid



finally contained in the flask. This is followed by 3 per cent. of the same total volume of 20 per cent. ammonia, and then the solution of arsenic is added. The flask, closed by a porcelain stopper, is heated in the water-bath or steam oven till the deposition of crystals has ceased, cooled, allowed to stand for a few hours, and the precipitate is then collected on a filter and washed with cold water. The precipitate can now be treated in any of the following ways:—(a) Dried in the steam oven to constant weight, and weighed on the tared filter as $\text{Co}_3(\text{AsO}_4)_2 \cdot \text{NH}_3 \cdot 7\text{H}_2\text{O}$. (b) Transferred as completely as possible to a large crucible, into which the rest is also got by solution on the filter in hot dilute nitric acid; the acid is then evaporated on the water-bath, and the crucible very gradually heated to dull redness till constant in weight. This plan is not so accurate as the former, but the weight of the residue in the crucible multiplied by the empirical coefficient 0.3193 gives fairly constant results. (c) Dissolved in hot dilute hydrochloric acid, the arsenic removed by Wöhler's method, or the cobalt precipitated by bromine and soda, and in either case the cobalt determined by electrolysis of the ammoniacal solution of the sulphate. Co_3 corresponds to As_2 . The author's figures, for amounts of arsenic from 1 to 500 mgms., are very satisfactory.—J. T. D.

Ferrochrome; Determination of Carbon in — A. A. Blair. *J. Amer. Chem. Soc.* 22, [11], 719—723.

IN burning ferrochrome with acid potassium sulphate in a stream of oxygen in a combustion tube, with copper oxide in the after part, carbon may get into the absorption apparatus from the oxidation, by the sulphuric acid, of the corks; the boat may become cemented into the tube by the spattering of the acid sulphate, and the tube is often broken by the swelling of the copper oxide, caused through absorption of sulphuric acid. The author avoids these difficulties by using a platinum tube for the combustion and substituting platinised asbestos for the copper oxide.

boat, and the tube is kept clean. The platinum tube has a ground joint at the rear end, is constricted at the fore end for the reception of the platinised asbestos, then further constricted, bent at right angles, and fused to the narrow glass U-tube filled with beads. The two plugs, of pumice, wrapped in platinum foil, are pushed in behind the boat, and serve to check diffusion backwards, and consequent deposition of sulphuric acid near the joint. The general arrangement of the apparatus (Fig. 2) for the most part explains itself. D D contain chromic acid solution (150 grms. with 300 c.c. of strong sulphuric acid per litre), and stand on a copper plate heated by a Bunsen burner; E is filled with glass beads, F with pumice saturated with chromic acid, and G with calcium chloride. The guard tube beyond the absorption apparatus is connected with an aspirator to relieve the otherwise high pressure in the apparatus.

The method is as follows:—Put 25 grms. of acid sulphate in the boat, and melt it. When cold, spread over it 1 gm. of finely divided ferrochrome, put the boat into the platinum tube, followed by the plugs, and connect up the apparatus, sending a slow stream of oxygen through. Heat the platinised asbestos first, then work backwards till the whole of the boat is red-hot. After 20 minutes, turn off the oxygen, and allow the tube to cool for half an hour in a current of air. A slow current of oxygen must be used to ensure the condensation of the sulphuric anhydride, and the tube must be heated very gradually, so that the sulphur dioxide may never be in excess of the oxygen. A combustion takes about two hours and a half.—J. T. D.

Uranium and Vanadium Ores; Analysis of — O. P. Fritchie. *Eng. and Mining J.* 1900, 70, [19], 548.

THE following method, which is particularly adapted to the analysis of the mineral carnotite, depends upon the reduction of the uranium and vanadium in sulphuric acid solution to their lower oxides by metallic aluminium, and

Fig. 1.

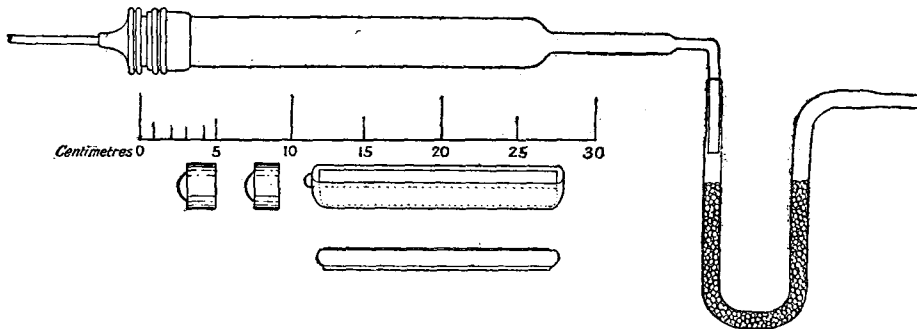
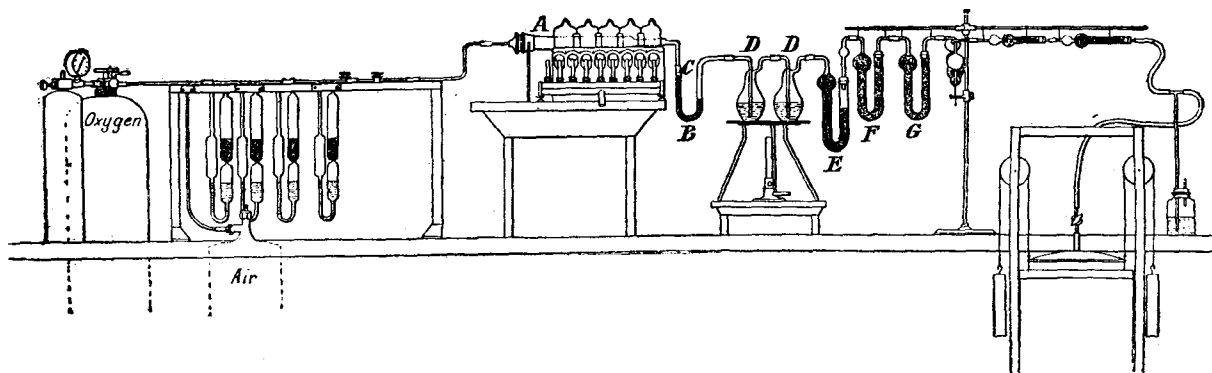


Fig. 2.



Two platinum boats are used (Fig. 1), one inside the other. The lid of the inner boat is so arranged that particles of the melted sulphate spirted against it drip into the outer

then oxidation to their higher oxides with permanganate solution. Metallic aluminium was found to be preferable to either zinc or sulphurous acid as a reducing agent.



0.5 gm. of the finely powdered mineral is moistened with water and digested for one hour with 10 c.c. of nitric acid, at a temperature at which the liquid boils gently. The solution is diluted with 10 c.c. of water, neutralised with a saturated solution of sodium carbonate, 5 c.c. excess of the latter added, and then 20 c.c. of a 20 per cent. solution of caustic soda. The whole is boiled gently for about half an hour and then allowed to settle. The uranium, vanadium, and iron are all precipitated by the sodium carbonate, but the vanadium is redissolved on boiling with the excess of caustic soda. The precipitate is filtered off and washed a few times with caustic soda solution. Water must not be used for washing, or some of the precipitate may pass through the filter. The filtrate should not give any uranium reaction when acidified with nitric acid and treated with potassium ferrocyanide. The whole of the vanadium is contained in the filtrate, but it is better to weigh out a fresh sample of the material for the determination of this constituent.

The precipitate is dissolved on the filter with 20 c.c. of hot dilute nitric acid (1 : 1), and the solution run into the original flask, where it is diluted with about 40 c.c. of water, treated with ammonia until a slight permanent precipitate is formed, and then with 40 c.c. of a saturated solution of ammonium carbonate, which has been freshly prepared and heated slightly to remove any excess of carbon dioxide. The uranium is readily soluble in the excess of ammonium carbonate, whilst the iron remains undissolved. The liquid is heated to incipient ebullition for a few minutes, and the iron precipitate filtered off and well washed with a 2 per cent. solution of ammonium carbonate. The filtrate, which should not give any vanadium reaction (red coloration) when acidified with nitric acid and treated with hydrogen peroxide, is treated with 20 c.c. of dilute sulphuric acid (1 : 1), added gradually, and boiled until dense white fumes are given off. It is then cooled, diluted to about 100 c.c., about 4 sq. ins. of sheet aluminium cut into six strips added, and the liquid boiled until the yellow colour changes to a sea-green. The solution is diluted, and titrated whilst hot with a standard solution of permanganate. The uranium equivalent of the permanganate is obtained by multiplying the iron equivalent by 120/56.

For the determination of the vanadium, 0.5 gm. of the ore is moistened with water and heated with 10 c.c. of nitric acid and 10 c.c. of sulphuric acid, until the whole of the nitric acid is expelled and dense white fumes of sulphuric anhydride are evolved. The solution is cooled, diluted, and reduced with aluminium. It is then further diluted, and titrated whilst hot with permanganate. The number of c.c. of permanganate solution used, less the number of cubic centimetres required for the uranium and iron, is the permanganate required for the oxidation of the vanadium. The vanadium equivalent of the permanganate is obtained by multiplying the iron equivalent by 51.1/112. The end reaction is slow with vanadium, and permanganate must be added gradually until a permanent pink is obtained.

—A. S.

Titanic Acid; Colorimetric Determination of —.

J. Brakes.

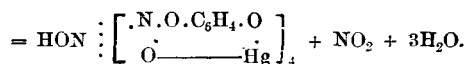
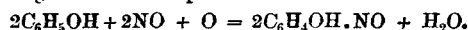
See page 23.

ORGANIC CHEMISTRY.—QUALITATIVE.

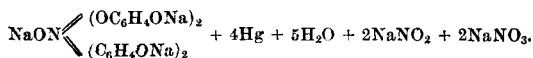
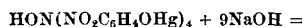
Millon's Reagent. W. Vaubel. Zeits. angew. Chem. 1900, [45], 1125—1130.

MILLON'S reaction which is given by phenolic substances and derivatives thereof, such as albuminoids, consists in the production of a red coloration or the separation of a red precipitate on adding Millon's reagent to a solution of the substance and if necessary, warming. The reagent is obtained by adding sufficient mercury to nitric acid to produce the mercurous salt. For example, one part by weight of metallic mercury is dissolved in one part by weight of nitric acid (sp. gr. 1.4), the mixture being finally gently warmed and then diluted with two parts by weight of distilled water. Hence the reagent contains together with some nitric acid principally mercurous nitrate and nitric oxide. Possibly part of the latter is converted by the atmospheric oxygen into nitrogen dioxide and since

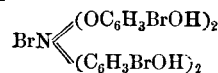
it is necessary that these gases should be present, it is advisable to employ only gentle heat in preparing the reagent. The author has investigated the behaviour of a number of substances to Millon's reagent and arrives at the following conclusions. (1) Substances of the formula 1.4 C₆H₄OH.X, such as tyrosin, *p*-diphenol, phenolphthalein and hydroquinone give the reaction. (2) The same is also the case with substances of the formula 1.2 C₆H₄OH.X and 1.2.4 C₆H₃OH.X₂ such as pyrocatechol, guaiacol, *p*-nitrosalicylic acid; of the formula 1.2.3 C₆H₃OH.X₂ and 1.2.3 C₆H₂OH.X₃ such as α - and β -naphthol, 1.4 bromo- and chloro- α -naphthol and bromo- β -naphthol, and also substances like resorcinol and *m*-cresol of the general formula 1.3 C₆H₄OH.X. (3) Substances of the general formula 1.2.4.6 C₆H₂OH.X₃ such as tribromophenol, dibromo-*p*-diphenol, dibromotyrosin, dibrom-*o*-cresol, dibromo-*p*-cresol and dibromo-*p*-nitrophenol and those of the formula 1.3.5 C₆H₃OH.X₂, like orcinol and phloroglucinol, do not give the reaction. The same is also true of thymol and pyrogallol. (4) In the case of phenol the following reactions take place:—



(5) On heating with soda lye, these products lose mercury and a compound is obtained soluble in soda lye with a reddish brown colour and precipitated by acids—



(6) By the action of bromine these compounds yield products of the type—



(7) No reaction takes place with Millon's reagent in the case of di-*o*- and di-*m*-substituted compounds. (8) In the case of the naphthols, only β -naphthol yields a product analogous to that from phenol. Other naphthol derivatives so far as they have been investigated give nitroso compounds.—T. A. L.

Methyl Alcohol in Mixtures; Detection of —. S. P.

Mulliken and H. Scudder. Amer. Chem. Journ. 1900, 24, [5], 444—452.

The method given by the authors for the detection of methyl alcohol in mixtures, *viz.*, oxidation of the alcohol to formaldehyde followed by condensation of the latter with resorcinol with the formation of a red precipitate, is objected to by Jandrier on the grounds that acrolein answers to the test, and that the test is interfered with by furfural; he further recommends the use of gallic acid as a reagent for the formaldehyde, but the authors find that the colours thus obtained are also given by the oxidation products of many other compounds. An improved method of applying the resorcinol test is as follows:—Only that part of a mixture is tested for methyl alcohol which can be completely distilled between 50° and 100° C., and which, after distillation, gives a clear, colourless solution when shaken with two or three times its volume of water. A blank experiment should be made on the liquid before the latter is oxidised, to make sure that no precipitate or coloured ring is formed. No solution suspected to contain phenols, alkaloids, or organic bases should be tested without preliminary treatment. Methyl alcohol may be separated easily from most colouring matters, oils, resins, sugars, glycerin and glycols by distillation; from phenols and acids by distillation with aqueous caustic alkali; from bases by distillation from strongly acidified aqueous solutions. Should the blank experiment, without oxidation, yield a coloration or precipitate, and the solution also give aldehydic reactions with ammoniacal silver nitrate and with Schiff's Rosaniline aldehyde reagent, 12 c.c. of the alcoholic distillate, which must



contain at least 75 per cent. of water, is heated in a stoppered bottle with 3 grms. of resorcinol and 1 c.c. of concentrated sulphuric acid in a water-bath for two hours at 70°–80° C.; the cooled solution is diluted to 50 c.c. with water, 5 c.c. being then distilled off and tested in the usual way. If ethyl alcohol be present with methyl alcohol in the liquid, acetaldehyde will be formed on oxidation, but this is got rid of by the new method of testing. Two c.c. of the liquid are made up to 6 c.c. with water and then treated six times in succession with intermediate cooling with a short, closely-wound spiral of light copper wire which is heated to redness and superficially oxidised, and then plunged into the liquid. The test-tube, which should be 6–7 ins. long, is next fitted with a double-bored stopper, one hole containing a piece of glass tube connected with a Bunsen pump, and the other fitted with a piece of glass tube drawn out to a very fine capillary, the end of which reaches nearly to the bottom of the tube. The latter is then immersed about two-thirds in water at 25°–30° C., the air passage partially stopped by a screw-clamp, and gentle suction applied so as to saturate the liquid with air. The clamp is next screwed tight, and the pump turned full on, when a stream of bubbles, consisting of acetaldehyde, alcohol, and water vapours, rises from the capillary. After one-half the liquid has been boiled away in this manner, to the residue is added one drop of a solution of one part of resorcinol in 200 of water, the liquid being then carefully poured into a second tube containing sulphuric acid, so that no mixing occurs. After standing for three minutes, the tube is rocked slowly to produce a gentle mixing of the layers. If methyl alcohol be present, this treatment will cause the separation of more or less voluminous flocks of a characteristic rose-red colour. One part of methyl alcohol in 2,000 parts of the solution as prepared for oxidation, can be detected in this way. With a mixture of ethyl and methyl alcohols in the proportion of 100 parts of the former to three of the latter, the test answers, but it cannot be depended on if there be only two parts of methyl to 100 of ethyl alcohol. The only substances giving the same reaction as methyl alcohol with the above described test are the methyl esters and ethers (including methylal) and secondary and butyl alcohols.

—T. H. P.

Maize in Wheaten Flour; Detection of — G. Embrey. Analyst 1900, 25, [297], 315–316.

BAUMANN'S quantitative method (this Journal, 1899, 301) has not given satisfactory results in the author's hands, and he has, therefore, devised the following modification:—Mixtures of pure wheat and maize flours are prepared containing respectively 10, 15, 20, 25, and 30 per cent. of the maize. Weighed quantities (0.2 gm.) of each of these and of the sample under examination are placed in test tubes (15 cm. x 2 cm.) which are fitted with paraffined corks. To each are added 20 c.c. of potassium hydroxide solution (18 grms. per litre), and the tubes shaken uniformly for three minutes. Twelve drops of hydrochloric acid (HCl of sp. gr. 1.16, 50 c.c.; water, 100 c.c.) are next introduced and the tubes whirled in a centrifugal machine at 600 revolutions per minute. One c.c. of the clear liquid is transferred to a Nessler tube, and diluted to 50 c.c., after which 1 c.c. of an iodine solution (I, 0.25 gm.; KI, 1 gm.; water, to 250 c.c.) is added. The tint obtained compared with those of the standard tubes gives the proportion of maize within about 5 per cent. For a more exact determination, 10 c.c. of the clear liquid from each tube are boiled for two hours with 1 c.c. of dilute sulphuric acid (1:7), then neutralised, diluted to 50 c.c., and run from a burette into a boiling mixture of Gerrard's solution, 10 c.c., and Fehling's solution 2 c.c., until the colour is discharged. The percentage of maize is obtained from the standard tube of which the same amount is required to discharge the colour.

Gerrard's Solution is prepared by diluting 10 c.c. of freshly-prepared Fehling's solution with 40 c.c. of water, and adding a solution (about 5 per cent.) of potassium cyanide from a burette, until the blue colour is only just perceptible. During the addition of the cyanide, the diluted Fehling's solution is kept boiling and constantly stirred in a porcelain dish.—C. A. M.

Maize in Wheaten Flour; Detection of — E. J. Bevan. Analyst, 1900, 25, [297], 316.

ACCORDING to the author the following test of A. C. Wilson gives satisfactory results:—The flour is mixed with clove oil and examined under the microscope with a $\frac{1}{4}$ or $\frac{1}{8}$ objective. Wheat or other starches are practically invisible, whilst the hilum of maize is indicated by a black dot or star.—C. A. M.

"Saccharin" in Wine and Beer in the Absence of Salicylic Acid; Detection of — F. Wirthle. Chem. Zeit. 1900, 24, 1035.

SCHMITT'S method of detecting saccharin (cf. this Journal, 1887, 6, 681) consisting of heating the extracted substances with caustic soda for half an hour in the oil-bath at 250° C., has not always proved satisfactory. This may be due to an incorrect use of the thermometer, as the author finds that when using two exactly similar thermometers, one completely immersed, the other so far immersed that the mercury column projects 37° above the cork, the indications at the same moment were 260° and 221° respectively. Results are satisfactory if the treatment with soda last for 15 minutes at a temperature indicated as 210°–220° C., when the thermometer is placed with the mercury column projecting 37° above the cork. It is recommended that 100 c.c. of the wine to be tested be evaporated to about 20 c.c., which is then transferred to a separating funnel, any residue being washed in with a few drops of caustic soda and some water; the whole is then acidified strongly with sulphuric acid, and shaken three times successively with 50 c.c. of ether. The ethereal solution is filtered into an Erlenmeyer-flask, and shaken with 10 c.c. of a 5 per cent. solution of caustic soda, after which the ether is distilled off. The residue is rinsed into a small porcelain dish, about 1 gm. of solid caustic soda is added, and the whole is heated slowly in an air-bath to 215° C., after which it is kept for 15 minutes at a temperature indicated as 210°–220° C. by a thermometer, of which the mercury column projects 37° above the cork. After cooling, the mixture is taken up with hot water, and is then carefully acidified with sulphuric acid and shaken with ether and petroleum spirit. The evaporation-residue from the resulting ethereal solution is diluted with a few c.c. of water. The addition of a few drops of very dilute ferric chloride solution will produce a beautiful violet-colour, even if only 1 mgrm. of saccharin had been present in 100 c.c. of the wine. Wines containing no saccharin, even though they contained much tannin, showed at most a dirty yellow-red (never a violet) coloration under these conditions. It is recommended always to try a blank experiment, simultaneously with a wine test, evaporating the alcoholic solution of 1 mgrm. of saccharin with 1 c.c. of caustic soda solution, and then adding 1 gm. of the solid soda. Beer is tested in the same way; the author having found that the presence of hops (and of tannic acid from that source) is without influence on the applicability of the test.

—W. G. M.

Dulcine (Phenetol-carbamide) in Foods and Beverages; Detection of — J. Bellier. Ann. de Chim. Analyt. 5, 333. Pharm. J. 1900, 65, [1587], 616.

DULCINE, in concentrated sulphuric acid solution, if treated with a few drops of formaldehyde, and the mixture diluted with water, gives a turbidity or precipitate, whilst saccharin does not. With less than 1 mgrm. of dulcine, a distinct precipitate is obtained by dissolving in 1 c.c. of sulphuric acid, adding 1 drop of formaldehyde, and diluting with water to 5 c.c. In order to apply this reaction, the dulcine is extracted from syrups, lemonade, waters, &c., by making alkaline, and shaking out with acetic ether. Beer is treated with sodium phosphotungstate, acidulated with a few drops of sulphuric acid, filtered and made alkaline, before shaking out. Fruit syrups, preserves, confectionery, and similar articles are rendered fit for extraction by dilution and precipitation with basic lead acetate. Wines should be first treated with mercuric acetate.

For the quantitative determination of dulcine, the sample is evaporated, if necessary, to free from alcohol, treated with the purifying precipitant, filtered, the solution made alkaline, and twice extracted with acetic ether (50 c.c. each.

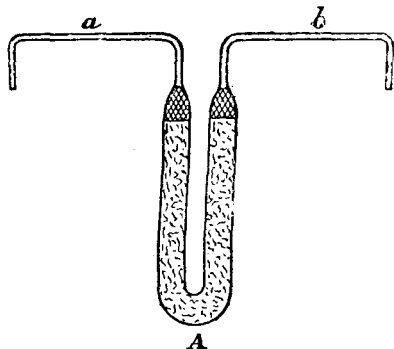


time). The evaporation residue of the extract is dissolved in from 1 to 5 c.c. of concentrated sulphuric acid, a few drops of formaldehyde added, and the solution, after standing for 15 minutes, diluted to ten times its volume. After standing for 24 hours, the precipitate is collected on a tared filter, washed with distilled water, the filter and contents drained between filter paper, dried and weighed.—A. S.

ORGANIC CHEMISTRY—QUANTITATIVE.

Coal Gas; New Method for the Volumetric Determination of Carbon Monoxide in — A. Smits, H. Raken, and P. C. E. Meerum Terwogt. *Zeits. angew. Chem.* 1900, [40], 1002—1004. (Compare this Journal, 1898, 377 and 490.)

The principle of the method depends on the oxidation of the carbon monoxide to carbon dioxide, which is subsequently absorbed by caustic potash. The oxidising agent employed is I_2O_5 at a temperature of 150° — 180° C. In the accompanying illustration, the U-tube A is filled with a mixture of I_2O_5 (about 8 grms.) and asbestos. Two asbestos plugs keep the mixture in position, and immediately above these plugs the limbs of the U-tube are attached to two capillary tubes *a* and *b*. The tube *a* is connected to the gas burette, whilst *b* communicates with a KOH pipette.



In performing an analysis, the illuminating gas, previously freed from carbon dioxide, heavy hydrocarbons and oxygen, is passed through the I_2O_5 pipette, heated at 150° — 180° C. The iodine liberated sublimes into the tube *b*, whilst the CO_2 is absorbed by the KOH pipette. If there is any tendency for the tube *b* to become blocked up by the sublimed iodine, this can easily be overcome by passing the gas backwards and forwards rapidly through the apparatus, in order to distribute the iodine between the tubes *a* and *b*. Finally, the gas is passed through very slowly to complete the oxidation.

After allowing the I_2O_5 pipette to cool down to the normal temperature, the diminution in volume of the gas represents the amount of carbon monoxide contained in it. The authors have confirmed the statements made by Nicloux and Gautier, *viz.*, that under the above conditions, neither hydrogen nor methane is attacked by the hot I_2O_5 or the nascent iodine.

In subsequently determining the hydrogen and methane, corrections must be made on account of the free space in the I_2O_5 and palladium pipettes. Assuming that the analysis was made with 100 c.c. of illuminating gas, and that *a* c.c. were removed by the caustic potash pipette, *b* c.c. by the fuming sulphuric acid pipette, *c* c.c. by the phosphorus pipette, *d* c.c. by the iodine pentoxide pipette, *e* c.c. by the palladium pipette, and that the remaining *f* c.c. of gas was found to contain *g* c.c. of methane: then the true percentages of hydrogen and methane are—

$$H_2 = \frac{e}{A} (A + p) - \frac{p+q}{5} \text{ per cent.}$$

$$CH_4 = \frac{g}{f} \cdot \frac{A+p}{A} (A + q - e) \text{ per cent.}$$

where *p* represents the free space in the I_2O_5 pipette, *q* the free space in the palladium pipette, and *A* is the volume of

the gas immediately before absorbing the hydrogen, *viz.*, $100 - (a + b + c + d)$.

The spaces *p* and *q* should, of course, be kept as small as possible, and *p* should be redetermined from time to time as the I_2O_5 gradually becomes used up.—J. S.

Sulphuretted Hydrogen in Coal-Gas; Determination of — H. Leicester Greville. *J. Gas Lighting*, 1900, 76, [1958], 1264.

The author published some years ago a method for the rapid determination of sulphuretted hydrogen in gas liquor. The process is based upon the use of a standard solution of ammoniacal copper sulphate, which reacts with the sulphuretted hydrogen with formation of copper sulphide. The results obtained differ at the most by only 0.025 per cent. from those obtained by precipitation as arsenic sulphide. It is now proposed to apply this method to the determination of sulphuretted hydrogen in coal-gas. The gas is passed into Harcourt tubes, such as are used for the ordinary volumetric determination of carbon dioxide and sulphuretted hydrogen. The first tube is charged with a solution prepared by mixing 1 volume of strong liquid ammonia with 10 volumes of water; and the second is filled with pure distilled water. A small piece of lead test-paper is placed in the outlet of the second tube, as a check on the total absorption of the sulphuretted hydrogen by the solutions. After a definite quantity of the gas has been drawn through the apparatus, the contents of the tubes are washed into a porcelain basin and titrated with the ammoniacal copper solution, which is of such strength that each c.c. equals 0.05 grain of sulphuretted hydrogen. It is stated that $\frac{1}{10}$ cb. ft. of gas can be passed through in 10—15 minutes without the slightest discoloration of the lead test-paper.—A. S.

Sulphuretted Hydrogen in Coal-Gas; Determination of — A. Müller. *J. für Gasbeleucht.* 43, [42], 792—793.

The author applies Schulte's process for the estimation of sulphur in iron (*Stahl und Eisen*, 1896, 865) to the estimation of sulphuretted hydrogen in gas in the following manner:—A known volume—about 15 litres—of the gas is bubbled slowly through 25 c.c. of a solution consisting of 25 grms. of cadmium acetate and 200 c.c. of acetic acid, made up to a litre with distilled water. The volume of gas may be measured by means of a small meter, or by means of a bottle having the necessary capacity between its mouth and a mark slightly above a tubulure near its bottom. The bottle is filled with water covered by a layer of petroleum, and is connected through the tubulure with a levelling vessel, by lowering which it is filled down to the mark with gas, which is then forced, by raising the levelling vessel, through the solution of cadmium. After the gas has been bubbled through the solution, the bubbling tube is washed into the latter and removed. There is then added to the solution, after warming to 50° — 60° C., 10 c.c. of a solution made by dissolving 80 grms. of pulverised crystals of cupric sulphate in 750 c.c. of water, and adding, when cool, 175 c.c. of concentrated sulphuric acid, and making up to a litre with distilled water, and filtering. The liquid changes in colour, on addition of the copper solution, from yellow—due to suspended cadmium sulphide, which can be filtered off and washed only with difficulty—to brownish-black, due to the formation of cupric sulphide, which is filtered off, well washed with hot water, dried, and ignited. The cupric oxide thus obtained is weighed, and the weight (in grammes) multiplied by $\frac{34}{79 \times 1.43} = 0.301$, gives the volume (in litres) of sulphuretted hydrogen in the volume of gas dealt with, on the assumption that the temperature of the latter was about 18° C., at which temperature a litre of sulphuretted hydrogen weighs 1.43 grms.—J. A. B.

Metacresol in Mixtures of Cresols; Determination of — H. Ditz. *Zeits. angew. Chem.* 1900 [42], 1050.

Referring to the method of estimation described by Raschig (*this Journal*, 1900, 857), the author points out that it has the great advantage of giving directly the amount of metacresol, though it is not applicable when the



mixture of cresols contains a large proportion of phenol, or when xylene is present. He considers that in the case of pure cresol mixtures, the method first described by himself and Cedivoda (Zeits. angew. Chem. 1899, 873 and 897), is the most suitable.

About 1 grm. of the anhydrous cresol mixture is weighed out, dissolved in water with the aid of some sodium hydroxide, and the solution diluted to 250 c.c. Two portions of 25 c.c. each are transferred to well-stoppered flasks, and decomposed with a sufficient quantity of Koppeshaar's bromide-bromate solution, and 10 c.c. of hydrochloric acid (1:1). After being shaken for exactly one minute, 20 c.c. of a 5 per cent. solution of potassium iodide are introduced, the iodine which separates titrated with standard thiosulphate after one hour, and the amount of bromine absorbed calculated from the result. The quantity of metacresol is then obtained from the equations—

$$x + y = a \quad \text{and} \quad \frac{3Br x + 2Br y}{108 \cdot 08} = b,$$

in which x = the amount of metacresol; y , the sum of the ortho- and para-cresol; a , the weight of the total cresols; and b the weight of bromine absorbed, hence—

$$x = a - y = a - \frac{2 \cdot 2195a - b}{0 \cdot 7397} = \frac{b - 1 \cdot 4798a}{0 \cdot 7397}$$

If the cresol mixture contain any traces of water, the latter is removed preferably by heating 5 to 10 grms. of the mixture in a small fractionating flask, and after removal of the water distilling over the cresol. According to the author's experimental results, the accuracy of the method is within 0.5 per cent.

It is not possible to determine separately by this method each of the individual constituents in a mixture of phenol with the three cresols, but it suggested that this problem may be solved by a combination of the author's method with that of Raschig. The only difficulty is that in the latter, the presence of more than 10 per cent. of phenol interferes, but this may be obviated by adding to the mixture a known quantity of pure metacresol, or a definite quantity of a cresol mixture which is free from metacresol, so as to reduce the total amount of phenol below 10 per cent. (this Journal, 1900, 278).—C. A. M.

Wax; Acid and Saponification Values of.—Modification of Hübl's Method of Determining them. O. Eichhorn. Zeits. anal. Chem. 1900, 39, [10], 640—645.

The modification recommended consists in the use of amyl alcohol as a solvent.

Determination of the Acid Value.—About 6 grms. of the wax are heated with 60 c.c. of pure amyl alcohol until the liquid boils, when it is titrated with decinormal potassium hydroxide solution. The advantage over the ordinary method is that the last drops of alkali can be added at a temperature of about 60° C. without the wax separating, and thus avoiding a partial saponification. Hence in all the experiments described, the results were considerably lower than those usually obtained. Thus, with a pure yellow wax, the respective values were 22.34 and 22.8. In the case of Carnuba wax it is best to use only 3 grms. and 120 c.c. of amyl alcohol. The value found by the author (9.71) is the highest yet recorded.

Determination of the Saponification Value.—About 5 grms. of the wax are placed in an Erlenmeyer flask, into which are then introduced 60 c.c. of amyl alcohol and 25 c.c. of normal alcoholic potassium hydroxide, and the same quantities of amyl alcohol and alkali are placed in a second flask for a blank determination. Both flasks are then placed in a boiling water bath, where they are left for 30 minutes, with occasional shaking at first. 1 c.c. of a 1 per cent. phenolphthalein solution is now added, and the excess of alkali titrated with semi-normal hydrochloric acid.

The author states that all the waxes examined by him gave too low results when saponified by the usual Hübl method. That the action is complete in 15 minutes in the new method is shown by the following results, taken from the author's longer table:—

	Saponification, 15 minutes.	Saponification, 30 minutes.	Saponification, 50 minutes.	Saponification, 90 minutes.
Wax, No. 1	94.6 } 94.4 94.3 }	94.5 } 94.5 94.5 }	94.3 } 94.3 94.4 }	94.4
" No. 3	89.2 } 89.4 89.6 }	89.5 } 89.5 89.6 }	89.3 } 89.3 89.4 }	89.3
" No. 7	86.3 } 86.4 86.5 }	86.4 } 86.4 86.4 }	86.5 } 86.5 86.5 }	86.5

The presence of ceresin neither prevents nor retards the saponification. With Carnuba wax the mean saponification value of 95.1 was obtained.—C. A. M.

Proteid Nitrogen in Vegetable Matter; Determination of.—G. S. Fraps and J. A. Bizzell. J. Amer. Chem. Soc. 22, [11], 709—719.

A COMPARATIVE study of the methods of Stutzer (copper hydroxide), Mallet (phosphotungstic acid at 90° C.), and Wiley (bromine), as applied to the precipitation of proteids in vegetable materials. The authors conclude that—(i) Phosphotungstic acid does not precipitate proteids completely at 90° or 100°, though at 60° C. it precipitates practically the same amount as does copper hydroxide; (ii) Extraction of proteids with hot water does not always give concordant results; (iii) Bromine is not a suitable precipitant for proteids in vegetable materials; (iv) The Stutzer method is that open to the fewest objections. It is carried out as follows:—Place 0.7 grm. of the substance in a beaker, add 100 c.c. of water, heat to boiling (with substances rich in starch, heat on the water bath for ten minutes); add a quantity of copper hydroxide mixture containing about 0.5 grm. of the hydroxide; stir thoroughly, filter when cold, wash with cold water on the filter, and determine the nitrogen in the precipitate, adding sufficient potassium sulphide solution to precipitate all copper and mercury. If the substance is rich in alkaline phosphates, add a little concentrated solution of alum before adding the copper hydroxide. It is not certain that albumoses are completely precipitated by copper hydroxide; but in the rare cases when they do occur, they can be precipitated by the addition of tannic acid after the copper hydroxide.

—J. T. D.

Alkaloids; Use of Tannin in Purifying Residues containing.—C. Kippenberger. Zeits. anal. Chem. 1900, 39, [10], 627—633.

ACETONE has been found by the author to be a suitable solvent for alkaloids in combination with tannin, and for separating them from albuminous substances. It dissolves the freshly precipitated tannates of the following alkaloids:—Brucine, strychnine, atropine, morphine, aconitine, veratrine, papaverine, narséine, thebaïne, codeïne, emetine, nicotine, conine, sparteïne, quinine, narcotine, and cocaine. On the other hand, the precipitates formed by tannin in solutions of albumin and peptone did not yield any trace of the albuminous constituents to the solvent after being treated with acetone for 1½ hour, although tannin was found in solution.

In applying this principle in forensic analysis the following method is recommended:—The substance under examination is extracted with acidified alcohol, and the alcohol evaporated. The residue is stirred into a paste with a little water and acetone, mixed with tannin, and gently warmed with a sufficient quantity of acetone containing a few drops of hydrochloric acid. The filtrate from this is mixed with 10 to 20 c.c. or more of glycerin, together with some water and 1 or 2 c.c. of hydrochloric acid, evaporated on the water bath so as to expel all acetone, diluted with water and filtered. The liquid is then ready for extraction with chloroform.

The author still advocates the retention of his former method of direct extraction with glycerin containing tannin (Zeits. anal. Chem. 34, 303—308) for cases in which alkaloids which are volatile with steam are present.

—C. A. M.



Nux Vomica; Determination of. F. C. J. Bird. Pharm. J. 65, [1587], 574.

As an alternative for the method of Dunstan and Short, in which the alkaloids are extracted by hot percolation with a chloroform-alcohol menstrum, the author recommends a method of cold maceration in a solvent of amyl alcohol, chloroform, and ether, as being more rapid, more convenient, and not requiring the same degree of comminution of the drug.

Process for Analysing Nux Vomica Seeds.—5 grms. of the seeds, in No. 10 powder, are triturated in a mortar with solution of potash (10 per cent.) 2 c.c. until uniformly moistened. The extraction menstrum is composed of amyl alcohol, 1 vol.; chloroform, 3 vols.; ether, 4 vols.; 20 c.c. of this mixture is placed in a separator previously plugged above the stopcock with cotton wool, and the moistened powder added to it. The whole is macerated for half an hour, with occasional agitation; at the end of that time a pressure ball is adapted to the separator and the liquid forced out, as completely as possible, by air pressure. The residual drug is again covered with a fresh portion of solvent, and again macerated, with occasional agitation, for 15 minutes, and the liquid removed as before. This process is repeated until a drop of the extract, when evaporated, gives no reaction with Mayer's alkaloidal reagent. Usually five to six extractions will be sufficient. To remove all the alkaloids, the mixed ethereal extracts are then shaken out with a mixture of dilute sulphuric acid, 6 c.c., and water, 25 c.c., in three successive portions. The acid solutions are transferred to a 200 c.c. separator half filled with water at 21° C. and having the neck above the stopcock plugged with a very small pledget of cotton wool. To this, a freshly prepared solution of potassium ferrocyanide (1.25 grms. in water, 25 c.c.) is added, and the separator completely filled with water at 21° C. and closed by a cork carrying a thermometer. The temperature is carefully maintained at 21° C., the contents of the separator rotated occasionally for 30 minutes, then allowed to remain at rest for 90 minutes. A pressure ball is then fitted, and the mother liquor forced out. The residual precipitate is washed with 50 c.c. of a mixture of 5 c.c. of dilute sulphuric acid and 19 c.c. of water at 37.7° C., the liquid being removed by air pressure as before. The remainder of the wash water is then employed in a similar manner. Washing being completed, the stopper is inserted, the separator inverted, the cotton plug displaced by a stiff wire passed through the stopcock; 10 c.c. of water is then added to suspend the precipitate, 75 c.c. of chloroform and 2 c.c. of strong solution of ammonia are introduced, and the whole well agitated. After separating the chloroformic layer, the aqueous portion is shaken out with another portion of that solvent. To the mixed chloroformic extracts, 2 c.c. of amyl alcohol is added, the solvent evaporated off, and the residual strychnine weighed when dry. An addition of 0.002 gm. is made to the weight obtained, as the equivalent to the amount of strychnine ferrocyanide dissolved in the wash-water.

The packing of the cotton wool in the neck of the separator demands some care, or it may either be displaced by agitation, or, if too tight, impede the flow of liquid. To avoid this, a single tuft of wool, about 3 cm. in diameter, is placed lightly in the neck of the separator by means of a pointed glass rod, the point of which is passed down to the plug of the stopcock. In this way the wool forms a hollow cone, which filters rapidly and has no tendency to become misplaced.

Alternative Method for Analysing Liquid and Solid Extracts of Nux Vomica.—The following method obviates difficulties met with in separating immiscible solvents due to the presence of varying quantities of fatty oil in extracts of nux vomica. To wash the alkaloidal extracts, ammonium carbonate solution is substituted for that of ammonium hydrate usually employed, since it exhibits less tendency to form an inseparable emulsion. 10 c.c. of liquid extract (or 3 gm. of solid extract, dissolved in hot water, 6 c.c., and alcohol, 90 per cent., 2 c.c.) is placed in a small separator (No. 1), with chloroform, 10 c.c., and ether, 5 c.c., and after agitation, strong solution of ammonia, 4 c.c., is

added. The mixture is agitated and separated, the immiscible layer being run into a second small separator (No. 2), and shaken out with three successive portions of 5, 5, and 3 c.c. of 10 per cent. ammonium carbonate solution, the washed ethereal liquid being then passed on to a third small separator (No. 3).

To the mixed aqueous washings in No. 2, chloroform, 10 c.c., and ether, 3 c.c., are added. This is shaken out and run off into the mother liquor in No. 1, well shaken, and the ethereal layer run into (empty) No. 2, washed with ammonium carbonate solution twice, using 3 c.c. each time; the washed ethereal extract is run off into No. 3. To the mixed aqueous washings in No. 2, another 13 c.c. of the ether-chloroform solvent is added, and again shaken out as before, and transferred to No. 1. The ethereal layer is washed in No. 2 with 1 c.c. of ammonium carbonate solution. From the washed ethereal extracts in No. 3, the alkaloid is then removed by shaking out with a solution of dilute sulphuric acid, 6 c.c., in water, 25 c.c., used in three portions of 11, 10, and 10 c.c. From this stage the process is conducted as directed for the assay of the seeds.

Tincture of Nux Vomica.—100 c.c. of tincture is evaporated to 8 c.c., 2 c.c. of alcohol, 90 per cent., is added, and the process continued as described under the liquid extract.

—J. O. B.

Lemon Oil; Determination of Citral in — Schimmel's Semi-ann. Rept., Oct. 1900, 25.

ALTHOUGH the cyanacetic method of E. J. Parry (this Journal, 1900, 384) is found to give fairly accurate results with mixtures of limonene and citral, it is not found to be workable with commercial lemon oils. From the presence of foreign substances, probably derived from the constituents of the peel, a thick layer of insoluble, waxy matter is formed in the graduated tube of the Hirschsohn flask, which renders correct reading of the volume of the supernatant liquid impossible. The problem of devising a workable method for the determination of citral in lemon oil has, therefore, yet to be solved.—J. O. B.

Lemon Oil; Determination of Citral in — E. J. Parry. Chem. and Druggist, 57, [1091], 1000.

Messrs. Schimmel and Co. raise (see preceding abstract) two objections to the author's method (this Journal, 1900, 384). The first objection raised is, that, although the results are satisfactory, a certain proportion of the citral passes over in the distillation at very low pressure, whilst this is made up by an absorption of limonene by the cyanacetic acid. They find, they say, as much as 1 per cent. of citral goes over in the distillation, and therefore 1 per cent.—or rather more, as the results are always a little too high—of limonene is absorbed by the acid, or, taking into account the concentration, the aqueous reagent is said to absorb 2.5 per cent. of its volume of terpene. This, on the face of it, is very improbable. The author has distilled many samples of lemon oil, keeping the pressure down to the lowest possible limit, possibly below even 10 mm., and he has never found any portion of the limonene to contain more than merest traces of citral. Indeed, in general, unless the pressure has been allowed to rise, there is practically no absorption by any of the usual aldehydic reagents.

The second objection raised, is that the reading is obscured by the presence of the stearoptene in the concentrated oil. He has not found that there is much more difficulty in reading the dividing line in this case than in the case of several other absorption processes, and he does not think it more than a trifling difficulty in the process. He reiterates his claim that this method yields more accurate results than any other.

XXIV.—SCIENTIFIC & TECHNICAL NOTES.

Reaction Velocities; Influence of Chemically Indifferent Solvents on — N. Menshutkin. Zeits. Phys. Chem. 1900, 34, 157—167. (Through Science Abstr. 3, [11], 887.)

FROM the results of fresh experiments here given and from those previously obtained (Ber. 1897, 30, 2966), the influence of various solvents on reactions between aromatic



amino compounds and allyl- or methyl-bromide, &c., is examined. It appears: that chemical reactions between organic non-electrolytes in fluid systems occur in a similar manner whether the bodies interact directly or in the presence of indifferent solvents; that the regularities in the relations between the velocities of formation depend on chemical structure and are independent of the presence of indifferent solvents; that the presence of solvents facilitates the study of such relations, and that, with aromatic compounds showing side-chain isomerism, the relative magnitude of the reaction velocities of the isomers often depends on the nature of the solvent used.—W. G. M.

Reactions; Change of Weight in Chemical and Physical
— A. Heydweiller. *Phys. Zeits.* 1900, 1, 527—529.
(Through *Science Abstr.* 3, [11], 886—887.)

CONTINUING Landolt's experiments (*Zeits. Phys. Chem.* 1893, 12, 1), and examining the reactions of Fe with CuSO_4 in neutral, acid and alkaline solutions; of CuSO_4 and KOH; of oxalic acid and ammonia; of BaCl_2 and H_2SO_4 ; and also the solution of CuSO_4 in neutral and acid aqueous solutions, and the mixing of CuSO_4 and dilute H_2SO_4 solutions, the author finds the greatest alteration in weight to be 0.229 mgrm.; that the changes are in all cases but one decreases; and that they are not proportional to the reacting masses; in many cases they are produced only in the presence of small quantities of foreign substances, and are therefore probably due to a secondary action.
—W. G. M.

Radio-Active Lead and Rare Earths. K. A. Hofmann and E. Strauss. *Ber.* 33, [16], 3126—3131.

THE authors have obtained, from various minerals, lead compounds and rare earths which did not contain a trace of Bi, Ba, Ti, Th, or U, but which, nevertheless, on testing by 24 hours' exposure to a gelatin-bromide photographic plate, were found to be radio-active.

Active Pb from Pitchblende.—The mineral was heated with soda for several hours, the mass extracted with water, the residue decomposed by repeated evaporation with hydrochloric acid, extracted with hot water, and the lead precipitated by H_2S . The PbSO_4 obtained by evaporation of the PbS with nitric and sulphuric acids, was strongly radio-active.

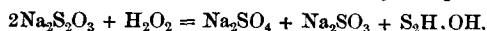
Active Pb and Rare Earths from Bröggerite.—Bröggerite consists mainly of uranate of uranium, thorium, and lead. The mineral was decomposed by repeated evaporation with sulphuric acid. Both the lead rendered insoluble as PbSO_4 , and that subsequently precipitated from the solution were found to be active, through the methods of purification precluded the possibility of polonium being present. The ammonium sulphide precipitate from the solution of the mineral was oxidised by aqua regia and the earths precipitated with oxalic acid. The ignited precipitate was converted into sulphates, dissolved in hot water, thrown down by a large excess of ammonium bicarbonate, and the earths remaining insoluble were purified by precipitation as oxalates from their chloride solution. Thoria, in the authors' opinion, was thus excluded, as were also radium, polonium, and lead, yet the oxalates were radio-active and the oxides obtained on ignition were still more so. The ignited U_3O_8 obtained from bröggerite was active, but by repeated crystallisation of the oxalate, inactive oxalate, yielding inactive U_3O_8 , was obtained in the more readily soluble fractions.

Active Pb, Ba, and Rare Earths from Cleveite.—Cleveite was decomposed in the same way as bröggerite, and yielded active Pb, Ba, ThO_2 , and rare earths. On the other hand the PbCl_2 , which crystallised out from the hydrochloric acid solution of the mineral, was inactive.

From *autunite*, *copper-uranite*, and *zeunerite* were obtained radio-active Ba, Pb, Bi, and U; on the other hand As, Cu, Fe, Al, and Zn were inactive. *Samarските* yielded active PbSO_4 , ThO_2 , and rare earths. *Euxenite*, however, yielded ThO_2 , rare earths, TiO_2 , and Pb only in the inactive condition, and U_3O_8 very strongly active.—H. B.

Hydrogen Peroxide on Thiosulphates; Action of
A. Nabl. *Ber.* 1900, 33, [16], 3093.

In the presence of very dilute sulphuric acid, according to the author, the action takes place as shown by the equation:



Dilute sulphuric acid must be added gradually during the course of the reaction to neutralise the basic body $\text{S}_2\text{H.OH}$. The latter has not yet been obtained pure in sufficient quantity to establish its exact composition. It is a weak base having reducing properties, and in many respects resembles hydroxylamine. With mercuric chloride it gives a precipitate consisting of a mercurio-mercuric double salt. This property has been utilised to separate the base from the sulphate and sulphite, with which it is mixed. The mercury compound was filtered off, washed, and decomposed with sulphuretted hydrogen. The solution was then extracted with a mixture of sulphuric acid and alcohol. The sulphate of the base was filtered off, washed with ether-alcohol, dissolved in water, and decomposed with barium carbonate. By this means a colourless solution was obtained having a green fluorescence and a strong alkaline reaction.
—A. M.

Cadmium Selenide. Fonzes-Diacon. *Comptes Rend.* 131, [22], 895—897.

CRYSTALLISED cadmium selenide, CdSe , is obtained by passing hydrogen selenide, largely diluted with hydrogen, over red-hot cadmium chloride. It is isomorphous with zinc selenide similarly obtained. Hydrogen selenide gives, in a solution of cadmium sulphate, a chocolate-brown precipitate of cadmium selenide; but in a solution of a cadmium halide, it gives a yellow or orange double salt (e.g., 3CdSe.CdI_2).—J. T. D.

Xanthorhamnin and Quercitrin; Sugar Constituents of
— E. Votocek and V. Fric. *Zeits. Zuckerind.*
Böhmen, 1900, 25, [1], 1—7.

CONTRARY to the view hitherto held that rhamnose is the only sugar constituent of xanthorhamnin, the latter is found to contain galactose also.

The glucoside was prepared from Persian berries by digestion with 85 per cent. alcohol on the water-bath, and purified by repeated recrystallisation from alcohol. Distillation with 12 per cent. of hydrochloric acid, gave methyl furfural, which furnished phloroglucide, equal to 37.52 and 37.9 per cent. of rhamnose, calculated on the dry xanthorhamnin. Now, as Liebermann and Hörmann found 55.14 per cent. of the sugar by titration with Fehling solution, the presence of another sugar, not a methyl-pentose, was indicated. This was further confirmed by the polarisation and cupric reducing power of a large quantity of substance.

The syrup obtained on hydrolysis gave an osazone which, purified by soaking with acetone on a porous tile, fused at 196° C., the melting-point of galactosazone. In appearance it also agreed with that substance. The presence of galactose was further confirmed by the mucic acid test, and finally, a mixture of 2 mols. of rhamnose and 1 mol. of galactose gave polarisation equal to that found directly.

The hydrolysed syrup from quercitrin (*Quercitron bark*) was found to contain neither galactose nor mannose, but only rhamnose.—L. J. de W.

Gentianose and Sucrose in Fresh Gentian Root; Simultaneous Presence of
— E. Bourquelot and H. Hérissé. *Comptes Rend.* 131, [19], 750—752.

FROM the mother liquors in the preparation of gentiopicroin (this *Journal*, 1900, 846), the authors were able to extract, by systematic treatment with alcohol, the sugar gentianose (this *Journal*, 1898, 257). The residue from this extraction contained another, more highly dextro-rotatory sugar, which was extracted by methyl alcohol, and finally obtained in a pure state, when it was found to be cane sugar. The authors suggest that as gentianose, though its constitution is not yet clearly made out, certainly contains at least as many carbon atoms in the molecule as cane sugar, the latter may arise in the plant through the molecular change or decomposition of gentianose.
—J. T. D.



Erythritol in Trentepohlia Jolithus. M. Bamberger and A. Landsiedl. *Monatsh. Chem.* 21, 571—573.

DURING the extraction of this alga with ether, there appeared in the boiling flask first, brownish, afterwards white, crystalline crusts, which, after recrystallising from alcohol and from glacial acetic acid, had the appearance, taste, melting-point, and composition of erythritol.

—J. T. D.

Algæ; Soluble Colouring Matter of Blue-Green —. R. Kolkwitz. *Zeits. Vereins deutsch. Zucker-Ind.* 1900, [538], 1015—1016.

THE author draws attention to the fact that the blue-green colouring matter—"Phykocyan"—present in many *Algæ* (*Polycystis*, *Oscillaria*, and *Nostoc*), although retained by the living plant, becomes readily soluble and diffusible in water when the plant dies. The aqueous solution is indigo-blue in colour, and exhibits a fine blood-red fluorescence. A phenomenon of this kind, occurring, for example, in the waste water from sugar factories, &c., in which liquid, algæ are very apt to appear, must not, therefore, too hastily be ascribed to the presence of an aniline dyestuff.

—H. T. P.

Milk; Production by Lactic Bacteria of Acetic Acid in —. C. Bartel. *Centralbl. Bakt. (II. Abth.)*, 1900, 419; through *Zeits. Spiritusind.* 1900, 23, [48], 438.

THE formula for the decomposition of milk sugar into lactic acid, $C_{12}H_{22}O_{11} + H_2O = 4C_3H_5O_3$, is not correct, other products being also formed, such as ethyl alcohol, carbon dioxide, and acetic acid. The author's experiments were directed mainly to the estimation of the acetic acid. Leichmann's *B. lactis acid* was employed and allowed to ferment milk, both with strong aëration and in absence of air. The quantities of acetic acid produced in the two cases were as 3:2. As regards the effect of temperature on the production of acetic acid, it was found that the quantity increased as the temperature was lowered. The smallest proportion of acetic acid was produced at the temperature at which the lactic bacteria thrive best. Hence it is concluded that acetic acid is a pathogenic product of the cell life of the bacterium.—J. F. B.

α- and β-Naphthol; Comparison of —. Maximowitch. *Therap. Gaz.* 24, 402. *Pharm. J.* 1900, 65, [1587], 572.

THE author states that the preference for β-naphthol for medicinal use is not well-founded. It is shown that α-naphthol is three times as antiseptic as β-naphthol and only one-third as poisonous; also β-naphthol is not so well tolerated by the stomach, and causes irritation of the mucous membrane of mouth and stomach.—A. S.

Lichens; Composition of —. VI. W. Zopf. *Annalen*, 1900, 313, [3], 317—344. (See this Journal, 1898, 807.)

Lepraria latebrarum Ach.—After extraction of this lichen with two vols. of hot ether, and removal of about five-sixths of the solvent, leprarine and atranoric acid crystallise out on standing, whilst roccellic acid, $C_{17}H_{32}O_4$, remains in solution, from which it is obtained in colourless plates on slow evaporation. When carbon dioxide is passed through a solution of roccellic acid in sodium carbonate, the sodium salt is precipitated; under the same conditions hydroxyroccellic acid, $C_{17}H_{32}O_5$, remains in solution. If the above mixture of leprarine and atranoric acid be boiled for a moment with alcohol, the former dissolves, whilst the latter remains insoluble, but if boiled for an hour with absolute alcohol, leprarine is converted into hæmatommic acid.

If leprarine, $C_{21}H_{40}O_{10}$, be boiled with methyl, ethyl, or normal propyl alcohol and two drops of strong hydrochloric acid, leprarinine (melting at 135° C.), leprarinidine (melting point 120°—121° C.), or lepraline (melting point 100° C.) is obtained respectively. These three substances are insoluble in caustic alkalis, which colour them yellow; their alcoholic solutions redden litmus, and give a wine-red coloration with traces of ferric chloride.

Gyrophora vellea (L.) Ach. — The ethereal extract deposits gyrophoric acid, which was identified by its decomposition into orsellinic acid and its ethyl ester on long boiling with absolute alcohol.

Cladonia Deformis L.—From this lichen zeorine and usnic acid were extracted. *Cladonia cyanipes* Sommerfeldt also contains usnic acid in fair quantity.

Parmelia incurva (Pers.) Fr. contains usnic acid.

Rhizocarpon viridiatrum (Flörke).—From this lichen, by extraction with chloroform, removal of the solvent, and gradual evaporation of the ethereal solution of the residue, rhizocarpic acid was obtained. The same acid had been previously found in *Rhizocarpon geographicum* L. (*Annalen*, 284, 114).

Pertusaria amara (Ach.) Nylander.—Hesse has recently found five different substances in a lichen he supposed to be identical with *P. amara*, but did not obtain picrolichenine (J. prakt. Chem. 58, 501). From what follows, it would appear that Hesse's lichen could not be *P. amara*. The material employed by the author was tested by taste; no other *Pertusaria* has an intensely bitter taste. On concentration of the ethereal extract, a white crystalline powder was obtained. It gave red salts with alkalis, and was identical with salazinic acid (*Annalen*, 306, 309—311). The ethereal extract, on further concentration, yielded a substance melting at 175°—176° C. with evolution of gas, dissolving in alkalis to red solutions, and expelling carbonic acid from carbonates; it is identical with picrolichenine.

Evenia furfuracea L.—This lichen, as also *Parmelia olivetorum* Nyl., contains a substance giving a red coloration with bleaching powder; the author regarded this substance as erythrin, Hesse as lecanoric acid. It is now proved to be a new compound, for which the name olivetoric acid is proposed. The lichens are extracted by cold absolute alcohol, and the filtered extract precipitated by water. After purification, the substance melts at 141°—142° C., the alcoholic solution reddens litmus and is coloured violet by ferric chloride. Dilute potash gives a yellow solution, turning red on boiling. Baryta water gives a yellow solution, which changes to green and then becomes colourless. Analysis indicates the formula $C_{27}H_{36}O_3$.

—A. C. W.

Iron Nitride. G. J. Fowler. *Proc. Chem. Soc.* 16, [229], 209.

NITRIDE of iron was prepared by three different methods: by the action of ammonia on (a) finely divided iron, (b) ferrous chloride and bromide, (c) iron amalgam. Of these methods (a) is the most convenient. The substance was found to correspond to the formula Fe_2N . The temperatures of the formation of iron nitride in ammonia and of its decomposition in hydrogen are identical. These results confirm the conclusions of Stahlschmidt. Heated in a current of nitrogen, iron nitride begins to decompose at about 600°; it is slightly magnetic; its specific gravity is 6.35.

When oxidised in air or oxygen, only traces of oxides of nitrogen are produced; heated in a current of air, the substance begins to be converted into ferric oxide and nitrogen at about 200°. It takes fire in chlorine either spontaneously or when slightly warmed, ferric chloride and nitrogen being formed, but no trace of nitrogen chloride. It is only slowly attacked by bromine, the action probably being due to the presence of hydrobromic acid in the bromine as an impurity. An ethereal solution of iodine has no action on it.

Dilute hydrochloric and sulphuric acids yield the corresponding ferrous and ammonium salts, hydrogen being liberated, according to the following equation: $2Fe_2N + 6H_2SO_4 = 4FeSO_4 + 2NH_4HSO_4 + H_2$.

The simultaneous action of hydrogen peroxide and sulphuric acid is not distinguishable from that of the acid alone. Nitric acid acts only slowly on the nitride even when strong; the products formed vary with the concentration of the acid.

Gaseous hydrochloric acid begins to attack the nitride at about 220°, and at 350° the reaction becomes rapid, the substance being completely converted into ferrous chloride and ammonium chloride. Gaseous hydrogen sulphide has a precisely similar action at 200°.

Nitric oxide acts similarly to oxygen, and converts the nitride into oxide, the reaction beginning at about 120° and becoming rapid at 170°. Carbon dioxide oxidises the nitride



at about 530°. On heating the nitride in steam at 100°, ammonia is very slowly formed. The nitride heated with sodium and carbon yields sodium cyanide.

PATENTS.

Abrasive Material from Bauxite or other Hydrous Oxides of Aluminium; Processes of Manufacturing — B. J. B. Mills. London. From The General Electro-Chemical Company, New Jersey, U.S.A. Eng. Pat. 16,529, Sept. 17, 1900.

BAUXITE or other hydrous oxides of aluminium may be transformed into a hard material suitable for abrasives by first calcining the soft amorphous aluminium hydrate to drive out the water, and then heating it to a state of quiet fusion in an electric furnace, after which it is allowed to cool slowly into a solid crystalline mass. A finer grain of crystal may be obtained by agitating the mass while cooling.—G. H. R.

Tobacco; Free or Partly Free from Nicotine; Production of — F. W. Haase, L. Broeckmann, and C. Haase, Bremen. Eng. Pat. 23,808, Nov. 29, 1899.

THE process claimed is for the production of tobacco free or partly free, from nicotine, with improvement in its quality, by macerating the leaf tobacco in an aqueous solution of hydrogen peroxide, with or without the addition of ammonia. The treatment is continued for a length of time sufficient to convert the nicotine into oxynicotine and nicotinic acid, either completely or to the desired extent. Oxynicotine is non-volatile, and only produces small quantities of volatile pyridine bases on combustion. The oxidation products of the nicotine may either be left in the treated tobacco, or, if desired, may be removed by washing and pressing.—J. F. B.

New Books.

MICROBES ET DISTILLERIE. Par LUCIEN LÉVY, D. ès Sc., &c., Professeur à l'École nat. des Ind. agric. de Douai et à l'Institut d. ferment. de Bruxelles. Georges Carré et C. Naud, 3, rue Racine, 3, Paris. 1900. Price Fr. 10.

8vo volume, containing introduction, 316 pages of subject-matter, and the table of contents. The text, illustrated with 25 engravings, is divided into two parts. 1st. A Systematic Study of Microbes from the two points of view of morphology and physiology. 2nd. The Theory of their Application. In this section, the applications considered are those of the Spirit Distillery, &c., Culture of Yeasts, and in the Brewery, &c.

DIE ARZNEIMITTEL - SYNTHESE AUF GRUNDLAGE DER BEZIEHUNGEN ZWISCHEN CHEMISCHEM AUFBAU UND WIRKUNG. Für Aertze und Chemiker. Von Dr. SIGMUND FRÄNKEL, Dozent für med. Chemie an der Wiener Universität. Julius Springer's Verlag, Monbijouplatz 3, Berlin, N. 1900. Price M. 12.

THIS work is devoted to the chemistry of those materials used in the latest developments of pharmacology. It is an 8vo volume, containing introduction, subject-matter filling 520 pages, and the alphabetical index. The following are the main heads of the work, which is divided into two special parts, *viz.*, THE GENERAL and THE SPECIAL. GENERAL PART: I. Theory of the Actions of Inorganic Bodies. II. Of Organic Bodies. III. Significance as to Modes of Action of the Atomic Groups. IV. Changes which the Substances undergo in the Organism. SPECIAL: I. General methods for building up bodies of equal physiological action from substances of known effects, in which, however, certain objectionable counter-reactions shall be absent. II. Antipyretics. III. Alkaloids. IV. Narcotics and Anæsthetics. V. Antiseptics and Astringents. VI. The Ichthyol Group. VII. Substances which act on the Intestinal Membranes and Lining. VIII. Camphors and Terpenes. IX. Reducing Agents for the Epidermis. X. Glycerophosphates. XI. Diuretics. XII. Gout Specifics.

HANDBOOK OF INDUSTRIAL ORGANIC CHEMISTRY. Adapted for the Use of Manufacturers, Chemists, and all interested in the Utilisation of Organic Materials in the Industrial Arts. By SAMUEL P. SADDLER, Ph.D., F.C.S., Professor of Chemistry in the Philadelphia College of Pharmacy, and in the Franklin Institute of the State of Pennsylvania, &c. Third Revised and Enlarged Edition. J. B. Lippincott Company, Philadelphia, U.S.A. 1900. Price 25s. 36, Southampton Street, Covent Garden, London.

LARGE 8vo volume, containing prefaces, table of contents, 503 pages of subject-matter, and an appendix of 25 pages. The work concludes with an alphabetical index of subject-matter. It is illustrated with 126 engravings and 16 diagrams. The following subjects of Technology are treated of:—I. Petroleum and Mineral Oil Industry. II. Industry of the Fats and Fatty Oils. III. Essential Oils and Resins. IV. Cane Sugar Industry. V. Starch and its Alteration Products. VI. Fermentation Industries. A. Nature and Varieties of Fermentation. B. Malt Liquors and the Industries connected therewith. C. Manufacture of Wine. D. Manufacture of Distilled Liquors or Ardent Spirits. E. Breadmaking. F. Manufacture of Vinegar. VII. Milk Industries. VIII. Vegetable Textile Fibres. IX. Textile Fibres of Animal Origin. X. Animal Tissues and their Products. A. Leather Industry. B. Glue and Gelatin Manufacture. XI. Industries based upon Destructive Distillation. XII. Artificial Colouring Matters. XIII. Natural Dye-Colours. XIV. Bleaching, Dyeing, and Textile Printing. In each of the foregoing groups respectively, a general method of treatment is adopted, the following subdivisions representing the course laid down. 1. Raw Materials. II. Processes of Treatment. III. Products. IV. Analytical Tests and Methods. V. Bibliography and Statistics.

THE NEWER REMEDIES. Including their Synonyms, Sources, Methods of Preparation, Tests, Solubilities, Incompatibles, Medicinal Properties, and Doses as far as known, together with Sections on Organo-Therapeutic Agents, and Indifferent Compounds of Iron. A Reference Manual for Physicians, Pharmacists, and Students. By VIRGIL COBLENTZ, M.A., Ph.D., &c., Professor of Chemistry and Physics in the New York College of Pharmacy, &c. Third Edition. Revised and very much enlarged. P. Blakiston's, Son and Co., 1012, Walnut Street, Philadelphia, U.S.A. 1899. Price \$1.00.

8vo volume containing preface to third edition, and 141 pages of subject-matter, followed by appendix covering six pages. As the substances are arranged alphabetically in the text, there is no need of an alphabetical index. The author says in his preface: "In addition to giving as complete a list as possible of all modern medicinal synthetics, the author has endeavoured to include all such proprietary combinations as are made up of mixtures containing one or more of these synthetics; also such other preparations as employ specially coined titles, many of which are deceptively similar to those of well-known chemical compounds."

Trade Report.

LEGISLATION; TARIFF CHANGES AND CUSTOMS REGULATIONS.

FRANCE.

Allowance to Sugars of French Colonies during the season, 1900-1901, "for waste in manufacture."—Under the provisions of Article 2, Section 1, of the Law of the 13th July, 1886, sugars of French Colonies shipped to France, are entitled to an allowance for waste in manufacture equivalent to the average excess-yield obtained by the home sugar industry in the preceding season. This average excess-yield having been equal to 28.72 per cent. in the season 1899-1900, French colonial sugars imported into France during the season from the 1st September, 1900, to the 31st August, 1901, will receive an allowance for waste of 28.72 per cent.



Residuum from the manufacture of Maize-Starch.—This article (also known as gluten meal, gluten-cake, maize-cake, &c., and imported in powder, lumps, or loaves), when it contains less than 40 per cent. of starch, is to be free of duty under No. 166 of the Tariff as "cake of oilseed and malt." When containing more than 40 per cent. of starch, it is to be dutiable as maize in the grain, under No. 72 of the Tariff, at the rate of 3 francs per 100 kilos., gross weight (1s. 2½d. per cwt., gross weight).

NEW ZEALAND.
Customs Divisions.

Articles, and how Classified.	Unit.	Rate of Duty.
Leather, viz., "mineral kip," chrome dressed; as kip.	Lb.	4d.
Leather, "tan hide"; as buff.....	"	3d.
Manganese borate, and resinates; as articles and materials suited only for, and to be used solely in, the fabrication of goods in the Colony.	"	Free.
Manganese oxide; as chemicals not otherwise enumerated in the tariff.	ad val.	15 %.
Nuoline (nucoa butter); as articles not otherwise enumerated in the tariff.	"	Free.
Oil of myrban; as articles and materials suited only for, and to be used solely in, the fabrication of goods in the Colony.	"	"
Terpineol (artificial oil of violets); as articles and materials suited only for, and to be used solely in, the fabrication of goods in the Colony.	"	"
Vermin-killer, Battle's; as insecticide	"	"

NETHERLANDS.

Salt for purifying Gum Copal and Gum Dammar.—A Dutch Decree, dated the 26th October last, exempts salt required for purifying gum copal and gum dammar from Excise duty.

Spirit in Perfumed Waters.—A Dutch Decree, dated the 9th Nov., provides that, in the case of perfumed waters and toilet waters exported by manufacturers in quantities containing at least 50 litres of spirit at 50 per cent., drawback of the Excise duty paid shall be allowed for the quantity of spirit contained in the exported liquids.

Customs treatment of Casein.—It has been decided by the Dutch Customs authorities that casein, if it does not contain any sweetening substances, fats, or salt, is to be admitted into the Netherlands free of duty.

On the other hand, a liquid composed of casein, lime-water, oil, and a little phenol, and used in the manufacture

of colours, is to be dutiable at the rate of 5 per cent. *ad val.*, as a colouring matter prepared with oil.

GREECE.

Treatment of Copper Sulphate.

The following words are to be added to class 103 paragraph *a*, under which the articles specified will be exempt from import duty—"and sulphate of copper (blue vitriol) as well as chemical preparations of sulphate of copper mixed with other materials employed against peronosporus."

Sulphate of copper (blue vitriol) was formerly dutiable under class 103, paragraph *b*, of the Tariff at the rate of 5 drachmæ per 100 okes.

SERVIA.

Import Duty on Olein.

Under a Decree of the Servian Ministry of Finance dated the 17th March last, olein is to be subject to duty under No. 266 of the Servian Tariff at the rate of two dinars per 100 kilos. (9½d. per cwt.), instead of being free of duty as heretofore under No. 273.

NEW VENEZUELAN CUSTOMS TARIFF.

See *Bd. of Trade J.*, Jan. 10, p. 84.

UNITED STATES.

Customs Decisions.

"Iraldeine."— "Iraldeine," a preparation containing alcohol, is dutiable under paragraph 2 of the Tariff, as an alcoholic compound, at the rate of 60 cents per lb. and 45 per cent. *ad valorem*. It is immaterial that the alcohol contained in the compound is of small commercial value as compared with the value of the article as imported.

Dyestuffs from Coal Tar.—So-called "Alizarin Black," "Alizarin Black G A," "Alizarin Black F," and other dyestuffs, produced by various methods from coal-tar products and from substances other than alizarin or anthracene, are dutiable at the rate of 30 per cent. *ad valorem*.

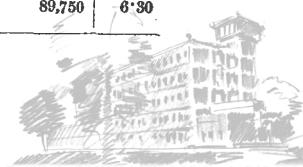
Phthalic and Tetra-chlor-phthalic Acid, and Anhydride.—1. So called phthalic acid or anhydride, a product of coal tar used in making the phthalein series of dyestuffs, is exempt from duty under the provision for phthalic acid in paragraph 464 of the present Tariff Act.

2. Tetra-chlor-phthalic acid or anhydride is dutiable at the rate of 25 per cent. *ad valorem* under the provision for "all other acids not specially provided for," &c., in paragraph 1 of the Tariff, being a distinct and different article from phthalic acid.

UNITED STATES MINERAL AND METAL PRODUCTION.

Eng. and Mining J., Jan. 5, 1901.

No.	Products.	Customary Measures.	1899.				1900.			
			Quantity.		Value at Place of Production.		Quantity.		Value at Place of Production.	
			Customary Measures.	M. Tons or Kilos.	Totals.	Per M. Ton or Kilo.	Customary Measures.	M. Tons or Kilos.	Totals.	Per M. Ton or Kilo.
NON-METALLIC.										
1	Asbestos	Sh. T.	912	827	13,860	16776	1,100	998	15,400	1543
2	Barytes	"	32,636	29,607	137,071	463	41,910	33,021	171,831	452
3	Bauxite	L. T.	36,813	37,402	101,235	271	23,145	23,515	71,749	305
4	Bromine	"	433,003	196	125,571	64067	512,743	232	143,568	61883
5	Carborundum	"	1,741,245	790	156,712	19837	2,660,000	1,207	239,400	19834
6	Cement, nat. hydraul.	Bls.	10,150,947	1,381,332	5,175,950	375	8,832,240	1,201,883	4,256,233	374
7	Cement, Portland	"	5,805,620	1,053,365	10,441,431	991	8,503,308	1,542,376	11,947,614	775
8	Cement, slag	"	244,757	44,408	360,800	810	493,150	89,473	715,067	799
9	Coal, anthracite	Sh. T.	60,622,398	54,996,279	103,753,780	189	54,255,540	49,220,303	97,229,032	197
10	Coal, bituminous	"	191,456,350	173,688,061	172,301,679	099	220,592,239	200,119,966	224,502,483	112
11	Coal, cannel	"	36,639	33,239	91,537	276	25,000	22,680	60,750	268
12	Coke	"	18,025,256	16,352,405	42,081,002	257	18,928,372	17,171,706	48,456,334	282
13	Cobalt oxide	Lbs.	10,200	4,627	15,810	342	11,200	5,080	20,160	396
14	Copper sulphate	"	67,903,370	30,801	3,530,975	11464	76,959,486	34,909	3,770,278	10800
15	Copperas	Sh. T.	13,770	12,492	103,508	869	13,735	12,506	110,280	882
16	Crushed steel	"	337	316	47,250	15441	345	313	48,300	30331
17	Fluorspar	"	24,030	21,800	152,355	700	23,456	21,279	114,700	535
18	Fuller's earth	"	13,620	12,356	81,900	663	15,700	14,243	89,750	630



UNITED STATES MINERAL AND METAL PRODUCTION—cont.

No.	Products.	Customary Measures.	1899.				1900.			
			Quantity.		Value at Place of Production.		Quantity.		Value at Place of Production.	
			Customary Measures.	M. Tons or Kilos.	Totals.	Per M. Ton or Kilo.	Customary Measures.	M. Tons or Kilos.	Totals.	Per M. Ton or Kilo.
NON-METALLIC—cont.										
19	Garnet	Sh. T.	2,565	2,327	Dols. 27,672	Dols. 31'23	2,913	2,643	Dols. 83,890	Dols. 31'74
20	Grahamite	"	3,150	2,858	97,650	84'17	3,300	2,991	105,060	35'11
21	Graphite, amorphous	"	1,030	934	8,240	8'82	340	308	3,000	9'74
22	Graphite, crystalline	Lbs.	3,632,608	1,647,740	145,304	0'09	3,518,731	1,596,086	143,640	0'09
23	Graphite, artificial	"	405,870	18,410	32,475	0'18	845,000	38,329	67,600	0'18
24	Iron ore	L. T.	25,341,000	25,744,456	58,284,300	2'26	26,417,315	26,839,992	79,251,945	2'95
25	Lead, white	Sh. T.	103,486	93,864	10,812,197	115'20	90,853	82,421	9,962,858	120'15
26	Lead, red	"	10,199	9,252	1,070,895	115'67	9,918	8,968	1,096,033	121'83
27	Lead, orange mineral	"	928	843	139,200	165'32	829	752	99,112	130'47
28	Lepidolite	"	124	112	4,600	41'07	100	91	3,709	40'66
29	Limestone flux	L. T.	6,707,435	6,814,754	3,475,525	0'51	6,964,255	7,073,683	3,691,053	0'53
30	Litharge	Sh. T.	10,020	9,090	1,032,060	113'53	10,209	9,261	1,121,663	121'11
31	Magnesite	"	2,000	1,814	7,600	4'19	2,768	2,511	10,518	4'19
32	Monazite	Lbs.	330,000	150	18,480	123'20	350,000	159	19,600	123'27
33	Petroleum, crude	Bls.	57,234,304	8,007,368	64,143,890	8'01	63,100,595	8,828,090	75,365,686	8'54
34	Phosphate rock	L. T.	1,823,391	1,852,565	7,031,785	3'80	1,599,990	1,625,590	5,569,131	3'43
35	Pyrites	"	178,498	181,263	583,323	3'22	208,409	211,743	694,318	3'28
36	Salt	Bls.	19,861,948	2,522,610	5,437,941	2'16	20,905,099	2,655,097	6,471,098	2'44
37	Slate, roofing	Squares	1,098,374	332,146	3,055,988	2'78	987,412	298,198	2,775,698	2'81
38	Slate Manufactures .....	"	..	..	540,434	..	..	..	516,755	..
39	Soda, manufactured	M. T.	..	387,020	5,925,276	15'31	..	395,902	6,655,113	16'81
40	Sulphur	L. T.	1,565	1,590	33,585	21'12	4,630	4,704	101,212	21'51
41	Zinc-white	Sh. T.	39,663	35,982	3,331,692	92'04	44,568	40,432	3,788,180	33'69
42	Zinc Ore, exported	"	28,220	25,601	725,944	28'36	37,920	34,401	1,140,612	33'16
	Other products, unspecified ..	"	..	..	141,063,263	..	..	..	165,040,973	..
	Total non-metallic .....	..	..	..	645,754,305	..	..	..	755,680,991	..
METALLIC.										
43	Aluminium	Lbs.	6,500,000	2,948,881	2,112,500	0'72	7,150,000	3,243,219	2,388,000	0'71
44	Antimony	"	2,500,000	1,137	241,250	212'18	3,100,000	1,406	286,750	203'92
45	Copper	"	581,319,091	263,685	100,916,994	382'72	685,576,802	279,223	100,154,345	358'69
46	Gold	Ozs.	3,391,196	105,471	70,096,021	664'60	3,805,455	118,362	78,658,755	664'60
47	Iron, pig	L. T.	13,400,735	13,616,360	234,725,754	17'24	13,914,596	14,137,230	238,078,737	16'84
48	Iridium	Ozs.	5'6	..	165	..	..	..	240	..
49	Lead	Sh. T.	217,085	196,938	19,407,399	98'55	251,781	228,414	22,005,659	96'34
50	Nickel	Lbs.	22,500	10,205'9	8,156	0'80	20,000	9,072	7,800	0'86
51	Platinum	Ozs.	Nil.	Nil.	Nil.	Nil.	173	5'4	3,113	576'48
52	Quicksilver	Flasks	28,879	993	1,155,160	1168'30	32,315	1,121	1,474,533	1,315'37
53	Silver	Ozs.	57,126,834	1,776,829	34,036,168	19'16	60,478,276	2,881,068	37,085,248	19'71
54	Zinc	Sh. T.	129,675	117,644	14,912,625	126'76	122,850	111,449	10,786,230	96'78
	Other metals unspecified .....	"	..	..	18,415,128	..	..	..	18,971,532	..
	Total metals .....	..	..	..	496,057,320	..	..	..	509,800,992	..
	Total non-metals and metals ..	..	..	..	1,141,811,625	..	..	..	1,265,481,983	..
	Deduct duplications .....	..	..	..	92,581,031	..	..	..	108,319,801	..
	Grand total .....	..	..	..	1,049,230,594	..	..	..	1,157,162,182	..

III.—TAR PRODUCTS, PETROLEUM, Etc.

NEW OIL DISTRICT IN MEXICO.

Bd. of Trade J., Dec. 27, 1900, 705.

According to the *Iron Age* (New York), of 6th inst., arrangements have just been concluded at Tampico, Mexico, for the purchase, by a Californian syndicate, of 400,000 acres of prospective oil lands, situated 25 miles west of Tampico, at a cost of over 200,000*l.* The land is said to contain also large deposits of liquid asphaltum.

OIL SHALES OF THE LOTHIAN, SCOTLAND.

Eng. and Mining J., Dec. 29, 1900, 754.

At a recent meeting of the Edinburgh Geological Society, Mr. Henry M. Cadell gave an address, in which he said that, although the mineral oil industry had existed in Scotland for 30 years, the Geological Survey had never published any general account of the rocks of the lower carboniferous system. The correct reading of the geological sections and the construction of the oil shale districts was for several reasons a matter of no small difficulty, and no geologist had up till now been successful in working out the structure by merely examining the surface outcrops and natural sections. It was necessary to compare natural sections with mining information derived from pits and borings all over the district, and even then there still remained many uncer-

tainties and gaps to fill up, and much was still left in this direction for future geological investigators to accomplish. In the shale districts, several well-marked horizons or landmarks existed for the guidance of mining men and geologists. The lowest of these was the Burdiehouse, Camps, or Queensferry limestone, which was, in the West Calder district, 2,400 ft. below the Hurlet or carboniferous limestone, and above which were to be found all the oil shales hitherto worked, with the exception of the shales of Pumpherston, which were situated 600 ft. below that landmark. Above this limestone were the barracks shale, an inferior seam, then the Dunnet, 500 ft. higher up, under the Binny sandstone, then the Broxburn shale above the sandstone, and the Fells shale above the marls that covered the Broxburn seams. The Houston coal, with its distinctive green and red overlying marls, formed another very conspicuous landmark all over the district, and above the marl only one seam of value—the Raeburn shale—was to be found. Oil shale was now worked for ammonia as well as oil, and the production of sulphate of ammonia, which had a high agricultural value, formed an important branch of the industry. The lowest seams of shale at Pumpherston were richest in ammonia; and Mr. Cadell thought it likely that the shales richest in ammonia would prove to be those in which the proportion of animal to plant remains was greatest, while the shales richest in hydrocarbons, such as those of Broxburn, probably contained an excess of vegetable matter.



V.—TEXTILES.

ARTIFICIAL SILK FACTORY IN BELGIUM.

Bd. of Trade J., Dec. 27, 1900, 712.

According to the *Handels Museum*, of the 13th inst., a factory for the production of artificial silk has been established by a French firm in Soignies, in Belgium. This factory, which is the first of its kind in Belgium, commenced work on the 1st October last. About 40 operatives are employed.

VII.—ACIDS, ALKALIS, AND SALTS.

CHEMICALS IMPORTS OF UNITED STATES IN 1900.

Eng. and Mining J., Jan. 5, 1901, 34.

Substance.	Imports.	Re-exports.	Entered for Consumption.	
			1900.	1899.
Bleaching pow-der.	143,000,000	148,250	142,851,750	123,588,061
Potash:—				
Chlorate... Lb.	1,275,000	342,500	932,500	1,478,948
Muriate "	96,000,000	279,000	95,721,000	117,219,080
Nitrate "	12,000,000	26,500	12,063,500	18,849,853
Other..... "	49,750,000	14,500	49,735,500	46,441,086
Soda:—				
Ash..... "	67,000,000	43,250	66,956,750	48,641,284
Caustic..... "	7,800,000	1,025,000	6,775,000	12,330,708
Sal..... "	4,600,000	1,200	4,598,800	6,238,772
Nitrate..... "	192,591	3,930	188,661	144,032
Other..... "	18,000,000	260,000	17,740,000	26,409,718
Salt..... "	416,000,000	3,550,000	412,450,000	381,162,816
Brim-Long Tons stone.	153,000	415	152,585	142,757
Pyrites .. "	335,000	..	335,000	310,615
Grayhite .. "	12,500	4	12,496	20,760

THE CHLORATE OF POTASH EXPLOSION AT ST. HELENS.

This Journal, Dec. 1900, p. 1159.

ERRATUM.

The report of the proceedings before Mr. Justice Bucknill contains the following errors:—

1st. Line 36 from bottom:—"The defendants denied that they manufactured and stored chlorate of potash," &c. This denial was never made, since chlorate of potash has actually been manufactured and stored ever since the Company existed, and for 40 years previously by its predecessors.

2nd. Line 28 from bottom:—"Mr. Brock is spoken of as "the Manager of the defendants' works," whereas Mr. Brock is, of course, the Chairman of the United Alkali Co., Ltd.

SULPHATE OF AMMONIA STATISTICS.

Bradbury and Hirsch, Liverpool.

Production in the United Kingdom during 1900 from all sources:—

Gasworks.....	Tons.	133,000
Iron.....	18,000	
Shale.....	39,000	
Coke and carbonising works.....	15,000	
	210,000	

Of this production—

England contributed	Tons.	134,000
Scotland ..	73,000	
Ireland ..	3,000	

The production during the previous five years was:—

—	1899.	1898.	1897.	1896.	1895.
Gasworks.....	Tons. 136,500	Tons. 130,000	Tons. 133,000	Tons. 127,500	Tons. 119,600
Iron.....	18,000	17,700	18,000	16,500	14,600
Shale.....	38,500	37,300	37,000	38,000	38,300
Coke and carbonising works.....	15,000	11,500	10,000	9,000	7,000
Total.....	208,000	196,500	198,000	191,000	179,500

IX.—CEMENTS, Etc.

BRICKS FROM GLASS-WORKS REFUSE.

U.S. Cons. Reps., Dec. 1900, 456.

Dr. Ormandy, of St. Helen's, has recently discovered a process by which good furnace bricks can be made from glass-works refuse. The refuse consists mainly of spent sand, minute particles of glass, and about 3 per cent. of iron from the various processes, and it has hitherto been considered that the presence of the iron prevented the use of the material for the manufacture of bricks.

Patents have been taken out to protect the process, and a large firm is now putting up an extensive plant for the manufacture of the bricks. It is claimed that the bricks will stand a great amount of heat. They are about the colour of silica bricks and can be glazed. Considerable secrecy is observed as to the process.

CONCRETE IN MINES.

Eng. and Mining J., Dec. 29, 1900, 754.

At the collieries of the John Cockerill Company at Seraing, in Belgium, concrete has been extensively used instead of brickwork for lining circular shafts, lining drifts, air-passages, &c. The concrete used has been made entirely from blast furnace slags, those from forge-iron broken to 30 or 50 mm. being used as ballast, while the mortar is made of granulated slags, hydraulic lime in the proportion of 5 to 1 by volume and slag cement. These are incorporated in a mortar-mill, but no addition of water is necessary, as the granulated slag contains enough. Slag cement is made of about 75 per cent. of granulated gray iron slags and 25 per cent. of slacked lime. When the slags are tolerably uniform in character, chemical analysis of the materials is not necessary except when the furnace charges contain magnesia, which should not be present to a greater extent than 3 per cent. The materials required for a cubic metre of concrete are 0.750 cubic metre granulated slag and 0.150 cubic metre hydraulic lime.

FULLER'S EARTH PRODUCTION.

Chem. and Druggist, Jan. 12, 1901, 68.

The production of fuller's earth in the United States has increased greatly in the last five years, though recently it has shown a decline, owing to large importations of the English material, which is preferred for filtering cotton-seed and lard oils. The chief source of the material in the United States is Quincy, Florida, though deposits have been found in New York, Colorado, and Utah, as well as one of a promising nature in South Dakota, which furnishes almost an exact duplicate of the English earth. The American product is largely used as a substitute for bone-black in the filtering of mineral oils. As the cotton-seed oil business is growing rapidly, there promises to be a large demand for the English earth, and, naturally, for such of the native material as comes up to the standard.

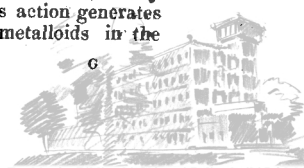
X.—METALLURGY.

TROPENAS PROCESS FOR STEEL CASTINGS.

Eng. and Mining J., Dec. 29, 1900, 761.

Since March, 1900, the Sargent Company, at Chicago Heights, has been manufacturing small steel castings by what is known as the Tropenas process. This method was adopted after several years of experience with open hearth and crucible steel plants, and after a careful study of the subject of steel making at home and abroad, where the process is in successful operation in some 40 different plants.

The Tropenas process consists in the use of special converters, in which pig iron and selected scrap, previously melted in a cupola, are subjected to an air blast of 3 to 4 lb. pressure per square inch, directed horizontally across the top of the molten bath. This action generates intense heat by the combustion of the metalloids in the



pig iron, and after a period varying from 16 to 20 minutes, depending on the quality of the charge used, there remains in the converter a bath of nearly pure iron. Addition is made of ferro-manganese, of ferro-silicon, or both, to bring up the silicon, manganese and carbon contents to the specified proportions, when the metal is drawn off into a ladle and poured. The process is very simple and the product very uniform.

The peculiar advantage of the Tropenas process lies in the fact that the resultant metal is better, and consequently more fluid than that produced by any other method, and it is this fact which makes it valuable in the manufacture of small and intricate castings, as it can be poured over the lip of the ladle in as small a stream as desired, and will run through thin sections, producing solid castings free from pin holes and cracks. Any grade of metal is readily produced by varying the additions. It is consequently valuable not only in the production of low carbon steel of the maximum permeability, so much desired in electrical castings, but also in the production of special grades of hard steel for mining machinery parts and other purposes.

HUELVA INDUSTRIES.

Bd. of Trade J., Dec. 27, 1900, 685.

In a report published in the *Moniteur Officiel du Commerce*, of 22nd November last, by M. Prévost, the French Commercial Adviser at Huelva, upon the trade of that district, he calls attention to the recent creation of various companies formed for working copper and manganese mines, which offer little prospect of being of permanent value. Attention is also called in the report to the opportunities for the sale of mining material of all descriptions, and especially of overhead cables for transport purposes, in this district.

Exports.—The quantities of merchandise exported from Huelva during 1899 were as follow:—

	Tons.
Copper pyrites, averaging from 1½ to 3 per cent. of copper.....	950,000
Iron pyrites, averaging from 45 to 50 per cent. of sulphur.....	350,000
Carbonate of manganese, averaging from 30 to 35 per cent. of manganese.....	136,000
Copper matte, containing an average of 30 per cent. of copper.....	16,000
Copper precipitate, containing an average of 70 per cent. of copper.....	30,000
Iron ore.....	25,000
Sulphate of copper.....	5,000
Lead ore, zinc ore, &c.....	5,000
Fruit, cereals, cork, &c.....	4,000
Wine.....	50,000
	1,551,000

Mining.—Besides the pyrites mines, several deposits of carbonate of manganese of low grade containing 30 per cent. to 35 per cent. of mineral, are worked for the most part by native concessionaires; these mines are usually in the form of small pockets or lodes, and will doubtless be exhausted in a comparatively short time.

PLATINUM IN 1900.

Eng. and Mining J., Jan. 5, 1900, 21.

The world's supply of platinum has for several years past ranged between 160,000 and 170,000 troy ounces. In 1900 the total, so far as ascertained, was about 165,000 oz., which is somewhat below the demand, so that the metal has commanded high prices throughout the year, its cost gradually approaching that of an equal weight of gold. The uses of the metal are limited by the high prices and could be much extended if the supply could be increased.

Over 90 per cent. of the total comes from the Russian placers, the output of which in 1900 was approximately 153,000 oz. The conditions of production in Russia have not changed materially, though the business is gradually passing into the hands of the combination of Russian mine owners and of Belgian and French refiners, which was formed in 1898. The details of this combination have been

kept from the public, and it is hard to obtain definite knowledge about its operations or the exact production.

The only considerable production outside of Russia is in Columbia, in South America. The output of that country is about 11,500 oz. An increase was promised in 1900, but the revolution there and the prolonged contest between the Government and the insurgents prevented any extension in mining.

The production in the United States is insignificant; it amounts to about 200 oz. yearly, which is obtained at the San Francisco Mint in parting and refining gold from certain localities in Trinity, Shasta, and Plumas counties. Imports into the United States increased in 1900, the total for the 10 months ending with October being 6,305 lb., indicating a total for the year of about 7,000 lb., or 800 lb. more than in 1899. A considerable part of the imports is in crude form, the metal being refined here.

A small quantity of platinum is obtained from British Columbia, being parted from gold, as in California. Some platinum is known to exist in nickel matte from the Sudbury District in Ontario, but we are not advised of any production from that source.

New discoveries were reported in 1899, but have not yet resulted in the marketing of any quantity of the metal. The most promising of these is on the Hootalinqua River in the Yukon Territory in Canada. No work has been done on the discovery, which was reported in Algeria two years ago.

The price of platinum in New York at the close of the year is 18.20 dols. to 18.50 dols. per troy ounce. In London, the quotation is 75s. an ounce, or about on a parity with New York. Manufactured into chemical ware or wire, the price in New York is 72 c. per gm.

MERCURY IN TEXAS.

Chem. and Druggist, Jan. 19, 1901, 105.

The cinnabar or quicksilver deposits in Brewster County, Tex., are being developed on an extensive scale. Although it has been only about a year since any recognition was taken of these deposits, over 1,000 flasks of quicksilver were produced up to January 1, 1900. The production for the present year will reach several thousand flasks. This new quicksilver district is located near the Rio Grande border, and is over fifty miles distant from the nearest railroad-point. Fuel and water are scarce, otherwise the development of the field would be much more rapid than at present.

MERCURY STATISTICS.

Alex. S. Pickering, London.

—	Imports.	Exports.	Price.	
			Highest.	Lowest.
	Bottles.	Bottles.	£ s. d.	£ s. d.
1900	32,725	25,869	9 12 6	9 2 6
1899	51,696	32,239	9 12 6	7 15 0
1898	54,563	34,014	7 15 0	6 16 0
1897	54,734	30,768	7 7 6	6 9 6
1896	47,159	35,211	7 6 0	6 5 6
1895	49,654	36,327	7 8 6	6 7 6
1894	51,251	43,598	6 14 0	5 7 0
1893	52,525	38,022	6 17 0	6 2 0
1892	56,990	50,211	7 13 0	6 1 0
1891	62,771	56,643	9 0 0	7 5 0

Estimated consumption, United Kingdom, 13,000 bottles per annum.

XII.—OILS, Etc.

SEAL OIL IN GREENLAND.

Bd. of Trade J., Jan. 3, 1901.

The trade in seal blubber is carried on directly with the Greenlanders at the various trading stations and the outlying stations in connection therewith, where it is boiled down into oil, in which form it is exported to Denmark. There the oil is still further refined, and is put upon the market



as light brown and brown seal oil. A third kind of oil is the so-called "three crown oil," i.e., seal oil which has undergone a further boiling and refining process. The seal oil of the Greenland trade is stated to be very well known, and to be everywhere recognised as an excellent product. One thing that always brings it (the so-called "Company Oil") to the front is that it is always produced as an unadulterated article. During the last few years, with a view to safeguard purchasers abroad against imitations, a law has been in force that, if desired, every cask of seal oil must, on delivery, have the bung-hole closed with the seal of the Greenland Company. By this precautionary measure the purchaser has a guarantee that the oil in the cask is real "Company Oil." About 10,000 casks of seal oil are produced annually, of which about one-fifth is light brown oil. Seal oil was formerly sold by auction, but is now sold privately at prices which are fixed by the administration of the Greenland Company in Copenhagen. The Greenland trade always has been, and is monopolised by the State, and only Government vessels are allowed to sail in Greenland waters. This is to protect the Greenlander from being deceived by unscrupulous merchants, and from selling more than they can dispense with.

XIII. A.—PIGMENTS, PAINTS, Etc.

OCHRE IN GERMANY.

Eng. and Mining J., Dec. 15, 1900, 696.

United States Consul-General Mason writes from Berlin, Nov. 9, 1900, that he has received a sample of crude ochre from Texas, which he requested in a previous report. Mr. Mason adds: "This sample I caused to be divided and distributed among several of the leading consumers of yellow ochre in Germany, who, after examination, report unanimously that the tint and quality of the ochre are alike excellent, but that it should be prepared for market by being first washed free from sand and other impurities, then dried, pulverized and put up in wooden casks. In this condition it would meet with a ready and extensive sale in Germany, where its wholesale value would range from 19.44 dols. to 21.87 dols. per metric ton, including casks, c. i. f. Hamburg. As above indicated, it will be necessary, in order to introduce the new product into this country, that the exporters shall provide for its transportation to a German port—preferably Hamburg or Bremen—and give a definite price free on board at one or other of those ports. It is impossible for importers in this country to ascertain freights or provide charters from a port on the Gulf of Mexico to Germany. That belongs to the exporter, whose product will in the present case have to compete with French ochre, which has for many years controlled the market in Germany."

XIII. C.—INDIA-RUBBER, Etc.

CAOUTCHOUC IN THE CONGO.

Bd. of Trade J., Jan. 3, 1901.

Caoutchouc is the largest item in the export records both of the French Congo and the Congo Free State, and the following figures show the quantity and value of the export of this article during the four years 1896—1899:—

Exports of Caoutchouc.

Years.	From French Congo.		From Congo Free State.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£
1896	548	105,000	1,317	263,000
1897	518	99,000	1,632	332,000
1898	578	111,000	2,113	634,000
1899	670	120,900	3,716	1,124,000

CAOUTCHOUC TRADE IN HAMBURG.

Bd. of Trade J., Dec. 27, 1900, 713.

According to the *Dépeche Coloniale* of 13th inst., caoutchouc has a tendency to occupy an increasingly im-

portant position on the Hamburg market. The following table shows the quantity and value of caoutchouc imported during the last four years:—

Year.	Quantity.	Value.
	Tons.	£
1896	7,191	1,253,000
1897	7,576	1,422,000
1898	9,026	2,012,000
1899	11,493	2,333,000

Nearly the whole of the quantity imported is used in Germany; in 1899 only 6,625 tons were re-exported. The imports of caoutchouc come either direct from the countries of origin (East and West Africa, Madagascar, Brazil, &c.) or from European entrepôts, principally English ports.

CAOUTCHOUC SUBSTITUTE.

The *India Rubber Trades Journal* says that preparations are being made for the erection of a plant in Monterey, Mexico, for the manufacture of rubber substitute from a native shrub called guayula. It is claimed that the substance can be vulcanised, and is in every way equal to the product of the rubber tree. The shrub grows in unlimited quantity in many of the Central American states, and has been hitherto considered useless.

XV.—MANURES, Etc.

PHOSPHATE DISCOVERIES IN EGYPT.

Bd. of Trade J., Dec. 27, 1900, 704.

According to a report from the German Consulate in Cairo, published in the *Nachrichten für Handel und Industrie*, discoveries of phosphate deposits have recently been made in Egypt by geologists commissioned by the Government to make exhaustive investigations in consequence of traces of such deposits having been observed.

It appears that, apart from deposits of minor importance, two phosphate deposits of considerable extent and depth have been found, which could be worked without great difficulty, one being situated in the desert, east of Kenah, near the great caravan route leading thence to Kosseir, on the Red Sea, and the other in the Dakleh oasis in the Libyan desert. From both places transport to the Nile Valley, possibly by means of light railways, could be easily effected, especially in the case of Dakleh, which is only 275 kilom. (170 miles) distant, and whence the export of dates on camels is accomplished in seven or eight days' march.

Chemical experts speak somewhat favourably of the phosphate found. So far as samples have yet been analysed, phosphoric acid has been found in quantities corresponding to from 40 to 60 per cent. of phosphate of lime. The German Consul is of opinion that these discoveries may have an important effect on Egyptian agriculture, as on account of their high price, foreign artificial manures have so far been relatively little used in that country, where there was reason to fear that the phosphoric constituents of the soil were being exhausted, and the Government on this account decided about a year ago to admit artificial manures duty free.

PHOSPHATE ROCK PRODUCTION OF UNITED STATES.

Eng. and Mining J., Jan. 5, 1901, 31.

State.	1896.	1897.	1898.	1899.	1900.
Florida	498,400	543,490	546,881	706,677	582,990
Tennessee	49,047	121,251	272,191	462,561	436,000
South Carolina	382,068	333,676	434,273	636,153	562,000
North Carolina	7,418	7,000	2,200	15,000	15,250
All other.....	439	2,000	2,100	3,000	3,750
Total { Long Tons }	937,372	1,007,367	1,257,645	1,823,391	1,599,990



NITRATE OF SODA.

W. Montgomery & Co.'s Half Yearly Report.

Our earliest trade information regarding nitrate of soda is derived from a circular issued by Mr. Alfred Bourne, in January, 1841, in which Mr. Bourne reviews the business of the previous 10 years, and tells us that imports into England in 1831 amounted to 100 tons, the price at that date being 28s. per cwt. That the imports gradually increased during the decade, reaching 7,200 tons in 1840, with a price of 20s. 6d. per cwt. That the increase was chiefly for agricultural purposes, and also that there were symptoms of demand from Scotland and for transhipment to France.

For the 20 years ending with 1860, progress in consumption was very slow, reaching to 50,000 tons; nearly the whole of which was used in the British Isles. During the next decade these figures had little more than doubled, the quantity being about equally distributed between the United Kingdom and the Continent.

From 1870 to 1875, with remunerative prices for cereals in England, the consumption rapidly rose until in the latter year it reached 165,000 tons in the United Kingdom and 132,000 tons on the Continent. For the next 22 years, until 1897, there was an almost unbroken record of greatly reduced deliveries. It was in the year 1879 that the relative positions of the United Kingdom and Continent began to change as regards consumption, and the latter speedily and irretrievably left the former far behind.

Nitrate of soda has, from time to time, suffered serious mishaps. In 1868 a terrible earthquake and tidal wave overtook and destroyed Iquique, causing great havoc to the nitrate industry, and producing in Europe violent changes in price. In 1877 Peru was again visited with a similar calamity, although not so disastrous. This was followed in 1879 by the outbreak of war between Chili and Peru, which lasted over 12 months, and its effect upon the nitrate shipments was very serious. In the end the whole of the rich nitrate districts which belonged to Peru passed into the possession of Chili. For a few years preceding this war Peru had been expropriating the nitrate fields. When Chili took possession, she adopted the policy of permitting the private owners to work their own deposits, the Government merely imposing an export duty of about 2l. 12s. 6d. per ton, and this system has continued down to the present date.

One consequence of the curtailed shipments, caused by the war between Chili and Peru, was to raise the price in Europe from 13s. per cwt. to 19s. 6d. per cwt., and the following season the European farmer used 30 per cent. less than the previous year.

With a recurrence to more moderate prices and a great stimulus in agriculture on the Continent, especially in the cultivation of beetroot, a vast increase in the consumption of nitrate was noticeable in the decade ending with the year 1890.

The figures during that period for the Continent grew from 113,000 tons to 666,000 tons. In the United Kingdom during the same time, owing to agricultural depression, caused chiefly by the disastrously low price of cereals and the consequently reduced acreage under cultivation, especially of wheat, the consumption fluctuated between about 70,000 tons in 1880 to 120,000 in 1890. From 1890 until to-day, the record of consumption throughout the world is one of almost unbroken advance, slow perhaps, but of such uniform steadiness that there is every reason to believe that it is of a staying character. The following figures will show at a glance the total progress made during the periods to which we have referred:—

Year.	World's Consumption.	Price on 31st December.
	Tons.	Per Cwt. s. d.
1831	100	28 0
1840	7,200	20 6
1860	50,000	15 0
1870	103,000	15 9
1880	228,000	14 3
1890	885,000	7 7½
1900	1,324,000	8 6

NITRATE OF SODA.

Shipments, Consumption, Stocks, and Prices for Three Years

	1898.	1899.	1900.
Shipments from South American Ports to all parts for the six months ending 31st December.....	819,000	819,000	889,000
Shipments from South American Ports for the 12 months ending 31st December.....	1,260,000	1,373,000	1,421,000
Afloat for Europe on 31st December..	571,000	505,000	573,000
Stocks in United Kingdom ports:—			
	1898.	1899.	1900.
	Tons.	Tons.	Tons.
Liverpool..	4,500	6,000	10,000
London....	2,400	1,800	4,000
Out ports..	9,100	22,200	21,000
Stocks in Continental ports on 31st December.....	116,000	296,000	186,000
Consumption in United Kingdom for the six months ending 31st December	32,000	31,000	43,600
Consumption in Continent for the six months ending 31st December.....	234,000	270,000	235,000
Consumption in United Kingdom for the 12 months ending 31st December	132,000	123,000	135,000
Consumption in Continent for the 12 months ending 31st December.....	900,000	1,017,000	991,000
Consumption in United States for the 12 months ending 31st December..	142,000	160,000	175,000
Consumption in other Countries for the 12 months ending 31st December	12,000	30,000	21,000
Consumption in the World for the 12 months ending 31st December.....	1,186,000	1,330,000	1,324,000
Visible supply on 31st December (including the quantity afloat for Europe, and Stocks in United Kingdom and Continent).....	703,000	741,000	791,000
Price on 31st December .....per Cwt.	7s. 7½d.	7s. 9d.	8s. 6d.

XVI.—SUGAR.

BEET SUGAR INDUSTRY OF GERMANY.

U.S. Cons. Repts., Dec. 1900, 450.

The official year of the German sugar industry is calculated from the 1st of August to the 31st of July, and the *Reichsanzeiger* has recently published an interesting summary of the production and export of sugar for last year, with a comparison with preceding years, from which the following statement is taken:—

While the consumption of raw beets was somewhat greater last year, it was considerably less than some former years. There were consumed last year 12,466,432 tons of raw beets, while the consumption in the preceding year (1899) was 12,150,644 tons. In the year 1897-98, the consumption of raw beets was 13,697,892 tons; in 1896-97, 13,721,601 tons. While in comparison with the preceding year the increase was 315,790 tons, or 2.6 per cent., on the contrary, the beet consumption in the years 1897-98 and in 1896-97 was more than 1,000,000 tons greater than in the year now ended. The sugar production was as follows:—

Year.	Raw Sugar.	Refined Sugar.	Total in Raw Sugar (including Crystallised).
	Tons.	Tons.	Tons.
1899-1900	1,576,673	1,212,471	1,791,252
1898-99	1,521,716	1,165,322	1,722,429
1897-98	1,664,263	1,207,350	1,844,400
1896-97	1,659,057	1,004,934	1,821,223
1895-96	1,467,437	1,084,395	1,637,037
1894-95	1,692,011	989,862	1,827,974

Accordingly, the raw-sugar production was 54,957 tons and the refined sugar was 26,549 tons greater last year than in the preceding, while the increase in crystallised sugar, which is computed in the last column of raw sugar (nine parts of crystallised sugar being reckoned as 10 parts raw



sugar), was 68,823 tons, or almost 4 per cent. better than last year. The years 1894-95, 1896-97, and 1897-98 produced certainly considerably greater quantities of raw sugar; but the production in refined sugar was in no former year so great as this season. The total production of raw sugar averaged in the five preceding years 1,770,621 tons; consequently, the production last year exceeded the average by 20,631 tons. For the production of 1 kilo. (2·2046 lb.) of raw sugar, 6·96 kilos. (15·3 lb.) of raw beets were, on the average, necessary last year, while in the year 1898-99, 7·05 kilos. (15·5 lb.) of raw beets were necessary. In the year 1897-98, 7·43 kilos. (16·4 lb.), and in the year 1896-97, 7·53 kilos. (16·6 lb.) were required. The results were more favourable than in any of the previous years, not excepting the unusually warm year 1895-96, during which 7·13 kilos. (15·7 lb.) of beets were required for the production of 1 kilo. of sugar. The Strontium process played an important part in the extraction of sugar. By means of this process, 91½ per cent. of sugar was extracted, as compared with 89 per cent. in the year 1898-99.

In spite of the increase in the production of sugar, the export during the last business year has been less than in the preceding year. There was exported the following quantity:—

Year.	Raw Sugar.	Loaf Sugar.	Total.
	Tons.	Tons.	Tons.
1899-1900	485,935	417,408	924,562
1898-99	499,603	436,785	956,214
1897-98	478,941	478,812	982,869
1896-97	760,657	405,114	1,186,962

According to this, the export of raw sugar decreased about 13,700 tons, and that of loaf sugar 19,000 tons, and the total export, accordingly, decreased 31,700 tons. The figures for the year 1899-1900 include the exports during the five last months of 1899 and the first seven months of 1900. The following table shows the export of sugar to the different countries during the last three official years:—

Country.	1899-1900.	1898-99.	1897-98.
	Tons.	Tons.	Tons.
Great Britain.....	521,981	607,595	628,367
United States.....	218,540	188,852	142,434
British North America.....	40,500	51,474	38,474
Free harbour of Hamburg.....	27,541	9,105	43,292
Japan.....	20,392	16,074	31,326
Norway.....	20,233	17,681	17,328
Switzerland.....	12,654	12,127	12,925
Denmark.....	11,845	13,004	7,358
Portugal.....	8,262	7,778	6,765
Uruguay.....	7,412	1,056	369
Netherlands.....	6,200	6,801	9,636
Sweden.....	5,459	8,569	359
Chile.....	4,024	3,932	5,426
British East Indies.....	2,557	1,135	20,239
British Australia.....	1,793	549	2,628

According to this, the export of sugar to Great Britain was 85,614 tons, or 14·1 per cent. less last year than in the preceding. Great Britain received, in the year 1898-99, 63·5 per cent. of the total export of German sugar; in the year 1899-1900, only 56·6 per cent. On the contrary, the export to the United States increased during last year almost 30,000 tons. In the year 1897-98, the United States took 14·5 per cent. of the total German export; in 1898-99, 19·7 per cent.; and in 1899-1900, 23·6 per cent. This is so much the more remarkable as the increase was during the period in which new tariff rules were prescribed, which increased the duty on sugars exported from premium-paying countries. Consequently an additional duty was imposed upon sugar exported from Germany in proportion to the premium paid, and thereby the market for raw sugar, as well as for sugar exported from countries which paid no premium, was favoured. The export to British North America decreased during last year because the tariff by which Canada favours the mother country and its colonies has gone into effect. Also the export to Sweden, Denmark, and the Netherlands has decreased. On the other hand, the export to Japan, British East Indies, and Australia

has increased considerably, in comparison with the great falling off in the year 1898-99. The export to Norway has also increased.

BET-SUGAR INDUSTRY OF FRANCE.

U.S. Cons. Repts., Dec. 1900, 452.

"Beet Sugar in France from 1800 to 1900" is the title of a quarto volume of 220 pages and 15 engravings, recently brought out by M. Jules Helot. It is a complete history of the sugar industry in this country, and a review of the legislation and the inventions that have aided or retarded its progress since the first protective decree under Napoleon I. up to the ninety-eighth law enacted during the presidency of the late Félix Faure.

The beginning of the industry in France was really under Napoleon I., in 1810-12, when he established five great schools for study and instruction in "sugar chemistry," and four large imperial sugar mills, exempt from all taxation.

M. Helot follows the discoveries and inventions by which the yield of the beet has been increased from 2 per cent. in 1810 to 12 per cent. in 1900.

There are now in France 340 sugar factories, the average production of which has increased threefold in 18 years. They consume 540,000 lb. of beets every 24 hours. The average daily consumption of Germany is 860,000 lb. Since 1888 the consumption of coal in the sugar mills of France has fallen from 442 lb. to 286 lb. per ton of beets.

The following table gives the product of raw sugar for the countries named:—

Country.	1869-70.	1879-80.	1889-90.	1899-1900.
	Met. Tons.	Met. Tons.	Met. Tons.	Met. Tons.
Germany.....	217,000	415,000	1,261,000	1,786,000
Austria-Hungary.....	180,000	420,000	799,000	1,200,000
Russia.....	130,000	300,000	526,000	900,000
France.....	283,000	478,000	755,000	805,000
Belgium.....	46,000	75,000	173,000	300,000
Holland.....	13,000	24,000	55,000	180,000
Other countries.....	3,000	8,000	87,000	275,000
Total.....	878,000	1,720,000	3,657,000	5,450,000

Although France has almost trebled her production in the last 30 years, she has fallen from the first place in 1870 to the fourth place in 1900, and to-day there is a difference of 120 per cent. between her and Germany. In France 255,000 hectares (630,105 acres) are devoted to the cultivation of the beet, against 427,000 hectares (1,055,117 acres) in Germany. The product of beets per hectare in Germany is nearly 30,000 kilos., and in France it is 28,000 kilos. Moreover, in France the yield is 12 per cent., while in Germany it is over 13 per cent.

Since 1896, while there has been a very high protective tariff on sugar—in fact, an increasing tariff—the price has been steadily declining.

STARCH INDUSTRY IN GERMANY.

Bd. of Trade J., Dec. 27, 1900, 715.

The German Government have recently collected statistics showing the production in various branches of industry in the Empire, and figures showing the quantity and value of different kinds of starch (exclusive of rice starch) produced in Germany have recently been published in the *Nachrichten für Handel und Industrie*, issued by the German Home Office. Although relating to the business year 1897-98, the figures may be of interest as showing the annual output of this branch of German industry. The

	Quantity.	Value.
	100 Kilos.	Marks.
Potato starch.....	1,344,578	20,666,820
Wheat ".....	121,291	4,591,219
Maize ".....	85,076	2,236,896
Potato sago.....	4,158	110,734
Starch sugar.....	71,733	1,749,362
Starch syrup.....	348,021	8,293,456
"Couleur".....	48,113	1,556,593
Dextrin and starch gum.....	189,588	5,338,069



quantities and value of the principal products of the starch industry are given in the foregoing table.

XVII.—BREWING, WINES, SPIRITS.

ROYAL COMMISSION ON BEER POISONING.

Standard, Jan. 11, 1901.

We are officially informed that a Royal Commission has been appointed to make investigations respecting the beer-poisoning epidemic.

The Commissioners are Lord Kelvin, Sir W. Hart Dyke, Sir W. S. Church, President of the Royal College of Physicians; Professor T. E. Thorpe, Government Analyst; Mr. H. Cosmo Bonsor; and Dr. B. A. Whitelegge, Her Majesty's Chief Inspector of Factories. Dr. G. S. Buchanan, one of the Medical Inspectors of the Local Government Board, is the Secretary to the Commission. The instructions to the Commissioners are—

To ascertain with respect to England and Wales:—

1. The amount of recent exceptional sickness and death attributable to poisoning by arsenic;

2. Whether such exceptional sickness and death have been due to arsenic in beer, or in other articles of food or drink, and, if so,

(a) To what extent;

(b) By what ingredients, or in what manner, the arsenic was conveyed; and

(c) In what way any such ingredients became arsenicated; and,

3. If it is found that exceptional sickness and death have been due to arsenic in beer, or in other articles of food or drink, by what safeguards the introduction of arsenic therein can be prevented.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

Articles.	Year ending 31st Dec.	
	1899.	1900.
	£	£
Metals.....	28,304,450	33,186,303
Chemicals and dyestuffs	5,768,374	5,558,037
Oils	9,680,576	11,016,595
Raw materials for non-textile industries.	56,777,299	8,277,124
Total value of all imports	485,035,583	623,633,486

SUMMARY OF EXPORTS.

Articles.	Year ending 31st Dec.	
	1899.	1900.
	£	£
Metals (other than machinery)	40,307,079	45,422,986
Chemicals and medicines	8,854,813	9,271,510
Miscellaneous articles	34,872,251	36,565,410
Total value of all exports	264,492,211	291,451,306

IMPORTS OF OILS FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
			£	£
Cocoa-nut..... Cwt.	458,297	552,743	545,612	667,207
Olive..... Tuns	15,939	12,046	553,286	461,084
Palm..... Cwt.	945,472	938,350	1,937,265	1,086,555
Petroleum..... Gall.	240,147,367	255,852,261	4,574,989	5,574,533
Seed..... Tons	46,416	41,225	879,171	1,036,564
Train, &c..... Tuns	20,358	21,324	346,906	339,712
Turpentine..... Cwt.	495,898	595,480	809,906	978,943

IMPORTS OF MISCELLANEOUS ARTICLES FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
			£	£
Cement..... Tons	..	104,768	..	211,532
China and earth-ware.	..	361,371	..	832,070
Drugs..... Value £	..	..	1,078,837	1,198,950
Glass:—				
Sheet..... Cwt.	1,301,581	1,165,979	672,553	650,251
Plate..... " "	359,154	316,094	390,828	354,679
Flint..... " "	..	487,731	..	900,948
Bottles..... Gross	1,266,959	1,591,213	127,534	678,429
Other..... Cwt.	906,975	343,070	1,617,895	617,185
Glue and gelatin. " "	..	212,063	..	463,867
Leather, unmanufactured.	1,354,186	1,408,923	8,582,379	8,792,231
Oil seed cake.... Tons	441,934	394,889	2,648,184	2,547,535
Paints and pig-ments.	..	..	..	1,349,184
Paper, pasteboard Cwt.	5,365,390	6,332,573	3,723,094	4,411,557
Scientific instruments.	..	..	..	648,817
Soap and soap powder.	..	191,214	..	244,345
Zinc manufactures.	423,736	434,960	593,930	559,765

IMPORTS OF METALS FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
			£	£
Copper:—				
Ore..... Tons	125,292	101,453	1,130,528	1,173,042
Regulus..... " "	82,179	37,720	2,512,572	3,517,506
Unwrought..... " "	59,550	71,086	4,315,455	5,276,859
Lead, pig and sheet " "	198,377	195,880	2,883,837	3,319,574
Pyrites..... " "	701,174	740,753	1,164,667	1,236,841
Quicksilver..... Lb.	3,877,184	2,454,438	415,430	297,243
Silver ore..... Value £	..	..	1,032,580	1,022,886
Tin..... Cwt.	543,478	662,360	3,228,182	3,269,133
Zinc..... Tons	69,949	69,536	1,863,331	1,442,032

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
			£	£
Bark, Peruvian.. Cwt.	33,579	41,108	77,469	92,177
Caoutchouc..... "	449,651	514,226	5,923,897	6,987,113
Gum:—				
Arabic..... "	67,926	82,995	168,510	177,063
Lac, &c..... "	108,758	113,074	372,587	363,609
Gutta-percha..... "	82,497	126,059	1,065,966	1,685,568
Hides, raw:—				
Dry..... "	446,725	751,504	1,148,189	1,996,743
Wet..... "	763,543	634,375	1,639,898	1,467,750
Ivory..... "	9,989	9,887	404,063	398,551
Manure:—				
Bones..... Tons	68,915	68,737	313,659	301,803
Guano..... "	26,911	33,636	140,075	178,009
Nitrate of soda..... "	140,351	141,155	1,069,771	1,153,462
Phosphate of lime " "	420,168	355,430	682,940	588,789
Paraffin..... Cwt.	1,077,003	984,671	1,011,067	1,337,261
Linen rags..... Tons	20,426	16,612	174,801	161,861
Esparto..... "	207,604	200,280	806,354	800,498
Pulp of wood..... "	415,113	488,827	1,988,703	2,633,789
Rosin..... Cwt.	1,708,630	1,802,098	399,656	461,426
Skins:—				
Goat..... No.	..	14,876,710	..	1,413,070
Sheep..... "	..	15,045,195	..	1,600,723
Tallow and stearin Cwt.	2,031,137	2,177,991	2,380,033	2,335,208



IMPORTS OF CHEMICALS AND DYESTUFFS FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
Alkali..... Cwt.	237,761	322,051	£ 133,878	£ 168,158
Borax..... "	60,566	308,407	30,815	155,409
Brimstone..... "	431,218	450,681	101,615	109,048
Nitrate of potash.. "	248,717	251,928	204,485	214,975
Chemicals, other Value £	..	..	1,461,817	1,498,624
Cutch and gambier. Tons	21,526	19,466	347,025	386,099
Dyes:—				
Alizarin..... Value £	..	..	215,228	186,264
Aniline and other ..	..	..	493,569	533,824
Indigo..... Cwt.	58,977	33,518	986,090	542,089
Bark..... "	324,725	293,755	136,971	109,724
Valonia..... Tons	24,333	32,663	281,471	313,656

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
Brass..... Cwt.	113,920	120,698	£ 562,783	£ 631,525
Copper..... "	997,647	748,627	3,746,880	2,981,793
Lead..... Tons	40,289	36,269	635,987	690,310
Plated wares... Value £	..	..	420,869	460,471
Tin..... Cwt.	93,908	112,462	586,850	763,340
Zinc..... "	132,704	153,402	153,748	166,970

EXPORTS OF DRUGS AND CHEMICALS FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
Alkali..... Cwt.	3,808,800	3,657,154	£ 1,030,871	£ 1,120,862
Bleaching materials "	1,300,100	1,270,101	321,157	370,784
Chemical manures Tons	440,138	400,384	2,427,046	2,411,444
Copper sulphate ..	40,193	42,914	835,225	1,013,594
Medicines..... Value £	..	..	1,155,637	1,263,913

EXPORTS OF MISCELLANEOUS ARTICLES FOR YEAR ENDING 31ST DEC.

Articles.	Quantities.		Value.	
	1899.	1900.	1899.	1900.
Gunpowder.... Lb.	7,923,600	7,021,000	£ 180,366	£ 155,857
Candles..... "	27,733,300	23,538,100	412,181	397,982
Caoutchouc.... Value £	..	..	1,388,805	1,423,413
Cement..... Tons	352,378	359,932	690,835	673,062
Products of coal. Value £	..	..	1,543,942	1,812,174
Earthenware ..	..	..	1,871,531	1,854,147
Stoneware..... "	..	..	170,315	184,647
Glass:—				
Plate..... Sq. Ft.	1,764,100	2,165,072	100,030	135,423
Flint..... Cwt.	88,401	101,742	216,000	245,038
Bottles..... "	794,650	861,398	377,855	428,065
Other kinds ... "	240,229	225,629	222,463	233,153
Leather:—				
Unwrought.... "	157,437	136,458	1,483,114	1,449,537
Wrought..... Value £	..	..	429,637	481,698
Seed oil..... Tons	38,174	42,690	758,657	1,112,660
Floorcloth..... Sq. Yds.	26,887,500	27,848,200	1,164,267	1,311,464
Painters' materials Val. £	..	..	1,833,937	2,052,392
Paper..... Cwt.	930,014	1,066,848	1,423,924	1,649,188
Rags..... Tons	64,893	62,282	341,629	375,882
Soap..... Cwt.	932,700	872,610	941,575	929,647

Monthly Patent List.

* 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.

I.—PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

23,032. I. C. McClethen. Improvements in smoke-consuming apparatus. Dec. 17.

23,051. K. E. Markel and J. J. Crosfield. Improvements in or relating to apparatus for separating solid matters from liquids. Dec. 17.

23,052. J. M. Gibson and The Buckley Brick and Tile Company, Ltd. Improvements in packing material for Gay Lussac, Glover, and the like towers. Dec. 17.

23,109. H. de Witt. Improvements in continuous kilns. Complete Specification. Dec. 18.

23,244. L. Kaufmann. Improved process for effecting rapid crystallisation. Complete Specification. Dec. 19.

23,574. E. H. Stein. Improved iron shaft-furnace for burning cement, lime, and the like. Complete Specification. Dec. 24.

23,608. J. E. Bousfield.—From The Snowflake Refrigerator Company, Ltd., South Australia. Improvements in refrigerators. Complete Specification. Dec. 24.

23,754. G. W. Johnson.—From P. Naef, United States. Improvements in means to be employed in absorbing, precipitating, distilling, lixiviating, and generally for subjecting matter to the action of gases or liquids. Dec. 28.

1901.

592. W. P. Grath. Improvements in kilns. Complete Specification. Jan. 9.

654. S. J. Ingram. Improvements in apparatus for charging coal-gas and other retorts. Jan. 10.

765. A. J. Boulton.—From A. Landsiedl, Austria. Improvements in and relating to distilling or condensing apparatus. Jan. 11.

826. D. W. Forbes. A conical carburettor. Jan. 12.

839. W. Reeves. Improvements in filtering apparatus. Jan. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1899.

25,640. G. N. Vis. Vacuum evaporating apparatus for separating salt from solution, especially from brine. Dec. 31.

1900.

451. F. Pinther. Apparatus for regulating the supply of air to furnaces. Jan. 16.

534. E. G. Behrend. Cooling or refrigerating apparatus. Jan. 16.

2823. J. W. Macfarlane. Weston's centrifugal machines. Dec. 31.

3080. F. Simpson and A. R. T. Woods. Evaporators. Jan. 16.

3748. E. G. Scott. Vacuum evaporators. Dec. 28.

5826. V. E. J. Durafort. Capsules or vessels for containing compressed or liquefied gas. Jan. 9.

5917. H. Schaffstädt. Surface condensers. Dec. 28.

5918. H. Schaffstädt. Condensers. Dec. 28.

17,924. S. M. Lillie. Treatment of solutions to precipitate matter contained therein. Dec. 31.



II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 23,027. C. Carpenter. Improvements relating to the igniting of incandescent gas burners. Complete Specification. Dec. 17.
- 23,044. P. Naef. Apparatus for recovering products from fuel. Dec. 17.
- 23,116. S. Chandler, jun., and J. Chandler. Improvements in gas scrubbers and washers. Dec. 18.
- 23,132. C. S. Snell. Improvements in burners used for incandescent gas lighting. Dec. 18.
- 23,133. C. S. Snell. Improvements in burners used for incandescent gas lighting. Dec. 18.
- 23,136. M. E. H. Dennstedt. Improvements relating to the desulphuration of illuminating gas. Dec. 18.
- 23,222. W. P. Thompson.—From The Firm of S. Zielenziger, Germany. Improvements in incandescent gas lamps. Complete Specification. Dec. 19.
- 23,236. W. J. R. Sims and A. L. Davis. Improvements in means for extracting roots and foreign matter from peat. Complete Specification. Dec. 19.
- 23,237. W. J. R. Sims and A. L. Davis. Improvements in processes for treating and drying peat. Complete Specification. Dec. 19.
- 23,251. A. Scholl. An improved hydraulic gas-compressing apparatus. Complete Specification. Dec. 19.
- 23,320. W. S. Rock. Improvements in the production of oxide of iron. Dec. 20.
- 23,346. H. Higgins. Improvements in or relating to the treatment of peat and in apparatus therefor. Dec. 20.
- 23,605. The Portable Gas Fountain Syndicate Ltd.—From J. Thovert, France. Improvements in incandescent gas burners. Dec. 24.
- 23,615. J. B. S. Macellwaine. Improvements in the manufacture of 'acetylene' gas for the purpose of illumination and in the apparatus used in the manufacture of such gas. Dec. 27.
- 23,642. O. Reitz. Improvements in appliances connected with incandescent gas lighting apparatus. Complete Specification. Dec. 27.
- 23,662. A. J. Boulton.—From Desiderius Turk and The Actien Gesellschaft "Lauchhammer," Germany. Improved process for the production of gases of high calorific value from low-caloric fuel material. Dec. 27.
- 23,701. A. Rosenberg. Improvements in and connected with self-igniting incandescent gas-lights. Dec. 28.
- 23,742. C. G. Redfern.—From H. Collins, Belgium. The manufacture of a silicated material for use for fuel or for the production of refractory and other articles. Dec. 28.
- 23,765. W. Young and S. Glover. See Class B.
- 23,768. H. Oldham. Improvements in or relating to incandescent gas burners. Dec. 29.
- 23,813. W. Young, S. Glover, and T. Glover. Improvements in removing and preventing naphthalene deposits and in apparatus therefor. Dec. 31.
- 23,815. E. W. T. Richmond. An improved Bunsen or atmospheric burner. Dec. 31.
- 23,849. J. St. Clair Legge. Improvements in vapour incandescent lighting apparatus. Dec. 31.
- 23,850. A. G. Brookes.—From The Incandescent Gas Light Company, United States. Improvements in or relating to apparatus for so-called incandescent gas lighting. Complete Specification. Dec. 31.
- 1901.
51. M. Göhler. Improvements in gas-producing apparatus. Complete Specification. Jan. 1.
83. J. Bonnet and J. S. Müller. Improvements relating to machines for the manufacture of incandescent gas mantles. Jan. 1.
100. E. J. Duff and The United Alkali Company, Ltd. Improvements in means to be employed in the treatment of producer gases. Jan. 1.

127. F. E. Ross. Improvements in apparatus for the production of combustible gas. Jan. 2.

179. The Atmospheric Gas Company, Ltd., and H. Thornton. Improvements in producing mixtures of vaporised oil and air for heating, lighting, and motor purposes. Jan. 3.

194. J. S. Morriss. Improvements in mantles for incandescent lighting. Jan. 3.

212. T. Machin. Improvements in acetylene generators. Jan. 3.

240. J. A. Burgess. Improvements in acetylene gas generators. Jan. 3.

241. J. A. Burgess. Process or method for treating and purifying acetylene gas. Jan. 3.

243. E. Cervenka, J. Bernt, and R. Lehmann. Improvements in or relating to incandescent burners for liquid fuel. Jan. 3.

405. G. Daubenspeck and O. H. Smith. Improvements in and relating to refractory incandescent mantles. Jan. 7.

415. J. A. Ageron, C. E. Baumes, and E. Deleourt. A new or improved process and apparatus for producing a new kind of gas for illuminating, heating, or motive purposes. Jan. 7.

478. T. Kautny and R. W. Lotz. Improvements relating to acetylene gas generators. Complete Specification. Jan. 8.

571. C. Clamond. An improvement in incandescence mantles. Jan. 9.

572. J. H. Calkins. Improvements in apparatus for generating acetylene gas. Filed Jan. 9. Date applied for June 9, 1900, being date of application in United States.

645. R. Beese. Self-igniting attachment for gas burners. Complete Specification. Jan. 10.

697. J. Radcliffe. Improvements in the manufacture of gas and in apparatus therefor. Jan. 10.

763. W. Hooker. Improvements in incandescence gas burners. Jan. 11.

781. P. Naef. Improvements to be employed in connection with the production of gas in gas producers, and its treatment and utilization in internal combustion engines. Filed Jan. 11. Date applied for June 14, 1900, being date of application in United States.

798. W. H. Sherburn. Improvements in Bunsen burners. Jan. 12.

827. G. Kohl. Improvements in incandescent bodies, and in the method of manufacturing same. Complete Specification. Jan. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

410. E. J. Duff. Gas producers. Dec. 28.

905. A. Graetz. Blue burners for light carburetted hydrogen gas. Jan. 16.

1037. J. West. Charging machine for gas retorts. Jan. 9.

1336. B. R. Chicken, A. G. Smith, and The Bon-Accord Acetylene Gas Company. Method of purifying acetylene gas, with the necessary apparatus connected therewith. Dec. 28.

1959. A. J. Boulton.—From E. Fleischer, Germany. Process for the production of water-gas. Jan. 9.

2005. A. Holstein and A. O. Teschich. Vaporising or evaporating device for generating gas from dense hydrocarbonic substances for oil, gas, and hot-air motors. Jan. 9.

2063. W. T. Sugg. Apparatus to be used for incandescent gas lighting. Dec. 31.

2855. Sir C. S. Forbes, Bart. Acetylene gas generators. Jan. 16.

3631. E. J. Duff. Gas producers. Dec. 28.

3745. A. Messer. Acetylene gas generators. Dec. 31.

4134. C. B. Tully. Processes for enriching or carburating coal and other gases for illuminating purposes, and appliances connected therewith. Jan. 9.



- 11,979. M. Graham. Hot coke conveyers. Dec. 28.
 14,553. G. C. Dymond.—From The Firm of S. Zeilenziger, Germany. Incandescent gas lamps. Jan. 16.
 17,025. J. Predmerszky and G. Predmerszky. Acetylene gas generator. Dec. 31.
 18,499. F. Deimel. Self gas-lighter. Jan. 16.
 18,839. A. J. Boulton.—From A. Exbrayat, France. Manufacture of coal briquettes and the like, and of agglutinant material for the same. Jan. 16.
 19,016. L. D. Railsback. Acetylene gas generator. Dec. 31.
 19,337. D. McDonald. Acetylene gas-generating apparatus. Jan. 9.
 20,947. K. G. Gustafsson. Apparatus for generating acetylene gas. Jan. 16.
 21,890. W. P. Thompson.—From Boguslaw Jolles and the Firm of Zietz and Brune Gesellschaft mit beschränkter Haftung, Germany. Burners for incandescent gas light. Jan. 9.
 21,974. C. A. Bronder. Machinery for discharging gas retorts. Jan. 9.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

279. F. Rauch. Improvements in the manufacture of tar. Complete Specification. Jan. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

408. J. Beveridge and the Linlithgow Oil Co., Ltd. Retorts for distilling shale and like minerals, and for dealing with the burnt or spent shale. Dec. 31.
 19,406. S. Fränkel and A. König. Process to render sulphurised hydrocarbons soluble in water. Jan. 16.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

- 23,231. The British Oil and Cake Mills, Ltd., and A. G. Wass. Improvements in or applicable to the manufacture of printing ink. Complete Specification. Dec. 19.
 23,338. B. Willcox.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the conversion of indigo leuco compounds into indigo, and the application thereof to colouring textile fibres. Dec. 20.
 23,419. R. B. Ransford.—From L. Cassella and Co., Germany. Improvements in the manufacture of hydroxylated acridines. Dec. 21.
 23,548. J. Levinstein, H. Levinstein, and Leviustein, Ltd. Improvements in the manufacture of naphthoacridine derivatives, and of colouring matters therefrom. Dec. 24.
 23,600. A. Allers. Improved method of manufacturing a brown and dark brown colouring matter. Dec. 24.
 23,687. G. W. Johnson.—From C. F. Boehringer and Soehne, Germany. Improvements in the manufacture of triphenylmethane colouring matters. Complete Specification. Dec. 27.
 23,858. H. J. Haddan.—From A. S. Ramage, United States. A new or improved process of obtaining colour substance from ferrous liquors. Complete Specification. Dec. 31.
 23,859. H. J. Haddan.—From A. S. Ramage, United States. See Class VII.
 23,887. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in or connected with the manufacture and production of naphthalene compounds and their employment in dyeing and printing. Dec. 31.

- 23,902. F. Kehrmann. Manufacture of colouring matters of the thiazine series and of intermediate products therefor. Dec. 31.

1901.

274. A. Zimmermann.—From The Chemische Fabrik auf Actien vorm. E. Schering, Germany. The manufacture of ortho-oxycarbonic acids. Jan. 4.
 295. A. G. Green, R. J. Lévy, and The Clayton Aniline Company, Ltd. Improvements in the manufacture and production of colouring matters of the thiazol series. Jan. 4.
 330. C. D. Abel.—From Actiengesellschaft für Anilinfabrikation, Germany. Manufacture of a black colouring matter directly dyeing cotton. Jan. 5.
 392. O. Imray.—From Farbwerke vormals Meister, Lucius und Brüning, Germany. Manufacture of a blue-grey dye-stuff for cotton. Jan. 7.
 751. O. Imray.—From Farbwerke vormals Meister, Lucius und Brüning, Germany. Manufacture of a dyestuff from 1:5 dinitronaphthalene. Jan. 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

530. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. See Class XX.
 1094. O. Imray.—From The Farbwerke vormals Meister, Lucius und Brüning, Germany. Manufacture of hydrogenised oxybenzylamine and hydrogenised benzylamine bases, and transformation of the latter into hydrogenised cyclic aldehydes or terpenaldehydes. Dec. 31.
 1760. O. Imray.—From The Farbwerke vormals Meister, Lucius und Brüning, Germany. Manufacture of transformation products of coal-tar colours. Dec. 28.
 2683. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Manufacture or production of new azo-dyestuffs for cotton. Dec. 28.
 2772. O. Imray.—From The Farbwerke vormals Meister, Lucius und Brüning, Germany. Manufacture of a violet-black azo-dyestuff for wool. Jan. 16.
 2784. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Manufacture and production of azo-colouring matter, and of lakes from azo-colouring matters. Jan. 16.
 3208. R. B. Ransford.—From L. Cassella and Co., of Frankfurt, Germany. Production of dyestuffs deriving from β , β amidonaphtholdisulpho acid. Dec. 28.
 3615. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Manufacture or production of new azo-colouring matters and of new intermediate products for the production of such colouring matters. Dec. 28.
 3673. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Manufacture or production of new tri-azo colouring matters. Dec. 28.
 4175. G. W. Johnson.—From C. F. Boehringer und Soehne, Germany. Production of amines from the corresponding nitro compounds. Jan. 9.
 4792. A. G. Green, A. Meyenberg, and The Clayton Aniline Company, Ltd. Preparation of intermediate products for colouring matters. Dec. 31.
 5122. C. D. Abel.—From Actiengesellschaft für Anilinfabrikation, Berlin, Germany. Manufacture of new organic bromo compounds. Jan. 16.
 5123. C. D. Abel.—From Actiengesellschaft für Anilinfabrikation, Berlin, Germany. Manufacture of new organic iodo compounds. Jan. 16.
 13,664. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new intermediate products of new azo-colouring matters, their use in dyeing and treatment of the fibre. Jan. 9.
 20,864. O. Imray.—From The Basle Chemical Works, Switzerland. Manufacture of aromatic sulphinic acids. Dec. 31.



V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

23,157. C. F. Topham. Improvements in apparatus for use in the production of textile fibres or filaments from solutions of cellulose or of other material from which fibres or filaments can be formed. Dec. 18.

23,636. G. Mitchell. Improvements in the treatment of cellulose. Dec. 27.

23,722. H. H. Lake.—From National Package Company, United States. Improvements relating to the manufacture of fibrous compositions. Complete Specification. Dec. 28.

1901.

273. W. A. E. Crombie. A process for the manufacture of artificial threads or fibres. Jan. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

2157. L. Schreiner. Machine for use in connection with mercerising and similarly treating yarn in hanks under tension. Jan. 9.

10,438. A. J. Bouit.—From F. Wislicki, Belgium. Treatment of wool and other animal or vegetable fibrous materials. Dec. 31.

11,055. E. Maertens. Machines for washing, rinsing, or chemically treating wool and other animal fibres. Dec. 28.

11,426. A. Goldzweig. Process and apparatus for purifying fibrous materials from grease, mineral oil, and other impurities. Dec. 31.

21,397. E. Simons. Mercerising or silk finishing cotton. Jan. 16.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

23,110. A. J. Bault.—From A. Gagedois, France. Improvements in or relating to the bleaching of vegetable fibres and fabrics. Dec. 18.

23,400. W. Mather. Improvements in apparatus for bleaching, dyeing, and otherwise treating fabrics. Complete Specification. Dec. 21.

23,401. W. Mather. Improvements in bleaching and dyeing, and in apparatus therefor. Complete Specification. Dec. 21.

23,663. P. Schirp. Improvements in apparatus for dyeing, washing, and bleaching textile materials. Complete Specification. Dec. 27.

1901.

228. C. Rigamonti and G. Tagliani. Improvements in kiers for bleaching cotton fabrics. Complete Specification. Jan. 3.

838. R. B. Ransford.—From L. Cassella and Co., Germany. Improvements in dyeing mixed fabrics. Jan. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

379. O. Hoffmann. Process for producing repetitions of long suites of colours upon threads. Dec. 28.

509. J. Major and T. J. Wood. Apparatus for dyeing, bleaching, or otherwise treating cops of spun yarn. Dec. 28.

3288. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Discharging of dyed textile fabrics. Jan. 16.

5066. H. Hadfield. Process and apparatus for bleaching textile fabrics. Jan. 16.

5409. C. L. Jackson and E. W. Hunt. Method of and means for scouring, bleaching, dyeing, mercerising, or otherwise treating piece goods in the open state. Jan. 9.

14,229. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Production of discharge effects on indigo-dyed silk and woollen goods. Dec. 28.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

23,207. W. Eschweiler and H. C. Woltereck. Process of producing hydrocyanic acid and cyanides. Dec. 19.

23,493. U. Alvisi. Improved process for chlorinating natural or artificial sulphides by means of free chlorine. Filed Dec. 22. Date applied for, June 11, 1900, being date of application in Italy.

23,678. W. P. Thompson.—From G. Flick, Germany. Improvements in the manufacture of nitrites. Complete Specification. Dec. 27.

23,781. E. W. Engels. Improved process for the production of carbonic oxide. Complete Specification. Dec. 29.

23,811. J. G. Lorrain.—From G. Thomson, United States. Improvements in or connected with the treatment of liquids containing copper and the like. Dec. 29.

23,859. H. J. Haddan.—From A. S. Ramage, United States. Process of obtaining ferro-ferric oxide. Complete Specification. Dec. 31.

1901.

121. R. Hodgson and A. Scropton. A new or improved invention for the manufacture of broad or common salt by steam or the like. Jan. 2.

184. F. M. Spence, D. D. Spence, H. Spence, and T. J. I. Craig. Improvements in and connected with the manufacture of sodium bichromate. Complete Specification. Jan. 3.

230. A. Cerasoli. Improvements in or relating to the production of carbon dioxide. Jan. 3.

276. G. M. Vis. Improvements in the purification of brine. Jan. 4.

284. H. A. Frasch. Improved nickel salt, and process of making same. Complete Specification. Jan. 4.

524. J. W. Woodall and F. Windham. Improvements in or relating to carbide of calcium. Jan. 8.

601. P. L. Martin. Improvements relating to the manufacture of anhydrous caustic baryta. Jan. 9.

754. R. Wolfenstein. Improvements in the manufacture of peroxide preparations. Jan. 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1899.

25,077. P. Pressneck. Manufacture of acetic acid. Dec. 28.

1900.

1763. J. Imray.—From E. Bronnert, M. Frémery, and J. Urban, Germany. Manufacture of cuprammonia solution. Dec. 28.

2089. G. E. Davis and A. R. Davis. Manufacture of chloride of zinc and chloride carbonate of lead from mixed sulphide ores containing lead and zinc. Dec. 28.

2146. J. Dewrance and J. H. Paul, of the Albion Chemical Company. Means applicable for use in the desulphurisation of sulphuretted hydrogen. Jan. 9.

19,432. H. J. Haddan.—From H. Wartenberg and A. M. Miller, United States. Art of manufacturing carbon. Dec. 31.

20,144. L. Kaufmann. Crystallisation of salts. Dec. 28.

VIII.—GLASS, POTTERY, AND ENAMELS.

APPLICATIONS.

23,520. S. Hill. Improvements in the manufacture of glass bottles by machinery, and apparatus therefor. Dec. 22.

23,577. C. H. Thompson and J. Wilkinson. Improved manufacture of glass plates suitable for facing walls and other like purposes. Dec. 24.

23,579. W. F. Stiel. Improvements in and relating to compressing moulds for manufacturing glass or enamel facing plates. Complete Specification. Dec. 24.



23,580. W. F. Stiel. Improvements in glass or enamel facing plates, and process of manufacturing same. Complete Specification. Dec. 24.

23,652. G. V. Jameson, R. W. Papineau, and R. T. Hollis. A glaze or varnish for protecting the polish of metallic and other surfaces. Dec. 27.

23,879. G. von dem Borne and W. von Debschütz. Improvements in the manufacture of polychrome ornamented glazed or similar ceramic ware. Complete Specification. Dec. 31.

1901.

210. R. B. Ransford.—From Société Parisienne de Céramique, France. Improvements in ornamenting ceramic ware. Complete Specification. Jan. 3.

449. C. Billington and J. Newton. Novel or improved appliance or instrument for use in decorating ceramic ware. Jan. 8.

531. C. H. Thompson and J. Wilkinson. Improved manufacture of glass plates suitable for facing walls and other like purposes. Jan. 8.

579. F. M. David. An improvement in the manufacture of window glass. Jan. 9.

628. A. Gosling. Improvements in the production of multi-coloured slabs or tiles. Jan. 10.

643. R. J. Friswell and The British Uralite Company, Ltd. Improvements in the manufacture of refractory or semi-refractory materials. Jan. 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

338. C. Czerny and C. Schlimp. Kilns for firing ceramic ware and the like. Jan. 16.

3611. J. H. Storey and W. E. McCalla. Manufacture of plates or tablets of glass, metal, earthenware, porcelain, and like articles of similar substances for various purposes, and having a surface capable of adhering to plaster or cement. Dec. 28.

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

APPLICATIONS.

23,040. C. Krause and A. Beddies. A process for the impregnation of wood and fibrous substances. Complete Specification. Dec. 17.

23,368. T. Bradley. Improvements in the manufacture of coloured bricks, terra cotta blocks, tiles, and the like. Dec. 21.

23,375. J. Fielding. Improvements in apparatus for making concrete flags or blocks. Dec. 21.

23,572. H. C. Webb and A. A. Webb. Improvements in the production of inlaid ornamental tiles, bricks, blocks, slabs, and such like formed or plastic or mouldable substances, such as clay, and in the manufacture of certain kinds of such tiles, bricks, and slabs without inlays. Dec. 24.

23,574. E. H. Stein. See Class I.

23,718. W. W. Hewitt. An improvement in cement kilns and drying chambers. Dec. 28.

23,734. W. P. Thompson.—From P. J. Moran, United States. Improvements in street paving. Dec. 28.

23,851. C. Diesler. Improvements in the manufacture of cement. Dec. 31.

1901.

457. A. G. Brookes. From C. Hörisch, Germany. A new or improved process for hardening artificial stone or the like. Jan. 8.

651. L. A. Garchey. Improvements in the manufacture of glass stone and in articles made therefrom. Jan. 10.

801. J. S. Rigby. An improved kiln for the manufacture of Portland cement or lime. Jan. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

791. H. Schurholz. Process for the production of artificial stones. Jan. 16.

2740. A. W. Green. Construction of fireproof floors and roofs. Dec. 22.

3262. H. H. Lake.—From American Wood Fire-Proofing Co., Ltd., United States. Treatment of wood and other combustible substances to render them fireproof, and for other purposes. Dec. 28.

21,913. A. Clemens. Presses for manufacturing facing bricks. Jan. 9.

22,015. O. Imray.—From C. F. Buente, United States. Fire-proof floors. Jan. 9.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

22,997. J. Bedford. Improved method or process for annealing self-hard steel. Dec. 17.

23,046. The Société Internationale des Usines et Fonderies d'Aluminium (Société Anonyme). A process for uniting aluminium and steel or iron. Complete Specification. Filed Dec. 17. Date applied for June 20, 1900, being date of application in Belgium.

23,303. E. H. Hopkins. Improvements in the distillation of zinc and other volatile metals. Dec. 20.

23,315. A. Reynolds. Improvements in converters. Dec. 20.

23,320. W. S. Rock. See Class II.

23,350. S. Cowper-Coles. Improvements in vanadium alloys. Dec. 21.

23,403. G. Huth.—From F. Pich, Germany. An improved flux for brazing. Complete Specification. Dec. 21.

23,418. The Mining Machinery Improvement Company, Ltd., and A. A. Lockwood. Improvements in extracting copper and other metals from ores. Dec. 21.

23,476. W. B. Middleton. An improvement in the treatment of zinc ores. Dec. 22.

23,477. A. J. Boulton.—From E. C. Pohlé and S. Croasdale, United States. Improvements in processes for the reduction of refractory ores. Complete Specification. Dec. 22.

23,522. R. B. Ransford.—From L. W. Gans, Germany. Improvements in the manufacture of metal foil or leaf. Dec. 22.

23,652. G. V. Jameson, R. W. Papineau, and R. T. Hollis. See Class VIII.

23,600. M. Seligsohn. A method or process of treating ores. Complete Specification. Dec. 27.

23,725. H. L. Herrenschmidt. Improvements in the treatment of nickel ores. Dec. 28.

23,803. J. E. Jasset and A. E. Cinqualbre. An improved process for depositing nickel and other metals upon metallic surfaces. Dec. 29.

1901.

12. S. E. Page.—From R. W. Davies and H. W. Hartman, United States. Improvements in and relating to apparatus for casting metal and other substances suitable for casting, especially casting iron into pigs. Complete Specification. Jan. 1.

318. D. Laird. An improved furnace for smelting ore for the recovery of metals. Jan. 5.

331. J. C. Butterfield. Improvements in or relating to obtaining antimony and separating gold from antimony ores. Jan. 5.

332. J. C. Butterfield. Improvements in or relating to the treatment of complex ores. Jan. 5.

374. J. Nicholas. Improvements in the recovery of metals from ores and other material, and in the plant employed therein. Jan. 7.

430. R. Langhans. Improved process of metallising with precious metals. Jan. 8.



470. W. B. Middleton. An improvement in the treatment of zinciferous lead fumes (known as "sludge") and other zinc products as produced by the Ellershausen process. Jan. 8.

493. H. M. Taquet. Improvements relating to the treatment of zinc ores. Jan. 8.

510. W. J. Foster. An improved method of keeping cool the tuyeres of blast and like furnaces and forges, and of heating the air or blast used. Jan. 8.

778. W. S. Lockhart and The Automatic Gem and Gold-Separator Syndicate, Ltd. An improved apparatus for the concentration of ores, substances held in slimes, and the like. Jan. 11.

788. W. W. Slater and J. Galloway. Improvements in apparatus for the economical treatment of auriferous matters. Jan. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

817. A. W. Tangye. Process of and apparatus for oxidising or roasting ores containing metallic sulphides, and for the production of gases suitable for the manufacture of sulphuric acid. Jan. 16.

1221. O. Imray.—From W. H. Rogers and J. A. Beaver, United States. Manufacture of tin-plate and apparatus therefor. Dec. 28.

1810. R. C. Baker. Obtainment of hardening and toughening compounds for alloying with steel and other metals. Jan. 16.

2089. G. E. Davis and A. R. Davis. See Class VII.

3421. A. James. Apparatus for precipitating gold and silver from their solutions. Dec. 28.

13,260. O. Imray.—From J. S. Hey, United States. Manufacture of tool steel and of tools therefrom. Jan. 9.

18,425. J. P. Roe. Process of puddling iron. Dec. 28.

19,863. R. W. James.—From J. H. Robertson, J. B. Campbell, and D. R. Case, United States. Process for coating fibrous material with metal. Jan. 16.

20,142. H. H. Lake.—From A. G. Betts, United States. Coating of aluminium or its alloys. Dec. 28.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

23,106. C. A. Allison.—From The Waterbury Battery Company, United States. Improvements in galvanic batteries. Complete Specification. Dec. 18.

23,107. C. A. Allison.—From The Waterbury Battery Company, United States. Improvements in galvanic batteries. Complete Specification. Dec. 18.

23,309. The British Power Traction and Lighting Company, Ltd., and G. J. Gibbs. Improvements in electrical accumulators. Dec. 20.

23,310. The British Power Traction and Lighting Company, Ltd., and G. J. Gibbs. Improvements in electrical accumulators. Dec. 20.

23,314. J. MacTear. Improvements in electrolytic apparatus for production of chlorine and alkali. Dec. 20.

23,408. A. Pouteaux and A. Wolff. Improvements relating to electric accumulators. Dec. 21.

23,413. G. E. Vaughan.—From H. Koegel, Germany. Improvements in or connected with the electro-deposition of metals or metallic alloys. Dec. 21.

23,543. W. E. Ayrton and A. W. Fithian. Improvements in plates for secondary or storage cells. Dec. 24.

23,647. H. C. Harrison and J. Day. Improvements in the electrolytic deposition of metals. Dec. 27.

23,729. Baron H. F. d'Arnould. Improvements relating to secondary batteries. Filed Dec. 28. Date applied for June 22, 1900, being date of application in France.

23,743. E. Tiquet. Improvements in battery cells. Complete Specification. Dec. 28.

1901.

56. H. C. Harrison. Improvements in the electrolytic deposition of metals. Jan. 1.

294. M. M. Bair. Improvements relating to galvanic cells or batteries. Jan. 4.

393. P. A. Newton.—From The National Electrolytic Company, United States. Improvements in electrolytic and apparatus therefor. Complete Specification. Jan. 7.

441. O. Lauckner.—From A. Vogelsang, Germany. Improvements in the electrolytic bleaching of cotton and other textile materials and in apparatus therefor. Jan. 8.

469. O. Böhrend. Improvements in or connected with electrical batteries or accumulators. Jan. 8.

484. H. H. Lake.—From Globe Electric Company, United States. Improvements relating to secondary electric batteries. Complete Specification. Jan. 8.

612. R. Kennedy. Improvements in the manufacture of sulphate of ammonia from furnace gases and the like by electrolysis. Jan. 10.

624. M. Sutherland and E. Marcuson. Improvements in or relating to electric storage batteries. Jan. 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1899.

22,830. S. Robinson.—From S. R. V. Robinson, United States. Primary batteries. Dec. 28.

1900.

2543. S. W. Maquay. Primary batteries. Dec. 31.

3524. W. P. Thompson.—From H. Becker, France. Features for the anodes in electrolytic apparatus. Jan. 9.

12,702. A. A. Riassé and J. J. A. Sengeisen. Accumulators. Dec. 28.

20,960. T. A. Edison. Reversible galvanic cells or so-called storage batteries. Jan. 16.

21,216. P. M. Justice.—From The International Acheson Graphite Company, United States. Method of graphitizing electrodes. Jan. 16.

XII.—FATS, OILS, AND SOAP.

APPLICATIONS.

23,804. A. Klumpp. Improvements in the manufacture of soap. Complete Specification. Dec. 29.

1901.

117. C. Weygang. Improvements in the treatment of oils and fats suitable for soap making. Jan. 2.

160. W. H. Power. Improvements in the manufacture of soaps. Jan. 2.

759. W. F. Haywood. Improvements in means or apparatus to be employed in the manufacture of soap. Jan. 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

1155. V. Camiz and A. Gobba. Apparatus for recovering oil. Jan. 9.

3363. P. Magnier, P. A. Brangier, and C. Tissier. Process for saponifying fatty substances and converting oleic acid into solid fatty acid. Jan. 16.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

APPLICATIONS.

23,603. A. J. Boulton.—From P. C. Ralli, H. Mayer, and L. Toch, United States. Improved compound to be used as a substitute for gutta-percha. Complete Specification. Dec. 24.

23,909. T. H. L. Bake. Oxidised lead compounds. Dec. 31.



1901.

50. C. O. Weber and A. Cairns. Improvements in compounded india-rubber. Jan. 1.

424. M. E. Melsom and G. H. Griffin. Improvements in or relating to the treatment of waste or scrap material manufactured from rubber and textile fabric or the like for reclaiming the rubber therefrom. Jan. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

16,827. H. Lesser. Refined linseed-oil putty. Jan. 16.

17,475. C. A. R. Steenstrup. Manufacture of substances similar to india-rubber. Dec. 31.

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

APPLICATION.

23,250. J. Wezel. Improvements in the preparation of a substitute for animal glue. Complete Specification. Dec. 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

1809. G. A. Clowes. Manufacture and treatment of leather. Dec. 28.

16,306. C. Schill and C. Seilacher. Apparatus for treating glue, gelatin, and the like. Jan. 9.

19,141. M. Dietrich and A. Langer. Production of blood albumen. Dec. 28.

21,467. R. Haddan.—From E. R. Edson, United States. Process of and apparatus for making gelatin. Dec. 31.

XV.—AGRICULTURE AND MANURES.

APPLICATION.

1901.

694. R. Hartleb. A method for producing cultures of bacteroids of micro-organisms of the leguminosae and the permanent forms of such bacteroids and for inoculating seeds and soils with micro-organisms. Complete Specification. Jan. 10.

COMPLETE SPECIFICATION ACCEPTED.

1900.

19,574. J. Hughes. Basic superphosphate. Jan. 16.

XVI.—SUGARS, STARCHES, AND GUMS, ETC.

APPLICATIONS.

23,156. J. Robin-Langlois. Improvements in and relating to the refining of sugar. Dec. 18.

23,415. W. P. Thompson.—From H. C. P. Geerligs and K. R. Hamakers, Java. Improvements in the process of extracting sugar from beetroot-cane sugar, sorghum, and other plants. Dec. 21.

23,508. J. C. F. Lafeuille. Improvements in apparatus for the moulding and centrifugal treatment of sugar. Dec. 22.

COMPLETE SPECIFICATION ACCEPTED.

1900.

1804. C. Steffen. Process of utilising the vapours of factory plants, especially sugar factories. Jan. 16.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

23,198. H. McPhail. Improvements in and relating to the treatment of pot-ales, wash liquors, sewage, and other aqueous waste or by-products. Dec. 19.

23,634. E. S. Beaven. Improvements in the process of frying malt, hops, and other substances, and apparatus therefor. Dec. 27.

1901.

40. J. H. Brodrick. Improvements in compounds and processes for making home-made wines. Jan. 1.

377. A. Méyer. Improvements in vessels for mashing and fermenting purposes. Jan. 7.

735. J. Heaton. Improved sparger. Complete Specification. Jan. 11.

742. O. E. Nycander. Improvements in or connected with the manufacture of distillers' yeast. Jan. 11.

COMPLETE SPECIFICATION ACCEPTED.

1899.

25,418. M. P. Hatschek. Manufacture of bakers' yeast. Dec. 28.

XVIII.—FOODS, SANITATION, ETC., AND DISINFECTANTS.

APPLICATIONS.

A.—Foods.

23,377. P. Mongiraud and H. Labranche. New or improved apparatus for the sterilisation and aseptic transfer or storage of milk. Dec. 21.

23,893. R. Hengstenberg. Improvements in the preservation and sterilisation of food products and other substances of all kinds. Complete Specification. Dec. 31.

1901.

647. A. Sauer. Process for producing a milk preservative affording a rich milk similar to mother's milk. Complete Specification. Jan. 10.

755. S. Székely and E. Kovács. An improved process for the separation of milk into casein and whey. Complete Specification. Jan. 11.

B.—Sanitation.

23,198. H. McPhail. See Class XVII.

23,412. D. Cameron, F. J. Commin, and A. J. Martin. Improvements in apparatus for purifying sewage and other liquids. Dec. 21.

23,765. W. Young and S. Glover. Improvements in methods and apparatus for the treatment of coal, town refuse, and similar substances, in producing heating gases therefrom, also by-products when desirable. Dec. 29.

1901.

30. G. D. Wild. Improvements in means or apparatus for use in the treatment of sewage and like liquid refuse. Jan. 1.

497. R. Orchard and C. F. Fox. Improvements in and relating to the purification or sterilisation of water. Jan. 8.

517. F. Candy. Improvements in the treatment of sewage and other polluted liquids, and in apparatus for use in connection therewith. Jan. 8.

607. C. N. Russell. Improved treatment and utilisation of house refuse. Jan. 9.

C.—Disinfectants.

1901.

508. A. Strandh. An improved disinfectant compound known as "Lettubrin." Jan. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

B.—Sanitation.

1900.

3036. E. Springborn. Precipitation of sewage. Jan. 16.

5607. G. Green. Apparatus for filtering and purifying water. Jan. 16.

17,071. J. F. Lester and L. A. Dean. Furnaces for burning garbage, night-soil, and other refuse material. Dec. 28.

C.—Disinfectants.

19,569. R. P. Kuhn. Formaldehyde generators. Jan. 16.



XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

23,379. D. N. Bertram and S. Milne. Improvements in and relating to strainers for treating pulp. Dec. 21.

23,636. G. Mitchell. See Class V.

23,716. R. W. Barker.—From H. G. Stripe, United States. Improvements in bordering note paper. Dec. 28.

1901.

249. F. Billing. Improvements in connection with the manufacture of paper. Jan. 4.

528. W. H. Caldwell. Improvements in the manufacture of paper pulp. Jan. 8.

536. L. Joseph. A supplementary process for the manufacture of waterproof and airtight paper impervious to fat and with glazed surface. Jan. 8.

630. L. H. A. von Giese. Process of and means for rendering non transparent or opaque paper temporarily transparent. Complete Specification. Jan. 10.

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

APPLICATIONS.

23,419. R. B. Ransford.—From L. Cassella and Co., Germany. See Class IV.

23,507. O. Imray.—From The Farbwerke vormals Meister, Lucius und Brüning, Germany. Manufacture of neutral soluble silver compounds. Dec. 22.

23,727. C. Moureu. Manufacture of useful products from heptene and octene. Dec. 28.

1901.

274. A. Zimmermann.—From The Chemische Fabrik auf Actien vormals E. Schering, Germany. The manufacture of ortho-oxy-carbonic acids. Jan. 4.

526. G. W. Johnson.—From C. F. Boehringer und Soehne, Germany. Improvements in the manufacture or production of homologues of xanthin. Complete Specification. Jan. 8.

COMPLETE SPECIFICATION ACCEPTED.

1900.

H. E. Newton.—From Farbenfabriken vormals Iyer and Co., Germany. Manufacture or production chloro-carbonic ethers, and compounds therefrom. c. 28.

XXII.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

23,064. J. Ramsden and W. R. Hirst. Improvements in matches. Dec. 17.

23,252. P. M. Justice.—From The International Smokeless Powder and Dynamite Company, United States. Improvements in smokeless powder in the process of manufacturing the same and in apparatus therefor. Complete Specification. Dec. 19.

23,414. J. von Romoeki.—From W. Tettel, Germany. Improvements in the manufacture of lucifer matches. Dec. 21.

1901.

201. S. B. Earle. Improvements in or relating to explosives or explosive compounds. Jan. 3.

COMPLETE SPECIFICATIONS ACCEPTED.

1899.

23,853. F. A. Ludlow. Fog signals. Dec. 31.

1900.

214. A. C. Girard. Improvements in or relating to the manufacture of explosives. Jan. 9.

1323. F. Bale. Manufacture and production of matches, and in the substances and processes employed therein. Dec. 28.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

23,737. J. Waring. Process of gaging high vacua. Filed Dec. 28. Date applied for June 4, 1900, being date of application in United States.

COMPLETE SPECIFICATIONS ACCEPTED.

1900.

618. J. Y. Johnson.—From The Chemische Fabrik vormals Goldenberg, Geromont and Co., Germany. Manufacture or production of materials with platinum surfaces for use as contact substance in chemical operations. Jan. 16.

4114. A. Denaeyer. Process for chemically agglomerating powdered materials. Jan. 9.

PATENT UNCLASSIFIABLE.

COMPLETE SPECIFICATION ACCEPTED.

1900.

4676. M. Otto. Product obtained by the solution of ozone in petroleum. Jan. 9.

