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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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INDEX.

- ABBE (DR. C., JUN.), the Climate of Alaska, 212
Abel (N. W.), Sa Vie et Son Œuvre, Ch. Lucas de
Pesloüan, 603
Abetti (Prof.), Comet 1906 g, 137
Abold (Herr), Search-ephemeris for Comet 1900 III.
(Giacobini), 498
Abruzzi's (The Duke of the) Ascents in the Ruwenzori
Range, 282
Acoustics: Wireless Telephony Experiments, Prof. Slaby,
227; Church Bells Cracked by Sound Waves Produced by
Explosions or Heavy Firing, 541
Actinium, the Production of Radium from, Bertram B.
Boltwood, 54; Prof. E. Rutherford, F.R.S., 270
Actinium and Helium, Radium, H. S. Allen, 126
Action of Tram-car Brakes, the, 86
Adams (Prof. Frank D.), Geological Survey of Canada,
149; an Investigation into the Elastic Constants of
Rocks, more Especially with Reference to Cubic Com-
pressibility, 451
Adams (J.), Guide to the Principal Families of Flowering
Plants, 29
Adams (Walter S.), Character and Cause of Sun-spot
Spectra, 113
Aërodynamics: Institut aërodynamique de Koutchino, 609
Aërography, a Résumé of, L'Abbé Th. Moreux, 231
Aëronautics: the First "Manned" Flying Machine, 35;
the Balloon *Milano's* Journey from Milan to Aix-les-Bains,
60; Santos Dumont's Airship, 61; the Flight Problem,
82; the Flying Fish Problem, Lieut.-Colonel C. D.
Durnford, 109; the 1906 Zeppelin Airship, Dr. Wilhelm
Krebs, 229; North Pole Expedition, Walter Wellman,
540; the Exploration of the Air, Major B. F. S. Baden-
Powell, 551; the Belgian International Balloon Service,
572; an Aëronautical Exhibition, Prof. G. H. Bryan,
F.R.S., 585
Etiology of Leprosy, 412
Africa: Geological Research in South Africa, 115; Mollusca
collected by S. A. Neave in South-east Rhodesia,
J. Cosmo Melville and R. Standen, 216; the Duke of the
Abruzzi's Ascents in the Ruwenzori Range, 282; the
Ruwenzori Boundary Dispute, 321; the Snow-peaks of
Ruwenzori, 500; the Geology of the Oban Hills (Southern
Nigeria), J. Parkinson, 286; Return of Lieut. Boyd
Alexander, 398; the Forest-pig of Central Africa, Prof.
Henry H. Giglioli, 414; the Brachyurous Crustacea of
the Third Tanganyika Expedition, Dr. W. A. Cunningham,
527; the Lower Niger and its Tribes, Major Arthur Glyn
Leonard, 602; Wissenschaftliche Beihefte zum Deutschen
Kolonialblatte, Dr. Ottweiler, 616; Mitteilungen aus dem
Deutschen-schutzgebieten; Die Niederschlags-verhältnisse
von Deutsch-sudwestafrika, Dr. F. von Duncelman,
616
Agar (W. E.), Development of the Anterior Mesoderm and
Paired Fin in Lepidosiren and Protopterus, 455
Agathocles, the Position of, during the Eclipse of B.C. 310,
August 15, P. H. Cowell, F.R.S., 10
Aggregates, the Theory of Sets of Points, W. H. Young and
G. C. Young, 193
Agriculture: Experiments at the Cawnpore Experimental
Farm, 12; Cotton: its Cultivation, Marketing, Manu-
facture, and the Problems of the Cotton World, Prof.
C. W. Burkett and C. H. Poe, 27; Cotton Cultivation
in India, 109; Cotton Cultivation in the Bombay Presi-
dency, F. Fletcher, 207; Cotton Cultivation in the United
States of America, 226; Forecast of the Indigo Crop of
Bengal for 1906, 37; Indigo Culture in India, 109; Cyril
Bergtheil, 497; Gumming of Sugar-cane Plants, N. A.
Cobb, 38; Microbiologie Agricole, Dr. Edmond Kayser;
Prof. R. T. Hewlett, 99; Indian Output of Sugar, 157;
Artificial Fertilisers, A. D. Hall at Society of Arts, 185;
the American Gooseberry-mildew, 160, 613; E. S. Salmon,
247; Silk-worm Culture, K. Toyama, 255; Agricultural
Education and Research, 394; the Principles and Prac-
tice of Agricultural Analysis, Dr. H. W. Wiley, 458;
Mexican Cotton-boll Weevil, 495; a New Gooseberry
Pest, W. E. Collinge, 496; *Termes gestroi*, a White Ant
Rubber Pest, E. P. Stebbing, 516; Diseases of Fruit
and Fruit-bearing Plants, 532; the Weather and the
Crops, R. H. Hooker, 545; Agricultural Experiments,
594; Experiments on Tomato Seedlings, E. P. Sandsten,
594; Variation in the Composition of Milk, Dr. Alex
Lauder, 594; Lucerne treated with Hiltner's Inoculating
Material, 595
Air and Nitrogen, Inversion Temperatures for, Prof. K.
Olszewski, 379
Aitken (Mr.), Comet 1906 g (Thiele), 231
Alaska: Coal Resources of the Cape Lisburne Region,
A. J. Collier, 256; the Rampart Gold-placer Region,
L. M. Prindle and F. L. Hess, 256
Albe (E. E. Fournier d'), the Electron Theory; a Popular
Introduction to the New Theory of Electricity and
Magnetism, 292
Albedoes of the Superior Planets, the, J. E. Gore, 615
Albrecht (Dr. Sebastian), Line Intensity and Spectral
Type, 304
Albrecht (Prof.), Wireless Telegraphy in Longitude Deter-
minations, 544
Alden (W. C.), the Delavan Lobe of the Lake Michigan
Glacier, 184
Aldin (W. C.), the Drumlins of South-eastern Wisconsin,
182
Alexander (Lieut. Boyd), Return of, 398
Algebra, a College, Prof. H. B. Fine, 74
Algué (Rev. José), the Hong Kong Typhoon, 211-2
Allen (H. S.), Radium, Actinium and Helium, 126
Allen (H. Stanley), Photoelectric Fatigue of Zinc, 262
Allen (Mr.), Minerals of the Composition $MgSiO_3$, 596
Allen (T. Fenwick), Some Founders of the Chemical
Industry, Men to be Remembered, 100
Allorge (M. M.), Obituary Notice of Prof. Marcel Bertrand,
441
Alloys of Aluminium and Copper, on the Properties of,
Prof. H. C. H. Carpenter and C. A. Edwards at the
Institution of Mechanical Engineers, 426
Alpini, I grandi Trafori, G. B. Biadego, 291
Alternating Currents: a Text-book for Students of Engin-
eering, C. G. Lamb, 97
Amazonicum Arboretum, Museu Paraense de Historia e
Ethnographia, Dr. J. Huber, 459
Ambronn (Prof.), Comet 1906 g, 137
America: Cotton: its Cultivation, Marketing, Manufac-
ture, and the Problems of the Cotton World, Prof.
C. W. Burkett and C. H. Poe, 27; Cotton Cultivation
in the United States of America, 226; Mineral Resources

- Radiation, Ladislas Gorczyński, 326; a Peculiar Short-period Variable (155.1906 Cassiopeiæ), Messrs Müller and Kempf, 327; a Catalogue of 8560 Astrographic Standard Stars between Declinations -40° and -52° for the Equinox 1900 from Observations made at the Royal Observatory, Cape of Good Hope, during the years 1896-99, under the Direction of Sir David Gill, K.C.B., F.R.S., 331; Catalogues of Stars for the Equinox 1900-0 from Observations made at the Royal Observatory, Cape of Good Hope, during the years 1900-1904, under the Direction of Sir David Gill, K.C.B., F.R.S., 331; Astrographic Catalogue, 1900-0, Oxford Section, Dec. $+24^{\circ}$ to $+32^{\circ}$, Prof. H. H. Turner, F.R.S., 331; a Quickly Changing Variable Star, F. H. Seares, 350; Accuracy of Astronomical Clocks, Prof. W. S. Eichelberger, 353; Obituary Notice of Prof. Antonio Mascari, W. E. Rolston, 373; the Spectroscopic Binary σ Leonis, W. Zurhellen, 378; Stars with Variable Radial Velocities, 378; United States Naval Observatory, 378; New Variable Stars with Very Rapid Variations in Light Intensity, Jules Baillaud, 383; the Late Dr. Roberts's Celestial Photographs, 402; a Lost Comet (1905 f), Prof. Barnard, 402; Miss Leavitt, 402; Sun and Planet Chart, 402; Thirty-six New Variable Stars, Miss Leavitt, 402; Death of H. C. Russell, F.R.S., 420; Obituary Notice of, 442; a New Form of Cœlostet Telescope, Prof. Hale, 424; the Spectroscopic Binary λ Andromedæ, Mr. Burns, 425; Plan of Selected Areas, Prof. J. C. Kapteyn, W. E. Rolston, 427; Stars having Peculiar Spectra, Mrs. Fleming, 448; Photographs of Faint Stars, Prof. E. C. Pickering, 448; Model to Illustrate Effects of the Earth's Rotation, G. Blum, 448; Prominence Observations (1906), 448; Transactions of the International Union for Co-operation in Solar Research, 458; Discovery of a Comet (1907 a), Prof. Giacobini, 469, 498; Comet 1907 a (Giacobini), M. Ebell, 497, 518, 569; Dr. Rheden, 544; M. Giacobini, 544; Observations of the Giacobini Comet (1907 a), MM. Rambaud and Sy, 528; Solar Research at Meudon, MM. Deslandres and d'Azambuja, 469; the Electrical Influence of the Sun, Dr. A. Nodon, 469; Recently Discovered Asteroids, J. Bauschinger, 469; Search-ephemeris for Comet 1900 III. (Giacobini), Herr Abold, 498; Herr Scharbe, 498, 544; Solar Observations at Catania, Prof. Ricco, 498; Intensification of "Contrast" by Means of a Polariscopes, Dr. Felix Biske, 498; the Minor Planet (588), [1906 T.G.], Dr. Bidschhof, 498, 564; Researches in Stellar Photometry, J. A. Parkhurst, 498; La Découverte de l'Anneau de Saturne par Huygens, Jean Mascart, 509; Observation of Comet 1905 IV., Dr. Kopff, 518; Prof. E. Becker, 593; Prof. Weiss, 593; Standard Stellar Magnitudes, Prof. Pickering, 518; Two Rapidly-changing Variable Stars, J. Baillaud, 518; a New Astronomical Journal, 518; Astronomical Refraction, 538; Prof. Bakhuyzen, 539; Man's Place in the Universe, Prof. Turner, 544; the Astronomical Society of Antwerp, 544; Wireless Telegraphy in Longitude Determinations, Prof. Albrecht, 544; Ancient Chinese Astronomy, M. de Saussure, 544; the World Machine, the First Phase, the Cosmic Mechanism, Carl Snyder, 553; Death and Obituary Notice of Prof. J. K. Rees, 540; Presence of Europium in Stars, Joseph Lunt, 549; the Brightness of the Sky near the Sun's Limb, Prof. Ceraski, 569; Radial Velocity of η Piscium, 569; the Sun as a Variable Star, Prof. Turner, 569; Annals of the Astronomical Observatory, Harvard College, 593; Galileo in the Val D'Arno, Janet Ross, 593; Another New Astronomical Journal, 593; the Stonyhurst College Observatory, Father Sidgreaves, 593; a New Comet (1907 b), Mr. Mellish, 593; Comet 1907 b (Mellish), Messrs. Lamson and Frederick, 615; a new Nebula, Rev. T. E. Espin, 593; a New Variable or Nova 156.1906, Prof. E. Millosevich, 615; the Albedoes of the Superior Planets, J. E. Gore, 615; the Second Globular Cluster in Hercules, Messier 92, Dr. Karl Böhlin, 616
- Astro-physics: On Homer Lane's Problem of a Spherical Gaseous Nebula, Lord Kelvin, O.M., F.R.S., 368; Elementare Kosmische Betrachtungen über das Sonnensystem und Widerlegung der von Kant und Laplace Aufgestellten Hypothesen über dessen Entwicklungsgeschichte, Prof. Gustav Holzmüller, 582
- Atlantic, a Meteorite in the, (October 17), C. B. Anderson, 159
- Atlas, the M.P., a Collection of Maps showing the Commercial and Political Interests of the British Isles and Empire throughout the World, 580
- Atmosphere, Studies on the Diurnal Periods in the Lower Strata of the, Prof. Frank Hagar Bigelow, Dr. Charles Chree, F.R.S., 186
- Atmospheric See-saw Phenomenon and the Occurrence of Typhoon Storms, Wilhelm Krebs, 560
- Atomic Theory of Electricity, 292
- Atomic Weight of Nickel, the, Dr. Charles G. Barkla, 368; F. E. Hackett, 535
- Attrition Tests of Road-making Stones, E. J. Lovegrove. Petrographical Descriptions by Dr. John S. Flett and J. Allen Howe, 220
- Auger (V.), Esterification of Arsenious Anhydride by Alcohols and Phenols, 167; Copper Metaphosphate, 359
- August Meteors, Observations of the, Prof. von Konkoly, 182
- Auld (S. J. M.), Hydrolysis of Amygdalin by Emulsin, 503
- Aurora, Magnetic Storm and, on February 9-10, Dr. Charles Chree, F.R.S., 367
- Austin (Mr.), Platinum-point Electrolytic Detector for Electrical Waves, 234
- Australia: the University Movement in Western Australia, 35; Mythes et Légendes d'Australie, Études d'Ethnographie et de Sociologie, A. van Gennepe, 49; the Rusts of Australia; their Structure, Nature, and Classification, D. McAlpine, 101; the "Lloyd" Guide to Australasia, 102; on the Extinct Emeu of the Small Islands off the South Coast of Australia and probably Tasmania, Prof. Henry H. Giglioli, 534; Glimpses of Australian Bird Life, R. Hall, 595
- Ayres (H. B.), the Southern Appalachian Forests, 184
- Azambuja (M. d'), Solar Research at Meudon, 469
- Backhouse (T. W.), Mira Ceti, 126
- Bacon (R. F.), Substances Used by the Filipinos for Stupefying or Poisoning, 468
- Bacteriology: Statistical Study of Generic Characters of the Coccaceæ, C. E. A. Winslow and Anne F. Rogers, 39; the Fixation of Nitrogen by *Azotobacter chroococcum*, Dr. R. Greig-Smith, 192; the Fixation of Nitrogen by *Rhizobium leguminosarum*, Dr. R. Greig-Smith, 192; Bactericidal Action of Coins, 256; Infection of Bovines by the Avian Tubercle Bacillus, Prof. Mettam, 407; on De-Novo Origin of Bacteria, Bacilli, Vibriones, Micrococci, Torulæ, and Moulds in certain previously superheated Saline Solutions contained within Hermetically-sealed Tubes, Dr. H. Charlton Bastian, F.R.S., at Royal Medical and Chirurgical Society, 425; Death and Obituary Notice of Dr. Allan Macfadyen, 442; "Bud-rot" of the Cocoa-nut Palm due to Bacteria, 468; Bacteriological Examination of Deep Well Waters and of Upland Waters, Dr. Houston, 544; the Transmission of Plague in the Rat, Dr. Klein, 544; Bacteriological Test whereby Particles shed from the Skin may be detected in the Air, Dr. Gordon, 545; Conditions under which "Specific" Bacteria from Sewage may be present in Drains, Major W. H. Horrocks, 599; *Spirophyllum ferrugineum*, a New Genus and Species of Thread Bacteria, D. Ellis, 623
- Baden-Powell (Major), "Unilens," 15; the Exploration of the Air, 551
- Bagg (R. M., jun.), Miocene Foraminifera from the Monterey Shale of California, 183
- Bahr (P. H.), the "Bleating" or "Drumming" of the Snipe, 359
- Baikié (James), Through the Telescope, 222
- Bailey (Prof. Solon I.), Annals of the Astronomical Observatory of Harvard College, Peruvian Meteorology, 283
- Baillaud (Jules), New Variable Stars with very Rapid Variations in Light Intensity, 383; Two Rapidly-changing Variable Stars, 518
- Bain (H. O. Foster), the Copper Deposits of Missouri, 184

- Bainbridge (F. A.), the Relation of the Kidneys to Metabolism, 357
- Baker (W. M.), Elementary Geometry, 74
- Bakhuis-Roozeboom (Prof. H. W.), Obituary Notice of, F. D. Chattaway, 464
- Bakhuyzen (Prof.), Astronomical Refraction, 539
- Balaton, Lake, *Physische Geographie des Balatonsees und seiner Umgebung*, Dr. Moriz Staub and Dr. J. Bernatsky, Dr. E. von Chohnoky, Dr. Baron Bela Harkanyi, 79; *Die Biologie des Balatonsees*, Dr. Geza Entz, Dr. A. Weiss, and Theodore Kormos, Dr. Josef Pantocsek, 79; *Social- und Anthro-geographie des Balatonsees*, Gyula Rhé, Dr. Johann Janko and Dr. Willibald Semayer, 79; *Bibliographie des Balatonsees*, Julius von Sziklay, 79; *Spezialkarte der Balatonsees und seiner Umgebung*, Dr. Ludwig von Loczy, 79
- Baldwin (James Mark), Thoughts and Things or Genetic Logic, 1
- Baldwin (J. M.), Behaviour of Iron under Weak Periodic Magnetising Forces, 70
- Baldwin-Wiseman (Mr.), Relationship between the Porosity of Rocks and the Flow of Water through the Interstices, 110
- Balfour (Andrew), Second Report of the Wellcome Research Laboratories at Gordon Memorial College, Khar-toum, 351
- Ball (Lionel C.), Black Ridge, Clermont, 377
- Ballistics: Flight of an Elongated Shot, P. D. Strachan, 367; Prof. A. G. Greenhill, F.R.S., 367; J. W. Sharpe, 391
- Ballot-box, the, F. H. Perry-Coste, 509; Dr. Francis Galton, 509
- Bamber (Kelway), the Preparation of Rubber, 377
- Banks (A. J.), a New Chemical Test for Strength in Wheat, 460
- Barger (G.), the Alkaloids of Ergot, 406
- Barker (T. V.), Growth of Crystals of Soluble Salts on Each Other, 119
- Barkla (Dr. Charles G.), the Atomic Weight of Nickel, 368
- Barlow (W.), Development of the Atomic Theory, 94
- Barnard (Prof.), the Zodiacal Light, 16; the System of 61 Cygni, 40; an Interesting Visible Star, 64; Photographic Observations of Giacobini's 1905 Comet, 111; Observations of Nova Sagittarii, 137; Some Remarkable Small Nebulae, 159; a Lost Comet (1905 f), 402
- Barnes (Howard T.), Ice Formation, with Special Reference to Anchor-ice and Frazil, 267
- Barometer, the Recent High, 330
- Barratt (Dr. J. O. Wakelin), Oponins in Relation to Red Blood Cells, 188
- Barrett (C. L.), Origin of Parasitic Habits in Cuckoos, 135
- Barrett (E.), the Velocity of Reaction of Bromine with some Unsaturated Acids in Aqueous Solutions, 359
- Barrett (W. F.), Introductory Practical Physics, 436
- Barrow (G.), Geology of the Isles of Scilly, 305
- Barrowcliff (M.), Constitution of Chaulmoogric and Hydrocarpic Acids, 503
- Bastian (Dr. H. Charlton, F.R.S.), on De-Novo Origin of Bacteria, Bacilli, Vibriones, Micrococci, Torulae, and Moulds in certain Previously-superheated Saline Solutions contained within Hermetically-sealed Tubes, Lecture at Royal Medical and Chirurgical Society, 425
- Bates (Mr.), Spectrum Lines as Light Sources, 233
- Bathymetrical Survey of Scottish Lakes, 470
- Bats, Breeding Habits of British, Arthur Whitaker, 495
- Bauschinger (Dr.), Minor Planets, 40; Recently Discovered Asteroids, 469
- Baxter (Gregory P.), Revision of the Atomic Weight of Bromine, 85
- Baylac (J.), Toxic Effects of Oysters, 456
- Bayley (R. Child), the Complete Photographer, 75
- Beard (Dr. J.), the Treatment of Cancer, 247
- Beare (John I.), Greek Theories of Elementary Cognition from Alcmaeon to Aristotle, 122
- Beaumont (W. Worby), Motor Vehicles and Motors: their Design, Construction, and Working by Steam, Oil, and Electricity, 457; Petrol Motor-omnibuses, 517
- Beazley (C. Raymond), the Dawn of Modern Geography, 343
- Beck (Prof.), the Relation between Ore Veins and Pegmatites, 258
- Beck (T. C.), Resolution of Tetrahydro-p-toluquinaldine into its Optically Active Components, 358
- Becker (Prof. E.), Comet 1905 IV., 593
- Bequerel (Henri), Phosphorescence of Uranium Salts in Liquid Air, 479; Contribution to the Study of Phosphorescence, 575
- Bequerel (Jean), Influence of Temperature on Absorption in Crystals, 455
- Bequerel (Paul), the Respiration of Seeds in the State of Latent Life, 191
- Beddard (A. P.), the Relation of the Kidneys to Metabolism, 357
- Bedford (C. H.), Determination of Higher Alcohols in Spirits, the "Ester-Iodine" Method, 334
- Bedford (Duke of, K.G.), Seventh Report of the Woburn Experimental Fruit Farm, 569
- Beldam (G. W.), Great Bowlers and Fielders, 8
- Belgian International Balloon Service, the, 572
- Bell (Alexander Graham), Lectures upon the Mechanism of Speech, 196
- Bell (J. M.), Geology of the Hokitika Sheet, 306
- Bellamy (Mr.), Two Stars with a Common Proper Motion, 208
- Belot (Émile), Formula Applicable to the Times of Direct Rotation of the Planets and the Sun, 239
- Benoit (A.), Naked-eye Observations of Venus, 111
- Bentabol y Ureta (Don Horacio), the Causes of Solar Phenomena, 231
- Benzene, Ultra-violet Fluorescence of, Dr. J. Stark, 295
- Berberich (A.), *Astronomischer Jahresbericht*, 6
- Berger (E.), New Method for Estimating Free Sulphur, 239
- Bergholz (Dr. P.), Meteorological Observations, Bremen, 1905, 212
- Bergman (Prof. E. von), Death of, 515
- Bergonié (J.), Measurement of the Radio-chromometric Degree by the Electrostatic Voltmeter in the Utilisation of the Röntgen Rays in Medicine, 287
- Bergtheil (C.), the Efficiency of the Present Process of Natural Indigo Manufacture, 30; Indigo Culture in India, 497; Synthetic and Natural Indigo, 614
- Berkeley (Earl of), Application of Van der Waal's Equation to Solutions, 549
- Berkshire, Highways and Byways in, James Edmund Vincent, 149
- Berlemont (G.), a New Method of Regulating X-ray Tubes, 624
- Bernatsky (Dr. J.), *Physische Geographie des Balatonsees und seiner Umgebung*, 79
- Berry (A. J.), Results of Gauging High Vacua by the Evaporation Test, 310
- Berthaud (J.), New Method of Formation of Organic Compounds of Phosphorus, 239
- Berthelot (Daniel), Molecular Weights of Various Gases Calculated by the Method of Critical Densities, 383
- Berthelot (M.), Combinations between Carbon and Free Nitrogen, 431
- Berthelot (M. P. E.), Death of, 493; Obituary Notice of, P. J. Hartog, 512
- Bertrand (Gabriel), Vicianine, a New Cyanogenetic Glucoside contained in Vetch Seeds, 144; an Extremely Sensitive Method for the Precipitation of Zinc, 167; the Distribution of Vicianine and of its Diastase in the Seeds of Leguminosae, 191
- Bertrand (Prof. Marcel), Death of, 420; Obituary Notice of, M. M. Allorge, 441
- Bevan (E. J.), Researches on Cellulose, 147; Xanthogenic Esters of Starch, 575
- Beyer (E. L.), Death of, 323
- Bezold (Prof. J. F. W.), Death and Obituary Notice of, 397
- Biadego (G. B.), I grandi Trafiori Alpini, 291
- Bidschof (Dr.), the Minor Planet (588) [1906 T.G.], 498; Ephemeris for the Minor Planet (588) [1906 T.G.], 544
- Bigelow (Prof. Frank Hagar), Studies on the Diurnal Periods in the Lower Strata of the Atmosphere, 186
- Biggs (C. V.), the Hermite Electrolytic Process at Poplar, 95
- Bigourdan (G.), Relation between Falls of Barometric Pressure and the Evolution of Fire-damp in Mines, 383

- Bilancioni (Dr. Guglielmo), *Dizionario di Botanica Generali*, 28
- Binet (Alfred), *les Révélations de l'Écriture d'Après un Contrôle scientifique*, 148
- Biology: Jan Ingen-Housz, *Sein Leben und Sein Wirken als Naturforscher und Arzt*, Prof. Julius Wiesner, 3; Statistical Study of Generic Characters of the Coccaceæ, C. E. A. Winslow and Anne F. Rogers, 39; *Die Biologie des Balatonsees*, Dr. Geza Entz, Dr. A. Weiss and Theodore Kormos, Dr. Josef Pantocsek, 79; Specific Adjvants of Experimental Parthenogenesis, Yves Delage, 167; Observations of a Naturalist in the Pacific between 1896 and 1899, H. B. Guppy, 217; the Association of Economic Biologists, 284; the Immortality of the Protozoa, J. Shawcross, 320; Entomology, with Special Reference to its Biological and Economic Aspects, Dr. J. W. Folsom, 340; on the De-Novo Origin of Bacteria, Bacilli, Vibriones, Micrococci, Torulæ, and Moulds in certain Previously Superheated Saline Solutions contained within Hermetically-sealed Tubes, Dr. H. Charlton Bastian, F.R.S., at Royal Medical and Chirurgical Society, 425; the Origin of Flight, Dr. Baron F. Nopcsa, 478; Sex and Character, Otto Weininger, 481; Untersuchungen über Künstlichen Parthenogenese und das Wesen des Befruchtungsvorgangs, Prof. Jacques Loeb, 486; Die Chemische Energie der Lebenden Zellen, Prof. Oscar Loew, 508; the Analysis of Racial Descent in Animals, T. H. Montgomery, jun., 530; the Fluctuations of Sampling to be Expected in Counting with a Hæmacytometer, 542; Biometrical Study of Conjugation in Paramecium, Raymond Pearl, 542; Influence of Parasites on their Hosts, Prof. H. B. Ward, 571; Biologische und Morphologische Untersuchungen über Wasser- und Sumpfpflanzgewächse, Prof. Hugo Glück, 579; Marine Biology: the Marine Biological Association and International Fishery Investigations, 106; Scientific Fishery Investigations, 185; Value of the Osmotic Pressures in the Cells of certain Marine Algæ, B. M. Duggar, 401; Rhythmical Pulsation in Scyphomedusæ, Alfred G. Mayer, 545; *Acanthephyra purpurea* and *A. debilis*, S. W. Kemp, 550; the "Seamignonette" (*Primnoa reseda*), Prof. J. A. Thomson, 566
- Biometrical Study of Conjugation in Paramecium, Raymond Pearl, 542
- Birds: Birds shown to the Children, M. K. C. Scott, 176; British Birds' Nests, How, Where, and When to Find and Identify Them, R. Kearton, 562; the Habits of the Flightless Birds of New Zealand, R. Henry, 595; Glimpses of Australian Bird Life, R. Hall, 595
- Birdwood (Dr. H. M.), Death of, 421
- Birley (Caroline), Death and Obituary Notice of, 421
- Biske (Dr. Felix), Intensification of "Contrast" by Means of a Polariscopes, 498
- Black Man's Mind, at the Back of the, or Notes on the Kingly Office in West Africa, R. E. Dennett, 248
- Blackman (Dr. F. F., F.R.S.), Plant Response as a Means of Physiological Investigation, Prof. Jagadis Chunder Bose, 313
- Blagden (C. O.), Pagan Races of the Malay Peninsula, 415
- Blake (G. S.), Baddeleyite from Ceylon, 574
- Blakesley (Thomas H.), the Principles of Microscopy; a Handbook to the Microscope, Sir A. E. Wright, F.R.S., 386; les Ultramicroscopes, A. Cotton and H. Mouton, 505
- Blakeslev (T. H.), Logarithmic Lazy-tongs and Lattice Works, 622
- Blanc (A.), Action of a Magnetic Field on Ionised Air in Motion, 599
- Blanc (G.), Synthesis of 3:3-dimethyl- and 3:3:6-trimethyl-cyclohexanones, 335
- Bloxham (W. P.), Some Constituents of Natural Indigo, 406
- Blue Hill Observatory, the Twentieth Year at, 593
- Blum (G.), Model to Illustrate Effects of the Earth's Rotation, 448
- Boas (Franz), Kwakiutl Texts, 68
- Bodily Movements, Mathematics of, 146
- Boeke (H. E.), the Dimorphism of Calcium and Barium Carbonates, 39
- Boggs (Dr. T. R.), Method for the Estimation of Proteids in Milk, 14
- Böhlén (Dr. Karl), the Second Globular Cluster in Hercules Messier, 616
- Bolk (Prof. Louis), Das Cerebellum der Säugetiere, Eine vergleichend anatomische Untersuchung, Supp. to March 14, ix
- Bologna Observatory, Prof. Rajna, 41
- Boltwood (Bertram B.), the Production of Radium from Actinium, 54; Radium and its Disintegration Products, 223
- Bongiovanni (Dr.), Influence of Radium on the Virus of Rabies, 15
- Bonney (Prof. T. G.), Southern Origin Attributed to the Northern Zone in the Savoy and Swiss Alps, 622
- Bonnier (Gaston), the Division of Labour amongst Bees, 190
- Books of Science, Forthcoming, 473
- Borchardt (W. G.), Junior Arithmetic with Answers, 74; Junior Arithmetic Examples, 409
- Bordas (M.), Disillation and Desiccation in a Vacuum with the Aid of Low Temperatures, 23
- Bosanquet (Helen), the Family, 78
- Bose (Prof. Jagadis Chunder), Plant Response as a Means of Physiological Investigation, 313
- Botany: Jan Ingen-Housz, *Sein Leben und Sein Wirken als Naturforscher und Arzt*, Prof. Julius Wiesner, 3; the Evolution of the Colorado Spiderwort, Prof. T. D. A. Cockerell, 7; Indian Wheat Rusts, E. J. Butler and J. M. Hayman, 14; Analyses of Bamboo, of the Bark of *Picrasma javanica* and of Latices from a Ficus, D. Hooper, 14; Illustriertes Handwörterbuch der Botanik, Dr. O. Porsch and C. K. Schneider, 28; *Dizionario di Botanica Generali*, Dr. Guglielmo Bilancioni, 28; Guide to the Principal Families of Flowering Plants, J. Adams, 29; Linnean Society, 71, 166, 215, 333, 430, 526, 550, 621; the Structure of Bamboo Leaves, Sir Dietrich Brandis, 71; the Systematic Position of *Hectorella caespitosa*, Hook, f., Prof. A. J. Ewart, 71; the Seeds and Flowers of Callipteris, M. Grand'Eury, 71; Linnean Society, New South Wales, 72, 191, 311; the Stinging Property of the Giant Nettletree, Dr. J. M. Petrie, 72; the Relation of Desert Plants to Soil Moisture and to Evaporation, Dr. B. E. Livingston, 84; Influence of Spectral Colours on the Sporulation of Various Species of Saccharomyces, J. E. Purvis and G. R. Warwick, 95; the Rusts of Australia, their Structure, Nature, and Classification, D. McAlpine, 101; Variations in the Leaves of Ferns Grown in the Sun or in Shade, Miss J. H. M'Ilroy, 109; the Fungus of *Lolium temulentum*, E. M. Freeman, 109; Hydrocyanic Acid in Plants, P. Fitschy, 136-7; the American Gooseberry-mildew, 160, 613; E. S. Salmon, 247; American Gooseberry-mildew in Ireland, Dr. G. H. Pethybridge, 567; Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and Tibet, Lieut-General Sir Richard Strachey, 171; the Distribution of Vicianine and of its Diastase in the Seeds of Leguminosæ, Gabriel Bertrand and Mlle. L. Rivkind, 191; the Respiration of Seeds in the State of Latent Life, Paul Becquerel, 191; Jugendform und Blütenreife im Pflanzenreich, Dr. L. Diels, 194; Old-fashioned Flowers and other Open-air Essays, Maurice Maeterlinck, 199; Rubber Cultivation in the East, and the Ceylon Rubber Exhibition, Dr. J. C. Willis, 209; the Preparation of Rubber, Dr. J. C. Willis, 377; Kelway Bamber, 377; Rubber in the East, 437; the Museum Beetle, *Anthrenus muscorum*, Prof. A. J. Ewart, 215; Observations of a Naturalist in the Pacific between 1896 and 1899, H. B. Guppy, 217; British Flowering Plants, W. F. Kirby, 222; Diseases of Palms, E. J. Butler, 229; Chromogenic Fungi on Wood, G. G. Hedgcock, 280; *Hydnora africana*, Dr. Marloth, 287; Manual of the New Zealand Flora, T. F. Cheeseman, 293; How Ferns Grow, M. Slosson, 298; the Study of Plant Life for Young People, M. C. Stopes, 298; Plant Life-studies in Garden and School, H. F. Jones, 298; the Romance of Plant Life, G. F. Scott-Elliott, 298; the Green Gateway: a Peep into the Plant World, F. G. Heath, 298; Familiar Trees, Prof. G. S. Boulger, 319; Fertilisation of Flowers by Insects, E. W. Swanton, 320; Dr. Alfred R. Wallace, F.R.S., 320; New Species of Cacti, Dr. J. N. Rose, 349; Water Hyacinth a Nuisance in New South Wales, 350; Pre-

- sence of Formaldehyde in Green Plants, G. Kimpflin, 335; the Active Substances of *Tephrosia vogelii*, M. Harriot, 335; Seasonal Botany, a Supplementary Text-book, M. O'Brien Harris, 341; Transpiration Current in Plants, Prof. H. H. Dixon, 358; the Plants of New South Wales, W. A. Dixon, 366; Value of the Osmotic Pressures in the Cells of certain Marine Algæ, B. M. Duggar, 401; Cycads, the Ovule of the Genus *Dioon*, Prof. J. C. Chamberlain, 401; Death of Dr. H. M. Birdwood, 421; Observations of Climbing Plants, Rev. John Gerard, 430; the Life of Sir Charles J. F. Bunbury, Bart., 433; Cyanogenesis in Plants and the Constitution of Phaseolunatin, 452; *Museu Paraense de Historia e Ethnographia, Arboretum Amazonicum*, Dr. J. Huber, 459; Death of Sir Thomas Hanbury, K.C.V.O., 465; Substances Used by the Filipinos for Stupefying or Poisoning Fish, R. F. Bacon, 468; "Bud-rot" of the Cocoa-nut Palm due to Bacteria, 468; Fungi of the Nests of White Ants of Ceylon, T. Petch, 524; Flora of Ritigala, Dr. Willis, 524; Growth under Different Conditions in Ceylon, Blackman's Theory, A. M. Smith, 524; the Leaves of *Passerina*, Madeline Carson, 527; Light Sense-organs in Xerophilous Stems, R. J. D. Graham, 535; the Living *Welwitschia*, Prof. H. H. W. Pearson, 536; Agave, Prof. W. Trelease, 542; Subsidiary Spore-forms, G. R. Lyman, 567; the Orchids of the North-western Himalaya, J. F. Duthie, 587; Peculiar Habitat of a Chlorophyte, *Myxonema tenue*, A. D. Hardy, 599; Variation and Correlation in *Ceratophyllum*, Prof. Raymond Pearl, O. M. Pepper, and F. J. Hagle, 612; Metamorphoses in Plants by Artificial Cultivation, Prof. G. Klebs, 613; the Origin of Angiosperms, E. A. Newell Arber and John Parkin, 621; Migration of Compounds possessing Smell in the Plant, Eugene Charabot and G. Laloue, 624
- Bottom-waters of the Northern Seas, Northern Waters, Captain Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, with a Discussion of the Origin of the, Fridtjof Nansen, 563
- Boulger (Prof. G. S.), Familiar Trees, 319
- Bourne (A. A.), Elementary Geometry, 74
- Boutwell (J. M.), Economic Geology of the Bingham Mining District, Utah, 184
- Bouvier (E. L.), Invertebrate Fauna of the Sargasso Sea, 591
- Bowlers and Fielders, Great, G. W. Beldam and C. B. Fry, 8
- Bowman (I.), Underground Water Resources of Long Island, New York, 183
- Bradley (Prof. O. Charnock), Craniometric Observations on the Skull of *Equus przewalskii* and other Horses, 190
- Bradley-Birt (F. B.), the Romance of an Eastern Capital, 297
- Bragg (Prof.), Ionisation of Gases by α Particles of Radium, 478
- Brakes, the Action of Tram-car, 86
- Brame (J. S. S.), Service Chemistry: a Short Manual of Chemistry and its Applications in the Naval and Military Services, 266
- Brandis (Sir Dietrich, K.C.I.E., F.R.S.), the Structure of Bamboo Leaves, 71; Indian Trees, being an Account of Trees, Shrubs, Woody Climbers, Bamboos, and Palms Indigenous or Commonly Cultivated in the British Empire, 385
- Bréon (Réné), Sands and Shingles of the Pas-de-Calais, 600
- Brewing: Death of Cornelius O'Sullivan, F.R.S., 253; Obituary Notice of, 277
- "Brier Patch Philosophy," W. J. Long, 176
- Briggs (J. F.), Xanthogenic Esters of Starch, 575
- Briggs (Dr. W.), Chemical Analysis, Qualitative and Quantitative, 26
- Brightness of the Sky near the Sun's Limb, the, Prof. Ceraski, 569
- Brindley (H. H.), the Procession of *Cnethocampa pinivorax*, 95
- Briner (E.), Formation of Ammonia Gas from its Elements under the Influence of the Electric Spark; the Influence of Pressure, 575
- Brioschi (Francesco), Opere matematiche di, 291
- Britain and Ireland, the Mammals of Great, J. G. Millais, 271
- British Association, the Leicester Meeting of the, 585
- British Birds' Nests, How, Where, and When to Find and Identify Them, R. Kearton, 562
- British Columbia, the Zoologist and Sportsman in, 410
- British Flowering Plants, W. F. Kirby, 222
- British Inland Waterways, 212
- British Isles: Map of the British Isles, W. and A. K. Johnston, 54; the M.P. Atlas, a Collection of Maps showing the Commercial and Political Interests of the British Isles and Empire throughout the World, 580
- British Journal Photographic Almanac and Photographer's Daily Companion, 1907, 222
- British Monuments, Notes on Ancient, Sir Norman Lockyer, K.C.B., F.R.S., 150
- British Museum, Catalogue of the Lepidoptera Phalænæ in the, vol. vi., Noctuidæ, 366
- British Museum, the History of the Collections Contained in the Natural History Departments of the, 125
- British North America, 1, the Far West: the Home of the Salish and Déné, C. Hill-Tout, 584
- British Rainfall, Dr. Hugh Robert Mill, 5
- British Science Guild, the, 327
- Brogliè (Maurice de), Conditions of Formation of Electrified Centres of Feeble Mobility in Gases, 503
- Bronson (Dr. Howard L.), Effect of Temperature on the Activity of Radium, 262
- Brooke (Colonel John Mercer), Death and Obituary Notice of, 347
- Brooks (A. H.), the Geography and Geology of Alaska, 184
- Brooks (Mr.), an Efficiency Meter for Electric Incandescent Lamps, 233
- Brown (Prof. Adrian J.), Golden Carp attacked by a Toad, 534
- Brown (S. E.), a Practical Chemistry Note-book for Matriculation and Army Candidates, 26
- Brown (Theodore), Direct Stereoscopic Projection, 451
- Brown (W.), Introductory Practical Physics, 436
- Browning (P. E.), Outlines of Qualitative Chemical Analysis, 581
- Brückner (Prof.), Influence of the Ocean upon Continental Precipitation, 211
- Brussels Sociological Society, the, 236
- Bryan (Prof. G. H., F.R.S.), Maximum Gravitational Attraction on a Solid, 439; an Aëronautical Exhibition, 585
- Büchner (Dr. E. H.), the Composition of Thorianite and the Relative Radio-activity of its Constituents, 165
- Buckmaster (Dr. George A.), Anæsthetic and Lethal Quantity of Chloroform in the Blood, 142
- Buckney (F.), an Optically Active Tetrahydroquinoline Compound, 551
- Budapest, International Geodetic Conference at, Sir G. H. Darwin, K.C.B., F.R.S., 33
- Bunbury (Sir Charles J. F., Bart.), the Life of, 433
- Burcharts (H.), Sand-blast Apparatus used for Testing Building Materials at Gross-Lichterfelde Institute, 158
- Burdett (F.), Influence of Light on Diazo-reactions, 215
- Burdon (E. R.), the Origin of the Name Chermes or Kermes, 216
- Burkett (Prof. C. W.), Cotton: its Cultivation, Marketing, Manufacture, and the Problems of the Cotton World, 27
- Burma: a Handbook of Practical Information, Sir J. George Scott, K.C.I.E., 440
- Burns (Mr.), the Spectroscopic Binary λ Andromedæ, 425
- Burrard (Lieut-Col. S. G., F.R.S.), Auxiliary Tables to Facilitate the Calculations of the Survey of India, Supp. to March 14, viii
- Burrows (H.), Condensation of Diethylmalonamide with Aldehydes, 407
- Bursaries at the Royal College of Science, London, Prof. John Perry, F.R.S., 79
- Busquet (R.), a Manual of Hydraulics, 29
- Buss (Mr.), the Helium Line D, in the Solar Spectrum, 281
- Bussard (Leon), Arboriculture Fruitière, 605
- Butler (Chas. P.), Russian Observations of the Solar Eclipse, August 30, 1905, 163
- Butler (E. J.), Indian Wheat Rusts, 14; Diseases of Palms, 229

- Butler (F. H.), Silver Deposit or Sedgman Lode in the Perran Mine, Cornwall, 574
- Cahen (E.), New Cerium Salts, 503
- Cake, Cutting a Round, on Scientific Principles, 173
- Calculus, First Steps in the, A. F. van der Heyden, 29
- Calculus, a Preliminary Course in Differential and Integral, A. H. Angus, 74
- Calcutta, Asiatic Society of Bengal, 191, 240, 504, 511
- Caldwell (R. J.), Hydrolysis of Amygdalin by Acids, 503; Mandelonitrile Glucosides, Prulaurasin, 503
- Calendar, the World's, Rev. J. P. Wiles, 173
- Calorific Emission of the Sun, G. Millochau and C. Féry, 23, 96
- Calorific Radiation of the Sun, the, MM. Millochau and Féry, 40
- Calzavara (Vittorio), I. Motori a Gaz, 291
- Cambridge, the Mathematical Tripos at, Prof. John Perry, F.R.S., 273
- Cambridge Natural History, the, Vol. I., Protozoa, Prof. Marcus Hartog, Porifera (Sponges), Igerna B. L. Sollas, Cœlenterata and Ctenophora, Prof. S. J. S. Hickson, Echinodermata, Prof. E. W. MacBride, F.R.S., 31
- Cambridge, the Needs of the University of, 404
- Cambridge Philosophical Society, 95, 189, 454, 551
- Camp-fires in the Canadian Rockies, Dr. William T. Hornaday, 410
- Campbell (Dr. Malcolm), Effects of a Meat Diet on the Minute Structure of the Uterus, 190
- Campbell (Marius R.), the Duration of the Coal Reserves of the United States, 543
- Campbell (N. R.), Radio-Activity of the Alkali Metals, 189
- Cams, and the Principles of their Construction, George Jepson, 460
- Canada, Geological Survey of, Prof. Frank D. Adams, 149
- Canadian Rockies, Camp-fires in the, Dr. William T. Hornaday, 410
- Canadian Tribes, Two Contrasted Western, C. Hill-Tout, 584
- Canals, Why the Lock System was Adopted for the Panama, Hon. W. H. Taft, 181
- Cancer, Cytological Investigation of, 1906, J. E. S. Moore and C. E. Walker, 587
- Cancer, the Treatment of, 177; Corr, 424; Dr. J. Beard, 247; the Writer of the Article, 247
- Candles, and Glycerine, Modern Soap, L. L. Lamborn, C. Simmonds, 362
- Caoutchouc, Coagulation of the Latex of, and the Elastic Properties of Pure Caoutchouc, Victor Henri, 455
- Cape of Good Hope, the University of the, 461
- Cape Observatory, the, Sir David Gill, 40
- Cape Town, South African Philosophical Society, 192
- Caries (P.), Fluorine in the Shells of Molluscs, 456
- Carle (P.), Causes which Modify the Estimation of Fluorine in Mineral Waters, 359
- Carmody (Prof. P.), Earthquake at Kingston on January 18, 398
- Carol-singers, Nature's, R. Kearton, 176
- Carp, Golden, attacked by a Toad, Prof. Adrian J. Brown, 534
- Carpenter (Prof. H. C. H.), on the Properties of Alloys of Aluminium and Copper, Lecture at the Institution of Mechanical Engineers, 426
- Carnegie Institution of Washington, No. 5, 1906, 607
- Carr (F. H.), the Alkaloids of Ergot, 406
- Carré (P.), Alkaline Reduction of *p*- and *m*-nitrobenzophenone, 287
- Carse (G. A.), Relation between the Ionic Velocity and the Volume of Organic Ions in Aqueous Solutions, 189
- Carshaw (H. S.), Introduction to the Theory of Fourier's Series and Integrals, and the Mathematical Theory of the Conduction of Heat, 459
- Carson (Madeline), the Leaves of Passerina, 527
- Carter (H. J.), Antennæ-joints in Trachiscelis, 622
- Carter (Prof. Oscar C. S.), Government Irrigation Project at Yuma, 591
- Cassiopeiæ, a Peculiar Short-period Variable, 155-1906, Messrs. Müller and Kemp, 327
- Castle (Dr. W. E.), Inheritance in Fishes, 83
- Castor, the Proper Motion of, Mr. Crommelin, 304
- Catalogue of the Lepidoptera, Phalaenae, in the British Museum, Vol. VI., Noctuidæ, 366
- Catania, Solar Observations at, Prof. Ricco, 498
- Caton (Dr. R.), the Gods of Healing of the Egyptians and Greeks, 499
- Cattell (Prof. McKeen), Men of Science in America, 259
- Caven (Dr. R. M.), Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, supp. to March 14, iv
- Caves and Waterways, E. A. Martel, Prof. Grenville A. J. Cole, 508
- Cecil (Rev. Lord William Gascoyne), Science and Religion, 126
- Celestial Photographs, the late Dr. Roberts's, 402
- Cell and Heredity, the, 98
- Cellulose, Researches on, C. F. Cross and E. J. Bevan, Dr. Arthur Harden, 147
- Century's Progress in Astronomy, a, Hector Macpherson, 173
- β Cephei, the Period of, Prof. Frost, 159
- Cerambycidae, Coleoptera, Vol. I., the Fauna of British India, including Ceylon and Burma, C. J. Gahan, 222
- Ceraski (Prof.), the Brightness of the Sky near the Sun's Limb, 569
- Cerebellum der Säugetiere, Das, Eine vergleichend anatomische Untersuchung, Prof. Louis Bolk, Prof. J. S. Macdonald, Supp. to March 14, ix
- Céruse et Blanc de Zinc, M. G. Petit, 509
- Cesáro (Prof. Ernesto), Obituary Notice of, Prof. Ernesto Pascal, 254
- Ceylon, Hunting and Shooting in, H. Story, 492
- Ceylon Rubber Exhibition, Rubber Cultivation in the East and the, Dr. J. C. Willis, 209
- Ceylon, Scientific Work in the Straits Settlements and, 594
- Chablay (E.), the Transformation of Cinnamic Alcohol into Phenylpropylene and Phenylpropyl Alcohol by the Metal Ammoniums, 143; New Method of Estimating the Halogens in Organic Compounds by Means of the Metal Ammoniums, 360
- Chabrie (C.), Gases Observed in the Attack of Tantalite by Potash, 71; New Chloride of Tantalum, 624
- Chadwick (H. Munro), the Origin of the English Nation, 555
- Challenger Society, 70, 383
- Chalmers (S. D.), a Method of Testing Prisms, 451
- Chamberlain (Prof. J. C.), Cycads, the Ovule of the Genus *Dioon*, 401
- Chance, a Problem in, Geo. P. Mudge, 461
- Chandler (Dr. William H.), Death of, 155
- Chapman (Dr. H. G.), the Action of Rennin, 191
- Charabot (Eugene), Migration of Compounds possessing Smell in the Plant, 624
- Character, Sex and, Otto Weininger, 481
- Charcoal, Absorption of the Inert Gases by, Sir James Dewar, F.R.S., 126
- Charcoal, Absorption of the Radio-active Emanations by, Sir James Dewar, F.R.S., 6
- Charpy (G.), the Use of Special Steels for Rivets, 239
- Charrin (M.), Fundamental Differences in the Mechanism and Evolution of the Increase of Resistance to Infection according to the Methods Utilised, 432
- Chase (Frederick L.), Parallax Investigations on 163 Stars, mainly of Large Proper Motion, 234
- Chattaway (F. D.), Obituary Notice of Prof. H. W. Bakhuis-Roozeboom, 464
- Chavassieu (M.), a Colour Reaction given by Reducing Sugars by *m*-Dinitrobenzene in Alkaline Solution, 191
- Cheeseman (T. F.), Manual of the New Zealand Flora, 293
- Chemistry: the Chemistry of Paints and Paint Vehicles, Clare H. Hall, 4; Method for the Estimation of Proteids in Milk, Dr. T. R. Boggs, 14; Analyses of Bamboo, of the Bark of *Picrasma javanica* and of Latices from a Ficus, D. Hooper, 14; Chemical Society, 23, 94, 118, 215, 262, 358, 406, 477, 503, 575; Conversion of Morphine and Codeine into Optical Isomerides, F. H. Lees and F. Tutin, 23; Pinocamphylamine, W. A. Tilden and F. G. Shephard, 23; the Nature of Ammoniacal Copper Solutions, H. M. Dawson, 23; the Existence of Chloride of Bromine, Paul Lebeau, 23; Revision of the Atomic Weight of Bromine, Gregory P. Baxter, 85; the Colouring Matters of the Stilbene Group, part iii., A. G. Green

and P. F. Crosland, 23; a Black Modification of Chromium Sesquioxide, E. A. Werner, 23; the So-called "Benzidine Chromate," J. Moir, 23; New Derivatives of Diphenol, J. Moir, 23; Interaction of the Alkyl Sulphates with the Nitrites of the Alkali Metals and Metals of the Alkaline Earths, P. C. Ray and P. Neogi, 23; Electrolytic Preparation of Dialkyldisulphides, T. S. Price and D. F. Twiss, 23; the Action of Nitrogen Sulphide on certain Metallic Chlorides, O. C. M. Davis, 23; the Pure Alloys of Tungsten and Manganese, and the Preparation of Tungsten, G. Arrivaut, 24; the Products of Condensation of Acetylenic Esters with Amines, Ch. Moureu and I. Lazennec, 24; the Atomic Weight of Dysprosium, G. Urbain and M. Demenitroux, 24; the Presence of Formal in certain Foods, G. Perrier, 24; Protoxide of Cæsium, E. Rengade, 24; a Practical Chemistry Note-book for Matriculation and Army Candidates, S. E. Brown, 26; Chemistry Note-books, E. J. Sumner, 26; the Science of Common Life, J. B. Coppock, 26; Practical Methods of Inorganic Chemistry, Dr. F. M. Perkin, 26; Chemical Analysis, Qualitative and Quantitative, Drs. W. Briggs and R. W. Stewart, 26; Methods of Organic Analysis, Dr. H. C. Sherman, 26; the Efficiency of the Present Process of Natural Indigo Manufacture, C. Bergtheil, 30; Constituents of Natural Indigo, A. G. Perkin, 477; some Constituents of Natural Indigo, A. G. Perkin and W. P. Bloxam, 406; the Rusting of Iron, Rev. Joseph Meehan, 31; Prof. Wyndham R. Dunstan, F.R.S., 390, 477; Dr. G. T. Moody, 438, 575; C. E. Stromeyer, 461; the Dimorphism of Calcium and Barium Carbonates, H. E. Boeke, 39; Migration of the Phenyl Group, M. Tiffeneau, 48; Death and Obituary Notice of Prof. A. K. Christomanos, 61; Gases observed in the Attack of Tantalite by Potash, C. Chabrie and F. Levallois, 71; the Alcoholysis of Fatty Bodies, A. Haller, 71; Selenium, (Echsner de Coninck, 71; Albumin from the Eggs of Fish: Comparison with Vitelline from Hens' Eggs, L. Hugoung, 71; Development of the Atomic Theory, W. Barlow and W. J. Pope, 94; Hydrolysis of "Nitrocellulose" and "Nitroglycerine," O. Silberrad and R. C. Farmer, 94; Acidic Constants of some Ureides and Uric Acid Derivatives, J. K. Wood, 94; the Depreciation of Electrolytically-produced Solutions of Sodium Hypochlorite, W. P. Digby, 95; the Hermite Electrolytic Process at Poplar, C. V. Biggs, 95; Reduction of Molybdic Acid in Solution by Molybdenum, M. Guichard, 96; Xanthone and Xanthidrol, R. Fosse, 96; some Founders of the Chemical Industry Men to be Remembered, T. Fenwick Allen, Dr. T. E. Thorpe, C.B., F.R.S., 100; Presence of Neon in Radio-active Minerals, Hon. R. J. Strutt, F.R.S., 102; the Study of Pseudo-solution, the Colloidal Forms of Ferric Hydroxide, F. Giolitti, 110; Determination of the Rate of Chemical Change by Measurement of Gases Evolved, F. E. E. Lamplough, 118; Anhydride of Phenylsuccinic Acid, F. B. Dehn and J. F. Thorpe, 118; Influence of Sodium Arsenate on the Fermentation of Glucose by Yeast-juice, A. Harden and W. J. Young, 118; the Organic Phosphorus Compound formed by Yeast-juice from Soluble Phosphates, W. J. Young, 477; the Elements of Chemical Engineering, Dr. J. Grossmann, 125; Radium, Actinium, and Helium, H. S. Allen, 126; Action of Radium and certain other Salts on Gelatin, W. A. Douglas Rudge, 141; Ionisation of Gases by α Particles of Radium, Prof. Bragg, 478; Enzymes capable of Possessing more than One Kind of Activity, L. Marino and G. Fiorentino, 136; Hydrocyanic Acid in Plants, P. Fitsch, 136-7; Alcoholysis of Cocoa Butter, A. Haller and M. Youssoufian, 143; Detection and Estimation of Methane and Carbon Monoxide, Nestor Gréhaut, 143; a Mode of Preparation of Hydrated Hypovanadic Acid, Gustave Gain, 143; Elements producing Phosphorescence in Minerals, G. Urbain, 143; the Transformation of Cinnamic Alcohol into Phenylpropylene and Phenylpropyl Alcohol by the Metal-ammoniums, E. Chablay, 143; New Method of Estimating the Halogens in Organic Compounds by means of the Metal Ammoniums, E. Chablay, 360; Method of Preparing the Oxynitrites ROCH_2CN , D. Gauthier, 143; Vicianine, a New Cyanogenetic Glucoside contained in Vetch Seeds, Gabriel Bertrand, 144;

the Culture of the Artificial Cell, Stéphane Leduc, 144; Preservatives in Food and Food Examination, Dr. John C. Thresh and Dr. A. E. Porter, C. Simmonds, 145; Chemical Structure of Cellulose, C. F. Cross and E. J. Bevan, Dr. Arthur Harden, 147; Death of Dr. William H. Chandler, 155; the Composition of Thorianite, and the Relative Radio-activity of its Constituents, Dr. E. H. Büchner, 165; Reduction of Oxide of Chromium by Boron, Binet du Jassonneix, 167; an Extremely Sensitive Method for the Precipitation of Zinc, Gabriel Bertrand and Maurice Javillier, 167; Nitrites and Carbamines, P. Lemoult, 167; Esterification of Arsenious Anhydride by Alcohols and Phenols, V. Auger, 167; the Constitution of Hordenine, E. Léger, 168; a History of Chemistry from Earliest Times to the Present Day, Ernst von Meyer, 169; a History of Chemistry, F. P. Armitage, 169; Radio-active Impurity in Ordinary Lead, Messrs. Elster and Geitel, 181; Material obtained by Decomposing a Solution of Hydrogen Sulphide with Sulphur Dioxide, a Hydrate having the Composition $\text{S}_2\text{H}_2\text{O}$, Prof. W. Spring, 182; a Delicate Reaction for Carbohydrates, Dr. Fenton, 189; Xanthoxalanil and its Analogues, S. Ruhemann, 189; the Solubility of Stereoisomerides in Optically-active Solvents, H. O. Jones, 190; Estimation of Copper, W. H. Foster, 190; the Action of Rennin, A. H. Moseley and Dr. H. G. Chapman, 191; a Colour Reaction given by reducing Sugars by *m*-Dinitrobenzene in Alkaline Solution, MM. Chavassieu and Morel, 191; a Tetrabromo-derivative of Methylalketone, M. Pastureau, 191; the Distribution of Vicianine and of its Diastase in the Seeds of Leguminosae, Gabriel Bertrand and Mlle. L. Rivkind, 191; Action of reducing Agents on 5-chloro-3-keto-1:1-dimethyl- Δ^2 -tetrahydrobenzene, A. W. Crossley and Miss N. Renouf, 215; a New Trinitroacetaminophenol and its Use as a Synthetical Agent, R. Meldola, 215; some Derivatives of Benzophenone, W. H. Perkin, Jun., and R. Robinson, 215; Influence of Light on Diazo-reactions, K. J. P. Orton, J. E. Coates, and F. Burdett, 215; Society of Chemical Industry, 215, 334, 383, 527, 622; the Direct Estimation of Antimony, H. W. Rowell, 215; Petroleum and its Products, Sir Boverton Redwood, 218; Anhydrous Protoxides of the Alkaline Metals, E. Rengade, 239; a Colloidal Compound of Thorium with Uranium, Béla Szilard, 239; Definite Compounds formed by Chromium and Boron, Binet du Jassonneix, 239; New Method for Estimating Free Sulphur, E. Berger, 239; the Hydroxamic Acids, R. Marquis, 239; New Method of Formation of Organic Compounds of Phosphorus, J. Berthaud, 239; a Butyric Lactone and Unsymmetrical Dimethyl-butylene Glycol, Louis Henry, 263; a New Manganese Silicide, G. Gin, 263; Solubility of Carbon in Manganese Sulphide, M. Houdard, 263; the Density of Gaseous Hydrochloric Acid, the Atomic Weight of Chlorine, Ph. A. Guye and G. Ter-Gazarian, 263; the Condensation of Hydrazines with Acetylenic Nitrides, Ch. Moureu and I. Lazennec, 263; New Laboratory Method for the Preparation of Hydrogen Sulphide, F. R. L. Wilson, 262; Affinity Constants of Aminocarboxylic and Aminosulphonic Acids as determined by the Aid of Methyl-orange, V. H. Veley, 262; Formulæ for Calculating Molecular Volumes of Complex Paraffins and Alcohols, G. Le Bas, 263; Service Chemistry: a Short Manual of Chemistry and its Applications in the Naval and Military Services, Vivian B. Lewes and J. S. S. Brame, 266; the New Physics and Chemistry: a Series of Popular Essays on Physical and Chemical Subjects, W. A. Shenstone, F.R.S., 269; Growing "Alumina," T. A. Vaughton, 281; the Distillation of Alloys of Silver and Copper, Silver and Tin, and Silver and Lead, Henri Moissan and Tosio Wetanabe, 287; Alkaline Reduction of *p*- and *m*-nitrobenzophenone, P. Carré, 287; Calcium as an Absorbent of Gases, and its Applications in the Production of High Vacua and for Spectroscopic Research, Frederick Soddy, 309; Results of Gauging High Vacua by the Evaporation Test, A. J. Berry, 310; a Sulphate of Chromium the Acid of which is Entirely Hidden, Albert Colson, 311; a Continuous Apparatus for the Preparation of Pure Oxygen, A. Seyewetz and M. Poizat, 311; Cours de Chimie organique, Fréd. Swarts, 316; Death and Obituary Notice

- of Prof. M. I. Konowaloff, 323; Determination of Higher Alcohols in Spirits, the "Ester-iodine" Method, C. H. Bedford and R. L. Jenks, 334; Preparation of Pure Helium by Filtration of Gases from Cleveite through a Wall of Silica, Adrien Jaquero and F. Louis Perrot, 335; Synthesis of 3:3-dimethyl-and 3:3:6-trimethyl-cyclohexanones, G. Blanc, 335; Synthesis of Natural Erythrite, M. Lespiau, 335; Presence of Formaldehyde in Green Plants, G. Kimpflin, 335; Reduction of Carbon Dioxide to Formaldehyde, Dr. Fenton, 551; the Active Substances of *Tephrosia vogelii*, M. Hanriot, 335; Practical Exercises in Chemistry, G. C. Donington, 341; Death of Prof. D. I. Mendeléeff, 347; Obituary Notice of, Dr. T. E. Thorpe, F.R.S., 371; Relation of Chemical Activity to Electrolytic Conductivity, John L. Sammis, 350; Organic Derivatives of Silicon, ii., *dl*-benzylethylpropylsilicol, F. S. Kipping, 358; the Association of Phenols in the Liquid Condition, J. T. Hewitt and T. F. Winnil, 358; a New Mercuric Oxchloride, J. T. Hewitt, 358; Preparation of Chromyl Dichloride, H. D. Law and F. M. Perkin, 358; the Relation of Colour and Fluorescence to Constitution, A. G. Green, 358; Resolution of Tetrahydro-p-toluquinaldine into its Optically-active Components, T. C. Beck and W. J. Pope, 358; the Velocity of Reaction of Bromine with some Unsaturated Acids in Aqueous Solution, E. Barrett and A. Lapworth, 359; the Solubility of Carbon in Barium and Strontium Carbides, H. Morel Kahn, 359; Copper Metaphosphate, V. Auger, 359; Causes which Modify the Estimation of Fluorine in Mineral Waters, P. Carle, 359; Acetyl Nitrate, Amé Pictet and Eugène Khotinsky, 360; Ethyl Benzoylglyoxylate, A. Wahl, 360; Modern Soap, Candles, and Glycerin, L. L. Lamborn and C. Simmonds, 362; the Atomic Weight of Nickel, Dr. Charles G. Barkla, 368; F. E. Hackett, 535; Molecular Weights of various Gases calculated by the method of Critical Densities, Daniel Berthelot, 383; some Reactions of Sodium Amide, Louis Meunier and E. Desparmet, 383; Chemical Composition of some Motor-tyre Rubbers, Dr. P. Schidrowitz and F. Kaye, 383; Einführung in die mikroskopische Analyse der Drogenpulver, Dr. L. Koch, 390; a New Chemical Test for Strength in Wheat Flour, T. B. Wood, 391; Dr. E. Frankland Armstrong, 439; A. J. Banks, 460; Obituary Notice of Prof. N. A. Menshutkin, 397; the Rapid Electro-analytical Deposition and Separation of Metals, part i., the Metals of the Silver and Copper Groups and Zinc, H. J. S. Sand, 406; the Alkaloids of Ergot, G. Barger and F. H. Carr, 406; the Absorption Spectra of Phthalic, Isophthalic, and Terephthalic Acids, Phthalic Anhydride, and Phthalimide, W. N. Hartley and E. P. Hedley, 406-7; Preparation of Acylcampholic Esters, A. Haller and Charles Weimann, 407; Camphor- β -sulphinic Acid and Camphorylsulphonium Bases, S. Smiles and T. P. Hilditch, 407; Condensation of Salicylamide with Aryl Aldehydes, C. A. Keane and W. W. S. Nicholls, 407; Condensation of Diethylmalonamide with Aldehydes, H. Burrows and C. A. Keane, 407; Catalytic Reduction of Unsaturated Ethyl Esters, G. Darzens, 408; Transformations of Primary Saturated Alcohols into the Corresponding Monobasic Acids, H. Fournier, 408; Physical Chemistry for Electrical Engineers, J. Livingston R. Morgan, 413; Death and Obituary Notice of Prof. Henri Moissan, Dr. R. S. Hutton, 419; the Transformation of Orthorhombic Sulphur, G. A. Rankin, 424; Osmotic Pressure from the Standpoint of the Kinetic Theory, Dr. T. M. Lowry, 429; Bearing of Actual Osmotic Experiments upon the Conception of the Nature of Solutions, Prof. L. Kahlenberg, 430; Summary of Experiments made with Glucose and Cane-sugar, H. N. Morse, 430; Combinations between Carbon and Free Nitrogen, M. Berthelot, 431; Catalytic Reactions Effected under the Influence of Wood Charcoal, Georges Lemoine, 431; Molecular Combinations of Metallic Halides with Organic Compounds, V. Thomas, 431; Reducing and Catalytic Power of Amorphous Carbon towards Alcohols, J. B. Senderens, 431; Positions of Mendeléeff's Group of Chemical Elements, C. E. Stromeyer, 431; Nomenclature of the Proteins, W. S. Giles, 439; Cyanogenesis in Plants and the Constitution of Phaseolunatin, 452; Electrolytic Alkali and Bleach Industry, J. B. C. Ker-
- shaw, 454; Fluorine in the Shells of Molluscs, P. Caries, 456; the Principles and Practice of Agricultural Analysis, Dr. H. W. Wiley, 458; Death and Obituary Notice of Prof. H. W. Bakhuys-Roozeboom, F. D. Chattaway, 464; New Iron Carbonyl, and on the Action of Light and Heat on the Iron Carbonyls, Sir James Dewar, F.R.S., and Dr. H. O. Jones, 477; Constitution of Hydroxyazo-compounds, W. B. Tuck, 477; Displacement of Halogens by Hydroxyl, G. Senter, 477; Velocity of Hydrolysis of Aliphatic Amides, J. C. Crocker, 477; Contribution to the Chemistry of the Rare Earths, M. Esposito, 477; Synthesis of Carvestrene and its Derivatives, W. H. Perkin, jun., and G. Tattersall, 478; Alcoholysis of Castor Oil, A. Haller, 479; Purification of Sewage, A. Muntz and E. Lainé, 479; the Constitution of the Atom, H. Pellat, 479; New Modes of Formation and Preparation of Titanium Tetrachloride, Em. Vigouroux and G. Arrivaut, 479; Death of Marcellin P. E. Berthelot, 493; Obituary Notice of, P. J. Hartog, 512; Funeral of M. and Mme. Berthelot, 514; Constitution of Chaulmoogric and Hydnocarpic Acids, M. Barrowcliff and F. B. Power, 503; Hydrolysis of Amygdalin by Acids, R. J. Caldwell and S. L. Courtauld, 503; Mandelonitrile Glycosides, Prulaurasin, R. J. Caldwell and S. L. Courtauld, 503; Hydrolysis of Amygdalin by Emulsin, S. J. M. Auld, 503; New Cerium Salts, G. T. Morgan and E. Cahen, 503; Depression of the Freezing-point of Aqueous Solutions of Hydrogen Peroxide by Potassium, Persulphate, and other Compounds, T. S. Price, 503; the Direct Dehydration of Dimethyl-isopropyl Carbinol, Louis Henry, 503; an Exact Method of Separating Ammonia and Methylamine, Maurice François, 504; Influence of Manganese Salts on Alcoholic Fermentation, E. Kayser and H. Marchand, 504; Die Chemische Energie der lebenden Zellen, Prof. Oscar Loew, 508; German Science Reader, C. R. Dow, 509; Ketene, N. T. M. Wilsmore and A. W. Stewart, 510; Death and Obituary Notice of Robert Warrington, F.R.S., 511; Modern Views of the Ether, Dr. Oliver Lodge, F.R.S., 519; the Lighter Constituents of Air, J. E. Coates, 526; Five Years' Experience in Measuring and Testing Producer Gas, R. Threlfall, F.R.S., 527; Ionisation of the Chromium Sulphates, Albert Colson, 528; the Alloys of Nickel and Tin, E. M. Vigouroux, 528; Nature of the Body extracted from Certain Rich Alloys of Nickel and Tin, E. M. Vigouroux, 576; Influence of Manganese Salts on Alcoholic Fermentation, E. Kayser and H. Marchand, 576; Inequality of the Resistance of Natural Starch and Artificial Amylose towards Extract of Barley, J. Wolff and A. Fernbach, 528; a Property of Platinum Amalgam, H. Moissan, 528; Arachic Alcohol from the Palm *Raphia ruffia* of Madagascar, A. Haller, 528; Chemische Kristallographie, P. Groth, Dr. A. E. H. Tutton, F.R.S., 529; the Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes, A. A. Campbell Swinton, 550; Dithioxanthoxalanil and its Homologues, S. Ruhemann, 551; an Optically-active Tetrahydroquinoline Compound, F. Buckney, 551; a Series of Substituted Bromanilines, J. R. Hill, 551; Resolution of Salts of Asymmetric Nitrogen Compounds and Weak Organic Acids, Miss A. Homer, 552; a New Coloured Fluorescent Hydrocarbon, Miss A. Homer, 552; Organic Derivatives of Silicon, F. S. Kipping, 575; Reduction of Carbon Dioxide to Formaldehyde in Aqueous Solution, H. J. H. Fenton, 575; Influence of Non-electrolytes and Electrolytes on the Solubility of Sparingly Soluble Gases in Water, J. C. Philip, 575; Trimethyl-platinimethyl Hydroxide and its Salts, W. J. Pope and S. J. Peachey, 575; the Decomposition of Mercurous and Silver Hyponitrites by Heat, P. C. Ray and A. C. Ganguli, 575; an Extension of the Benzoin Synthesis, R. W. L. Clarke and A. Lapworth, 575; Xanthogenic Esters of Starch, C. F. Cross, E. J. Bevan, and J. F. Briggs, 575; an Isomeric Change of Dehydracetic Acid, J. N. Collie and T. P. Hilditch, 575; Formation of Ammonia Gas from its Elements under the Influence of the Electric Spark; the Influence of Pressure, E. Briner and E. Mettler, 575; Notes on Qualitative Analysis, Concise and Explanatory, H. J. H. Fenton, 581; Church's Laboratory Guide, Prof. E. Kinch, 581; Inorganic Qualitative Chemical Analysis for Advanced

- Schools and Colleges, W. S. Leavenworth, 581; Outlines of Qualitative Chemical Analysis, F. A. Gooch and P. E. Browning, 581; Qualitative Analysis as a Laboratory Basis for the Study of General Inorganic Chemistry, W. C. Morgan, 581; Smaller Chemical Analysis, G. S. Newth, 581; the Chemistry of Globulin, William Sutherland, 598; Constitution of the Atom, and the Law of Colomb, H. Pellat, 599; Properties of the Alkaline Protoxides, E. Rengade, 600; a History of Chemical Theory and Laws, M. M. Pattison Muir, 601; Death and Obituary Notice of George E. Davis, 611; Problems of Applied Chemistry, Prof. George Lunge at the Royal Institution, 617; the Potential of Hydrogen liberated from Metallic Surfaces, H. Nutton and R. D. Law, 621; Cotton and Nitrated Cotton, H. de Mosenthal, 622; Hydrates in Aqueous Solutions of Electrolytes, Rev. S. M. Johnstone, 623; Application to Pyridine of the Method of Direct Hydrogenation by Nickel, Paul Sabatier and A. Mailhe, 623; Researches on Ammonium, Henri Moissan, 624; Reduction of Magnesia by Carbon, Paul Lebeau, 624; Sulphide of Aluminium and its Combinations with Manganese and Iron Sulphides, Marcel Houdard, 624; New Chloride of Tantalum, C. Chabrie, 624; Method of Synthesis of Non-substituted β -ketonic Amides, Ch. Moureu and I. Lazennec, 624; Introduction to General Inorganic Chemistry, Prof. Alexander Smith, Prof. Arthur Smithells, F.R.S., Supp. to March 14, iv.; Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Dr. R. M. Caven and Dr. G. D. Lander, Prof. Arthur Smithells, F.R.S., Supp. to March 14, iv.; Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi.
- Cheston (H. C.), Physics—Theoretical and Descriptive, 436
- Cheval, le, H. J. Gobert, 337
- Child (J. M.), Trigonometry for Beginners, 409
- Children, Birds shown to the, M. K. C. Scott, 176
- Chinese Astronomy, Ancient, M. de Saussure, 544
- Chisholm (Geo. G.), a Progressive Course of Comparative Geography on the Concentric System, P. H. L'Estrange, Supp. to March 14, v, Philips' Progressive Atlas of Modern Geography, Supp. to March 14, v; Stanford's Octavo Atlas of Modern Geography, Supp. to March 14, v
- Cholnoky (Dr. E. von), Physische Geographie des Balatonsees und seiner Umgebung, 79
- Chree (Dr. Charles, F.R.S.), Studies on the Diurnal Periods in the Lower Strata of the Atmosphere, Prof. Frank Hagar Bigelow, 186; Auroral and Sun-spot Frequencies Contrasted, 188; Magnetic Storm and Aurora on February 9-10, 367; some New Methods in Meteorology, 415
- Christian Churches, Incubation, or the Cure of Disease in Pagan Temples and, Mary Hamilton, 366
- Christomanos (Prof. A. K.), Death and Obituary Notice of, 61
- Christophers (Captain), *Leucocytosoon canis*, a Parasite of the Dog, 400
- Christophers (Capt. S. R.), the Anatomy and Histology of Ticks, 523
- Chromosphere, Silicon in the, Mr. Fowler, 304
- Chronology: Time and Clocks: a Description of Ancient and Modern Methods of Measuring Time, H. H. Cunynghame, C.B., 269
- Church (Prof. Irving P.), Hydraulic Motors with Related Subjects, including Centrifugal Pumps, Pipes, and Open Channels, 50
- Church's Laboratory Guide, Prof. E. Kinch, 581
- Civil Service, Science in Examinations for the Higher, 260
- Claremont (Leopold), the Gem-cutter's Craft, 321
- Clarke (G. A.), Brilliant Aurora on February 9, 374
- Clarke (R. W. L.), an Extension of the Benzoin Synthesis, 575
- Clayden (A. W.), the History of Devonshire Scenery: an Essay in Geographical Evolution, 127
- Clayden (Arthur W.), Green Sunset Colours, 295
- Clays, their Occurrence, Properties, and Uses, with Especial Reference to those of the United States, Dr. Heinrich Ries, 411
- Clayton (Rev. A. C.), the Paraiyan of Southern India, 207
- Clement (Mr.), Minerals of the Composition $MgSiO_3$, 596
- Clerk (Dugald), Thermodynamics of the Internal-combustion Engine, 446; Flame the Working Fluid in Gas and Petrol Engines, Lecture at Royal Institution, 546
- Clerke (Agnes M.), Death and Obituary Notice of, 299
- Climatological Atlas of India, Sir John Eliot, K.C.I.E., F.R.S., Prof. J. Hann, 241
- Clive's Mathematical Tables, 482
- Clive's New Shilling Arithmetic, 409
- Clocks, Time and, a Description of Ancient and Modern Methods of Measuring Time, H. H. Cunynghame, C.B., 269
- Coal, Storing, under Water, 14
- Coal-dust Problem, the, James Ashworth, 496
- Coal-dust, Dangers of, Reports on the Wingate Grange Colliery Explosion on October 14th, 1906, 567
- Coal Mining, the Principles and Practice of, James Tonge, 364
- Coal Question, the, W. Stanley Jevons, 244
- Coates (J. E.), Influence of Light-diazo-reactions, 215; the Lighter Constituents of Air, 526
- Cobb (N. A.), Gumming of Sugar-cane Plants, 38
- Cockerell (Prof. T. D. A.), the Evolution of the Colorado Spiderwort, 7
- Coelenterata and Ctenophora, Prof. S. J. Hickson, 31
- Cœlostet Telescope, a New Form of, Prof. Hale, 424
- Coffin (Prof. J. G.), Construction and Calculation of Inductance Standards, 233
- Cognition, Greek Theories of Elementary, from Alcmaeon to Aristotle, John I. Beare, 122
- Coker (Prof. Ernest G.), an Investigation into the Elastic Constants of Rocks, more Especially with Reference to Cubic Compressibility, 451
- Cole (Prof. Grenville A. J.), the Contact-phenomena at the Junction of Lias and Dolerite at Portrush, 120; Beobachtung als Grundlage der Geographie, 483; La Spéléologie au XX^e Siècle, E. A. Martel, 508
- Coleman (S. E.), the Elements of Physics, 436
- Coleoptera, vol. i., Cerambycidae, the Fauna of British India, including Ceylon and Burma, C. J. Gahan, 222
- Collie (J. N.), an Isomeric Change of Dehydracetic Acid, 575
- Collier (A. J.), Coal Resources of the Cape Lisburne Region, 256
- Collignon (Edouard), Solution of the Cubic Equation, 15
- Collinge (W. E.), a New Gooseberry Pest, 496
- Collins (A. F.), Manual of Wireless Telegraphy, 366
- Collins (F. G.), Emerald-green Sky Colour, 224
- Colorado Spiderwort, the Evolution of the, Prof. T. D. A. Cockerell, 7
- Colour: Death of E. L. Beyer, 323
- Colours, Photography in Natural, Julius Rheinberg, 103
- Colson (Albert), a Sulphate of Chromium the Acid of which is Entirely Hidden, 311; Ionisation of the Chromium Sulphates, 528
- Comagmatic Region, the Roman, Henry S. Washington, 379
- Comets: Discovery of a New Comet, 63; Another New Comet (1906 h), Joel Metcalf, 85; Mr. Hammond, 85; Comet 1906 h (Metcalf), Prof. Hartwig, 111; Dr. E. Strömgren, 111; M. Ebell, 137, 208; E. Esclanson, 159; Prof. Kreutz, 159; Prof. Millosevich, 159; J. Guillaume, 167; Mr. Crawford, 350; Comet 1906 g (Thiele), M. Ebell, 85; Prof. Kreutz, 86; Prof. Hartwig, 111; Dr. E. Strömgren, 111, 159; Prof. Abetti, 137; Prof. Ambronn, 137; Prof. Nijland, 137; Messrs. Aitken and Faith, 231; Ephemeris for Comet 1906 g (Thiele), Georg Dybeck, 257; Halley's Comet, Dr. J. Holetschek, 86; F. W. Henkel, 616; Perturbations of Halley's Comet, Messrs. Cowell and Crommelin, 447; Photographic Observations of Giacobini's 1905 Comet, Prof. Barnard, 111; Photographs of Giacobini's Comet (1905 c), 326; Comet 1906 d (Finlay), M. Ebell, 208; in the Days of the Comet, H. G. Wells, 124; Ephemerides of Comets and Planets, 231; Periodical Comet due to Return in 1907, 282; a Lost Comet (1905 f), Prof. Barnard, 402; Miss Leavitt, 402; Discovery of a Comet (1907 a), Prof. Giacobini, 469; Comet 1907 a (Giacobini), M. Ebell, 497, 518, 569; M. Giacobini, 498, 544; Dr. Rheden, 544; Search-ephemeris for Comet 1900 III. (Giacobini), Herr Abold, 498; Herr Scharbe, 498, 544; Observation of Comet 1905 IV., Dr. Kopff, 518; Prof. E. Becker, 593; Prof. Weiss, 593; a New Comet

- (1907 *b*), Mr. Mellish, 593; Comet 1907 *b* (Mellish), Messrs. Lamson and Frederick, 615
 "Companion to the Observatory," the, 257
 Congo, Rapport sur l'Expédition au, 1903-5, J. Everett Dutton and John L. Todd, Prof. R. T. Hewlett, 351
 Congress: the Tenth International Geological, 64
 Coninck (Echsner), Selenium, 71
 Conway (Prof. A. W.), a Theorem on Moving Distributions of Electricity, 119; Series in Spectra, 479
 Conyngham's (Major), Report on the Pendulum Observations for Determining the Force of Gravity, 403
 Coomaraswamy (Dr. A. K.), Mineralogical Survey of Ceylon, 306
 "Cooper Research Laboratory," Filter Presses, 248
 Copaux (H.), Structure of the Cubical Form of Sodium Chlorate possessing Rotatory Power, 479
 Coppock (J. B.), the Science of Common Life, 26
 Cordeira (F. J. B.), Analogy between Gyroscopes and Cyclones, 158
 Corney (Dr. B. Glanvill), Poisoning by Turtle's Flesh in Fiji, 590
 Cornish (C. J.), Animal Artizans and other Studies of Birds and Beasts, 437
 Cornish (Dr. Vaughan), Progressive Waves in Rivers, 597
 Cornwall, the Crustacea of Devon and, Canon A. M. Norman, F.R.S., and Dr. Thomas Scott, 387
 Correlation, Frequency-curves and, W. Palin Elderton, 507
 Cosmic Mechanism, the, the World Machine, the First Phase, Carl Snyder, 553
 Coste (Maurice), Electrical Conductivity of Selenium, 143
 Cotton: its Cultivation, Marketing, Manufacture, and the Problems of the Cotton World, Prof. C. W. Burkett and C. H. Poe, 27; Cotton Cultivation in the United States of America, 226; Mexican Cotton-boll Weevil, 495
 Cotton (A.), Measurements of the Zeeman Effect on the Blue Lines of Zinc, 335; Les Ultramicroscopes, 505
 Coupin (Dr. H.), the Romance of Animal Arts and Crafts, 76
 Cours d'Astronomie, Prof. H. Andoyer, 148
 Courtauld (S. L.), Hydrolysis of Amygdalin by Acids, 503; Mandelonitrile Glucosides, Prulaurasin, 503
 Coward (T. A.), the Lesser Horseshoe Bat, *Rhinolophus hipposiderus*, 166
 Cowell (P. H., F.R.S.), the Position of Agathocles during the Eclipse of B.C. 310, August 15, 10
 Cowell (Mr.), Perturbations of Halley's Comet, 447
 Cox (W. Gibbons), Irrigation with Surface and Subterranean Water, and Land Drainage, 221
 Cracknell (A. G.), Geometry, Theoretical and Practical, 74
 Cragin (F. W.), Palæontology of the Malone Jurassic Formation of Texas, 183
 Craigie (W. A.), the Origin of the English Nation, H. Munro Chadwick, 555
 Randall (Prof. Charles L.), Text-book on Geodesy and Least Squares Prepared for the Use of Civil Engineering Students, 339
 Craniology: Relative Stature of the Dolichocephalic, Mesaticephalic, and Brachycephalic Inhabitants of East Yorkshire, J. R. Mortimer, 166; Skulls of Horses from the Roman Fort at Newstead, near Melrose, and Observations on the Origin of Domestic Horses, Prof. J. C. Ewart, 190
 Crawford (Mr.), Metcalf's Comet 1906*h*, 350
 Crawley (A. Ernest), Research in India, 41; The Todas, W. H. R. Rivers, 462
 Creatures of the Night, A. W. Rees, 76
 Creodonts?, Marsupials or, W. J. Sinclair, 498.
 Cretaceous Ferns, 617
 Crew (Prof. H.), Fact and Theory in Spectroscopy, 353
 Crewdon (W.), The Hopi Indians at Oraibi, 166
 Crocker (J. C.), Velocity of Hydrolysis of Aliphatic Amides, 477
 Crommelin (Mr.), the Proper Motion of Castor, 304; Perturbations of Halley's Comet, 447
 "Crookes" Tubes, Positive Streams in, A. A. Campbell Swinton, 583
 Crops, the Weather and the, R. H. Hooker, 545
 Crosby (W. O.), Underground Water Resources of Long Island, New York, 183
 Crosland (P. F.), the Colouring Matters of the Stilbene Group, part iii., 23
 Cross (C. F.), Researches on Cellulose, 147; Xanthogenic Esters of Starch, 575
 Crossley (A. W.), Action of Reducing Agents on 5-Chloro-3-keto-1-dimethyl- Δ^4 -tetrahydrobenzene, 215
 Crustacea: Method of Detecting Successive Moults of the same Species among Crustacea, Dr. Fowler, 70; Das Tierreich, Crustacea, Rev. T. R. R. Stebbing, F.R.S., 365; the Crustacea of Devon and Cornwall, Canon A. M. Norman, F.R.S., and Dr. Thomas Scott, 387; the Brachyurous Crustacea of the third Tanganyika Expedition, Dr. W. A. Cunningham, 527
 Crystal-gazing, its History and Practice, with a Discussion of the Evidence for Telepathic Scrying, Northcote W. Thomas, 125
 Crystallisation of Minerals, Recent Experiments on the, A. L. Day and Mr. Shepherd, Dr. T. M. Lowry, 112
 Crystallography: the Isomorphous Crystals of Lead Nitrate and Barium Nitrate, P. Gaubert, 120; Structure of the Cubical Form of Sodium Chlorate possessing Rotatory Power, H. Copaux, 479; Geometrische Kristallographie, Ernst Sommerfeldt, 485; Chemische Kristallographie, P. Groth, Dr. A. E. H. Tutton, F.R.S., 529; Physikalische Kristallographie vom Standpunkt der Strukturtheorie, Ernst Sommerfeldt, 605
 Cumming (Dr. A. C. C.), Study of Strong Electrolytes, 238
 Cunha (A. Da), L'Année technique, 1906, 532
 Cunningham (Lieut.-Colonel A.), Hyper-even Numbers and Fermat's Numbers, 286
 Cunningham (J. T.), Abnormal Specimen of the Turbot, 478
 Cunningham (Dr. W. A.), the Brachyurous Crustacea of the third Tanganyika Expedition, 527
 Cunynghame (H. H., C.B.), Time and Clocks: a Description of Ancient and Modern Methods of Measuring Time, 269
 Currents, Alternating, a Text-book for Students of Engineering, C. G. Lamb, 97
 Cursiter (J. W.), Monumenta Orcadica: the Norseman in the Orkneys and the Monuments they have left, L. Dietrichson, 315
 Cutting a Round Cake on Scientific Principles, 173
 Cyanide Process, the, Alfred S. Miller, 149
 Cyanogenesis in Plants and the Origin of Phaseolunatin, 452
 Cycads, American Fossil, G. R. Wieland, 329
 Cygni, the System of 61, Prof. Barnard, 40
 Cytology: Die stofflichen Grundlagen der Vererbung im organischen Reich, Eduard Strasburger, 98
 Dacca, the Romance of an Eastern Capital, F. B. Bradley-Birt, J. F. Hewitt, 207
 Dale (T. N.), Taconic Physiography, 183
 Dale (T. Nelson), the Slate Deposits of the United States, 325
 Dallmeyer (T. R.), Death of, 253; Obituary Notice of, 279.
 Dalton (John), J. P. Millington, 246
 Daly (R. A.), the Differentiation of a Secondary Magma through Gravitational Adjustment, 596
 D'Arcy (R. F.), a New Trigonometry for Beginners, 74
 Darwin (Sir G. H., K.C.B., F.R.S.), International Geodetic Survey at Buda Pest, 33
 Darzens (G.), Catalytic Reduction of Unsaturated Ethyl Esters, 408
 Dautriche (M.), the Velocities of Detonation of Explosives, 48
 Davies (A. M.), the Rock of Studley and Arngrove, 167; Brilliant Aurora on February 9, 374
 Davies (D. O. S.), Magnetostriction, 102
 Davis (Arthur J.), Man and Superman, 501
 Davis (George E.), Death and Obituary Notice of, 611
 Davis (O. C. M.), Action of Nitrogen Sulphide on certain Metallic Chlorides, 23
 Davison (Dr. Charles), the Kingston Earthquake, 296
 Dawkins (Prof. W. Boyd), Results obtained in the Investigation of the South-eastern Coalfield, 468

- Dawn of Modern Geography, the, C. Raymond Beazley, 343
- Dawson (H. M.), the Nature of Ammoniacal Copper Solutions, 23
- Day (A. L.), Recent Experiments on the Crystallisation of Minerals, 112
- Dehn (F. B.), Anhydride of Phenylsuccinic Acid, 118
- Dehon (P.), Religion and Customs of the Uraons, 41
- Delage (Yves), Specific Adjuvants of Experimental Parthenogenesis, 167
- Demenitroux (M.), the Atomic Weight of Dysprosium, 24
- Denegri (M. A.), Mineral Resources of Peru, 517
- Dennett (R. E.), At the back of the Black Man's Mind, or notes on the Kingly Office in West Africa, 248
- Denning (Dr. A. du Pré), the Viscosity of the Blood, 47; Five-figure Mathematical Tables for School and Laboratory Purposes, 482
- Denning (W. F.), the January Meteors, 199; Observations of Venus, 208; February and March Meteors, 342; Heights of Meteors observed in 1906, 350; the Markings and Rotation Period of Venus, 469
- Denny (A.), Instrument for Measuring the Power given off by Turbines, 523
- der Heyden (A. F. van), First Steps in the Calculus, 29
- Derr (Prof. Louis), Photography for Students of Physics and Chemistry, Supp. to March 14, vi.
- Deslandres (M.), Solar Research at Meudon, 469
- Desparmet (E.), Some Reactions of Sodium Amide, 383
- Desplagnes (Lieut.), Lake Region of Central Nigeria, 114
- Deszendenztheorie, Einführung in die, Prof. Karl Camillo Schneider, 244
- Devon and Cornwall, the Crustacea of, Canon A. M. Norman, F.R.S., and Dr. Thomas Scott, 387
- Devonshire Scenery, the History of, an Essay in Geographical Evolution, A. W. Clayden, 127
- Dewar (Sir James, F.R.S.), Absorption of the Radio-active Emanations by Charcoal, 6; Absorption of the Inert Gases by Charcoal, 126; New Iron Carbonyl and on the Action of Light and Heat on the Iron Carbonyls, 477
- Diamonds and Garnets, the Relationship between, J. R. Sutton, 488
- Dickinson (H. C.), Heat Treatment of high-temperature Mercurial Thermometers, 233
- Dickson (Prof. L. E.), Invariants of the General Quadratic Form *Modulo* 2, 503
- Dictionary of Philosophy and Psychology, 73
- Diels (Dr. L.), Jugendform and Blütenreife im Pflanzenreich, 194
- Dietrich (Max), Modern Steam Turbines, vol. i., the Schulz Steam Turbine, 50
- Dietrichson (L.), Monumenta Orcadica, the Norsemen in the Orkneys and the Monuments They have Left, 315
- Differential Equations, Theory of, Dr. A. R. Forsyth, F.R.S., Supp. to March 14, x.
- Digby (W. P.), the Depreciation of Electrolytically-produced Solutions of Sodium Hypochlorite, 95
- Digestion, Mercers' Company Lectures on Recent Advances in the Physiology of, Prof. Ernest H. Starling, F.R.S., Prof. Benjamin Moore, 219
- Diseases: Immunity in Infective Diseases, Prof. Élie Metchnikoff, Prof. R. T. Hewlett, 99; the Milroy Lectures on Epidemic Disease in England, the Evidence of Variability and of Persistency of Type, Dr. W. H. Hamer, Prof. R. T. Hewlett, 99; Disease and its Prevention, Prof. R. T. Hewlett, 99; the Scientific Study of Infectious Diseases, Dr. W. H. Welch at the Rockefeller Institute for Medical Research, 213; Incubation or the Cure of Disease in Pagan Temples and Christian Churches, Mary Hamilton, 366; the Treatment of Diseases of the Digestive System, Prof. Robert Sandby, 366; Ticks as Transmitters of Disease, Dr. J. W. W. Stephens, 523; Diseases of Fruit and Fruit-bearing Plants, 532
- Dissociation of a Personality, the: a Biographical Study in Abnormal Psychology, Dr. Morton Prince, 102
- Dixey (W. A.), Periscopic Lenses in Spectacles, 451
- Dixon (Prof. A. C.), Harmonic Expansions of Functions of two Variables, 71
- Dixon (Prof. H. H.), Transpiration Current in Plants, 358
- Dixon (W. A.), the Plants of New South Wales, 366
- Dixon (Dr. W. E.), a Manual of Pharmacology, 2
- Dizionario di Botanica Generali, Dr. Guglielmo Bilancioni, 28
- Doberck (Prof.), Catalogue of Double Stars, 64; Orbits of three Double Stars, 282
- Dollo (Louis), *Prymnothonus Hookeri* Refound, 455
- Donington (G. C.), Practical Exercises in Chemistry, 341
- Double Stars, Catalogues of, Prof. Doberck, 64
- Double Stars, Orbits of Three, Prof. Doberck, 282
- Douglas (G. H.), Modern Commercial Arithmetic, 409
- Douglas (J. A.), Changes of Physical Constants in certain Minerals and Igneous Rocks, 550
- Dow (G. R.), German Science Reader, 509
- Doyon (M.), the Coagulability of the Subhepatic Blood, 48
- Drogenpulver, Einführung in die mikroskopische Analyse der, Dr. L. Koch, 390
- Drygalski (E. von), Der Gaussberg, seine Kartierung und seine Formen, 224
- du Jassonneix (Binet), Reduction of Oxide of Chromium by Boron, 167; Definite Compounds formed by Chromium and Boron, 239
- Dublin: Royal Dublin Society, 190, 359, 479; Royal Irish Academy, 119, 407
- Dudgeon (H.), Electric Tramways, 89
- Duggar (B. M.), Value of the Osmotic Pressures in the Cells of certain Marine Algae, 401
- Duhem (P.), Recherches sur l'Elasticité, 603
- Dumont (J.), Luminous Radiations and the Richness of Wheat in Nitrogen, 239
- Dumont's (Santos) Airship, 61
- Dunckelman (Dr. F. von), Mitteilungen aus dem deutschen Schutzgebieten; Die Niederschlags-verhältnisse von Deutsch-Sudwestafrika, 616
- Dunell (Bernard), Suction Gas for Marine Propulsion, 39
- Dunell (G. R.), Gyroscopic Apparatus for Steadying Ships, 561
- Dunstan (A. E.), the Viscosity of Liquid Mixtures, 215
- Dunstan (Prof. Wyndham R., F.R.S.), the Rusting of Iron, 390, 477
- Durnford (Lieut.-Colonel C. D.), the Flying-Fish Problem, 109
- Durrant (R. G.), Experimental Evidence of Ionic Migration in the Natural Diffusion of Acids and of Salts, 69
- Duthie (J. F.), the Orchids of the North-Western Himalaya, 587
- Dutton (J. Everett), Rapport sur l'Expédition au Congo, 1903-5, 351
- Duval (Georges), Arboriculture Fruitière, 605
- Dybeck (Georg), Ephemeris for Comet 1906g (Thiele), 257
- Dyeing: Fastness of Indigenous Dyes of Bengal, and Comparison with Typical Synthetic Dye-stuffs, part i., Dyeing on Cotton, F. R. Watson, 504; Synthetic and Natural Indigo, Cyril Bergtheil, 614
- Dynamics: the Dynamics of Bowling, 8; the Scientific Papers of J. Willard Gibbs, 301
- Dynamo Design, Elementary Principles of Continuous Current, H. M. Hobart, 221
- Earle (Rev. A.), Essays upon the History of Meaux Abbey and some Principles of Medieval Land Tenure, based upon a Consideration of the Latin Chronicles of Meaux, 170
- Earth's Rotation, Model to illustrate Effects of the, G. Blum, 448
- Earthquakes: Earthquakes in Iceland, 60; in Jamaica, 83; Earthquake at Kingston, Jamaica, 278, 514; Dr. Charles Davison 296; Earthquake at Kingston on January 18, Prof. P. Carmody, 398; Earthquake in Perth, Western Australia, 83; Earthquakes in Russia, 205; in Chili, 205; in Sweden, 278; in Norway, 278; at Simalu, 300; in Australia, 347; Calabrian Earthquake of September 8, 1905, 398; the Valparaiso Earthquake, August 17, 1906, R. D. Oldham, 439; Seismogram of Valparaiso Earthquake of August 17, 613; Earthquake at Bitlis, 539; the Earthquake at Bitlis on March 29, 565; the Study of Earthquakes, 586; the Mexican Earthquake, 589, 610; the Upheaval of the Sea Coast by Earthquakes, Dr. T. J. J. See, 224; J. M., 224

- Eastwood (Dr. Arthur), Comparative Histological and Bacteriological Investigations, 610
- Ebell (M.), Comet 1906g, 85; Comet 1906h, 137; Comets 1906h (Metcalf) and 1906d (Finlay), 208; Comet 1907a (Giacobini), 497, 518, 569
- Eberhardt (M.), Method of Destroying Larvæ in Plantations of Trees, 311
- Echinodermata, Prof. E. W. MacBride, F.R.S., 31
- Eckel (E. C.), the American Iron Industry, 446
- Eclipses: the Position of Agathocles during the Eclipse of B.C. 310, August 15, P. H. Cowell, F.R.S., 10; Eclipse Observations, Prof. Ricco, 16; the Solar Eclipse of next January, 111; the Recent Total Eclipse of the Sun, Prof. R. Schorr, 336; French Eclipse Expedition, 378; the Recent Solar Eclipse in India, 402; the Solar Eclipse of January 13, 544; Russian Observations of the Solar Eclipse, August 30, 1905, Chas. P. Butler, 163; Micrometer Measures during the Solar Eclipse of August, 1905, J. Merlin, 350; Observations of Total Solar Eclipses, M. le Comte A. de la Baume Pluvinel, 257; Eclipses of Jupiter's Satellites, 1878-1903, Prof. E. C. Pickering, 616
- Economic Biologists, the Association of, 284
- Ecriture, les Révélation de l', d'après un Contrôle scientifique, Alfred Binet, 148
- Eddington (A. S.), Systematic Motions of the Stars, 143; Systematic Stellar Motions, 182
- Edinburgh: New Physical and Engineering Departments of the University of Edinburgh, 20; Edinburgh Royal Society, 190, 334, 455, 622
- Education: the University Movement in Western Australia, 35; Bursaries at the Royal College of Science, London, Prof. John Perry, F.R.S., 79; Report of the Consultative Committee upon Questions affecting Higher Elementary Schools, 88; Death and Obituary Notice of Sir Richard Farrant, 108; Science in Examinations for the Higher Civil Service, 260; Science in Higher Education, 275; the Mathematical Tripos at Cambridge, Prof. John Perry, F.R.S., 273; the Mathematical Tripos, Dr. Edward J. Routh, F.R.S., 320; Death and Obituary Notice of the Very Rev. Robert H. Story, 277; the Public School Science Masters' Association, 285; the Teaching of Elementary Mechanics, Prof. Forsyth and C. E. Ashford, 317; the German Universities and University Study, Friedrich Paulsen, 338; Educational Theories, Ancient and Modern, Prof. C. M. Woodward, 352; Agricultural Education and Research, 394; the University of Toronto, Prof. A. B. Macallum, F.R.S., 396; the Needs of the University of Cambridge, 404; Education and the Metric System, 422; Higher Education in the United States, 510
- Edwards (C. A.), on the Properties of Alloys of Aluminium and Copper, Lecture at the Institution of Mechanical Engineers, 426
- Edwards (T.), an Idler in the Wilds, 176
- Efficiency of the Present Process of Natural Indigo Manufacture, the, C. Bergtheil, 30
- Egypt: the Physiography of the River Nile and its Basin, Capt. H. G. Lyons, 17; a Report on the Work of the Survey Department in 1905, Capt. H. G. Lyons, F.R.S., 250
- Egyptology: the Gods of Healing of the Egyptians and Greeks, Dr. R. Caton, 499; a Contribution to the Study of Mummification in Egypt, Prof. G. Elliot Smith, 537
- Eichelberger (Prof. W. S.), Accuracy of Astronomical Clocks, 353
- Elderton (W. Palin), Frequency-curves and Correlation, 507
- Electricity: the Wireless Telegraphy Conference, Maurice Solomon, 59; Manual of Wireless Telegraphy, A. F. Collins, 366; Experimental Evidence of Ionic Migration in the Natural Diffusion of Acids and of Salts, R. G. Durrant, 69; the Transmission of Electrical Energy at Niagara Falls, 83; Electric Tramways, R. N. Tweedy and H. Dudgeon, 89; Underground Conduit System for Tramways during Snowfall, 447; the Depreciation of Electrolytically Produced Solutions of Sodium Hypochlorite, W. P. Digby, 95; the Hermite Electrolytic Process at Poplar, C. V. Biggs, 95; a Theorem on Moving Distribution of Electricity, Prof. A. W. Conway, 119; Electrical Conductivity of Selenium, Maurice Coste, 143; Anode Rays, Dr. R. S. Willows, 173; Electric Radiation from Bent Antennæ, Prof. J. A. Fleming, 188; New Determination of the E.M.F. of the Weston and Clark Cells by a Gray Electrodynamometer, Dr. Guthe, 233; Mr. Rôsa, 233; Construction and Calculation of Inductance Standards, Prof. J. G. Coffin, 233; an Efficiency Meter for Electric Incandescent Lamps, Messrs. Hyde and Brooks, 233; Platinum Point Electrolytic Detector for Electrical Waves, Mr. Austin, 234; Study of Strong Electrolytes, Dr. A. C. C. Cumming, 238; Photoelectric Fatigue of Zinc, H. Stanley Allen, 262; Lichtstrahlung und Beleuchtung, Paul Högnér, 269; Conduction of Electricity through Gases, Prof. J. J. Thomson, F.R.S., 269; Growing "Alumina," T. A. Vaughton, 281; the Electron Theory; a Popular Introduction to the New Theory of Electricity and Magnetism, E. E. Fournier d'Albe, 292; Experiments for Determining the Lines of Flow in Electrolytes and the Distribution of Currents in Accumulators, U. Schoop, 302; Relation between Magnetisation and Electric Conductivity in Nickel at High Temperatures, Dr. C. G. Knott, 334; Relation of Chemical Activity to Electrolytic Conductivity, John L. Sammis, 350; Magnetic Detectors and the Action of Electric Oscillations, Ch. Maurain, 377; Recent Progress in Wireless Telephony, Prof. Fessenden, 378; Standard Electric Glow Lamps, 380; Utility of Resonance Phenomena in the Production of Strong Electric Sparks, G. A. Hemsalech and C. Tissot, 383; Applied Electricity, a Text-book of Electrical Engineering for Second Year Students, J. Paley Yorke, Maurice Solomon, 389; the Electrician Primers, Maurice Solomon, 389; Electricity of To-day: its Work and Mysteries Described in Non-technical Language, Charles R. Gibson, Maurice Solomon, 389; Physical Chemistry for Electrical Engineers, J. Livingston R. Morgan, 413; Electric Power in London, 418; Remarkable Luminous Effects Emanating from Electric Arc Lamps at the Instant of a Flash of Lightning, P. De Heen, 423; a First-year Course of Practical Magnetism and Electricity, Dr. P. E. Shaw, 436; the Positive Charge Carried by the α Particle, Frederick Soddy, 438; Motor Vehicles and Motors: their Design, Construction and Working by Steam, Oil and Electricity, W. Worby Beaumont, 457; the Electrical Influence of the Sun, Dr. A. Nodon, 469; Velocity of the Negative Ions in Flames, Ernest Gold, 476; Transformer Indicator Diagrams, Prof. T. R. Lyle, 478; Series in Spectra, Prof. A. W. Conway, 479; Conditions of Formation of Electrified Centres of Feeble Mobility in Gases, Maurice de Broglie, 503; Modern Views of the Ether, Dr. Oliver Lodge, F.R.S., 519; Rate of Recovery of Residual Charge in Electric Condensers, Prof. F. T. Trouton and S. Russ, 527; Ionisation of the Chromium Sulphates, Albert Colson, 528; Electric Railway Engineering, H. F. Parshall and H. M. Hobart, 531; the Discharge of Negative Electricity from Hot Calcium and from Lime, Dr. Frank Horton, 550; Retardation of Electroscopic Leak by Means of Recognised Radio-active Substances, Dr. W. S. Lazarus-Barlow, 559; Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressures in Different Gases, F. W. Aston, 574; Influence of the Surrounding Temperature on the Luminous Intensity of an Incandescent Electric Lamp, F. Laporte and R. Jouaust, 575; Positive Streams in "Crookes" Tubes, A. A. Campbell Swinton, 583; Mechanism of Power Transmission from Electric Motors, Wilfred L. Spence, 591; Oscillations of a Higher Order (Harmonics) in the Electric Spark, G. A. Hemsalech, 599; Electrical Method of Extracting Soot from Air in Flues, George W. Walker, 606; New High-tension Condenser on the Moscicki Principle, 614; the Potential of Hydrogen Liberated from Metallic Surfaces, H. Nutton and H. D. Law, 621; Electrolytic Deposition of Zinc using Rotating Electrodes, Dr. T. Slater Price, 621; Influence of Temperature on the Photo-electric Discharge from Platinum, Dr. W. Mansergh Varley and F. Unwin, 623
- Elgar (Dr. Francis, F.R.S.), Death and Obituary Notice of Sir Edward J. Reed, K.C.B., F.R.S., 153
- Eliot (Sir John, K.C.I.E., F.R.S.), Climatological Atlas of India, 241

- Elkin (William L.), Parallax Investigations on 163 Stars mainly of Large Proper Motion, 234
- Elles (Dr. Gertrude L.), the Lower Palæozoic Rocks of Pomeroy, 552
- Elliott (Prof. E. B.), Projective Geometry of a Binary Quartic and its Hessian, 407
- Ellis (D.), *Spirophyllum ferrugineum*, a New Genus and Species of Thread Bacteria, 623
- Ellis (John Devonshire), Death and Obituary Notice of, 61
- Ellis (William), Sunspots and Magnetism, 111
- Elongated Shot, the Flight of an, P. D. Strachan, 367; Prof. A. G. Greenhill, F.R.S., 367; J. W. Sharpe, 391
- Elster (M.), Radio-active Impurity in Ordinary Lead, 181
- Embalming: a Contribution to the Study of Mummification in Egypt, Prof. G. Elliot Smith, 537
- Embley (Dr. E. H.), Pharmacology of Ethyl Chloride, 165
- Emerald Green Sky Colour, J. W. Noble, 199; F. G. Collins, 224
- Emu, on the Extinct, of the Small Islands off the South Coast of Australia and Probably Tasmania, Prof. Henry H. Giglioli, 534
- Engineering: New Physical and Engineering Departments of the University of Edinburgh, 20; Suction Gas for Marine Propulsion, Bernard Dunell, 39; Steam Turbines, with an Appendix on Gas Turbines and the Future of Heat Engines, Dr. A. Stodola, 50; Steam Turbine Engineering, T. Stevens and H. M. Hobart, 50; Modern Turbine Practice and Water-Power Plants, John Wolf Thurso, 50; Hydraulic Motors with Related Subjects, including Centrifugal Pumps, Pipes, and Open Channels, Prof. Irving P. Church, 50; Turbines, W. H. Stuart Garnett, 50; Modern Steam Turbines, vol. i., the Schulz Steam Turbine, Max Dietrich, 50; Relation of the Engineer and Engineering to the World at Large, Sir Alexander Kennedy, F.R.S., 62; Single-phase Electric Traction, C. F. Jenkin, 85; the Action of Tram-car Brakes, 86; Alternating Currents: a Text-book for Students of Engineering, C. G. Lamb, 97; the Elements of Chemical Engineering, Dr. J. Grossmann, 125; Death of Sir Edward J. Reed, K.C.B., F.R.S., 134; Obituary Notice of, Dr. Francis Elgar, F.R.S., 153; Sand-blast Apparatus used for Testing Building Materials at Gross-Lichterfelde Institute, H. Burcharts, 158; Machine Design, Prof. Albert W. Smith and G. H. Marx, 172; Elements of Mechanical Drawing, A. A. Titsworth, 172; Why the Lock System was Adopted for the Panama Canal, Hon. W. H. Taft, 181; British Inland Waterways, 212; Elementary Principles of Continuous Current Dynamo Design, H. M. Hobart, 221; Wave Action in Relation to Engineering Structures, Major D. D. Gaillard, 260; I Motori a Gaz, Vittorio Calzavara, 291; I Motori ad Esplosione, a Gas luce e Gas povero, Fosco Laurente, 291; I grandi Trafori Alpini, G. B. Biadego, 291; Internal-combustion Engines for Marine Purposes, J. T. Milton, 325; Text-book on Geodesy and Least Squares Prepared for the Use of Civil Engineering Students, Prof. Charles L. Crandall, 339; the Tehuantepec Railways, 348; Standard Electric Glow Lamps, 380; Applied Electricity: a Text-book of Electrical Engineering for Second Year Students, J. Paley Yorke, Maurice Solomon, 389; the Electrician Primers, Maurice Solomon, 389; Electricity of To-day: its Work and Mysteries Described in Non-technical Language, Charles R. Gibson, Maurice Solomon, 389; Physical Chemistry for Electrical Engineers, J. Livingston R. Morgan, 413; on the Properties of Alloys of Aluminium and Copper, Prof. H. C. H. Carpenter and C. A. Edwards at the Institution of Mechanical Engineers, 426; the American Iron Industry, E. C. Eckel, 446; Thermodynamics of the Internal-combustion Engine, Dugald Clerk, 446; Rivetage, M. Fricker, 460; Cams, and the Principles of their Construction, George Jepson, 460; the Motor Exhibition at Olympia, 466; Novel Type of Electric Tempering Furnace Designed by Körting Brothers, 468; Text-book on the Strength of Materials, S. E. Slocum and E. L. Hancock, 484; Technical Terminology, 490; J. T. Richards, 510; Bridge at the Victoria Falls of the River Zambesi, G. A. Hobson, 517; Petrol Motor-omnibuses, W. Worby Beaumont, 517; Electric Railway Engineering, H. F. Parshall and H. M. Hobart, 531; Flame the Working Fluid in Gas and Petrol Engines, Dugald Clerk at Royal Institution, 546; Mechanism of Power Transmission from Electric Motors, Wilfred L. Spence, 591; L'Année technique, 1906, A. Da Cunha, 532; Standards and Exact Measurement, Dr. R. T. Glazebrook at Institution of Electrical Engineers, 570
- England, Untravelled, James John Hissey, 78
- English Nation, the Origin of the, H. Munro Chadwick, W. A. Craigie, 555
- Entomology: Ueber chitinöse Fortbewegungs Apparate einiger (insbesondere fussloser) Insektenlarven, Dr. Wilhelm Leisewitz, W. F. Kirby, 54; Entomological Society, 69, 95, 167, 430, 575, 622; the *Dracenta rusina*, Druce, from Trinidad, W. J. Kaye, 70; Leaf-hoppers and their Natural Enemies, 82; Entomological Photography, 83; the Procession of *Cnethocampa pinevorax*, H. H. Brindley, 95; Collection of Oribatidæ from British Guiana, C. Warburton and N. D. F. Pearce, 95; the Museum Beetle, *Anthrenus museorum*, Prof. A. J. Ewart, 215; the Origin of the Name Chermes or Kermes, E. R. Burdon, 216; the Fauna of British India, including Ceylon and Burma, Coleoptera, vol. i., Cerambycidae, C. J. Gahan, 222; a Synonymic Catalogue of Orthoptera, W. F. Kirby, 269; Life-history of the *Dracunculus medinensis*, or Guinea-worm, Mr. Leiper, 302; Fertilisation of Flowers by Insects, E. W. Swanton, 320; Dr. Alfred R. Wallace, F.R.S., 320; Entomology, with Special Reference to its Biological and Economic Aspects, Dr. J. W. Folsom, 340; Chinese Scale-insect (*Aspidiotus perniciosus*), C. L. Marlatt, 349; Sand-dwelling Insects, C. A. Hart and H. A. Gleason, 399; Mexican Cotton-boll Weevil, 495; a New Gooseberry Pest, W. E. Collinge, 496; *Terms gestroi*, the White Ant Rubber Pest, E. P. Stebbing, 516; the Histology and Development of the Divided Eyes of Certain Insects, G. D. Schafer, 541; Antennæ-joints in Trachisclis, H. J. Carter, 622
- Entz (La Gaza), Die Biologie des Balatonsees, 79
- Ephemerides of Comets and Planets, 231
- Epic, the Human, the Prehistoric Story of Mankind, John Frederick Rowbotham, 73
- Erosion at Niagara, G. K. Gilbert, 607
- Eruption of Vesuvius in April, 1906, the, Prof. Lacroix, 163
- Esclançon (E.), Comet 1906h (Metcalf), 159
- Espin (Rev. T. E.), a New Nebula, 593
- Eposito (M.), Contribution to the Chemistry of the Rare Earths, 477
- Esthonian Folk-lore, Dr. Jakob Hurt, 540
- Ether, Modern Views of the, Dr. Oliver Lodge, F.R.S., 519
- Ethnography: Mythes et Légendes d'Australie, Études d'Ethnographie et de Sociologie, A. van Gennep, 49; British North America, I., the Far West: the Home of the Salish and Déné, C. Hill-Tout, 584
- Ethnology: Contributions to the Ethnology of the Haida, J. R. Swanton, Dr. A. C. Haddon, F.R.S., 68; at the Back of the Black Man's Mind; or Notes on the Kingly Office in West Africa, R. E. Dennett, 248; Mediæval Rhodesia, Dr. David Randall-MacIver, 369; Pagan Races of the Malay Peninsula, W. W. Skeat and C. O. Blagden, 415; Burma: a Handbook of Practical Information, Sir J. George Scott, K.C.I.E., 440; Ethnology of Modern Egypt, Dr. C. S. Myers, 454, 478; the Lower Niger and its Tribes, Major Arthur Glyn Leonard, 602
- Etiology of Sleeping Sickness, 56
- Evans (O. H.), the Raised Beaches of Taltal (Northern Chile), 215
- Evans-Cross (G. W.), the Myriometer, 503
- Eve (A. S.), Ionisation by Spraying, 533
- Evolution: the Evolution of the Colorado Spiderwort, Prof. T. D. A. Cockerell, 7; the Evolution of Man: a Popular Scientific Study, Ernst Haeckel, 78; the Problem of the Origin of Species, Prof. C. O. Whitman, 109; Einführung in die Deszendenztheorie, Prof. Karl Camillo Schneider, 244; Species and Varieties: their Origin by Mutation, H. de Vries, 268; Life and Evolution, F. W. Headley, 434; the Analysis of Racial Descent in Animals, T. H. Montgomery, jun., 530; Recent Progress in the Study of Variation, Heredity and Evolution, R. H. Lock, 577

- Ewart (Prof. A.), the Systematic Position of *Hectorella caespitosa*, Hook, f., 71; the Museum Beetle, *Anthrenus muscorum*, 215
- Ewart (Prof. J. C.), Skulls of Horses from the Roman Fort at Newstead, near Melrose, and Observations on the Origin of Domestic Horses, 190; the Origin of the Modern Horse, 612; Coat Colour in Horses, 622
- Ewing (Dr. J. A., F.R.S.), the Structure of Metals, "Wilde" Lecture at Manchester Literary and Philosophical Society, 472
- Exner (Dr. Felix M.), the Yearly Air Movement as Determined by Registering Anemometers, 67
- Experiments on Animals, Stephen Paget, 121
- Explosions, Recording Calorimeter for, Prof. Bertram Hopkinson, 526
- Explosives: the Velocities of Detonation of Explosives, M. Dautriche, 48; Artillery and Explosives, Sir Andrew Noble, Bart., K.C.B., F.R.S., 174; the Explosion at Woolwich, 421
- Extirpation of the Tsetse-fly: a Correction and a Suggestion, Prof. E. A. Minchin, 30
- Faith (Mr.), Comet 1906g (Thiele), 231
- Falconer (Dr. J. D.), Geology of Androssan, 623
- Familiar Trees, Prof. G. S. Boulger, 319
- Family, the, Helen Bosanquet, 78
- Faraday Society, 95, 238, 334, 429, 454, 621
- Farmer (R. C.), Hydrolysis of "Nitrocellulose" and "Nitroglycerine," 94
- Farrant (Sir Richard), Death and Obituary Notice of, 108
- Fauna of British India, including Ceylon and Burma, Coleoptera, vol. i., Cerambycidae, C. J. Gahan, 222
- Fauna of the Tay Basin and Strathmore, a, J. A. Harvie-Brown, Supp. to March 14, vii.
- Fearnside (W. G.), the Lower Ordovician Succession in Scandinavia, 479; the Lower Palaeozoic Rocks of Pomeroy, 552
- Felix (Dr. Johannes), Die Leitfossilien aus dem Pflanzen und Thierreich in systematischer Anordnung, 388
- Fenneman (N. M.), Geology of the Boulder District of Colorado, 182
- Fenton (Dr. H. J. H.), a Delicate Reaction for Carbohydrates, 189; Reduction of Carbon Dioxide to Formaldehyde, 551; Reduction of Carbon Dioxide to Formaldehyde in Aqueous Solution, 575; Notes on Qualitative Analysis, Concise and Explanatory, 581
- Fernbach (A.), Inequality of the Resistance of Natural Starch and Artificial Amylose towards Extract of Barley, 528
- Ferns: How Ferns Grow, M. Slosson, 298
- Fertilisation of Flowers by Insects, E. W. Swanton, 320; Dr. Alfred R. Wallace, F.R.S., 320
- Féry (C.), the Calorific Emission of the Sun, 23, 96; the Calorific Radiation of the Sun, 40
- Fessenden (Prof.), Recent Progress in Wireless Telephony, 378
- Fessenden (Prof. Reginald A.), the Problem of the Random Path, 392
- Fiedler (Prof. H. G.), a Second German Course for Science Students, 413
- Field (Rear-Admiral A. Mostyn, F.R.S.), a New Volcanic Island, 414
- Field (F. H.), Meteorology of the Upper Air in India, 68
- Fields (Dr. John Charles), Theory of the Algebraic Functions of a Complex Variable, 603
- Fiji, Poisoning by Turtle's Flesh in, Dr. B. Glanvill Corney, 590
- Filchner (Wilhelm), Das Kloster Kumbum in Tibet, 172
- Filter Presses, the "Cooper Research Laboratory," 248
- Fine (Prof. H. B.), a College Algebra, 74
- Finlay, Comet 1906d, M. Ebell, 208
- Fiorentino (G.), Enzymes Capable of Possessing More than One Kind of Activity, 126
- Fischer (Otto), Theoretische Grundlagen für eine Mechanik der lebender Körper, 146
- Fish Eating, on Leprosy and, Jonathan Hutchinson, F.R.S., 412
- Fisher (W. R.), Dr. Schlich's Manual of Forestry, 558
- Fisheries: the Marine Biological Association and International Fishery Investigations, 106; Scientific Fishery Investigations, 185; International Fishery Investigations, 251; the Plaice Fishery of the Kattegat, Dr. Johansen, 252; the Life-history of the Common Eel, Dr. Johs. Schmidt, 252; Sea Fisheries, E. A. Shipley, F.R.S., 284; British Sea Fisheries, 301; Fisheries, Ireland, 376
- Fitschy (P.), Hydrocyanic Acid in Plants, 136-7
- Flack (M.), the Muscular Connections of the Vertebrate Heart, 612
- Flame the Working Fluid in Gas and Petrol Engines, Dugald Clerk at Royal Institution, 546
- Fleig (C.), Transformations in the Organism and Elimination of Formic Acid and the Formates, 432
- Fleming (Prof. J. A.), Electric Radiation from Bent Antennae, 188
- Fleming (Mrs.), Stars having Peculiar Spectra, 448
- Fletcher (F.), Cotton Cultivation in the Bombay Presidency, 207
- Flett (Dr. John S.), Attrition Tests of Road-making Stones, Petrographical Descriptions by, 220
- Flight of an Elongated Shot, the, P. D. Strachan, 367; Prof. A. G. Greenhill, F.R.S., 367; J. W. Sharpe, 391
- Flight Problem, the, 82
- Flora, Manual of the New Zealand, T. F. Cheeseman, 293
- Flowering Plants, British, W. F. Kirby, 222
- Flowering Plants, Guide to the Principal Families of, J. Adams, 29
- Flowers, Fertilisation of, by Insects, E. W. Swanton, 320; Dr. Alfred R. Wallace, F.R.S., 320
- Flowers, Old-fashioned, and Other Open-air Essays, Maurice Maeterlinck, 199
- Flues, Electrical Method of Extracting Soot from Air in, G. W. Walker, 606
- Fluorescence of Benzene, Ultra-violet, Dr. J. Stark, 295
- Flying Machine, the First "Manned," 35
- Foix (M.), Theory of the Radiation of Incandescent Mantles, 575
- Folk-lore: Contribution to the Ethnology of the Haida, J. R. Swanton, Dr. A. C. Haddon, F.R.S., 68; Kwakiutl Texts, Franz Boas and George Hunt, Dr. A. C. Haddon, F.R.S., 68; the Koryak, Religion and Myths, Waldemar Johelson, Dr. A. C. Haddon, F.R.S., 69; the Peninsular Malays, i., Malay Beliefs, R. J. Wilkinson, 245; Esthonian Folk-lore, Dr. Jakob Hurt, 540
- Folsom (Dr. J. W.), Entomology, with Special Reference to its Biological and Economic Aspects, 340
- Food, Preservatives in, and Food Examination, Dr. John C. Thresh and Dr. A. E. Porter, C. Simmonds, 145
- Forest-pig of Central Africa, the, Prof. Henry H. Giglioli, 414
- Forestry: Construction of a Tramway in Connection with the Extraction of Timber from the Forests of Goalpara, W. F. Perrée, 207; Method of Destroying Larvæ in Plantations of Trees, M. Eberhardt, 311; Indian Trees, Being an Account of Trees, Shrubs, Woody Climbers, Bamboos, and Palms Indigenous or Commonly Cultivated in the British Empire, Sir Dietrich Brandis, K.C.I.E., F.R.S., 385; the Timber Tree *Padauk* in the North Andaman Island, F. H. Todd, 422; Dr. Schlich's Manual of Forestry, W. R. Fisher, 558; the Level of Sub-soil Waters with Regard to Forests, R. S. Pearson, 613
- Forsyth (Dr. A. R., F.R.S.), Theory of Differential Equations, Supp. to March 14, x.
- Forsyth (Prof.), the Teaching of Elementary Mechanics, 317
- Fortbewegungs-apparate einiger (insbesondere füssloser) Insektenlarven, Ueber chitinöse, Dr. Wilhelm Leisewitz, W. F. Kirby, 54
- Fosse (R.), Xanthone and Xanthidrol, 96
- Fossils: American Fossil Cycads, G. R. Wieland, 329; Die Leitfossilien aus dem Pflanzen- und Thierreich in systematischer Anordnung, Dr. Johannes Felix, 388
- Foster (Sir Michael, K.C.B., F.R.S.), Death of, 323; Obituary Notice of, 345
- Foster (W. H.), Estimation of Copper, 190
- Foureaux (F.), Documents scientifiques de la Mission Saharienne (Mission Foureaux-Lamy d'Alger au Congo par le Tchad), 200

- Fourier's Series, Introduction to the Theory of, and Integrals and the Mathematical Theory of the Conduction of Heat, H. S. Carslaw, 459
- Fournier (H.), Transformation of Primary Saturated Alcohols into the Corresponding Monobasic Acids, 408
- Fowler (Dr.), Method of Detecting Successive Moults of the Same Species among Crustacea, 70
- Fowler (Mr.), Silicon in the Chromosphere, 304
- Fox, the Life Story of a, J. C. Tregarthen, 76
- François (Maurice), an Exact Method of Separating Ammonia and Methylamine, 504
- Fraser (Colin), Geology of the Hokitika Sheet, 306
- Frech (Prof.), Ueber die Klimaänderungen der Geologischen Vergangenheit, 65
- Frederick (Mr.), Comet 1907*b* (Mellish), 615
- Freeman (E. M.), the Fungus of *Lolium temulentum*, 109
- French Eclipse Expedition, 378
- French Readings in Science, de V. Payen-Payne, 341
- Frequency-curves and Correlation, W. Palin Elderton, 507
- Fricker (M.), Rivetage, 460
- Fritzsche (Dr. Richard), Attempt to Re-calculate from Recent Data the Total Yearly Rainfall over the Earth's Surface and to Indicate the Transference of Water between Land and Sea, 208
- Frost (Prof.), the Period of β Cephei, 159
- Fruit and Fruit-bearing Plants, Diseases of, 532
- Fruitière, Arboriculture, Leon Bussard and Georges Duval, 605
- Fry (C. B.), Great Bowlers and Fielders, 8
- Funzioni poliedriche e modulari, G. Vivanti, 198
- Gahan (C. J.), the Fauna of British India, Including Ceylon and Burma, Coleoptera, vol. i., Cerambycidae, 222
- Gaillard (Major D. D.), Wave Action in Relation to Engineering Structures, 260
- Gain (Gustave), a Mode of Preparation of Hydrated Hypovanadic Acid, 143
- Gale (Henry G.), Character and Cause of Sun-spot Spectra, 113
- Galileo in the Val D'Arno, Janet Ross, 593
- Galton (Dr. Francis, F.R.S.), One Vote, One Value, 414; Vox Populi, 450; the Ballot-box, 509
- Gambling and Mathematics, Hugh Richardson, 415; G. H. B., 415
- Ganguli (A. C.), the Decomposition of Mercurous and Silver Hyponitrites, 575
- Garbasso (Prof. A.), Vorlesungen über theoretische Spektroskopie, 554
- Gardner (J. A.), Anæsthetic and Lethal Quantity of Chloroform in the Blood, 142
- Garnets, the Relationship between Diamonds and, J. R. Sutton, 488
- Garnett (W. H. Stuart), Turbines, 50
- Garriott (Prof. E.), Cold Waves and Frosts in the United States, 210
- Gas: the Advantages and Disadvantages of Heating Buildings with Gas Stoves, Dr. Rideal, 460
- Gaseous Nebula, Homer Lane's Problem of a Spherical, Lord Kelvin, O.M., F.R.S., 368
- Gases: Absorption of the Inert Gases by Charcoal, Sir James Dewar, F.R.S., 126; Conduction of Electricity through Gases, Prof. J. J. Thomson, F.R.S., 260
- Gaubert (P.), the Isomorphous Crystals of Lead Nitrate and Barium Nitrate, 120
- Gauthier (D.), Method of Preparing the Oxynitriles ROCH.CN, 143
- Gautier (Cl.), the Coagulability of the Subhepatic Blood, 48
- Gehrcke (Mr.), Anode Rays, 614
- Geitel (M.), Radio-active Impurity in Ordinary Lead, 181
- Gem-cutter's Craft, the, Leopold Claremont, 321
- Genetic Logic, Thoughts and Things, or, James Mark Baldwin, 1
- Gennep (A. van), Mythes et Légendes d'Australie, Études d'Ethnographie et de Sociologie, 49
- Geodesy: the International Geodetic Conference at Buda Pest, Sir G. H. Darwin, K.C.B., F.R.S., 33; the Value of Gravity at Sea, Dr. Hecker, 33; the Measurement of Base Lines and the Jäderin Wires, M. Guillaume, 33; the Systematised Observation of the Variation of Latitude, Prof. Helmert, 33; Text-book on Geodesy and Least Squares Prepared for the Use of Civil Engineering Students, Prof. Charles L. Crandall, 339; Geodetic Operations in the United States, 1903-6, G. H. Wittman and John F. Hayford, 573; the Geodetic Evidence of Isostasy, with a Consideration of the Depth and Completeness of the Isostatic Compensation and of the Bearing of the Evidence upon Some of the Greater Problems of Geology, John F. Hayford, 573; General Report of the Survey of India, 592; Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Col. S. G. Burrard, F.R.S., Supp. to March 14, viii
- Geography: Commander R. E. Peary's Arctic Expedition, 37; Map of the British Isles, W. and A. K. Johnston, 54; the New "Dolomiten Strasse," 63; Example of River-capture in New South Wales, Dr. W. G. Woolnough and T. Griffith Taylor, 72; Hints to Travellers, Scientific and General, 77; Physische Geographie des Balatensees und seiner Umgebung, Dr. Moriz Staub and Dr. J. Bernatsky, Dr. E. von Cholnoky, Dr. Baron Bela Harkanyi, 79; the Siege of the South Pole, the Story of Antarctic Exploration, Dr. Hugh Robert Mill, 103; the Voyage of the *Scotia*, being the Record of a Voyage of Exploration in Antarctic Seas, 103; the History of Devonshire Scenery, an Essay in Geographical Evolution, A. W. Clayden, 127; das Kloster Kumbum in Tibet, Wilhelm Filchner, Lieut.-Colonel L. A. Waddell, 172; Documents scientifiques de la Mission Saharienne (Mission Foureau-Lamy d'Alger au Congo par le Tchad), F. Foureau, 200; Expedition in 1899-1901 to Mongolia and Cham, P. K. Kosloff, 235; Exploration of Shores of Kamchatka, Dr. W. N. Tuchoff, 235; the Duke of the Abruzzi's Ascents in the Ruwenzori Range, 282; the Ruwenzori Boundary Dispute, 321; the Snow-peaks of Ruwenzori, 500; the Dawn of Modern Geography, C. Raymond Beazley, 343; Return of Lieut. Boyd Alexander, 308; Death and Obituary Notice of Dr. Alfred Kirchhoff, 421; Beobachtung als Grundlage der Geographie, Prof. Albrecht Penck, Prof. Grenville A. J. Cole, 483; Man and Superman, Arthur J. Davis, 501; Royal Geographical Society's Medal Awards, 565; Progressive Waves in Rivers, Dr. Vaughan Cornish, 597; Rate of Recession of Niagara Falls, G. K. Gilbert, 607; the River Pilcomayo from its Discharge to Parallel 22° S., with Maps of Reference, Gunnar Lange, 617; a Progressive Course of Comparative Geography on the Concentric System, P. H. L'Estrange, Geo. G. Chisholm, Supp. to March 14, v; Philips' Progressive Atlas of Comparative Geography, Geo. G. Chisholm, Supp. to March 14, v; Stanford's Octavo Atlas of Modern Geography, Geo. G. Chisholm, Supp. to March 14, v
- Geology: Radium and Geology, Prof. J. Joly, F.R.S., 7, 294, 341; Prof. W. J. Sollas, F.R.S., 319; Edible Earth in New Guinea, W. Meigen, 14; the Tenth International Geological Congress, 64; Ueber die Klimaänderungen der Geologischen Vergangenheit, Prof. Frech, 65; the Sound (and Lake) Basins of New Zealand and the Cañons of Eastern Australia in their Bearing on the Theory of the Peneplain, E. C. Andrews, 72; Relationship between the Porosity of Rocks and the Flow of Water through the Interstices, Mr. Baldwin-Wiseman, 110; Geological Research in South Africa, 115; the Contact-phenomena at the Junction of Lias and Dolerite at Portrush, Prof. G. A. J. Cole, 120; the History of Devonshire Scenery, an Essay in Geographical Evolution, A. W. Clayden, 127; Geology of the Pilbara Goldfield, A. Gibb Maitland, 136; Upper Carboniferous Rocks of West Devon and North Cornwall, E. A. Newall Arber, 143; Titaniferous Basalts of the Western Mediterranean, Dr. H. S. Washington, 143; Geological Society, 143, 167, 215, 286, 334, 359, 430, 479, 550, 622; Goethe's Verhältnis zur Mineralogie und Geognosie, Rede gehalten zur Feier der Akademischen Preisverteilung am 16. Juni 1906, Dr. G. Linck, 146; Geological Survey of Canada, Prof. Frank D. Adams, 149; Death and Obituary Notice of John Ward, 155; the Rock of Studley and Arngrove, A. M. Davies, 167; Geology in the United States and Canada, 182; the Drumlins of South-eastern Wisconsin, W. C. Aldin, 182; Geology of the Boulder District of Colorado, N. M. Fenneman, 182; Taconic

- Physiography, T. N. Dale, 183; the Copper Deposits of the Clifton Morenci District, Arizona, W. Lindgren, 183; Underground Water Resources of Long Island, New York, A. C. Veatch, C. S. Slichter, I. Bowman, W. O. Crosby, and R. E. Horton, 183; Maryland Geological Survey (1905), 183; Miocene Foraminifera from the Monterey Shale of California, R. M. Bagg, jun., 183; Palaeontology of the Malone Jurassic Formation of Texas, F. W. Cragin, 183; the Configuration of the Rock Floor of Greater New York, W. H. Hobbs, 184; the Copper Deposits of Missouri, H. O. Foster Bain and E. O. Ulrich, 184; Mineral Resources of Elders Ridge Quadrangle, Pennsylvania, R. W. Stone, 184; the Fairhaven Gold Placers, Seward Peninsula, Alaska, F. H. Moffit, 184; the Gold Placers of Forty-Mile, Birch Creek, and Fairbanks Regions, Alaska, L. M. Prindle, 184; Methods and Costs of Gravel and Placer Mining in Alaska, C. W. Purington, 184; the Geography and Geology of Alaska, A. H. Brooks, 184; Geology of the Central Copper River Region, Alaska, W. C. Mendenhall, 184; the Delavan Lobe of the Lake Michigan Glacier, W. C. Alden, 184; the Lead, Zinc, and Fluorspar Deposits of Western Kentucky, E. O. Ulrich and W. S. Tangier Smith, 184; the Southern Appalachian Forests, H. B. Ayres and W. W. Ashe, 184; Economic Geology of the Bingham Mining District, Utah, J. M. Boutwell, 184; the Triassic Cephalopod Genera of America, A. Hyatt and J. P. Smith, 184; the Tertiary and Quaternary Pectens of California, R. Arnold, 184; Geology of the Tonopah Mining District, Nevada, J. E. Spurr, 184; Geology and Mineral Resources of Part of the Cumberland Gap Coalfield, Kentucky, G. H. Ashley and L. C. Glenn, 184; Annual Report of the Geological Survey of Canada for 1901, 185; the Geology of Samoa and the Eruptions in Savaii, H. I. Jensen, 191; Sand-movement on the New South Wales Coast, G. H. Halligan, 192; the Minerals and Genesis of the Veins and "Schlieren" traversing the Ægirine-syenite in the Bowral Quarries, D. Mawson, 192; a Treatise on the Geology of Armenia, Dr. Felix Oswald, 197; Documents scientifiques de la Mission Saharienne (Mission Foureau-Lamy d'Alger au Congo par le Tchad), F. Foureau, 200; Geological Conditions Contributing to the Success of the Artesian Boring for Water at Lincoln, Prof. E. Hull, 215; the Raised Beaches of Taltal (Northern Chile), O. H. Evans, 215; Deutsche Südpolar Expedition, 1901-1903, der Gaussberg, seine Kartierung und seine Formen, E. von Drygalski, Geologische Beschreibung des Gaussberges, E. Philippi, Petrographische Beschreibung der Gaussberg-Gesteine, R. Reinisch, 224; the Upeaval of the Sea Coast by Earthquakes, Dr. T. J. J. See, 224; J. M., 224; the Geology of Mining Areas, 258; the Klondike Goldfields, R. G. McConnell, 258; Gold-bearing Deposits of the Province of Sandia, Luis Pfücker, 258; the Diamond-pipes and Fissures of South Africa, Harold S. Harger, 258; the Relation between Ore Veins and Pegmatites, Prof. Beck, 258; Survey of the Komati Poort Coalfield, H. Kynaston, 259; the Country between Lydenburg and the Devil's Kantoor, A. L. Hall, 259; Oil Shales of the Lothians, 280; the Geology of the Oban Hills (Southern Nigeria), J. Parkinson, 286; Some Recent Work of Geological Surveys, 305; the Geology of the Country around Macclesfield, Congleton, Crewe, and Middlewich, T. L. Pocock, 305; Geology of the Isles of Scilly, G. Barrow, 305; Mineralogical Survey of Ceylon, Dr. A. K. Coomaraswamy, 306; Geology of the Hokitika Sheet, J. M. Bell and Colin Fraser, 306; the Slate Deposits of the United States, T. Nelson Dale, 325; the Contributions of America to Geology, Prof. Wm. North Rice, 354; Black Ridge, Clermont, Lionel C. Ball, 377; the Roman Comagmatic Region, Henry S. Washington, 379; the River Shannon, its Present Regimen and Geological History, J. R. Kilroe, 407; Clays, their Occurrence, Properties, and Uses, with Especial Reference to those of the United States, Dr. Heinrich Ries, 411; Death of Marcel Bertrand, 420; Obituary Notice of, M. M. Allorge, 441; Death and Obituary Notice of Caroline Birley, 421; Origin and Age of the Plateaus around Torquay, A. J. Jukes-Browne, 430; an Investigation into the Elastic Constants of Rocks, more Especially with Reference to Cubic Compressibility, Prof. Frank D. Adams and Prof. Ernest G. Coker, 451; Results obtained in the Investigation of the South-eastern Coalfield, Prof. W. Boyd Dawkins, 468; the Lower Ordovician Succession in Scandinavia, W. G. Fearnside, 479; Pseudomorphous Pebbles of Pyrites at the Crown Reef Mine (Witwatersrand), C. B. Horwood, 479; Raised Beach in the Cleadon Hills, Dr. D. Woolcott, 467; Silurian Inlier in the Eastern Mendips, Prof. S. H. Reynolds, 550; the Lower Palaeozoic Rocks of Pomeroy, W. G. Fearnside, Dr. Gertrude L. Elles, and B. Smith, 552; Rate of Recession of Niagara Falls, G. K. Gilbert, 607; Death and Obituary Notice of C. L. Griesbach, 611; Southern Origin attributed to the Northern Zone in the Savoy and Swiss Alps, Prof. T. G. Bonney, 622; Coral-rocks of Barbados, Prof. J. B. Harrison, 622; Geology of Androssan, Dr. J. D. Falconer, 623
- Geometry: Elementary Geometry based on Euclid's Elements, F. Purser, 74; Geometry, Theoretical and Practical, W. P. Workman and A. G. Cracknell, 74; Elementary Geometry, W. M. Baker and A. A. Bourne, 74; Elementary Descriptive Geometry, C. H. McLeod, 74; Geometry, an Elementary Treatise on the Theory and Practice of Euclid, S. O. Andrew, 409; Obituary Notice of Colonel Mannheim, Dr. J. Reveille, 422; Obituary Notice of Lieut.-General De Tilly, M. P. Mansson, 422; Geometrische Kristallographie, Ernst Sommerfeldt, 485; Space and Geometry, Dr. Ernst Mach, 603; Leçons de Géométrie supérieure, M. E. Vessiot, 603; La Géométrie analytique générale, H. Laurent, 603
- Gerard (Rev. John), Observations of Climbing Plants, 430
- Germany: the Geology of the German Antarctic Expedition, 224; the German Universities and University Study, Friedrich Paulsen, 338; Students in German Universities, 380; a Second German Course for Science Students, Prof. H. G. Fiedler and F. E. Sandbach, 413; German Science Reader, C. R. Dow, 509; die Niederschläge in den norddeutschen Stromgebieten, Prof. G. Hellmann, 556
- Giacobini (Prof.), Discovery of a Comet (1907a), 469; Comet 1907a (Giacobini), 498, 544
- Giacobini, Search-ephemeris for Comet 1900 III., Herr Abold, 498; Herr Scharbe, 498, 544
- (Giacobini) Comet 1907, M. Ebell, 518
- Giacobini's 1905 Comet, Photographic Observations of, Prof. Barnard, 111
- Giacobini's Comet (1905c), Photographs of, 326
- Giard (Alfred), Has the African Elephant a Pleural Cavity? 407
- Gibbs (J. Willard), the Scientific Papers of, 361
- Gibson (Charles R.), Electricity of To-day, its Work and Mysteries described in Non-technical Language, 389
- Gibson (J. H.), Instrument for Measuring the Power given off by Turbines, 523
- Gibson (J. S.), Physics, Theoretical and Descriptive, 436
- Gifford (J. W.), Refractive Indices of Water and Seawater, 165
- Giglioli (Prof. Henry H.), the Forest-pig of Central Africa, 414; on the Extinct Emeu of the Small Islands off the South Coast of Australia and probably Tasmania, 534
- Gilbert (G. K.), Gravitational Assemblage in Granite, 596; Rate of Recession of Niagara Falls, 607
- Giles (W. S.), Nomenclature of the Proteins, 439
- Gill (Sir David, K.C.B., F.R.S.), the Cape Observatory, 40; a Catalogue of 8560 Astrographic Standard Stars between Declinations -40° and -52° for the Equinox 1900 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1896-99 under the Direction of, 331; Catalogues of Stars for the Equinox 1900-0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1900-1904 under the Direction of, 331
- Gill (Theodore), Parental Care among Fresh-water Fishes, 467
- Gin (G.), a New Manganese Silicide, 263
- Giolitti (F.), the Study of Pseudo-solution, the Colloidal Forms of Ferric Hydroxide, 110
- Glasser (E.), Nepouite, 239
- Glazebrook (Dr. R. T.), Standards and Exact Measure-

- ment, Address at Institution of Electrical Engineers, 570
- Gleason (H. A.), Sand-dwelling Insects, 399
- Glenn (L. C.), Geology and Mineral Resources of Part of the Cumberland Gap Coalfield, Kentucky, 184
- Globular Cluster in Hercules Messier, Dr. Karl Bohlin, 616
- Glow Lamps, Standard Electric, 380
- Glück (Prof. Hugo), Biologische und morphologische Untersuchungen über Wasser- und Sumpfgewächse, 579
- Glycerin, Modern Soap, Candles and, L. L. Lamborn, C. Simmonds, 362
- Gobert (H. J.), le Cheval, 337
- Gods of Healing of the Egyptians and Greeks, the, Dr. R. Caton, 499
- Goeldi (Dr. E. A.), New Amazonian Tree-frog, *Hyla resinifictrix*, 406
- Goethe as Mineralogist and Geologist, Dr. G. Linck, 146
- Gold (Ernest), Velocity of the Negative Ions in Flames, 476
- Gooch (F. A.), Outlines of Qualitative Chemical Analysis, 581
- Goodwin (H. B.), Position-line Star Tables, for Fixing Ship's Position by Reduction to Meridian and Prime Vertical without Logarithmic Calculation, 197
- Gooseberry Mildew, American, 160, 613; E. S. Salmon, 247
- Gorczyński (Ladislav), the Solar Radiation, 326
- Gordon (Dr.), Bacteriological Test whereby Particles Shed from the Skin may be Detected in the Air, 545
- Gordon (J. W.), a Top Stop for the Microscope, 543
- Gore (J. E.), the Albedoes of the Superior Planets, 615
- Gore (Mr.), the Number of the Visible Stars, 64
- Goschen (Lord), Death and Obituary Notice of, 375
- Göttingen, die physikalischen Institut der Universität, Dr. J. A. Harker, 55
- Göttingen Royal Society of Sciences, 336, 384
- Gowland (Prof. W.), the Dolmens and Burial Mounds of the Early Emperors of Japan, 382
- Graff (K.), Jupiter's Satellites, 231
- Graham (R. J. D.), Light Sense-organs in Xerophilous Stems, 535
- Grand'Eury (M.), the Seeds and Flowers of Callipteris, 71
- Graphitic Iron in a Meteorite, W. Tassin, 137
- Gravitational Attraction on a Solid, Maximum, W. E. Miller, 439; Prof. G. H. Bryan, F.R.S., 439
- Gravity: the Pendulum Operations of the Survey of India, 12
- Gravity, Major Conyngham's Report on the Pendulum Observations for determining the Force of, 403
- Gray (Prof. Andrew, F.R.S.), Solutions of Physical Problems, 158
- Gray (A. C. H.), *Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes, 56
- Great Bowlers and Fielders, G. W. Beldam and C. B. Fry, 8
- Greek Theories of Elementary Cognition from Alcmaeon to Aristotle, John I. Beare, 122
- Greeks, the Gods of Healing of the Egyptians and, Dr. R. Caton, 499
- Green (A. G.), the Colouring Matters of the Stilbene Group, part iii., 23; the Relation of Colour and Fluorescence to Constitution, 358
- Green Sunset Colours, Arthur W. Clayden, 295
- Green Tints of Sunset, the, Joseph Offord, 342
- Greenhill (Prof. A. G., F.R.S.), the Flight of an Elongated Shot, 367
- Greenwich Observatory and the Power Station, 16
- Gréhan (Nestor), Detection and Estimation of Methane and Carbon Monoxide, 143
- Greig-Smith (Dr. R.), the Fixation of Nitrogen by *Azotobacter chroococcum*, 192; the Fixation of Nitrogen by *Rhizobium leguminosarum*, 192
- Grenville (L. W.), a Shilling Arithmetic, 74
- Griesbach (C. L.), Death and Obituary Notice of, 611
- Grossmann (Dr. J.), the Elements of Chemical Engineering, 125
- Groth (P.), Chemische Krystallographie, 529
- Guichard (M.), Reduction of Molybdic Acid in Solution by Molybdenum, 96
- Guillaume (J.), the Metcalf Comet (1906h), 167
- Guillaume (M.), the Measurement of Base Lines and the Jäderin Wires, 33
- Guillemin (Dr. A.), Tableaux logarithmiques, A et B, 482
- Guppy (H. B.), Observations of a Naturalist in the Pacific between 1896 and 1899, 217
- Guthe (Dr.), New Determination of the E.M.F. of the Weston and Clark Cells by a Gray Electro-dynamometer, 233
- Gutiérrez-Lanza (Father, S.J.), the Great Hurricane of October 17, 157
- Guye (Ph. A.), the Density of Gaseous Hydrochloric Acid, the Atomic Weight of Chlorine, 263
- Guyer (Dr. Michael F.), Animal Micrology, Practical Exercises in Microscopical Methods, 582
- Gwynne-Vaughan (D. T.), the Fossil Osmundaceæ, 455
- Gwyther (R. F.), the Range of Stokes's Progressive Waves of Finite Amplitude, 302
- Gyroscopic Apparatus for Steadying Ships, G. R. Dunell, 561
- Hackett (F. E.), the Atomic Weight of Nickel, 535
- Haddon (Dr. A. C., F.R.S.), Contributions to the Ethnology of the Haida, J. R. Swanton, 68; Kwakiutl Texts, Frank Boas and George Hunt, 68; the Koryak, Religion and Myths, Waldemar Jackson, 69
- Haeckel (Ernst), the Evolution of Man, a Popular Scientific Study, 78
- Hæmacytometer, the Fluctuations of Sampling to be Expected in Counting with a, 542
- Hagle (F. J.), Variation and Correlation in Ceratophyllum, 612
- Haida, Contributions to the Ethnology of the, J. R. Swanton, Dr. A. C. Haddon, F.R.S., 68
- Haileybury Natural History Lectures, 434
- Hale (Prof.), a New Form of Cælostat Telescope, 424
- Hale (George E.), Character and Cause of Sun-spot Spectra, 113
- Hall (A. D.), Artificial Fertilisers, Lecture at Society of Arts, 185
- Hall (A. L.), the Country between Lydenburg and the Devil's Kantoor, 259
- Hall (Clare H.), the Chemistry of Paints and Paint Vehicles, 4
- Hall (R.), Glimpses of Australian Bird Life, 595
- Haller (A.), the Alcoholysis of Fatty Bodies, 71; Alcoholysis of Cocoa Butter, 143; Preparation of Acyl-campholic Esters, 407; Alcoholysis of Castor Oil, 479; Arachic Alcohol from the Palm *Raphia Ruffia* of Madagascar, 528
- Halley's Comet, Dr. J. Holetschek, 86; F. W. Henkel, 616; Perturbations of, Messrs. Cowell and Crommelin, 447
- Halligan (G. H.), Sand-movement on the New South Wales Coast, 192
- Hallock (Dr. William), Outlines of the Evolution of Weights and Measures and the Metric System, 290
- Halm (Dr.), Variation of Wave-lengths in the Solar Spectrum, 304
- Hamer (Dr. W. H.), the Milroy Lectures on Epidemic Disease in England, the Evidence of Variability and of Persistency of Type, 99
- Hamilton (Mary), Incubation, or the Cure of Disease in Pagan Temples and Christian Churches, 366
- Hammond (Mr.), Another New Comet (1906h), 85
- Hampson (Dr. W.), Paradoxes of Nature and Science, 341, 606
- Hanbury (Sir Thomas, K.C.V.O.), Death of, 465; Obituary Notice of, 494
- Hancock (E. L.), Text-book on the Strength of Materials, 484
- Hands (Alfred), the Protection of Buildings from Lightning, 179
- Hann (Prof. J.), Diurnal Range of Temperature in the Tropics, 211; Climatological Atlas of India, Sir John Eliot, K.C.I.E., F.R.S., 241
- Hanriot (M.), the Active Substances of *Tephrosia Vogellii*, 335

- Harden (A.), Influence of Sodium Arsenate on the Fermentation of Glucose by Yeast-juice, 118
- Harden (Dr. Arthur), Researches on Cellulose, C. F. Cross and E. J. Bevan, 147
- Hardman (J. E.), Cobalt, New Silver Mining District of Canada, 613
- Hardy (A. D.), Peculiar Habitat of a Chlorophyte *Myxone-ma Tenue*, 599
- Harger (Harold S.), the Diamond-pipes and Fissures of South Africa, 258
- Harkanyi (Dr. Baron Bela), *Physische Geographie des Balatonsées und seiner Umgebung*, 70
- Harker (Dr. J. A.), die physikalischen Institute der Universität, 55; Recent Work of the American Bureau of Standards, 233
- Harrington (Prof. B. J.), Isomorphism as Illustrated by Certain Varieties of Magnetite, 406
- Harris (M. O'Brien), Seasonal Botany, a Supplementary Text-book, 341
- Harrison (Prof. J. B.), Coral Rocks of Barbados, 622
- Hart (C. A.), Sand-dwelling Insects, 399
- Hartley (W. N.), Spectrographic Analysis of a Meteoric Stone, 23; the Absorption Spectra of Phthalic, Iso-phthalic, and Terephthalic Acids, Phthalic Anhydride and Phthalimide, 406-7
- Hartmann (Prof.), Two Stars with Variable Radial Velocities, 137
- Hartmann (Dr. J.), the Spectrocomparator, 182
- Hartog (Prof. Marcus), Protozoa, 31
- Hartog (P. J.), Obituary Notice of M. P. E. Berthelot, 512
- Hartwig (Prof.), Comets 1906g (Thiele) and 1906h (Met-calf); 111
- Harvard College, Annals of the Astronomical Observatory of, Peruvian Meteorology, Prof. Solon I. Bailey, 283
- Harvard College, Annals of the Astronomical Observatory, 593
- Harvie-Brown (J. A.), a Fauna of the Tay Basin and Strathmore, Supp. to March 14, vii
- Haworth (Mr.), Case against the Metric System, 515
- Hayford (John F.), Geodetic Operations in the United States, 1903-6, 573; the Geodetic Evidence of Isostasy with a Consideration of the Depth and Completeness of the Isostatic Compensation and of the Bearing of the Evidence upon some of the Greater Problems of Geology, 573
- Hayman (J. M.), Indian Wheat Rusts, 14
- Headley (F. W.), Life and Evolution, 434
- Health of the School Child, the, Dr. W. Leslie Mackenzie, 435
- Health, Public, Prof. R. T. Hewlett, 544
- Heat: Specific Heat of Gases at Constant Volume and High Pressure, W. A. D. Rudge, 189; Behaviour of Certain Substances at their Critical Temperatures, Dr. Morris W. Travers, F.R.S., and Francis L. Usher, 47; Heat Treatment of High-temperature Mercurial Thermometers, H. C. Dickinson, 233; Temperatures obtainable by the Use of Solid Carbon Dioxide under Different Pressures, John Zeleny and Anthony Zeleny, 230; Effect of Temperature on the Activity of Radium, Dr. Howard L. Bronson, 262; Method of determining the Thermal Conductivity of India-rubber, G. F. C. Searle, 454; Relations between Thermal Conductivities at Ordinary and at Low Temperatures, Dr. Pietro Macchia, 326; Heat, Light, and Sound, an Introductory Course of Practical Exercises, J. R. Ashworth, 426; Influence of Temperature on the Photoelectric Discharge from Platinum, Dr. W. Mansergh Varley and F. Unwin, 623; Hydrates in Aqueous Solutions of Electrolytes, Rev. S. M. Johnstone, 623; the Coefficient of Expansion of Fused Quartz, Howard Minchin, 568; the Expansion of Crystalline Quartz in the Direction of the Axis and of Platinum, Palladium, and Quartz Glass between the Temperatures of -100° C. and $+100^{\circ}$ C., 568; the Steam-table, a Table of the Thermal and Physical Properties of Saturated Steam Vapour and of the Specific Heat of Water, Prof. Sidney A. Reeve, 533; Introduction to the Theory of Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat, H. S. Carslaw, 459; the Advantages and Disadvantages of Heating Buildings with Gas Stoves, Dr. Rideal, 469; Recording Calorimeter for Explosions, Prof. Bertram Hopkinson, 526
- Heath (F. G.), the Green Gateway, a Peep into the Plant World, 298
- Heavens at a Glance, 1907, the, 257
- Hecker (Dr.), the Value of Gravity at Sea, 33
- Hedgcock (G. G.), Chromogenic Fungi on Wood, 280
- Hedley (E. P.), the Absorption Spectra of Phthalic, Iso-phthalic, and Terephthalic Acids, Phthalic Anhydride and Phthalimide, 406-7
- Heen (P. De), Remarkable Luminous Effects Emanating from Electric Arc Lamps at the Instant of a Flash of Lightning, 423
- Helbronner (Paul), Altitude of the Grand Pic de la Meije, 599
- Helium: Radium and Helium, Dr. B. Walter, 102; Radium, Actinium, and Helium, H. S. Allen, 126; Helium and Argon in Common Rocks, Hon. R. J. Strutt, F.R.S., 271; the Helium Line D_3 in the Solar Spectrum, Mr. Buss, 281; an Occurrence of Helium in the Absence of Radio-activity, Hon. R. J. Strutt, F.R.S., 390
- Hellmann (Dr.), a Simplified Method of Transforming Readings of Fahrenheit Thermometer into Centigrade Values, and *vice versa*, 85; Corr., 111
- Hellmann (Prof. G.), die Niederschläge in den nord-deutschen Stromgebieten, 556
- Helmert (Prof.), the Systematised Observation of the Variation of Latitude, 33
- Helmholtz (Hermann von), Leo Koenigsberger, 198
- Hemsalech (G. A.), Utility of Resonance Phenomena in the Production of Strong Electric Sparks, 383; Oscillations of a Higher Order (Harmonics) in the Electric Spark, 599
- Henkel (F. W.), Halley's Comet, 616
- Henri (Victor), Coagulation of the Latex of Caoutchouc and the Elastic Properties of Pure Caoutchouc, 455
- Henry (Alfred J.), Weather Forecasting by Synoptic Chart, 14
- Henry (John R.), the Leonid Meteors, 30; the Lyrid Meteors, 560
- Henry (Louis), a Butyric Lactone and Unsymmetrical Dimethyl-butylene Glycol, 263; the Direct Dehydration of Dimethyl-isopropyl Carbinol, 503
- Henry (R.), the Habits of the Flightless Birds of New Zealand, 595
- Hercules Messier, the Second Globular Cluster in, Dr. Karl Bohlin, 616
- Heredity: die stofflichen Grundlagen der Vererbung im organischen Reich, Eduard Strasburger, 98; Is there Determinate Variation? Prof. Vernon L. Kellogg, 237; Recent Progress in the Study of Variation, Heredity, and Evolution, R. H. Lock, 577
- Herger (Franz), Death of, 515
- Hergesell (Prof.), Wind Currents in the Vicinity of the Canary Islands, 211
- Herrick (J. C.), Dental Apparatus of the Gastropod Fulgur, 38
- Hertet (Prof. E.), Effect of Stimulating Organisms with Different Light-rays, 516
- Hess (F. L.), Rampart Gold-placer Region, Alaska, 256
- Hewitt (J. F.), the Romance of an Eastern Capital, F. B. Bradley-Birt, 297
- Hewitt (J. T.), the Association of Phenols in the Liquid Condition, 358; a New Mercuric Oxochloride, 358
- Hewlett (Prof. R. T.), Immunity in Infective Diseases, Prof. Élie Metchnikoff, 99; the Inflammation Idea in General Pathology, Dr. W. H. Ransom, F.R.S., 99; the Milroy Lectures on Epidemic Disease in England, the Evidence of Variability and of Persistency of Type, Dr. W. H. Hamer, 99; Microbiologie Agricole, Dr. Edmond Kayser, 99; the Thompson-Yates and Johnston Laboratories Report, 351; Rapport sur l'Expedition au Congo, 1903-5, J. Everett Dutton and John L. Todd, 351; Second Report of the Wellcome Research Laboratories at Gordon Memorial College, Khartoum, Andrew Balfour, 351; Public Health, 544
- Hickson (Prof. S. J.), Cœlenterata and Ctenophora, 31
- Highways and Byways in Berkshire, James Edmund Vincent, 149

- Hilditch (T. P.), Camphor- β -sulphinic Acid and Camphoryl-sulphonium Bases, 407; an Isomeric Change of Dehydracetic Acid, 575
- Hilger's (Adam) 1907 Wave-length Spectroscope, 568
- Hill (G. W.), the Collected Mathematical Works of, 123
- Hill (Prof. J. P.), the Fœtal Dentition of the Australian Duckbill or Platypus (*Ornithorhynchus*), 566
- Hill (J. R.), a Series of Substituted Bromanelines, 551
- Hill-Tout (C.), British North America, i., the Far West, the Home of the Salish and Déné, 584
- Hills (Major E. H.), Irregular Movement of the Earth's Axis of Rotation, 143
- Hiltner's Inoculating Material, Lucerne treated with, 595
- Himalaya, the Orchids of the North-western, J. F. Duthie, 587
- Hirtz (M.), Experimental Reproduction of Lithospherical Folding, 239
- Hissey (James John), Untravelled England, 78
- Histology: the Essentials of Histology, Descriptive and Practical, Prof. E. A. Schäfer, F.R.S., 558; Animal Micrology, Practical Exercises in Microscopical Methods, Dr. Michael F. Guyer, 582
- History: Two Histories of Chemistry, Ernst von Meyer, F. P. Armitage, 169; Death of Prof. H. F. Pelham, 374; the Origin of the English Nation, H. Munro Chadwick, W. A. Craigie, 555; a History of Chemical Theory and Laws, M. M. Pattison Muir, 601
- Hobart (H. M.), Steam Turbine Engineering, 50; Elementary Principles of Continuous Dynamo Design, 221; Electric Railway Engineering, 531
- Hobbs (W. H.), the Configuration of the Rock Floor of Greater New York, 184
- Hobson (Dr. E. W.), the Uniform Convergence of Fourier's Series, 286; Repeated Integrals, 407
- Hobson (G. A.), Bridge at the Victoria Falls of the River Zambezi, 517
- Högner (Paul), Lichtstrahlung und Beleuchtung, 269
- Holetschek (Dr. J.), Halley's Comet, 86
- Holland (Philip), Sands and Sediments, 595
- Holmes (Sir George C. K.), Ancient and Modern Ships, 506
- Holz Müller (Prof. Gustav), Elementare kosmische Betrachtungen über das Sonnensystem und Widerlegung der von Kant und Laplace aufgestellten Hypothesen über dessen Entwicklungsgeschichte, 582
- Homer (Miss A.), Resolution of Salts of Asymmetric Nitrogen Compounds and Weak Organic Acids, 552; a New Coloured Fluorescent Hydrocarbon, 552
- Hooker (R. H.), Mean or Median, 487; the Weather and the Crops, 545
- Hooley (R. W.), *Goniopholis crassidens* from the Wealden Shales of Atherfield (Isle of Wight), 167
- Hooper (D.), Analysis of Bamboo, of the bark of *Picrasma javanica* and of Latices from a *Ficus*, 14
- Hopkinson (Prof. Bertram), Recording Calorimeter for Explosions, 526
- Hornaday (Dr. William T.), Camp-fires in the Canadian Rockies, 410
- Horrocks (Major W. H.), Conditions under which "Specific" Bacteria from Sewage may be Present in Drains, 599
- Horses: Surgical Anatomy of the Horse, John T. Share-Jones, 337; le Cheval, H. J. Gobert, 337; the Origin of the Modern Horse, Prof. J. C. Ewart, 612
- Horticulture: the Horticultural Note Book, 198; the Principles of Horticulture, a Series of Practical Scientific Lessons, Wilfred Mark Webb, 557; Seventh Report of the Woburn Experimental Fruit Farm, Duke of Bedford, K.G., and Spencer U. Pickering, F.R.S., 560; Arboriculture Fruitière, Leon Bussard and Georges Duval, 605
- Horton (Dr. Frank), the Discharge of Negative Electricity from Hot Calcium and from Lime, 550
- Horton (R. E.), Underground Water Resources of Long Island, New York, 183
- Horwood (C. B.), Pseudomorphous Pebbles of Pyrites at the Crown Reef Mine (Witwatersrand), 479
- Houdard (M.), Solubility of Carbon in Manganese Sulphide, 263; Sulphide of Aluminium and its Combinations with Manganese and Iron Sulphides, 624
- Hough (Prof. Theodore), the Human Mechanism, its Physiology and Hygiene, and the Sanitation of its Surroundings, 318
- Houston (Dr.), Bacteriological Examination of Deep Well Waters and of Upland Waters, 544
- Houzé (Dr. E.), the Aryan and Anthroposociology, 237
- Howe (J. Allen), Attrition Tests of Road-making Stones, Petrographical Descriptions by, 220
- Huber (J.), Museu Paraense de Historia e Ethnographia: Arboretum Amazonicum, 459
- Hugounenq (L.), Albumen from the Eggs of Fish: Comparison with Vitelline from Hens' Eggs, 71
- Hull (Prof. E.), Geological Conditions Contributing to the Success of the Artesian Boring for Water at Lincoln, 215
- Human Mechanism, the, its Physiology and Hygiene, and the Sanitation of its Surroundings, Prof. Theodore Hough and Prof. W. T. Sedgwick, 318
- Hunt (George), Kwakiutl Texts, 68
- Hunt (H. F.), a Remarkable Lunar Halo, February 24, 439
- Hunter (Dr. James), Cases of Contour Zones of Molecular Arrangement from Surface Disturbance, 335
- Hunting and Shooting in Ceylon, H. Story, 492
- Hurt (Dr. Jakob), Esthonian Folk-lore, 540
- Hussak (E.), Bean-shaped Pebbles Indicative of the Presence of Diamonds in the Alluvial Gravels at Diamantina, Brazil, 158
- Hutchinson (Jonathan, F.R.S.), on Leprosy and Fish Eating, 412
- Hutton (Dr. R. S.), Obituary Notice of Prof. Henri Moissan, 419
- Huygens, la Découverte de l'Anneau de Saturne par, Jean Mascart, 509
- Hyatt (A.), the Triassic Cephalopod Genera of America, 184
- Hyde (Mr.), an Efficiency Meter for Electric Incandescent Lamps, 233; Talbot's Law as Applied to the Rotating Sected Disc, 233
- Hydraulics: a Manual of Hydraulics, R. Busquet, 29; Hydraulic Motors with Related Subjects, including Centrifugal Pumps, Pipes, and Open Channels, Prof. Irving P. Church, 50; Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the Welsbach Mantle, Prof. R. W. Wood, 558
- Hydrography: Death and Obituary Notice of Colonel John Mercer Brooke, 347
- Hygiene: the New Hygiene, Élie Metchnikoff, 583; the Nitrification of Sewage, Dr. G. Reid, 382; Purification of Sewage, A. Muntz and E. Lainé, 479; Conditions under which "Specific" Bacteria from Sewage may be present in Drains, Major W. H. Horrocks, 599; the Purification of Sewage by Turf Filters, Henri Pottevin, 600
- Ice Formation, with Special Reference to Anchor-ice and Frazil, Howard T. Barnes, 267
- Ichthyology: Inheritance in Fishes, Dr. W. E. Castle and A. P. Larrabee, 83; the Hearing of Fishes, M. Marage, 144; Filtering Apparatus Attached to the Gill-rakers of Deep-sea Fishes, Dr. Enoch Zander, 348; Development of the Anterior Mesoderm and Paired Fin in Lepidosiren and Protopterus, W. E. Agar, 455; *Prymnothous Hookeri* refound, Louis Dollo, 455; Parental Care among Fresh-water Fishes, Theodore Gill, 467; Abnormal Specimen of the Turbot, J. T. Cunningham, 478; the Tile Fish, *Lopholatilus chamaeleonticeps*, 516
- Idler in the Wilds, an, T. Edwards, 176
- Illustriertes Handwörterbuch der Botanik, Dr. O. Porsch and C. K. Schneider, 28
- Immortality of the Protozoa, the, J. Shawcross, 320
- Incubation, or the Cure of Disease in Pagan Temples and Christian Churches, Mary Hamilton, 366
- India: Report of the Board of Scientific Advice for India for the Year 1904-5, 11; Experiments at the Cawnpore Experimental Farm, 12; the Dalhousie Earthquake of April 4, 1905, 12; the Pendulum Operations of the Survey of India, 12; Research in India, A. Ernest Crawley, 41; Indigo and Cotton Cultivation in India, 109; Indigo Culture in India, Cyril Bergtheil, 407; the Fauna of British India, including Ceylon and Burma, Coleoptera, vol. i., Cerambycidae, C. J. Gahan, 222; Climatological Atlas of India, Sir John Eliot, K.C.I.E., F.R.S., Prof. J. Hann, 241; Under the Sun: Impressions of Indian Cities, P. Landon, 268; the Romance of an Eastern

- Capital, F. B. Bradley-Birt, J. F. Hewitt, 297; Indian Trees, being an Account of Trees, Shrubs, Woody Climbers, Bamboos, and Palms Indigenous or Commonly Cultivated in the British Empire, Sir Dietrich Brandis, K.C.I.E., F.R.S., 385; the Recent Solar Eclipse in India, 402; Science in India, 403; a New Volcanic Island, Rear-Admiral A. Mostyn Field, F.R.S., 414; Dr. Haffkine's Prophylactic, 514; *Termes gestroi*, the White Ant Rubber Pest, E. P. Stebbing, 516; Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, Dr. J. W. W. Stephens, 523; the Orchids of the North-western Himalaya, J. F. Duthie, 587; Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Col. S. G. Burrard, F.R.S., Supp. to March 14, viii
- Indigo Manufacture, the Efficiency of the Present Process of Natural, C. Bergtheil, 30
- Indigo, Synthetic and Natural, Cyril Bergtheil, 614
- Infection in Trypanosomes Generally, Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of, Prof. E. A. Minchin, 214
- Infectious Diseases, the Scientific Study of, Dr. W. H. Welch at the Rockefeller Institute for Medical Research, 213
- Infective Diseases, Immunity in, Prof. Élie Metchnikoff, Prof. R. T. Hewlett, 99
- Inflammation Idea in General Pathology, the, Dr. W. H. Ransom, F.R.S., Prof. R. T. Hewlett, 99
- Ingen-Housz (Jan), Sein Leben und sein Wirken als Naturforscher und Arzt, Prof. Julius Wiesner, 3
- Ingersoll (E.), the Life of Animals—the Mammals, 176
- Inland Waterways, British, 212
- Inoculation Accident at Mulkowal, the, Prof. Ronald Ross, C.B., F.R.S., 486; see Morbology and Serotherapy
- Inorganic Chemistry, Practical Methods of, Dr. F. M. Perkin, 26
- Insect-extermination, an Experiment in, 82
- Insects, Fertilisation of Flowers by, E. W. Swanton, 320; Dr. Alfred R. Wallace, F.R.S., 320
- Institution of Electrical Engineers, Standards and Exact Measurement, Dr. R. T. Glazebrook at, 570
- Institution of Mechanical Engineers, on the Properties of Alloys of Aluminium and Copper, Prof. H. C. H. Carpenter and C. A. Edwards at the, 426
- Instruments, the Technical College Set of Mathematical, 413
- International Balloon Service, the Belgian, 572
- International Chart and Catalogue, the, 111
- International Fishery Investigations, 251
- International Geodetic Conference at Buda Pest, Sir G. H. Darwin, K.C.B., F.R.S., 33
- International Seismological Association, the, 274
- International Union for Cooperation in Solar Research, Transactions of the, 458
- Inversion Temperatures for Air and Nitrogen, Prof. K. Olszewski, 379
- Ionisation and Absorption and Anomalous Dispersion, Dr. G. A. Schott, 271
- Ionisation and Anomalous Dispersion, Prof. R. W. Wood, 390, 583; G. A. Schott, 461
- Ionisation by Spraying, A. S. Eve, 533
- Ireland: Fisheries, 376
- Iron: the Rusting of Iron, Rev. Joseph Meehan, 31; Prof. Wyndham R. Dunstan, F.R.S., 390, 477; Dr. G. T. Moody, 438, 575; C. E. Stromeyer, 461; some Modern Conditions and Recent Developments in Iron and Steel Production in America, Frank Popplewell, 438
- Irrigation Project at Yuma, Government, Prof. Oscar C. S. Carter, 591
- Irrigation with Surface and Subterranean Water, and Land Drainage, W. Gibbons Cox, 221
- Ismailia, Suppression du Paludisme à, 204
- Italian Volcanic Rocks, Henry S. Washington, 379
- Italy, Archæology in, 596
- Jackson (C. S.), the Form of the Surface of a Searchlight Reflector, 188
- Jahresbericht, Astronomischer, A. Berberich, 6
- Jahresbericht, Zoologischer, für 1905, 6
- Jaquerod (Adrien), Preparation of Pure Helium by Filtration of Gases from Cleveite through a Wall of Silica, 335
- Janko (Dr. Johann), Social- und Anthropogeographie des Balatonsees, 79
- January Meteors, the, W. F. Denning, 199
- Japan: Remarkable Crystal Discovered at Masutomimura, 179; the Dolmens and Burial Mounds of the Early Emperors of Japan, Prof. W. Gowland, 382
- Japanese Singing Kettle, a, Prof. H. Nagaoka, 78
- Javillier (Maurice), an Extremely Sensitive Method for the Precipitation of Zinc, 167
- Jenkin (C. F.), Single-phase Electric Traction, 85
- Jenks (R. L.), Determination of Higher Alcohols in Spirits, the "Ester-iodine" Method, 334
- Jensen (Chr.), Anwendungen des Mikrophonprinzips, 153
- Jensen (H. I.), the Geology of Samoa and the Eruptions in Savaii, 191
- Jepson (George), Cams, and the Principles of their Construction, 460
- Jesup North Pacific Expedition, Further Results of the, J. R. Swanton, Dr. A. C. Haddon, F.R.S., 68
- Jevons (the late W. Stanley), the Coal Question, 244
- Jochelson (Waldemar), the Koryak, Religion and Myths, 69
- Johansen (Dr.), the Plaice Fishery of the Kattegat, 252
- Johnson (Walter), Neolithic Man in North-east Surrey, 124
- Johnston (W. and A. K.), Map of the British Isles, 54
- Johnstone (Rev. S. M.), Hydrates in Aqueous Solutions of Electrolytes, 623
- Jolly (Dr. W. A.), Functions of the Rolandic Cortex in Monkeys, 623
- Joly (Prof. J., F.R.S.), Radium and Geology, 7, 294, 341
- Jones (H. F.), Plant Life: Studies in Garden and School, 298
- Jones (Dr. H. O.), the Solubility of Stereoisomerides in Optically Active Solvents, 190; New Iron Carbonyl and on the Action of Light and Heat on the Iron Carbonyls, 477
- Joseph (H. W. B.), an Introduction to Logic, 1
- Joseph (Leonard), What are We? 318
- Jouast (R.), Influence of the Surrounding Temperature on the Luminous Intensity of an Incandescent Electric Lamp, 575
- Jouguet (M.), Waves of Shock, Application to the Explosive Wave, 455
- Jugendform und Blütenreife im Pflanzenreich, Dr. L. Diels, 194
- Jujutsu, the Fine Art of, Mrs. Roger Watts, Lady Lockyer, 250
- Jukes-Browne (A. J.), Origin and Age of the Plateaus around Torquay, 430
- Jupiter: the Red Spot on Jupiter, 1905-6, Stanley Williams, 327; Simultaneous Observations of Jupiter, 569; Jupiter's Satellites, J. E. Martin, 231; K. Graff, 231; A White Spot on Jupiter's Third Satellite, José Comas Solá, 281; Early Observations of Jupiter's Sixth Satellite, Miss Leavitt, 182; Simultaneous Disappearance of Jupiter's Four Satellites, Enzo Mora, 448; Eclipses of Jupiter's Satellites, 1878-1903, Prof. E. C. Pickering, 616
- Kafir Children, Savage Childhood, a Study of, Dudley Kidd, 128
- Kahlenberg (Prof. L.), Bearing of Actual Osmotic Experiments upon the Conception of the Nature of Solutions, 430
- Kahn (H. Morel), the Solubility of Carbon in Barium and Strontium Carbides, 359
- Kapp (Prof. Gisbert), Anwendungen des Mikrophonprinzips, Chr. Jensen and H. Sieveking, 153
- Kapteyn (Prof. J. C.), Plan of Selected Areas, 427
- Kareff (N.), the Coagulability of the Subhepatic Blood, 48
- Kaye (F.), Chemical Composition of Some Motor-tyre Rubbers, 383; Composition of Some New Crude Rubbers, 383
- Kaye (W. J.), the *Dracontia rusina*, Druce, from Trinidad, 70
- Kayser (Dr. Edmond), Microbiologie Agricole, 99
- Kayser (E.), Influence of Manganese Salts on Alcoholic Fermentation, 504, 576
- Keane (C. A.), Condensation of Diethylmalonamide with

- Aldehydes, 407; Condensation of Salicylamide with Aryl Aldehydes, 407
- Kearton (R.), Nature's Carol-singers, 176; British Birds' Nests, How, Where, and When to Find and Identify Them, 562
- Keith (A.), the Muscular Connections of the Vertebrate Heart, 612
- Kellogg (Prof. Vernon L.), Is There Determinate Variation? 237
- Kelvin (Lord, O.M., F.R.S.), Homer Lane's Problem of a Spherical Gaseous Nebula, 368
- Kemp (Mr.), a Peculiar Short-period Variable (155.1906 Cassiopeiae), 327
- Kemp (Louis C.), Anhydrite in Beds of Gypsum, 540
- Kemp (S. W.), *Acanthephyra purpurea* and *A. debilis*, 550
- Kennedy (Sir Alexander, F.R.S.), Relation of the Engineer and Engineering to the World at Large, 62
- Kershaw (J. B. C.), Electrolytic Alkali and Bleach Industry, 454
- Ketene, N. T. M. Wilsmore and A. W. Stewart, 510
- Kettle, a Japanese Singing, Prof. H. Nagaoka, 78
- Khotinsky (Eugène), Acetyl Nitrate, 360
- Kidd (Dudley), Savage Childhood, a Study of Kafir Children, 128
- Kidd (Dr. Walter), the Papillary Ridges and Papillary Layer of the Skin of the Hand and Foot of Lemurs, 83
- Kidston (R.), the Fossil Osmundaceæ, 455
- Kilroe (J. R.), the River Shannon, its Present Regimen and Geological History, 407
- Kimplin (G.), Presence of Formaldehyde in Green Plants, 335
- Kinch (Prof. E.), Church's Laboratory Guide, 581
- Kingsley (J. S.), Meristic Homologies in Vertebrates, 541
- Kingston Earthquake, the, Dr. Charles Davison, 296; see Earthquakes
- Kipping (F. S.), Organic Derivatives of Silicon, ii., *d*-benzylethylpropylsilicic acid, 358; Organic Derivatives of Silicon, 575
- Kirby (W. F.), Ueber chitinose Fortbewegungs-Apparate einiger (insbesondere fussloser) Insektenlarven, Dr. Wilhelm Leisewitz, 54; British Flowering Plants, 222; a Synonymic Catalogue of Orthoptera, 269
- Kirchhoff (Dr. Alfred), Death and Obituary Notice of, 421
- Kitchin (S.), Malacone, 23
- Klebs (Prof. G.), Metamorphoses in Plants by Artificial Cultivation, 613
- Klein (Dr.), the Transmission of Plague in the Rat, 544
- Knapp (M.), the Bacterial Nature of "Spirochaetes," 180
- Knott (Dr. C. G.), Relation between Magnetisation and Electric Conductivity in Nickel at High Temperatures, 334
- Koch (Dr. L.), Einführung in die mikroskopische Analyse der Drogenpulver, 390
- Koch (Prof.), Atoxyl an Effectual Remedy against Sleeping Sickness, 206
- Koenigsberger (Leo), Hermann von Helmholtz, 198
- Konkoly (Prof. von), Observations of the August Meteors, 182
- Konowloff (Prof. M. J.), Death and Obituary Notice of, 323
- Kopff (Dr.), Observation of Comet 1905 IV., 518
- Kormos (Theodore), Die Biologie des Balatonsees, 79
- Korselt (Dr.), Diurnal Variation of the Barometer, 211
- Koryak, the, Religion and Myths, Waldemar Jochelson, Dr. A. C. Haddon, F.R.S., 69
- Kosloff (P. K.), Expedition in 1899-1901 to Mongolia and Cham, 235
- Krebs (Dr. Wilhelm), the 1906 Zeppelin Airship, 229; Atmospheric See-saw Phenomenon and the Occurrence of Typhoon Storms, 560
- Kreutz (Prof.), Comet 1906g, 86; Comet 1906h (Metcalfe), 159; Two Stars with a Common Proper Motion, 208
- Kumaon, Catalogue of the Plants of, and of the Adjacent Portions of Garhwal and Tibet, Lieut.-General Sir Richard Strachey, 171
- Kumbum in Tibet, Das Kloster, Wilhelm Filchner, Lieut.-Col. L. A. Waddell, 172
- Kunz (Dr. George F.), Mineral Resources of the United States, Production of Precious Stones in 1905, 423
- Kuss (G.), Pathology of Pulmonary Anthracosis, 336
- Kwakiutl Texts, Franz Boas and George Hunt, Dr. A. C. Haddon, F.R.S.
- Kynaston (H.), Survey of the Komati Poort Coalfield, 259
- L'Estrange (P. H.), a Progressive Course of Comparative Geography on the Concentric System, Supp. to March 14, v
- La Touche (T. D.), Mineral Production of India during 1905, 157
- Laar (J. J. van), Sechs Vorträge über das thermodynamische Potential, &c., 77
- Laboratories: Die physikalischen Institute der Universität Göttingen, Dr. J. A. Harker, 55; Scottish Oceanographical Laboratory, 307; the Thompson-Yates and Johnston Laboratories' Report, Prof. R. T. Hewlett, 351; Second Report of the Wellcome Research Laboratories at Gordon Memorial College, Khartoum, Andrew Balfour, Prof. R. T. Hewlett, 351
- Laby (T. H.), Relation between the Ionic Velocity and the Volume of Organic Ions in Aqueous Solutions, 189
- Lacroix (A.), Products of the Fumerolles of Vesuvius, 96; the Eruption of Vesuvius in April, 1906, 163
- Lainé (E.), Purification of Sewage, 479
- Lake Balaton: Physische Geographie des Balatonsees und seiner Umgebung, Dr. Moriz Staub and Dr. J. Bernatsky, Dr. E. von Cholnoky, Dr. Baron Bela Harkanyi, 79; Die Biologie des Balatonsees, Dr. Geza Entz, Dr. A. Weiss, and Theodore Kormos, Dr. Josef Pantocsek, 79; Social- und Anthropogeographie des Balatonsees, Gyula Rhé, Dr. Johann Janko and Dr. Willibald Semayer, 79; Bibliographie des Balatonsees, Julius von Sziklay, 79; Spezialkarte der Balatonsees und seiner Umgebung, Dr. Ludwig von Loczy, 79
- Laloue (G.), Migration of Compounds Possessing Smell in the Plant, 624
- Lamb (C. G.), Alternating Currents, a Text-book for Students of Engineering, 97
- Lamborn (L. L.), Modern Soap, Candles, and Glycerin, 362
- Lamplough (F. E. E.), Determination of the Rate of Chemical Change by Measurement of Gases Evolved, 118
- Lamson (Mr.), Comet 1907b (Mellish), 615
- Lancereaux (M.), Aneurism of the Ophthalmic Artery Cured by Gelatin, 456
- Land Drainage, Irrigation with Surface and Subterranean Water and, W. Gibbons Cox, 221
- Lander (Dr. G. D.), Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Supp. to March 14, iv
- Landon (P.), Under the Sun: Impressions of Indian Cities, 268
- Lane's (Homer) Problem of a Spherical Gaseous Nebula, Lord Kelvin, O.M., F.R.S., 368
- Lange (Gunnar), the River Pilcomayo from its Discharge to Parallel 22° S., with Maps of Reference, 617
- Lankester (Prof. E. Ray), Origin of the Lateral Horns of the Giraffe in Fœtal Life, 406; Rudimentary Antlers in the Okapi, 406
- Lantern Slides, Stereoscopic, G. A. Shakespear, 199
- Lapidary, the Art of the, 321
- Laporte (F.), Influence of the Surrounding Temperature on the Luminous Intensity of an Incandescent Electric Lamp, 575
- Lapworth (A.), the Velocity of Reaction of Bromine with Some Unsaturated Acids in Aqueous Solution, 359; an Extension of the Benzoin Synthesis, 575
- Larmor (Prof. J.), Irregular Movement of the Earth's Axis of Rotation, 143
- Larrabee (A. P.), Inheritance in Fishes, 83
- Lau (Dr. H. E.), Measurements of the Effective Wavelengths in Stellar Spectra, 182
- Laubholzkunde, Illustriertes Handbuch der, C. K. Schneider, 199
- Lauder (Dr. Alex.), Variation in the Composition of Milk, 594
- Laurent (H.), la Géométrie analytique générale, 603
- Laurente (Fosco), I Motori ad Esplosione, a Gas luce e Gas povero, 291
- Laussedat (Colonel), Death and Obituary Notice of, 565

- Law (H. D.), Preparation of Chromyl Dichloride, 358; the Potential of Hydrogen Liberated from Metallic Surfaces, 621
- Lazarus-Barlow (Dr. W. S.), Retardation of Electroscopic Leak by Means of Recognised Radio-active Substances, 559
- Lazennec (I.), the Products and Condensation of Acetylenic Esters and Amines, 24; the Condensation of Hydrazines with Acetylenic Nitriles, 263; Method of Synthesis of Non-substituted β -ketonic Amides, 624
- Le Bas (G.), Formulæ for Calculating Molecular Volumes of Complex Paraffins and Alcohols, 263
- Lea (John), the Romance of Animal Arts and Crafts, 76
- Leaf-hoppers and their Natural Enemies, 82
- Leavenworth (W. S.), Inorganic Qualitative Chemical Analysis for Advanced Schools and Colleges, 581
- Leavitt (Miss), Discovery of a Nova, 137; New Variable Stars, 159; Early Observations of Jupiter's Sixth Satellite, 182; Thirty-six New Variable Stars, 402; a Lost Comet (1905f), 402
- Lebeau (Paul), the Existence of Chloride of Bromine, 23; Reduction of Magnesia by Carbon, 624
- Lecoq (Dr. von), Archæological Discoveries in Turkestan, 248
- Lecornu (L.), the Extinction of Friction, 239
- Leduc (Stéphane), the Culture of the Artificial Cell, 144
- Lees (F. H.), the Conversion of Morphine and Codeine into Optical Isomerides, 23
- Léger (E.), the Constitution of Hordenine, 168
- Leicester Meeting of the British Association, 585
- Leigh (Hon. M. Cordelia), Our School Out of Doors, 76
- Leiper (Mr.), Life-history of the *Dracunculus Medinensis* or Guinea-worm, 302
- Leisewitz (Dr. Wilhelm), Ueber chitinöse Fortbewegungs-Apparate einiger (insbesondere füssloser), Insektenlarven, 54
- Lemoine (Georges), Catalytic Reactions Effected under the Influence of Wood Charcoal, 431
- Lemoult (P.), Nitriles and Carbamines, 167
- Leonard (Major Arthur Glyn), the Lower Niger and its Tribes, 602
- Leonard (J. H.), Exercises in Physics for the Use of Schools, 436
- Leonid Meteors, the, John R. Henry, 30
- o Leonis, the Spectroscopic Binary, W. Zuhellen, 378
- Lepidoptera: a Certain Form of Butterfly Scale, Dr. Alfred C. Stokes, 350; Catalogue of the Lepidoptera Phalænæ in the British Museum, vol. vi., Noctuidæ, 366
- Leprosy and Fish Eating, on, Jonathan Hutchinson, F.R.S., 412
- Lespieau (M.), Synthesis of Natural Erythrite, 335
- Letulle (M.), a Respiratory Calorimetric Room, 168
- Levallois (F.), Gases observed in the Attack of Tantalite by Potash, 71
- Levy (Michel), Existence of Parameters Capable of Characterising the Magmas of a Family of Eruptive Rocks, 528
- Lévy-Franckel (M.), Fundamental Differences in the Mechanism and Evolution of the Increase of Resistance to Infection according to the Methods Utilised, 432
- Lewes (Vivian B.), Service Chemistry, a Short Manual of Chemistry and its Applications in the Naval and Military Services, 266
- Lewis (A. L.), a Dolmen at Presles, France, 478
- Lichtstrahlung und Beleuchtung, Paul Högnér, 269
- Life and Evolution, F. W. Headley, 434
- Light: Some Astronomical Consequences of the Pressure of Light, Prof. J. H. Poynting, F.R.S., at Royal Institution, 90; the Manufacture of Light, Prof. Silvanus P. Thompson, F.R.S., 269; the Tutorial Physics, vol. iii., a Text-book of Light, Dr. R. Wallace Stewart, 436; Light for Intermediate Students, F. E. Rees, 436
- Light Sense-organs in Xerophilous Stems, R. J. D. Graham, 535
- Lightning, the Protection of Buildings from, Alfred Hands, 179
- Linck (Dr. G.), Coethes Verhältnis zur Mineralogie und Geognosie, Rede gehalten zur Feier der akademischen Preisverteilung am 16 Juni, 1906, 146
- Lindemann (F. A. and C. L.), New Glass Transparent to Rays of very Short Wave-length, 614
- Lindgren (W.), the Copper Deposits of the Clifton Morenci District, Arizona, 183
- Line Intensity and Spectral Type, Dr. Sebastian Albrecht, 304
- Linné, the Lunar Crater, Dr. Wirtz, 231; Prof. W. H. Pickering, 231
- Linnean Society, 71, 166, 215, 333, 430, 526, 550, 621
- Linnean Society, New South Wales, 72, 191, 311
- Linsbauer (Prof. L. and Dr. K.), Vorschule der Pflanzenphysiologie eine Experimentelle Einführung in das Leben der Pflanzen, 602
- Linton (E.), Manner in which the Parasitic Fish *Fierasfer affinis* effects an Entrance into the Body of the Sea Cucumber, 348
- Lister's (Lord), the Commemoration of, Eightieth Birthday, 564
- Littell (Prof.), Transit-circle Observations, 257
- Liverpool School of Tropical Medicine, Memoir xxi. of the, Dr. J. W. W. Stephens, 523
- Liverpool, University of, and Royal Infirmary Cancer Research Laboratories, First Report on the Cytological Investigation of Cancer, 1906, J. E. S. Moore and C. E. Walker, 587
- Liversidge (Prof.), Gold Nuggets from New Guinea showing a Concentric Structure, 480
- Livingston (Dr. B. E.), the Relation of Desert Plants to Soil, Moisture, and to Evaporation, 84
- "Lloyd" Guide to Australasia, the, 102
- Lobstein (E.), Pathology of Pulmonary Anthracosis, 336
- Lock (Rev. J. B.), Trigonometry for Beginners, 409
- Lock (R. H.), Recent Progress in the Study of Variation, Heredity and Evolution, 577
- Lockyer (Lady), the Fine Art of Jujutsu, Mrs. Roger Watts, 250
- Lockyer (Sir Norman, K.C.B., F.R.S.), Notes on Ancient British Monuments, 150
- Lockyer (Commander H. C.), How to Learn on Shore the Rule of the Road at Sea, E. W. Owens, 126
- Loczy (Dr. Ludwig von), Spezialkarte der Balatonsees und seiner Umgebung, 79
- Lodge (Dr. Oliver, F.R.S.), Modern Views of the Ether, 519
- Lodge (R. B.), Pelicans in Eastern Europe, 38
- Loeb (Prof. Jacques), Untersuchungen über künstlichen Parthenogenese und das Wesen des Befruchtungsvorgangs, 486
- Loew (Prof. Oscar), die Chemische Energie der lebenden Zellen, 508
- Logarithmic Spirals, Instrument for Describing, Mr. Pochin, 621
- Logarithms: Tableaux logarithmiques, A et B, Dr. A. Guillemin, 482; Clive's Mathematical Tables, 482; Five-Figure Mathematical Tables for School and Laboratory Purposes, Dr. A. Du Pré Denning, 482
- Logic: Symbolic Logic and its Applications, Hugh MacColl, 1; the Development of Symbolic Logic, A. T. Shearman, 1; an Introduction to Logic, H. W. B. Joseph, 1; Thoughts and Things, or Genetic Logic, James Mark Baldwin, 1
- London, Electric Power in, 418
- Loney (S. L.), a Shilling Arithmetic, 74
- Long (W. J.), Brier Patch Philosophy, 176
- Longitude Determinations, Wireless Telegraphy in, Prof. Albrecht, 544
- Lovegrove (E. J.), Attrition Tests of Road-making Stones, 220
- Lowell (Prof.), the Temperature of Mars, 593
- Lowry (Dr. T. M.), Recent Experiments on the Crystallisation of Minerals, A. L. Day and Mr. Shepherd, 112; Osmotic Pressure from the Standpoint of the Kinetic Theory, 429
- Ludendorff (Dr. H.), Stars with Peculiar Spectra, 64
- Lumsden (J. S.), the Liquid Volume of a Dissolved Substance, 215
- Lunar Changes, Prof. W. H. Pickering, 16
- Lunar Crater Linné, the, Dr. Wirtz, 231; Prof. W. H. Pickering, 231
- Lunar Halo, a Remarkable, February 24, H. F. Hunt, 439
- Lunge (Prof. George), Problems of Applied Chemistry, Discourse at the Royal Institution, 617

- Lunt (Joseph), Presence of Europium in Stars, 549
 Lusk (Prof. Graham), the Elements of the Science of Nutrition, 413
 Lyle (Prof. T. R.), Transformer Indicator Diagrams, 478
 Lyman (G. R.), Subsidiary Spore-forms, 567
 Lyon (M. W.), Indo-Malay Slow-loris, 135
 Lyon (M. Ward), the Great Anteater of Central America (*Myrmecophaga centralis*), 156
 Lyons (Captain H. G., F.R.S.), the Physiography of the River Nile and its Basin, 17; a Report on the Work of the Survey Department in 1905, 250
 Lyrid Meteors, the, John R. Henry, 560
- Macallum (Prof. A. B., F.R.S.), the University of Toronto, 396
 McAlpine (D.), the Rusts of Australia, their Structure, Nature, and Classification, 101
 MacBride (Prof. E. W., F.R.S.), Echinodermata, 31
 Macchia (Dr. Pietro), Relations between Thermal Conductivities at Ordinary and at Low Temperatures, 326
 MacColl (Hugh), Symbolic Logic and its Applications, 1
 McConnell (R. G.), the Klondike Goldfields, 258
 MacCurdy (Prof.), Some Phases of Prehistoric Archaeology, 355
 Macdonald (Prof. J. S.), the Structure of Nerve Fibres, 187; das Cerebellum der Säugetiere eine vergleichend anatomische Untersuchung, Prof. Louis Bolck, Supp. to March 14, ix
 MacDowall (Alex. B.), Rothesay Rainfall and the Sun-spot Cycle, 488
 Macfadyen (Dr. Allan), Death and Obituary Notice of, 443
 Mach (Dr. Ernst), Space and Geometry, 603
 Machine Design, Prof. Albert Smith and G. H. Marx, 172
 M'Ilroy (Miss J. H.), Variations in the Leaves of Ferns Grown in the Sun or in Shade, 109
 McKechnie (James), Influence of Machinery on the Gun-power of the Modern Warship, 522
 McKee (J. L.), the Effect of Radium on the Strength of Threads, 224
 McKendrick (Prof. John G., F.R.S.), Lectures upon the Mechanism of Speech, Alexander Graham Bell, 196; Researches in Experimental Phonetics, the Study of Speech Curves, Dr. E. W. Scripture, 392
 Mackenzie (Dr. W. Leslie), the Health of the School Child, 435
 Mackie (Alexander), Nature Knowledge in Modern Poetry, 485
 Maclaren (J. Malcolm), Auriferous Tracts in Southern India, 157
 McLeod (C. H.), Elementary Descriptive Geometry, 74
 MacMahon (Major P. A.), the Diophantine Equation $x^n - Ny^m = z$, 188
 Macpherson (Hector), a Century's Progress in Astronomy, 173
 Maeterlinck (Maurice), Old-fashioned Flowers and Other Open-air Essays, 199
 Magnesium Light Photography, E. J. Mortimer, 101
 Magnetism: Behaviour of Iron under Weak Periodic Magnetising Forces, J. M. Baldwin, 70; Magnetostriction, D. O. S. Davies, 102; Sun-spots and Magnetism, William Ellis, 111; Auroral and Sun-spot Frequencies Contrasted, Dr. C. Chree, 188; Magnetic Storm and Aurora on February 9-10, Dr. Charles Chree, F.R.S., 367; Recent Progress in Magneto-optics, Prof. P. Zeeman at Royal Institution, 138, 160; the Electron Theory, a Popular Introduction to the New Theory of Electricity and Magnetism, E. E. Fournier d'Albe, 292; Relation between Magnetisation and Electric Conductivity in Nickel at High Temperatures, Dr. C. G. Knott, 334; Magnetic Detectors and the Action of Electric Oscillations, Ch. Maurain, 377; Magnetic Field and Inductance Coefficients of Circular, Cylindrical, and Helical Currents, A. Russell, 431; a First-year Course of Practical Magnetism and Electricity, Dr. P. E. Shaw, 426; Experiment with a Pair of Robison Ball-ended Magnets, G. F. C. Searle, 454; Transformer Indicator Diagrams, Prof. T. R. Lyle, 478; Action of a Magnetic Field on Ionised Air in Motion, A. Blanc, 599
 Magnetostriction, D. O. S. Davies, 102
 Mailhe (A.), Application to Pyridine of the Method of Direct Hydrogenation by Nickel, 623
 Maitland (A. Gibb), Geology of the Fubara Goldfield, 136
 Malaria: the Extirpation of the Tsetse-fly, a Correction and a Suggestion, Prof. E. A. Minchin, 30; Suppression du Paludisme à Ismailia, 204
 Malay Peninsula, Pagan Races of the, W. W. Skeat and C. O. Blagden, 415
 Malays, the, Peninsular, I., Malay Beliefs, R. J. Wilkinson, 245
 Malfitano (G.), Cryoscopy of Colloidal Solutions of Ferric Chloride, 239
 Mallet (F. R.), a New Mud-volcano Island, 460
 Mammals of Great Britain and Ireland, the, J. G. Millais, 271
 Man, the Evolution of, a Popular Scientific Study, Ernst Haeckel, 78
 Man and Superman, Arthur J. Davis, 501
 Man's Place in the Universe, Prof. Turner, 544
 Manchester Literary and Philosophical Society, 71, 189, 216, 431, 527
 Manchester Literary and Philosophical Society, "Wilde" Lecture at, the Structure of Metals, Dr. J. A. Ewing, F.R.S., 472
 Manly (Thomas), "Ozobrome" Carbon Printing, 134
 Mannheim (Colonel), Obituary Notice of, Dr. J. Reveille, 422
 Manning (Dr. Henry Parker), Irrational Numbers and their Representation by Sequences and Series, 603
 Manouélian (M.), Mechanism of the Destruction of Nerve-cells in Old Age and the Pathological States, 432
 Manson (M. P.), Obituary Notice of Lieut.-General De Tilly, 422
 Map of the British Isles, W. and A. K. Johnston, 54
 Marage (M.), the Hearing of Fishes, 144
 Marchand (H.), Influence of Manganese Salts on Alcoholic Fermentation, 504, 576
 Marine Biology: the Marine Biological Association and International Fishery Investigations, 106; Scientific Fishery Investigations, 185; Value of the Osmotic Pressures in the Cells of Certain Marine Algæ, B. M. Duggar, 401; Rhythmical Pulsation in Scyphomedusæ, Alfred G. Mayer, 545; *Acanthephyra purpurea* and *A. debilis*, S. W. Kemp, 550; the "Sea-mignonette" (*Primnoa reseda*), Prof. J. A. Thomson, 566; Invertebrate Fauna of the Sargasso Sea, E. L. Bouvier, 591
 Marine Engineering: Internal-combustion Engines for Marine Purposes, J. T. Milton, 325
 Marinesco (G.), the Transplantation of Nerve Ganglia in the Frog, 456
 Marino (L.), Enzymes Capable of Possessing more than One Kind of Activity, 126
 Markings and Rotation Period of Venus, the, Mr. Denning, 469
 Marlatt (C. L.), Chinese Scale-insect (*Aspidiotus perniciosus*), 349
 Marloth (Dr.), *Hydnora africana*, 287
 Marquis (R.), the Hydroxamic Acids, 239
 Marriott (W.), the Abnormal Weather of the Past Summer and its Effects, 119
 Mars, Observations of, José Comas Sola, 257
 Mars, the Temperature of, Prof. Lowell, 593
 Marsupials or Creodonts? W. J. Sinclair, 498
 Martel (E. A.), la Spéléologie au XXe Siècle, 508
 Martin (J. E.), Jupiter's Satellites, 231
 Martin (W. B. M.), Combining Properties of the Oposin of an Immune Serum, 621
 Martindale (Dr. W. Harrison), the Extra Pharmacopœia of Martindale and Westcott, 29
 Marx (G. H.), Machine Design, 172
 Mascari (Prof. Antonio), Obituary Notice of, W. E. Rolston, 373
 Mascart (Jean), la Découverte de l'Anneau de Saturne par Huygens, 509
 Matavanu in Savaii, the Eruption of, 1905-6, 351
 Materials, Text-book on the Strength of, S. E. Slocum and E. L. Hancock, 484

- Mathematics: Solution of the Cubic Equation, Edouard Collignon, 15; First Steps in the Calculus, A. F. van der Heyden, 29; Mathematical Society, 71, 188, 286, 407, 593, 599; Harmonic Expansions of Functions of Two Variables, Prof. A. C. Dixon, 71; Elementary Geometry based on Euclid's Elements, F. Purser, 74; Geometry, Theoretical and Practical, W. P. Workman and A. G. Cracknell, 74; Elementary Geometry, W. M. Baker and A. A. Bourne, 74; a Shilling Arithmetic, S. L. Loney and L. W. Grenville, 74; Junior Arithmetic with Answers, W. G. Borchardt, 74; a Junior Arithmetic, C. Pendlebury and F. E. Robinson, 74; a Preliminary Course in Differential and Integral Calculus, A. H. Angus, 74; a College Algebra, Prof. H. B. Fine, 74; a New Trigonometry for Beginners, R. F. D'Arcy, 74; Elementary Descriptive Geometry, C. H. McLeod, 74; a Simplified Method of Transforming Readings of Fahrenheit Thermometer into Centigrade Values and vice versa, Dr. Hellmann, 85; Corr., 111; the Collected Mathematical Works of G. W. Hill, 123; Theoretische Grundlagen für eine Mechanik der lebender Körper, Otto Fischer, 146; Analogy between Gyroscopes and Cyclones, F. J. B. Cordeira, 158; the Form of the Surface of a Searchlight Reflector, C. S. Jackson, 188; the Diophantine Equation $x^n - Ny^m = z$, Major P. A. MacMahon, 188; the Theory of Sets of Points, W. H. Young and G. C. Young, 193; Funzioni poliedriche e modulari, G. Vivanti, 198; Hermann von Helmholtz, Leo Koenigsberger, 198; Death of Dr. A. W. Panton, 205; les Nombres positifs, exposé des Théories modernes de l'Arithmétique élémentaire, M. Stuyvaert, 246; Obituary Notice of Prof. Ernesto Cesàro, Prof. Ernesto Pascal, 254; the Mathematical Tripos at Cambridge, Prof. John Perry, F.R.S., 273; the Mathematical Tripos, Dr. Edward J. Routh, F.R.S., 320; the Uniform Convergence of Fourier's Series, Dr. E. W. Hobson, 286; Hyper-even Numbers and Fermat's Numbers, Lieut.-Colonel A. Cunningham, 286; Opere matematiche di Francesco Brioschi, 291; Arithmétique graphique, Introduction à l'Étude des Fonctions arithmétiques, G. Arnoux, 319; Homer Lane's Problem of a Spherical Gaseous Nebula, Lord Kelvin, O.M., F.R.S., 368; Repeated Integrals, Dr. E. W. Hobson, 407; Projective Geometry of a Binary Quartic and its Hessian, Prof. E. B. Elliott, 407; Trigonometry for Beginners, J. W. Mercer, 409; Trigonometry for Beginners, Rev. J. B. Lock and J. M. Child, 409; Geometry, an Elementary Treatise on the Theory and Practice of Euclid, S. O. Andrew, 409; Modern Commercial Arithmetic, G. H. Douglas, 409; a New Shilling Arithmetic, C. Pendlebury and F. E. Robinson, 409; Junior Arithmetic Examples, W. G. Borchardt, 409; Clive's New Shilling Arithmetic, 409; Junior Practical Mathematics, W. J. Stainer, 409; a Rhythmic Approach to Mathematics, Edith L. Somervell, 409; the Technical College Set of Mathematical Instruments, 413; One Vote, One Value, Dr. Francis Galton, F.R.S., 414; the Ballot-box, F. H. Perry-Coste, 509; Dr. Francis Galton, F.R.S., 509; Mean or Median, R. H. Hooker, 487; G. Udney Yule, 534; Gambling and Mathematics, Hugh Richardson, 415; G. H. B., 415; Introduction to the Theory of Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat, H. S. Carslaw, 459; Death and Obituary Notice of Prof. Y. Y. Tswetkoff, 465; Tableaux logarithmiques, A et B, Dr. A. Guillemin, 482; Clive's Mathematical Tables, 482; Five-figure Mathematical Tables for School and Laboratory Purposes, Dr. A. Du Pré Denning, 482; the Myriometer, G. W. Evans-Cross, 503; Invariants of the General Quadratic Form *Modulo* 2, Prof. L. E. Dickson, 503; Frequency-curves and Correlation, W. Palin Elderton, 507; German Science Reader, C. R. Dow, 509; Vorlesungen über theoretische Spektroskopie, Prof. A. Garbasso, 554; Elementare kosmische Betrachtungen über das Sonnensystem und Widerlegung der von Kant und Laplace aufgestellten Hypothesen über dessen Entwicklungsgeschichte, Prof. Gustav Holzmüller, 582; Space and Geometry, Dr. Ernst Mach, 603; Irrational Numbers and their Representation by Sequences and Series, Dr. Henry Parker Manning, 603; Auslese aus meiner Unterrichts- und Vorlesungspraxis, Dr. Hermann Schubert, 603; Leçons de Géométrie supérieure, M. E. Vissiot, 603; la Géométrie analytique générale, H. Laurent, 603; N. H. Abel, sa Vie et son Œuvre, Charles Lucas de Pesloüan, 603; Theory of the Algebraic Functions of a Complex Variable, Dr. John Charles Fields, 603; Recherches sur l'Élasticité, P. Duhem, 603; Instrument for describing Logarithmic Spirals, Mr. Pochin, 621; Logarithmic Lazy-tongs and Lattice-works, T. H. Blakesley, 622; Theory of Differential Equations, Dr. A. R. Forsyth, F.R.S., Supp. to March 14, x
- Maurain (Ch.), Magnetic Detectors and the Action of Electric Oscillations, 377
- Mawley (E.), British Phenological Observations during 1906, 454
- Mawson (D.), the Minerals and Genesis of the Veins and "Schlieren" traversing the Ægirine-syenite in the Bowral Quarries, 192
- Mawson (J.), Vertebrate Fossils of Cretaceous Formation of Bahia (Brazil), 334
- Maximum of Mira, the Recent, P. M. Ryves, 378
- Mayer (Alfred G.), Rhythmic Pulsation in Scyphomedusæ, 545
- Mean or Median, R. H. Hooker, 487; G. Udney Yule, 534
- Measurement, Standards and Exact, Dr. R. T. Glazebrook at Institution of Electrical Engineers, 570
- Meaux Abbey, Essays upon the History of, and some Principles of Mediaeval Land Tenure, based upon a Consideration of the Latin Chronicles of Meaux, Rev. A. Earle, 170
- Mechanical Drawing, Elements of, A. A. Titsworth, 172
- Mechanics: the Teaching of Elementary Mechanics, Prof. Forsyth and C. E. Ashford, 317; Apparatus to determine the Resultant of Two Motions at Right Angles to One Another, John C. Packard, 401; la Mécanique des Phénomènes fondée sur les Analogies, M. M. Petrovitch, 533; Mechanism of Power Transmission from Electric Motors, Wilfred L. Spence, 591
- Mediaeval Land Tenure, Essays upon the History of Meaux Abbey and some Principles of, Rev. A. Earle, 170
- Mediaeval Rhodesia, Dr. David Randall-MacIver, 369
- Medicine: Death of Dr. E. Symes-Thompson, 108; Anæsthetic and Lethal Quantity of Chloroform in the Blood, Dr. George A. Buckmaster and J. A. Gardner, 142; Measurement of the Radio-chromometric Degree by the Electrostatic Voltmeter in the Utilisation of the Röntgen Rays in Medicine, J. Bergonié, 287; the Thompson-Yates and Johnston Laboratories Report, Prof. R. T. Hewlett, 351; Rapport sur l'Expédition au Congo, 1903-5, J. Everett Dutton and John L. Todd, Prof. R. T. Hewlett, 351; Second Report of the Wellcome Research Laboratories at Gordon Memorial College, Khartoum, Andrew Balfour, Prof. R. T. Hewlett, 351; Medical Inspection of School Children, 435; Aneurism of the Ophthalmic Artery Cured by Gelatin, MM. Lancereaux and Paulesco, 456
- Meehan (Rev. Joseph), the Rusting of Iron, 31
- Mees (C. E. K.), Photographic Processes, part iii., the Latent Image and its Destruction, 310
- Meigen (W.), Edible Earth in New Guinea, 14
- Meissner (Otto), die Meteorologischen Elemente und ihre Beobachtung, mit Ausblicken auf Witterungskunde und Klimalehre, 366
- Meldola (R.), a New Trinitroacetaminophenol and its Use as a Synthetical Agent, 215
- Mellish (Mr.), a New Comet (1907b), 593
- Mellish Comet 1907b, Messrs. Lamson and Frederick, 615
- Melville (J. Cosmo), Mollusca Collected by Mr. S. A. Neave in South-east Rhodesia, 216
- Men of Science in America, Prof. McKeen Cattell, 250
- Mendeléeff (Prof. D. I.), Death of, 347; Obituary Notice of, Dr. T. E. Thorpe, F.R.S., 371
- Mendeléeff's Group of Chemical Elements, Position of, C. E. Stromeyer, 431
- Mendenhall (W. C.), Geology of the Central Copper River Region, Alaska, 184
- Menschutkin (Prof. N. A.), Obituary Notice of, 397
- Mercer (J. W.), Trigonometry for Beginners, 409
- Mercers' Company Lectures on Recent Advances in the

- Physiology of Digestion, Prof. Ernest H. Starling, F.R.S., Prof. Benjamin Moore, 219
- Merlin (J.), Micrometer Measures during the Solar Eclipse of August, 1905, 350
- Merriam (Dr. J. C.), Recent Cave-exploration in California, 156
- Mertens (Prof. A.), the Urus or Aurochs, 349
- Metallurgy: the Internal Architecture of Metals, Prof. J. O. Arnold at Royal Institution, 43; Death and Obituary Notice of John Devonshire Ellis, 61; the Use of Special Steels for Rivets, G. Charpy, 239; the Assay of Silver Bullion by Volhard's Ammonium Thiocyanate Method, E. A. Smith, 303; the Best High-speed Tool Steel Composition, F. W. Taylor, 325; on the Properties of Alloys of Aluminium and Copper, Prof. H. C. H. Carpenter and C. A. Edwards, at the Institution of Mechanical Engineers, 426; Some Modern Conditions and Recent Developments in Iron and Steel Production in America, Frank Popplewell, 438; the American Iron Industry, E. C. Eckel, 446; Novel Type of Electric Tempering Furnace designed by Körting Brothers, 468; the Structure of Metals, Dr. J. A. Ewing, F.R.S., "Wilde" Lecture at Manchester Literary and Philosophical Society, 472; Handbook of Metallurgy, Dr. Carl Schnabel, 486; the Manufacture of Rolled Sterling-silver, E. S. Sperry, 496
- Metals, the Internal Architecture of, Prof. J. O. Arnold at Royal Institution, 43
- Metals, Minerals and, a Reference-book of Useful Data and Tables of Information, 341
- Metaphysics: What are We? Leonard Joseph, 318
- Metcalf (Joel), Another New Comet (1906h), 85
- Metcalf, Comet 1906h, Prof. Hartwig, 111; Dr. E. Stromgren, 111; E. Esclangon, 159; Prof. Kreutz, 159; Prof. Millosevich, 159; M. Ebell, 208; Mr. Crawford, 350
- Metchnikoff (Prof. Élie), Immunity in Infective Diseases, 99; the New Hygiene, 583
- Meteorology: British Rainfall, Dr. Hugh Robert Mill, 5; Attempt to re-calculate from Recent Data the Total Yearly Rainfall over the Earth's Surface and to Indicate the Transference of Water between Land and Sea, Dr. Richard Fritzsche, 208; Rainfall Observations of the British Isles during the Past Year, Dr. H. R. Mill, 303; Rothesay Rainfall and the Sun-spot Cycle, Alex. B. MacDowall, 488; Rainfall and Change of Climate in the United States, Prof. Willis L. Moore, 541; Experiments at the Cawnpore Experimental Farm, 12; Weather Forecasting by Synoptic Chart, Prof. Alfred J. Henry, 14; Meteorology of the Nile Valley, Captain H. G. Lyons, 17; Ueber die Klimaänderungen der Geologischen Vergangenheit, Prof. Frech, 65; Meteorological Notes, 67, 210; the Frequency of Thunderstorms in Relation to the Sun-spot Period, Dr. Aksel S. Steen, 67; the Yearly Air Movement as determined by Registering Anemometers, Dr. Felix M. Exner, 67; Meteorology of the Upper Air in India, F. H. Field, 68; a Simplified Method of Transforming Readings of Fahrenheit Thermometer into Centigrade Value and *vice versa*, Dr. Hellmann, 85; Corr., 111; Royal Meteorological Society, 119, 216, 334, 454, 551; the Abnormal Weather of the Past Summer and its Effects, W. Marriott, 110; the Great Hurricane of October 17, Father Gutiérrez-Lanza, S.J., 157; Analogy between Gyroscopes and Cyclones, F. J. B. Cordeira, 158; Studies on the Diurnal Periods in the Lower Strata of the Atmosphere, Prof. Frank Hagar Bigelow, Dr. Charles Chree, F.R.S., 186; Evaporation from Water Surfaces, J. R. Sutton, 190; Documents scientifiques de la Mission saharienne (Mission Foureau-Lamy d'Alger au Congo par le Tchad), F. Foureau, 200; Annales de l'Observatoire météorologique, physique et glaciaire du Mont Blanc, 203; Cold Waves and Frosts in the United States, Prof. E. B. Garriott, 210; Diurnal Range of Temperature in the Tropics, Prof. J. Hann, 210; Diurnal Variation of the Barometer, Dr. Korselt, 210; Influence of the Ocean upon Continental Precipitation, Prof. E. Brückner, 211; Wind Currents in the Vicinity of the Canary Islands, Prof. Hergesell, 211; the Hong Kong Typhoon, Rev. José Algué, 211-2; Report of the Fernley Observatory, Southport, for the Year 1905, 212; Climate of Alaska, Dr. C. Abbe, jun., 212; Meteorological Observations, Bremen, 1905, Dr. P. Bergholz, 212; Emerald Green Sky Colour, J. W. Noble, 199; F. G. Collins, 224; Green Sunset Colours, Arthur W. Clayden, 295; the Green Tints of Sunset, Joseph Offord, 342; Heat Treatment of High-temperature Mercurial Thermometers, H. C. Dickinson, 233; Climatological Atlas of India, Sir John Eliot, K.C.I.E., F.R.S., Prof. J. Hann, 241; Solar Halo of January 4, 254; Annals of the Astronomical Observatory of Harvard College, Peruvian Meteorology, Prof. Solon I. Bailey, 283; Death and Obituary Notice of Prof. A. F. W. Paulsen, 299; the Recent High Barometer, 330; die meteorologischen Elemente und ihre Beobachtung, mit Ausblicken auf Witterungskunde und Klimalehre, Otto Meissner, 366; Magnetic Storm and Aurora on February 9-10, Dr. Chas. Chree, F.R.S., 367; Brilliant Aurora on February 9, A. M. Davies, 374; G. A. Clarke, 374; Relation between Falls of Barometric Pressure and the Evolution of Fire-damp in Mines, G. Bigourdan, 383; Death and Obituary Notice of Prof. J. F. W. von Bezold, 397; Stormy Weather of February 19 and 20, 398; Some New Methods in Meteorology, Dr. Charles Chree, F.R.S., 415; a Remarkable Lunar Halo, February 24, H. F. Hunt, 439; Death and Obituary Notice of H. C. Russell, C.M.G., F.R.S., 442; Meteorological Observations, 448; British Phenological Observations during 1906, E. Mawley, 454; the Weather Reports of the Meteorological Office, 488; the Week's Weather, 495, 565; Death of Franz Herger, 515; die Niederschläge in den norddeutschen Stromgebieten, Prof. G. Hellmann, 556; the Weather and the Crops, R. H. Hooker, 545; the Exploration of the Air, Major B. F. S. Baden-Powell, 551; Atmospheric See-saw Phenomenon and the Occurrence of Typhoon Storms, Wilhelm Krebs, 560; Meteorologische Optik, Prof. J. M. Pernter, 577; Black Rain in Pembrokeshire on April 10, 589; Thunderbolt at Birkenhead, 589; Annals of the Astronomical Observatory, Harvard College, 593; Wissenschaftliche Beihefte zum deutschen Kolonialblatte, Dr. Ottweiler, 616; Mitteilungen aus den deutschen Schutzgebieten, die Niederschlags-verhältnisse von Deutsch-Sudwestafrika, Dr. F. von Duncelman, 616
- Meteors: the Leonid Meteors, John R. Henry, 30; a Bright Meteor, Mr. Rolston, 86; the Perseids, 1906, Prof. Zammarchi, 111; Observations of the August Meteors, Prof. von Konkoly, 182; the January Meteors, W. F. Denning, 199; a Brilliant Meteor, H. E. Wood, 208; February and March Meteors, W. F. Denning, 342; Heights of Meteors observed in 1906, Mr. Denning, 350; the Lyrid Meteors, John R. Henry, 560
- Meteorites: Graphitic Iron in a Meteorite, W. Tassin, 137; a Meteorite in the Atlantic (October 17), C. B. Anderson, 159
- Metric System: Outlines of the Evolution of Weights and Measures and the Metric System, Dr. William Hallock and Herbert T. Wade, 290; Education and the Metric System, 422; Case against Metric System, Mr. Haworth, 515
- Metrology: Draft Board of Trade Regulations with Respect to Weights, Measures, and Weighing Instruments, 42; Outlines of the Evolution of Weights and Measures and the Metric System, Dr. William Hallock and Herbert T. Wade, 290
- Mettam (Prof.), Infection of Bovines by the Avian Tubercle Bacillus, 407
- Mettler (E.), Formation of Ammonia Gas from its Elements under the Influence of the Electric Spark, the Influence of Pressure, 575
- Meudon, Solar Research at, MM. Deslandres and d'Azambuja, 469
- Meunier (Jean), Limits of Inflammability of Explosive Mixtures of Ether Vapour and Air, 624
- Meunier (Louis), Some Reactions of Sodium Amide, 383
- Mexican Earthquake, the, 610
- Meyer (Ernst von), a History of Chemistry from Earliest Times to the Present Day, 169
- Michel (L.), Cryoscopy of Colloidal Solutions of Ferric Chloride, 239
- Microbiologie Agricole, Dr. Edmond Kayser, Prof. R. T. Hewlett, 99

- Micrology, Animal, Practical Exercises in Microscopical Methods, Dr. Michael F. Guyer, 582
- Micrometer Measures during the Solar Eclipse of August, 1905, J. Merlin, 350
- Microscopy: Royal Microscopical Society, 70, 188, 287, 359, 478, 599; Microscopic Study of Strain in Metals, F. Rogers, 287; a Certain Form of Butterfly Scale, Dr. Alfred C. Stokes, 350; the Principles of Microscopy, a Handbook to the Microscope, Sir A. E. Wright, F.R.S., Thomas H. Blakesley, 386; Einführung in die mikroskopische Analyse der Drogenpulver, Dr. L. Koch, 390; les Ultramicroscopes, A. Cotton and H. Mouton, Thomas H. Blakesley, 505; a Top Stop for the Microscope, J. W. Gordon, 543; Animal Micrology, Practical Exercises in Microscopical Methods, Dr. Michael F. Guyer, 582
- Miers (Prof. H. A.), Experiments bearing on the Order of Crystallisation of Rock-constituents, 405
- Mikrophonprinzip, Anwendungendes, Chr. Jensen and H. Sieveking, Prof. Gisbert Kapp, 153
- Mildew, American Gooseberry, 160, 613; E. S. Salmon, 247
- Mill (Dr. Hugh Robert), British Rainfall, 5; the Siege of the South Pole, the Story of Antarctic Exploration, 103; Rainfall Observations of the British Isles during the Past Year, 303
- Millais (J. G.), the Mammals of Great Britain and Ireland, 271
- Miller (Alfred S.), the Cyanide Process, 149
- Miller (W. E.), Maximum Gravitational Attraction on a Solid, 439
- Millington (J. P.), John Dalton, 246
- Millockhau (G.), the Calorific Emission of the Sun, 23, 96; the Calorific Radiation of the Sun, 40; Photography of the Infra-red Solar Spectrum, 599
- Millosevich (Prof.), Comet 1906h (Metcalf), 159; Two Stars with a Common Proper Motion, 208; a New Variable of Nova 156, 1906, 615
- Milne (Prof. John, F.R.S.), Seismological Notes, 402
- Milroy Lectures on Epidemic Diseases in England: the Evidence of Variability and of Persistency of Type, Dr. W. H. Hamer, Prof. R. T. Hewlett, 99
- Milton (J. T.), Internal-combustion Engines for Marine Purposes, 325
- Mimicry: Sand-dwelling Insects, C. A. Hart and H. A. Gleason, 399
- Minchin (Prof. E. A.), the Extirpation of the Tsetse-fly: a Correction and a Suggestion, 30; *Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes, 56; the Scope and Problems of Protozoology, 115; Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of Infection in Trypanosomes generally, 214
- Minchin (Howard), the Coefficient of Expansion of Fused Quartz, 568
- Minea (J.), the Transplantation of Nerve Ganglia in the Frog, 456
- Mineralogy: Spectrographic Analysis of a Meteoric Stone, W. N. Hartley, 23; Malacone, S. Kitchen and W. G. Winterson, 23; Parallelism between Different Kinds of Peat and Different Kinds of Coal, Prof. Potonié, 84; Products of the Fumerolles of Vesuvius, A. Lacroix, 96; Crystals of Galena deposited at Eruption of Vesuvius in April, F. Zambonini, 158; Recent Experiments on the Crystallisation of Minerals, A. L. Day and Mr. Shepherd, Dr. T. M. Lowry, 112; Mineralogical Society, 119, 405, 574; Growth of Crystals of Soluble Salts on Each Other, T. V. Barker, 119; Ilmenite from Brazil, G. F. Herbert Smith, 119; Lengenbach Quarry and the Minerals found there, 1906, R. H. Solly, 119; Goethes Verhältnis zur Mineralogie und Geognosie, Rede gehalten zur Feier der akademischen Preisverteilung am 16 Juni, 1906, Dr. G. Linck, 146; Discovery of Corundum in the Farina District, South Australia, 155; Auriferous Tracts in Southern India, J. Malcolm Maclaren, 157; Bean-shaped Pebbles indicative of the Presence of Diamonds on the Alluvial Gravels at Diamantina, Brazil, E. Hussak, 158; the Relationship between Diamonds and Garnets, J. R. Sutton, 488; Nepouite, E. Glasser, 239; Mineralogical Survey of Ceylon, Dr. A. K. Coomaraswamy, 306; The Gem-cutter's Craft, Leopold Claremont, 321; Experiments bearing on the Order of Crystallisation of Rock-constituents, Prof. H. A. Miers, 405; Serpentine Rock from the Tarnthaler Köpfe, Dr. A. P. Young, 405-6; Isomorphism as illustrated by certain Varieties of Magnetite, Prof. B. J. Harrington, 406; Gold Nuggets from New Guinea, showing a Concentric Structure, Prof. Liversidge, 480; Préparation Mécanique des Minerais, F. Rigaud, 509; Mineral Resources of Peru, M. A. Denegri, 517; Existence of Parameters capable of Characterising the Magmas of a Family of Eruptive Rocks, Michel Levy, 528; Anhydrite in Beds of Gypsum, Louis C. Kemp, 540; Changes of Physical Constants in certain Minerals and Igneous Rocks, J. A. Douglas, 550; Baddeleyite from Ceylon, G. S. Blake and G. F. Herbert Smith, 574; Zinciferous Tennantite from the Binenthal, R. H. Solly and G. T. Prior, 574; Strüverite, a New Mineral, F. Zambonini and G. T. Prior, 574; Sands and Shingles of the Pas-de-Calais, René Bréon, 600
- Minerals: Mineral Resources of the United States, 140; Mineral Resources of the United States, Production of Precious Stones in 1905, Dr. George F. Kunz, 423; the Elements producing Phosphorescence in Minerals, G. Urbain, 143; Mineral Production of India during 1905, T. D. La Touche, 157; Remarkable Crystal Discovered at Masutomi-Mura, 179; Minerals and Metals: a Reference-book of Useful Data and Tables of Information, 341; Minerals of the Silvermines District, Co. Tipperary, A. Russell, 574; Synopsis of Mineral Characters, Alphabetically Arranged for Laboratory and Field Use, Ralph W. Richards, 583.
- Mining: Report on Mines and Quarries, Number of Persons Employed in British Mines and Quarries, 15; Mines and Quarries, General Report in Great Britain in 1905, 85; the Zinc Resources of British Columbia, 110; Coal Resources of the Cape Lisburne Region, A. J. Collier, 256; the Rampart Gold-placer Region, Alaska, L. M. Prindle and F. L. Hess, 256; Accidents in Mines and Quarries of the United Kingdom during the Year 1906, 303; the Principles and Practice of Coal Mining, James Tonge, 364; Coal at Baggeridge Woods, 348; Relation between Falls of Barometric Pressure and the Evolution of Fire-damp in Mines, G. Bigourdan, 383; Electrical Machinery in Collieries, 423; British Mineral Production in 1906, 468; Results obtained in the Investigation of the South-Eastern Coalfield, Prof. W. Boyd Dawkins, 468; the Coal-dust Problem, James Ashworth, 496; Reports on the Wingate Grange Colliery Explosion on October 14, 1906, Dangers of Coal-dust, 567; the Duration of the Coal Reserves of the United States, Marius R. Campbell, 523; Silver Deposit or Sedgman Lode in the Perran Mine, Cornwall, F. H. Butler, 574; Cobalt, New Silver Mining District of Canada, J. E. Hardman, 613.
- Minor Planets, Dr. Bauschinger, 40
- Mira Ceti, T. W. Backhouse, 126
- Mira Maximum of 1906, the, Prof. Nijland, 17
- Mira, the Recent Maximum of, P. M. Ryves, 378
- Mira, the Spectrum of, V. M. Slipher, 402
- Mira, Spectrum and Radial Velocity of, J. S. Plaskett, 518
- Moffat (C. B.), Problems of an Island Fauna, 501
- Moffit (F. H.), the Fairhaven Gold Placers, Seward Peninsula, Alaska, 184
- Moir (J.), the So-called "Benzidene Chromate," 23; New Derivatives of Diphenol, 23
- Moissan (Henri), the Distillation of Alloys of Silver and Copper, Silver and Tin, and Silver and Lead, 287; a Property of Platinum Amalgam, 528; Researches on Ammonium, 624
- Moissan (Prof. Henri), Death and Obituary Notice of, Dr. R. S. Hutton, 419
- Mollusca: Dental Apparatus of the Gastropod *Fulgur*, J. C. Herrick, 38; Mollusca Collected by S. A. Neave in South-East Rhodesia, J. Cosmo Melville and R. Standen, 216
- Monasticism, Rev. A. Earle, 170
- Monocular Vision, Perception of Relief by, T. Terada, 224; A. E. Smith, 321
- Mont-Blanc, Annales de l'Observatoire météorologique, physique et glaciaire du, 203

- Montgomery (T. H., Jun.), the Analysis of Racial Descent in Animals, 520
- Monuments, Notes on Ancient British, Sir Norman Lockyer, K.C.B., F.R.S., 150
- Moody (Dr. G. T.), the Rusting of Iron, 438; the Mechanism of the Rusting of Iron, 575
- Moon, the Temperature of the, F. W. Very, 281; see Astronomy
- Moore (Dr. Benjamin), Mercers' Company Lectures on Recent Advances in the Physiology of Digestion, Prof. Ernest H. Starling, F.R.S., 219
- Moore (J. E. S.), Cytological Investigation of Cancer, 1906, 587
- Moore (Prof. Willis L.), Rainfall and Change of Climate in the United States, 541
- Moorfield (W. R.), "So-called Gorgets" of Slate, 496
- Mora (Enzo), Simultaneous Disparition of Jupiter's Four Satellites, 448
- Morbology: *Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes, Prof. E. A. Minchin, A. C. H. Gray and the late F. M. G. Tulloch, 56; Malaria in Greece, Major Ronald Ross, F.R.S., 61; Suppression du Paludisme à Ismailia, 204; the Treatment of Cancer, 177; Dr. J. Beard, 247; the Writer of the Article, 247; Corr., 424; University of Liverpool and Royal Infirmary Cancer Research Laboratories, First Report of the Cytological Investigation of Cancer, 1906, J. E. S. Moore and C. E. Walker, 587; the Bacterial Nature of "Spirochaetes," MM. Novy and Knapp, 180; Atoxyl an Effectual Remedy against Sleeping Sickness, Prof. Koch, 206; Sleeping Sickness, 347; Effects Produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness, H. G. Plimmer, 429; the Scientific Study of Infectious Diseases, Dr. W. H. Welch at the Rockefeller Institute for Medical Research, 213; Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of Infection in Trypanosomes generally, Prof. E. A. Minchin, 214; Life-history of the *Dracunculus medinensis* or Guinea-worm, Mr. Leiper, 302; Pathology of Pulmonary Anthracosis, G. Kuss and E. Lobstein, 336; Undulant (Mediterranean) Fever in South Africa, P. D. Strachan, 376; Mediterranean Fever, Staff-Surgeon E. A. Shaw, 516; Infection of Bovines by the Avian Tubercle Bacillus, Prof. Mettam, 407; on Leprosy and Fish-eating, Jonathan Hutchinson, F.R.S., 412; Dr. Haffkine's Prophylactic, 514; Haffkine's Prophylactic and the Mulkowal Disaster, Prof. Ross, 588; the Transmission of Plague in the Rat, Dr. Klein, 544; Cholera Vaccine, 516; Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, Dr. J. W. W. Stephens, 523; the Anatomy and Histology of Ticks, Capt. S. R. Christophers, Dr. J. W. W. Stephens, 523; Memoir xxi. of the Liverpool School of Tropical Medicine, Dr. J. W. W. Stephens, 523
- Morel (M.), a Colour Reaction given by Reducing Sugar by *m*-Dinitrobenzene in Alkaline Solution, 191
- Moreux (l'Abbé Th.), a *Résumé* of Aërography, 231
- Morgan (G. T.), New Cerium Salts, 503
- Morgan (J. Livingston R.), Physical Chemistry for Electrical Engineers, 413
- Morgan (W. C.), Qualitative Analysis as a Laboratory Basis for the Study of General Inorganic Chemistry, 581
- Morphology: Biologische und Morphologische Untersuchungen über Wasser und Sumpfwächse, Prof. Hugo Glück, 579; das Cerebellum der Säugetiere, eine vergleichend anatomische Untersuchung, Prof. Louis Bolk, Prof. J. S. Macdonald, Supp. to March 14, ix
- Morris (Col. W. G.), Seeing Stereoscopic Pictures without Stereoscope, 614
- Morse (H. N.), Summary of Experiments made with Glucose and Cane-sugar, 430
- Mortimer (E. J.), Magnesium Light Photography, 101
- Mortimer (J. R.), Relative Stature of the Dolichocephalic, Mesaticephalic, and Brachycephalic Inhabitants of East Yorkshire, 166
- Morton (Prof. W. B.), the Effect of Radium on the Strength of Threads, 224
- Moseley (A. H.), the Action of Rennin, 101
- Mosenthal (H. de), Cotton and Nitrated Cotton, 622
- Mosquitoes: Suppression du Paludisme à Ismailia, 204
- Motors: I Motori a Gaz, Vittorio Calzavara, 291; I Motori ad Esplosione, a Gas luce e Gas povero, Fosco Laurenti, 291; Chemical Composition of some Motor-tyre Rubbers, Dr. P. Schidrowitz and F. Kaye, 383; Motor Vehicles and Motors: their Design, Construction, and Working by Steam, Oil, and Electricity, W. Worby Beaumont, 457; the Motor Exhibition at Olympia, 466; Petrol Motor-omnibuses, W. Worby Beaumont, 517
- Mountains: Recomputation of Captain Wood's Observations for Determining the Position of Everest, 404; Altitude of the Grand Pic de la Meige, Paul Helbronner, 599
- Moureu (Ch.), the Products and Condensation of Acetylenic Esters and Amines, 24; the Condensation of Hydrazines with Acetylenic Nitriles, 263; Method of Synthesis of Non-substituted β -Ketonic Amides, 624
- Mouton (H.), les Ultramicroscopes, 505
- Mrázek (Prof. Al.), Flat-worm *Scutariella didactyla* from Montenegro, 590
- Mudge (Geo. P.), a Problem in Chance, 461
- Mudge (G. P.), Intravascular Coagulation in Albinos and Pigmented Animals, 549
- Mud-Volcano Island, a New, F. R. Mallet, 460
- Muir (M. M. Pattison), a History of Chemical Theory and Laws, 601
- Muir (Prof. Robert), Combining Properties of the Opsonin of an Immune Serum, 621
- Mulkowal, the Inoculation Accident at, Prof. Ronald Ross, C.B., F.R.S., 486
- Müller (Mr.), a Peculiar Short-period Variable (155.1906, Cassiopeia), 327
- Mummification, a Contribution to the Study of, in Egypt, Prof. G. Elliot Smith, 537
- Muntz (A.), Purification of Sewage, 479
- Murray (James), Remarkable "Encystment" undergone by British "Water-Bear" (*Macrobiotus*), 349; Scottish Tardigrada, 455; Arctic Tardigrada, 455
- Museums: the History of the Collections contained in the Natural History Departments of the British Museum Catalogue of the Lepidoptera, Phalænæ in the British Museum, Vol. vi., Noctuidæ, 366; Museu Paraense de Historia e Ethnographia: Arboretum Amazonicum, Dr. J. Huber, 459
- Mutation, Species and Varieties, their Origin by, H. de Vries, 268
- Mycology: the Rusts of Australia, their Structure, Nature, and Classification, Dr. McAlpine, 101; American Goose-berry Mildew, 160, 613; E. S. Salmon, 247
- Myers (Dr. C. S.), Ethnology of Modern Egypt, 454, 478
- Mythes et Légendes d'Australie, Études d'Ethnographie et de Sociologie, A. van Gennep, 49
- Mythus und Sitte, Völkerpsychologie: eine Untersuchung der Entwicklungsgesetze von Sprache, Wilhelm Wundt, 363
- Nagaoka (Prof. H.), a Japanese Singing Kettle, 78
- Nansen (Fridthjof), Northern Waters: Capt. Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, with a Discussion of the Origin of the Bottom-Waters of the Northern Seas, 563
- Nansouty (Max de), Actualités scientifiques, 558
- Natal: First Report of the Natal Government Museum for the year ending December 31, 1904, 42; Annals of the Natal Government Museum, 42
- Natural Colours, Photography in, Julius Rheinberg, 103
- Natural History: the Cambridge Natural History, vol. i., Protozoa, Prof. Marcus Hartog. Porifera (sponges) Igera B. L. Sollas, Cœlenterata and Ctenophora, Prof. S. J. Hickson, Echinodermata, Prof. E. W. MacBride, F.R.S., 31; Dental Apparatus of the Gastropod *Fulgur*, J. C. Herrick, 38; Natural History in Natal, 42; Linnean Society, 71, 166, 215, 333, 430, 526, 550, 621; Linnean Society, New South Wales, 72, 191, 311; Nature's Story of the Year, C. A. Witchell, 76; Creatures of the Night, A. W. Rees, 76; the Life Story of a Fox, J. C. Tregarther, 76; the Romance of Animal Arts and Crafts, Dr. H. Coupin and John Lea, 76; Our School Out of Doors, Hon. M. Cordelia Leigh, 76; the History of the Collections contained in the Natural History Departments of the British Museum, 125; the Life of Animals—the

- Mammals, E. Ingersoll, 176; Nature's Carol-Singers, R. Kearton, 176; an Idler in the Wilds, T. Edwards, 176; I go a-Walking through the Woods and o'er the Moor, 176; Brier Patch Philosophy, W. J. Long, 176; Birds Shown to the Children, M. K. C. Scott, 176; the Division of Labour amongst Bees, Gaston Bonnier, 190; Observations of a Naturalist in the Pacific between 1896 and 1899, H. B. Guppy, 217; Manner in which the Parasitic Fish *Fierasfer affinis* Effects an Entrance into the Body of the Sea Cucumber, E. Linton, 348; Remarkable "Encystment" undergone by British "Water-Bear" (*Macrobiotus*), James Murray, 349; Sand-dwelling Insects, C. A. Hart and H. A. Gleason, 399; Haileybury Natural History Lectures, 434; Animal Artisans and other Studies of Birds and Beasts, C. J. Cornish, 437; an Incident in Ant Life, Major Sampson, 478; Nature Knowledge in Modern Poetry, Alexander Mackie, 485; Hunting and Shooting in Ceylon, H. Story, 492; Breeding Habits of British Bats, Arthur Whitaker, 495; Golden Carp attacked by a Toad, Prof. Adrian J. Brown, 534; a Fauna of the Tay Basin and Strathmore, J. A. Harvie-Brown, Supp. to March 14, vii
- Nature and Science, Paradoxes of, Dr. W. Hampson, 341, 606; the Reviewer, 606
- Naval Architecture: Death and Obituary Notice of Sir Edward J. Reed, K.C.B., F.R.S., Dr. Francis Elgar, F.R.S., 153; Ancient and Modern Ships, Sir George C. K. Holmes, 506; the Institute of Naval Architects, 522; Influence of Machinery on the Gun-power of the Modern Warship, James McKechnie, 522; Instruments for Measuring the Power given off by Turbines, A. Denny, 523; J. H. Gibson, 523; Gyroscopic Apparatus for Steadying Ships, G. R. Dunell, 561
- Naval and Military Services, Service Chemistry, a Short Manual of Chemistry and its Applications in the, Vivian B. Lewes and J. S. S. Brame, 266
- Naval Observatory, United States, 378
- Navigation: How to Learn on Shore the Rule of the Road at Sea, E. W. Owens, Commander H. C. Lockyer, 126; Position-line Star Tables, for Fixing Ship's Position by Reduction to Meridian and Prime Vertical without Logarithmic Calculation, H. B. Goodwin, 197
- Neave (S. A.), Mollusca Collected by, in South-east Rhodesia, J. Cosmo Melvill and R. Standen, 216
- Nebula, a New, Rev. T. E. Espin, 593
- Nebula, a Remarkable, Prof. Max Wolf, 281
- Nebulae, some Remarkable Small, Prof. Barnard, 159
- Negroes, Niger Delta, Major Arthur Glyn Leonard, 602
- Neogi (P.), the Interaction of the Alkyl Sulphates with the Nitrites of the Alkali Metals and Metals of the Alkaline Earths, 23
- Neolithic Man in North-east Surrey, Walter Johnson and William Wright, 124
- Neon in Radio-active Minerals, Presence of, Hon. R. J. Strutt, F.R.S., 102
- New South Wales Linnean Society, 72, 191, 311
- New South Wales, the Plants of, W. A. Dixon, 366
- New South Wales Royal Society, 191, 287, 480
- New York Meeting of the American Association, 352
- New Zealand: Manual of the New Zealand Flora, T. F. Cheeseman, 293; Geology of the Hokitika Sheet, J. M. Bell and Colin Fraser, 306; the Habits of the Flightless Birds of New Zealand, R. Henry, 595
- Newcomb (Prof. Simon), Side-lights on Astronomy and Kindred Fields of Popular Science, Essays and Addresses, 294
- Newth (G. S.), Smaller Chemical Analysis, 581
- Niagara Falls, the Transmission of Electrical Energy at, 83
- Niagara Falls, Rate of Recession of, G. K. Gilbert, 607
- Nicholls (W. W. S.), Condensation of Salicylamide with Aryl Aldehydes, 407
- Nichols (H. W.), New Forms of Concretions, 596
- Nickel, the Atomic Weight of, Dr. Charles G. Barkla, 368; F. E. Hackett, 535
- Niederschläge in den norddeutschen Stromgebieten, die, Prof. G. Hellmann, 556
- Niger, the Lower, and its Tribes, Major Arthur Glyn Leonard, 602
- Nijland (Prof.), the Mira Maximum of 1906, 17; Comet 1906g, 137
- Nile, the Physiography of the River, and its Basin, Captain H. G. Lyons, 17
- Nitrogen, Inversion Temperature for Air and, Prof. K. Olszewski, 379
- Nobel Prize Awards, 134
- Nobel Prizes, the, 155
- Noble (Sir Andrew, Bart., K.C.B., F.R.S.), Artillery and Explosives, 174
- Noble (J. W.), Emerald Green Sky Colour, 199
- Nodon (Dr. A.), the Electrical Influence of the Sun, 469
- Nomenclature of the Proteins, W. S. Giles, 439
- Nopcsa (Dr. Baron F.), the Origin of Flight, 478
- Norman (Canon A. M., F.R.S.), the Crustacea of Devon and Cornwall, 387
- Norsemen in the Orkneys and the Monuments they have left, Monumenta Orcadica, L. Dietrichson, J. W. Cursitor, 315
- Nova 156.1906, a New Variable or, Prof. E. Millosevich, 615
- Nova Sagittarii, Observations of, Prof. Barnard, 137; see Astronomy
- Novy (M.), the Bacterial Nature of "Spirochaetes," 180
- Nubian Antiquities, Profs. Karl Schmidt and H. Schäfer, 178
- Nutrition, the Elements of the Science of, Prof. Graham Lusk, 413
- Nutton (H.), the Potential of Hydrogen Liberated from Metallic Surfaces, 621
- O'Sullivan (Cornelius, F.R.S.), Death of, 253; Obituary Notice of, 277
- Observatories: Greenwich Observatory and the Power Station, 16; the Cape Observatory, Sir David Gill, 40; the Bologna Observatory, Prof. Rajna, 41; the United States Naval Observatory Publications, 86; United States Naval Observatory, 378; Annales de l'Observatoire météorologique, physique et glaciaire du Mont Blanc, 203; the Companion to the Observatory, 257; Stonyhurst College Observatory, Father Sidgreaves, 593; Annals of the Astronomical Observatory, Harvard College, 593
- Oceanography: Oceanographical Research, 307; Northern Waters, Captain Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, with a Discussion of the Origin of the Bottom-waters of the Northern Seas, Fridthjof Nansen, 563
- Offord (Joseph), the Green Tints of Sunsets, 342
- Oil-pipe Lines, New, 300
- Oldham (R. D.), the Valparaiso Earthquake, August 17, 1906, 439
- Olszewski (Prof. K.), Inversion Temperature for Air and Nitrogen, 379
- Opium, Anti-, Drug, L. Wray, 613
- Optics: "Unilens," Major Baden-Powell, 15; Influence of Spectral Colours on the Sporulation of Various Species of Saccharomyces, J. E. Purvis and G. R. Warwick, 95; Recent Progress in Magneto-optics, Prof. P. Zeeman at Royal Institution, 138, 160; Refractive Indices of Water and Sea-water, J. W. Gifford, 165; Luminosity produced by the Rubbing or Knocking together of Various Forms of Silica, R. L. Taylor, 189; "Chemiluminescence," Prof. E. Wedekind, 208; Perception of Relief by Monocular Vision, T. Terada, 224; A. E. Smith, 321; Fluorescence and Magnetic Rotation Spectra of Sodium Vapour, Prof. R. W. Wood, 230; Talbot's Law as applied to the Rotating Sector Disc, Mr. Hyde, 233; Death of T. R. Dallmeyer, 253; Obituary Notice of, 279; Photoelectric Fatigue of Zinc, H. Stanley Allen, 262; Improvements in Spectrophotometers, F. Tyman, 382; Transactions of the Optical Society, London, 451; Periscopic Lenses in Spectacles, W. A. Dixey, 451; Direct Stereoscopic Projection, Theodore Brown, 451; a Method of Testing Prisms, S. D. Chalmers, 451; Measurement of Absorption in Tinted Glasses, L. W. Phillips, 451; Remarkable Luminous Effects Emanating from Electric Arc Lamps at the Instant of a Flash of Lightning, P. De Heen, 423; Optical Intensification of Paintings, Prof. R. W. Wood, 424; Influence of Temperature on Absorption in Crystals, Jean Becquerel, 455; Effect of Stimulating Organisms

- with Different Light Rays, Prof. E. Hertel, 516; Influence of the Surrounding Temperature on the Luminous Intensity of an Incandescent Electric Lamp, F. Laporte and R. Jouaust, 575; Contribution to the Study of Phosphorescence, Henri Becquerel, 575; Meteorologische Optik, Prof. J. M. Pernter, 577; Seeing Stereoscopic Pictures without Stereoscope, Colonel W. G. Morris, 614
- Orbits of Three Double Stars, Prof. Doberck, 282
- Orchids of the North-western Himalaya, the, J. F. Duthie, 587
- Organic Analysis, Methods of, Dr. H. C. Sherman, 26
- Organique, Cours de Chimie, Fréd. Swarts, 316
- Origin of the English Nation, the, H. Munro Chadwick, W. A. Craigie, 555
- Orkneys, the Norsemen in the, and the Monuments they have left, Monumenta Orcadica, L. Dietrichson, J. W. Cursiter, 315
- Ornithology: Pelicans in Eastern Europe, R. B. Lodge, 38; Origin of Parasitic Habits in Cuckoos, C. L. Barrett, 135; Emu Remains from King Island, Bass Strait, Prof. Baldwin Spencer, 228; the "Bleating" or "Drumming" of the Snipe, P. H. Bahr, 359; Death of C. A. Wittchell, 444; the Habits of Birds-of-Paradise, C. C. Simpson, 445; British Birds' Nests, How, Where, and When to Find and Identify Them, R. Kearton, 562
- Orr (Prof. W. McF.), Stability or Instability of the Steady Motions of a Perfect Liquid, 119
- Orthoptera, a Synonymic Catalogue of, W. F. Kirby, 269
- Orton (K. J. P.), Influence of Light on Diazo-reactions, 215
- Osborn (Prof. H. F.), Prehistoric Crania from a Mound in Douglass County, Nebraska, 255
- Osteology: Occurrence of an "Intermetatarsal Bone" in the Human Foot, A. Rauber, 84
- Oswald (Dr. Felix), a Treatise on the Geology of Armenia, 197
- Ottweiler (Dr.), Wissenschaftliche Beihafte zum deutschen Kolonialblatt, 616
- Owens (E. W.), How to Learn on Shore the Rule of the Road at Sea, 126
- Oysters, Toxic Effects of, J. Baylac, 456
- Pacific, Observations of a Naturalist in the, between 1896 and 1899, H. B. Guppy, 217
- Packard (John C.), Apparatus to Determine the Resultant of Two Motions at Right Angles to One Another, 401
- Pagan Races of the Malay Peninsula, W. W. Skeat and C. O. Blagden, 415
- Pagan Temples and Christian Churches, Incubation, or the Cure of Disease in, Mary Hamilton, 366
- Paget (Stephen), Experiments on Animals, 121
- Paints, the Chemistry of, and Paint Vehicles, Clare H. Hill, 4
- Palæobotany: American Fossil Cycads, G. R. Wieland, 329; the Fossil Osmundaceæ, R. Kidston and D. T. Gwynne-Vaughan, 455; Beiträge zur Flora der unteren Kreide Quadlinburgs, Teil i., die Gattung Hausmannia, Dunker und einige seltene Pflanzenreste, P. B. Richter, 617
- Palæontology: Excavation of "Hyæna-dens" in the Mammoth Cave near Doneraile, R. J. Ussher, 83; Recent Cave-exploration in California, Dr. J. C. Merriam and Prof. F. W. Putnam, 156; *Goniopholis crassidens* from the Wealden Shales of Atherfield (Isle of Wight), R. W. Hooley, 167; Vertebrate Fossils of Cretaceous Formation of Bahia (Brazil), J. Mawson and Dr. A. S. Woodward, 334; New Dinosaurian from the Trias of Lossiemouth, Elgin, Dr. A. S. Woodward, 334; die Leitfossilien aus dem Pflanzen- und Thierreich in systematischer Anordnung, Dr. Johannes Felix, 388; Subfossil Prosimiæ from Madagascar, H. F. Standing, 574
- Panama Canal, why the Lock System was Adopted for the, Hon. W. H. Taft, 181
- Pantocsek (Dr. Josef), die Biologie des Balatonsees, 79
- Panton (Dr. A. W.), Death of, 205
- Paper Technology, an Elementary Manual on the Manufacture, Physical Qualities, and Chemical Constituents of Paper and of Paper-making Fibres, R. W. Sindall, 289
- Paradoxes of Nature and Science, Dr. W. Hampson, 341, 606; the Reviewer, 606
- Parallax Investigations on 163 Stars mainly of Large Proper Motion, Frederick L. Chase, Mason F. Smith, and William L. Elkin, 234
- Parasites: *Leucocytozoon canis*, a Parasite of the Dog, Captain Christophers, 400; Influence of Parasites on their Hosts, Prof. H. B. Ward, 571
- Paris Academy of Sciences, 23, 47, 71, 96, 120, 143, 167, 190, 238, 263, 287, 311, 335, 359, 383, 407, 431, 455, 479, 593, 528, 575, 599, 623; Prizes Awarded and Proposed by the, 231
- Parkhurst (J. A.), Researches in Stellar Photometry, 498
- Parkin (John), the Origin of Angiosperms, 621
- Parkinson (J.), the Geology of the Oban Hills (Southern Nigeria), 286
- Parshall (H. F.), Electric Railway Engineering, 531
- Parthenogenese, Untersuchungen über künstlichen, und das Wesen des Befruchtungsvorgangs, Prof. Jacques Loeb, 486
- Pascal (Prof. Ernesto), Obituary Notice of Prof. Ernesto Cesàro, 254
- Pastureau (M.), a Tetrabromo-derivative of Methylene-ketone, 191
- Pathology: Immunity in Infective Diseases, Prof. Élie Metchnikoff, Prof. R. T. Hewlett, 99; the Inflammation Idea in General Pathology, Dr. W. H. Ransom, F.R.S., Prof. R. T. Hewlett, 99; the Milroy Lectures on Epidemic Disease in England, the Evidence of Variability and of Persistence of Type, Dr. W. H. Hamer, Prof. R. T. Hewlett, 99; Microbiologie Agricole, Dr. Edmond Kayser, Prof. R. T. Hewlett, 99; Rudolf Virchow, Briefe an Seine Eltern, 1839 bis 1864, Supp. to March 14, iii
- Patkanoff (S.), the Tungus Race of Siberia, 236
- Paulesco (M.), Aneurism of the Ophthalmic Artery Cured by Gelatin, 456
- Paulsen (Prof. A. F. W.), Death and Obituary Notice of, 299
- Paulsen (Friedrich), the German Universities and University Study, 338
- Payen-Payne (de V.), French Readings in Science, 341
- Peachey (S. J.), Trimethylplatinimethyl Hydroxide and its Salts, 575
- Pearce (N. D. F.), Collection of Oribatidæ from British Guiana, 95
- Pearl (Prof. Raymond), Biometrical Study of Conjugation in Paramecium, 542; Variation and Correlation in Ceratophyllum, 612
- Pearson (Prof. H. H. W.), the Living Welwitschia, 536
- Pearson (R. S.), the Level of Subsoil Waters with Regard to Forests, 613
- Peary's (Commander R. E.) Arctic Expedition, 37
- Pelham (Prof. H. F.), Death of, 374
- Pellat (H.), the Constitution of the Atom, 479; Constitution of the Atom and the Law of Colomb, 599
- Penck (Prof. Albrecht), Beobachtung als Grundlage der Geographie, 483
- Pendlebury (C.), a Junior Arithmetic, 74; a New Shilling Arithmetic, 409
- Penrose's Pictorial Annual, 390
- Pepper (O. M.), Variation and Correlation in Ceratophyllum, 612
- Perception of Relief by Monocular Vision, T. Terada, 224; A. E. Smith, 321
- Péringuey (L.), Petroglyphs of Animals and Men in Africa, 229
- Perkin (A. G.), some Constituents of Natural Indigo, 406; Constituents of Natural Indigo, 477
- Perkin (Dr. F. M.), Practical Methods of Inorganic Chemistry, 26; Preparation of Chromyl Dichloride, 358
- Perkin (W. H., jun.), some Derivatives of Benzophenone, 215; Synthesis of Carvestrene and its Derivatives, 478
- Pernter (Prof. J. M.), Meteorologische Optik, 577
- Perrée (W. F.), Construction of a Tramway in Connection with the Extraction of Timber from the Forests of Goalpara, 207
- Perrier (G.), Presence of Formol in Certain Foods, 24
- Perrot (F. Louis), Preparation of Pure Helium by Filtra-

- tion of Gases from Cleveite through a Wall of Silica, 335
- Perry (Prof. John, F.R.S.), Bursaries at the Royal College of Science, London, 79; the Future in America, a Search after Realities, H. G. Wells, 265; the Mathematical Tripos at Cambridge, 273
- Perry-Coste (F. H.), the Ballot-box, 509
- Perseids, the, 1906, Prof. Zammarchi, 111
- Personality, the Dissociation of a, a Biographical Study in Abnormal Psychology, Dr. Morton Prince, 102
- Peruvian Meteorology, Prof. Solon I. Bailey, 283
- Peslôian (Ch. Lucas de), N. H. Abel, sa Vie et son Œuvre, 603
- Petch (T.), Fungi of the Nests of White Ants of Ceylon, 524
- Pethybridge (Dr. G. H.), American Gooseberry-mildew in Ireland, 567
- Petit (M. G.), Céruse et Blanc de Zinc, 509
- Petrie (Dr. J. M.), the Stinging Property of the Giant Nettle-tree, 72
- Petrography: Attrition Tests of Road-making Stones, E. J. Lovegrove, Petrographical Descriptions by Dr. John S. Flett and J. Allen Howe, 220; Petrographische Beschreibung der Gausberg-Gesteine, R. Reinisch, 224; Notes on Recent Petrography, 596; Sands and Sediments, Mellard Reade and Philip Holland, 596; New Forms of Concretions, H. W. Nichols, 596; Minerals of the Composition $MgSiO_3$, Messrs. Allen, Wright, and Clement, 596; Gravitational Assemblage in Granite, G. K. Gilbert, 596; the Differentiation of a Secondary Magma through Gravitational Adjustment, R. A. Daly, 596
- Petroleum and its Products, Sir Boverton Redwood, 218
- Petrology: the Roman Comagmatic Region, Henry S. Washington, 379
- Petrovitch (M. M.), la Mécanique des Phénomènes fondée sur les Analogies, 533
- Pfeffer (Dr. W.), the Physiology of Plants, a Treatise upon the Metabolism and Sources of Energy in Plants, 49
- Pflücker (Luis), Gold-bearing Deposits of the Province of Sandia, 258
- Pharmacology: a Manual of Pharmacology, Dr. W. E. Dixon, 2; the Extra Pharmacopœia of Martindale and Westcott, Dr. W. Harrison Martindale and W. Wynn Westcott, 29; Pharmacology of Ethyl Chloride, Dr. E. H. Embley, 165; Einführung in die mikroskopische Analyse der Drogenpulver, Dr. L. Koch, 390
- Pharmacy: Obituary Notice of Sir Thomas Hanbury, 494
- Phaseolunatin, Cyanogenesis in Plants and the Origin of, 452
- Philip (J. C.), Influence of Non-electrolytes and Electrolytes on the Solubility of Sparingly Soluble Gases in Water, 575
- Philippi (E.), Geologische Beschreibung des Gausberges, 224
- Philips' Progressive Atlas of Comparative Geography, Geo. G. Chisholm, Supp. to March 14, v
- Phillips (L. W.), Measurement of Absorption in Tinted Glasses, 451
- Philosophy: Manchester Literary and Philosophical Society, 71, 189, 216, 431, 527; Dictionary of Philosophy and Psychology, 73; Cambridge Philosophical Society, 95, 454, 551; Greek Theories of Elementary Cognition from Alcmaeon to Aristotle, John I. Beare, 122; Brier Patch Philosophy, W. J. Long, 176; John Dalton, J. P. Millington, 246; South African Philosophical Society, 287
- Phin (John), the Seven Follies of Science, a Popular Account of the most Famous Scientific Impossibilities and the Attempts which have been made to Solve Them, 25
- Phœbe, Observations of, in 1906, 159
- Phonetics: Lectures upon the Mechanism of Speech, Alexander Graham Bell, Prof. John G. McKendrick, 196; Researches in Experimental Phonetics, the Study of Speech Curves, Dr. E. W. Scripture, Prof. John G. McKendrick, F.R.S., 392
- Phosphorescence, Contribution to the Study of, Henri Becquerel, 575
- Photography: the Complete Photographer, R. Child Bayley, 75; Entomological Photography, 83; the Year-book of Photography for 1906-7, 101; the Photographic Picture Post-card, E. J. Wall and H. Snowden Ward, 101; Magnesium Light Photography, E. J. Mortimer, 101; Photography in Natural Colours, Julius Rheinberg, 103; Photographic Observations of Giacobini's 1905 Comet, Prof. Barnard, 111; Photographs of Giacobini's Comet (1905c), 326; "Ozobrome" Carbon Printing, Thomas Manly, 134; Stereoscopic Lantern Slides, G. A. Shakespear, 199; the British Journal Photographic Almanac and Photographer's Daily Companion, 1907, 222; Photographs of the Year 1906, 246; Photographic Processes, part iii., the Latent Image and its Destruction, S. E. Sheppard and C. E. K. Mees, 310; the late Dr. Roberts's Celestial Photographs, 402; British Plates in Germany, 423; Optical Intensification of Paintings, Prof. R. W. Wood, 424; Photographs of Faint Stars, Prof. E. C. Pickering, 448; Death and Obituary Notice of Colonel Laussedat, 565; M Screens and "Verichrome" and "Allochrome" Plates, Messrs. Wratten and Wainwright, 592; Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi
- Photometry, Researches in Stellar, J. A. Parkhurst, 498
- Physical Chemistry for Electrical Engineers, J. Livingston R. Morgan, 413
- Physical Geography: Sand-movement on the New South Wales Coast, G. H. Halligan, 192
- Physics: New Physical and Engineering Departments of the University of Edinburgh, 20; Distillation and Desiccation in a Vacuum with the Aid of Low Temperatures, MM. d'Arsonval and Bordas, 23; the Seven Follies of Science, a Popular Account of the most Famous Scientific Impossibilities and the Attempts which have been made to Solve Them, John Phin, 25; Behaviour of Certain Substances at their Critical Temperatures, Dr. Morris W. Travers, F.R.S., and Francis L. Usher, 47; the Velocities of Detonation of Explosives, M. Dautriche, 48; die physikalischen Institute der Universität Göttingen, Dr. J. A. Harker, 55; the Strength and Behaviour of Ductile Materials under Combined Stress, W. A. Scoble, 70; Behaviour of Iron under Weak Periodic Magnetising Forces, J. M. Baldwin, 70; Physical Society, 70, 143, 188, 382, 430, 478, 527, 621; Sechs Vorträge über das thermodynamische Potential, &c., J. J. van Laar, 77; some Astronomical Consequences of the Pressure of Light, Prof. J. H. Poynting, F.R.S., at Royal Institution, 90; the Study of Pseudo-solution, the Colloidal Forms of Ferric Hydroxide, F. Giolitti, 110; Stability or Instability of the Steady Motions of a Perfect Liquid, Prof. W. McF. Orr, 119; Dependence of Gravity on Temperature, L. Southern, 142; Anwendungen des Mikrophonprinzips, Chr. Jensen and H. Sieveking, Prof. Gisbert Kapp, 153; Solutions of Physical Problems, Prof. Andrew Gray, F.R.S., 158; a Compensated Micromanometer, B. J. P. Roberts, 165; Electric Radiation from Bent Antennæ, Prof. J. A. Fleming, 188; Relation between the Ionic Velocity and the Volume of Organic Ions in Aqueous Solutions, G. A. Carse and T. H. Laby, 189; the Solubility of Stereoisomerides in Optically Active Solvents, H. O. Jones, 190; Evaporation from Water Surfaces, J. R. Sutton, 190; the Liquid Volume of a Dissolved Substance, J. S. Lumsden, 215; the Viscosity of Liquid Mixtures, A. E. Dunstan and R. W. Wilson, 215; Change in Conductivity not Attributable to Change of Ionisation of Salt within the Solution, S. M. Sabat, 230; Temperatures Obtainable by the Use of Solid Carbon Dioxide under Different Pressures, John Zeleny and Anthony Zeleny, 230; the Extinction of Friction, L. Lecornu, 239; Cryoscopy of Colloidal Solutions of Ferric Chloride, G. Malfitano and L. Michel, 239; Ice Formation, with Special Reference to Anchor-ice and Frazil, Howard T. Barnes, 267; the New Physics and Chemistry, a Series of Popular Essays on Physical and Chemical Subjects, W. A. Shenstone, F.R.S., 269; Conduction of Electricity through Gases, Prof. J. J. Thomson, F.R.S., 269; Ionisation and Absorption and Anomalous Dispersion, Dr. G. A. Schott, 271; Ionisation and Anomalous Dispersion, Prof. R. W. Wood, 390, 583; G. A. Schott, 461; the Range of Stokes's Progressive Waves of Finite Amplitude, R. F. Gwyther, 302; Calcium as an Absorbent of Gases, and its Applications in the Production of High Vacua

- and for Spectroscopic Research, Frederick Soddy, 309; Results of Gauging High Vacua by the Evaporation Test, A. J. Berry, 310; Cases of Contour Zones of Molecular Arrangement from Surface Disturbance, Dr. James Hunter, 335; Inversion Temperature for Air and Nitrogen, Prof. K. Olszewski, 379; Brittle Materials under Combined Stress, W. A. Scoble, 382; an Occurrence of Helium in the Absence of Radio-activity, Hon. R. J. Strutt, F.R.S., 390; Major Conyngham's Report on the Pendulum Observations for Determining the Force of Gravity, 403; Osmotic Pressure from the Standpoint of the Kinetic Theory, Dr. T. M. Lowry, 429; Bearing of Actual Osmotic Experiments upon the Conception of the Nature of Solutions, Prof. L. Kahlenberg, 430; Summary of Experiments made with Glucose and Cane-sugar, H. N. Morse, 430; Exercises in Physics for the Use of Schools, J. H. Leonard and W. H. Salmon, 436; Introductory Practical Physics, W. F. Barrett and W. Brown, 436; Heat, Light, and Sound, an Introductory Course of Practical Exercises, J. R. Ashworth, 436; Light for Intermediate Students, F. E. Rees, 436; the Tutorial Physics, vol. iii., a Text-book of Light, Dr. R. Wallace Stewart, 436; the Elements of Physics, S. E. Coleman, 436; Physics, Theoretical and Descriptive, H. C. Cheston, J. S. Gibson, and C. E. Timmerman, 436; a First-year Course of Practical Magnetism and Electricity, Dr. P. E. Shaw, 436; Maximum Gravitational Attraction on a Solid, W. E. Miller, 439; Prof. G. H. Bryan, F.R.S., 439; an Investigation into the Elastic Constants of Rocks, more Especially with Reference to Cubic Compressibility, Prof. Frank D. Adams and Prof. Ernest G. Coker, 451; Curvature Method for Measuring Surface Tension, C. T. R. Wilson, 454; Waves of Shock, Application to the Explosive Wave, M. Jouguet, 455; Coagulation of the Latex of Caoutchouc and the Elastic Properties of Pure Caoutchouc, Victor Henri, 455; Ionisation of Gases by α Particles of Radium, Prof. Bragg, 478; Conditions of Formation of Electrified Centres of Feeble Mobility in Gases, Maurice de Broglie, 503; German Science Reader, C. R. Dow, 509; Modern Views of the Ether, Sir Oliver Lodge, F.R.S., 519; la Mécanique des Phénomènes fondée sur les Analogies, M. M. Petrovitch, 533; Ionisation by Spraying, A. S. Eve, 533; Church Bells Cracked by Sound Waves produced by Explosions or Heavy Firing, 541; Flame the Working Fluid in Gas and Petrol Engines, Dugald Clerk at Royal Institution, 546; Application of Van der Waals's Equation to Solutions, Earl of Berkeley, 549; the Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes, A. A. Campbell Swinton, 550; a Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the Welsbach Mantle, Prof. R. W. Wood, 558; the Coefficient of Expansion of Fused Quartz, Howard Minchin, 568; the Expansion of Crystalline Quartz in the Direction of the Axis, and of Platinum, Palladium, and Quartz Glass between the Temperatures of -100° C. and $+100^{\circ}$ C., 568; Terrestrial Physics in the United States, 573; Physikalische Kristallographie vom Standpunkt der Strukturtheorie, Ernst Sommerfeldt, 605; Hydrates in Aqueous Solutions of Electrolytes, Rev. S. M. Johnstone, 623; Limits of Inflammability of Explosive Mixtures of Ether Vapour and Air, Jean Meunier, 624; Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi
- Physiography: the Physiography of the River Nile and its Basin, Captain H. G. Lyons, 17; Man and Superman, Arthur J. Davis, 501
- Physiology: the Viscosity of the Blood, Dr. A. du Pré Denning and John H. Watson, 47; the Coagulability of the Subhepatic Blood, M. Doyon, Cl. Gautier, and N. Kareff, 48; Thermal Troubles in Cases of Absolute Privation of Sleep, N. Vauschide, 144; Theoretische Grundlagen für eine Mechanik der lebender Körper, Otto Fischer, 146; a Respiratory Calorimetric Room, M. Letulle and Mlle. Pompilian, 168; the Structure of Nerve Fibres, J. S. Macdonald, 187; Opsonins in Relation to Red Blood Cells, Dr. J. O. Wakelin Barratt, 188; the Influence of an Excessive Meat Diet on the Osseous System, Dr. Chalmers Watson, 190; Effects of a Meat Diet on Fertility and Lactation, Dr. B. P. Watson, 190; Effects of a Meat Diet on the Minute Structure of the Uterus, Drs. Malcolm Campbell and Chalmers Watson, 190; Mercers' Company Lectures on Recent Advances in the Physiology of Digestion, Prof. Ernest H. Starling, F.R.S., Prof. Benjamin Moore, 219; the Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings, Prof. Theodore Hough and Prof. W. T. Sedgwick, 318; Death of Sir Michael Foster, K.C.B., F.R.S., 323; Obituary Notice of, 345; the Hæmo-renal Salt Index as a Test of the Functional Efficiency of the Kidney, Dr. Dawson Turner, 334; the Relation of the Kidneys to Metabolism, F. A. Bainbridge and A. P. Beddard, 357; the Elements of the Science of Nutrition, Prof. Graham Lusk, 413; Transformations in the Organism and Elimination of Formic Acid and the Formates, C. Fleig, 432; Fundamental Differences in the Mechanism and Evolution of the Increase of Resistance to Infection according to the Methods Utilised, MM. Charrin and Lévy-Franckel, 432; Mechanism of the Destruction of Nerve-cells in Old Age and the Pathological States, M. Manouélian, 432; the Transplantation of Nerve Ganglia in the Frog, G. Marinesco and J. Minea, 456; Effect of Stimulating Organisms with Different Light Rays, Prof. E. Hertel, 516; Intravascular Coagulation in Albinos and Pigmented Animals, G. P. Mudge, 549; Influence of Parasites on their Hosts, Prof. H. B. Ward, 571; Functions of the Rolandic Cortex in Monkeys, Drs. W. A. Jolly and Sutherland Simpson, 623; Plant Physiology: the Physiology of Plants, a Treatise upon the Metabolism and Sources of Energy in Plants, Dr. W. Pfeffer, 49; Plant Response as a Means of Physiological Investigation, Prof. Jagadis Chunder Bose, Dr. F. F. Blackman, F.R.S., 313; Vorschule der Pflanzenphysiologie eine experimentelle Einführung in das Leben der Pflanzen, Prof. L. Linsbauer and Dr. K. Linsbauer, 602
- Pickard (G. W.), Measurement of Received Energy at Wireless Stations, 281
- Pickering (Prof.), New Variable Stars, 159; Standard Stellar Magnitudes, 518
- Pickering (Prof. E. C.), Photographs of Faint Stars, 448; Eclipses of Jupiter's Satellites, 1878-1903, 616
- Pickering (Spencer U., F.R.S.), Seventh Report of the Woburn Experimental Fruit Farm, 569
- Pickering (Prof. W. H.), Lunar Changes, 16; the Lunar Crater Linné, 231
- Pictet (Amé), Acetyl Nitrate, 360
- Pictorial Annual, Penrose's, 390
- Piette (E.), Domestication of the Horse during the Reindeer Epoch, 108
- Pilcomayo, the River, from its Discharge to Parallel 22° S., with Maps of Reference, Gunnar Lange, 617
- η Piscium, Radial Velocity of, 569
- Plague: Dr. Haffkine's Prophylactic, 514; Haffkine's Prophylactic and the Mulkowal Disaster, Prof. Ross, 588; the Transmission of Plague in the Rat, Dr. Klein, 544
- Planets: Minor Planets, Dr. Bauschinger, 40; Naked-eye Observations of Venus, A. Benoit, 111; Observations of Venus, Mr. Denning, 208; the Markings and Rotation Period of Venus, Mr. Denning, 469; Observations of Phœbe in 1906, 159; Early Observations of Jupiter's Sixth Satellite, Miss Leavitt, 182; Jupiter's Satellites, J. E. Martin, 231; K. Graff, 231; a White Spot on Jupiter's Third Satellite, José Comas Sola, 281; the Red Spot on Jupiter, 1905-6, Stanley Williams, 327; Simultaneous Disparition of Jupiter's Four Satellites, Enzo Mora, 448; Simultaneous Observations of Jupiter, 569; Eclipses of Jupiter's Satellites, 1878-1903, Prof. E. C. Pickering, 616; Ephemerides of Comets and Planets, 231; Observations of Mars, José Comas Sola, 257; the Temperature of Mars, Prof. Lowell, 593; Sun and Planet Chart, 402; the Minor Planet (588) [1906 T.G.], Dr. Bidschhof, 408; Ephemeris for the Minor Planet (588) [1906 T.G.], Dr. Bidschhof, 544; la Découverte de l'Anneau de Saturne par Huygens, Jean Mascart, 509; the Albedoes of the Superior Planets, J. E. Gore, 615
- Plant Physiology: the Physiology of Plants, a Treatise

- upon the Metabolism and Sources of Energy in Plants, Dr. W. Pfeffer, 49; Plant Response as a Means of Physiological Investigation, Prof. Jagadis Chunder Bose, Dr. F. F. Blackman, F.R.S., 313; *Vorschule der Pflanzenphysiologie, eine experimentelle Einführung in das Leben der Pflanzen*, Prof. L. Linsbauer and Dr. K. Linsbauer, 602
- Plants: Guide to the Principal Families of Flowering Plants, J. Adams, 29; *Jugendform und Blütenreife im Pflanzenreich*, Dr. L. Diels, 194; Plant Dispersal and Kindred Problems, 217; British Flowering Plants, W. F. Kirby, 222; the Study of Plant Life for Young People, M. C. Stopes, 298; Plant Life, Studies in Garden and School, H. F. Jones, 298; the Romance of Plant Life, G. F. Scott-Elliott, 298; the Green Gateway, a Peep into the Plant World, F. G. Heath, 298; the Plants of New South Wales, W. A. Dixon, 366
- Plaskett (J. S.), Spectrum and Radial Velocity of Mira, 518
- Pleyel (J. von), History and Origin of Zoological Gardens, 62
- Plimmer (H. G.), Effects produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness, 429
- Pluvinel (M. le Comte de la Baume), Observations of Total Solar Eclipses, 257
- Pochin (Mr.), Instrument for describing Logarithmic Spirals, 621
- Pocock (R. I.), English Domestic Cats, 478
- Pocock (T. L.), the Geology of the Country around Macclesfield, Congleton, Crewe, and Middlewick, 305
- Poe (C. H.), Cotton, its Cultivation, Marketing, Manufacture, and the Problems of the Cotton World, 27
- Poetry, Nature Knowledge in Modern, Alexander Mackie, 485
- Poisoning by Turtle's Flesh in Fiji, Dr. B. Glanvill Corney, 590
- Poizat (M.), a Continuous Apparatus for the Preparation of Pure Oxygen, 311
- Polariscope, Intensification of "Contrast" by Means of a, Dr. Felix Bisce, 498
- Pollok (Dr. J. H.), the Principal Lines of the Spark Spectra of the Elements, 359
- Pompilian (Mlle.), a Respiratory Calorimetric Room, 168
- Pope (W. J.), Development of the Atomic Theory, 94; Resolution of Tetrahydro-*p*-toluquinoline into its Optically Active Components, 358; Trimethylplatinimethyl Hydroxide and its Salts, 575
- Poppellwell (Frank), some Modern Conditions and Recent Developments in Iron and Steel Production in America, 438
- Porifera (Sponges), Igerna B. L. Sollas, 31
- Porsch (Dr. O.), *Illustriertes Handwörterbuch der Botanik*, 28
- Porter (Dr. A. E.), Preservatives in Food and Food Examination, 145
- Position-line Star Tables, for Fixing Ship's Position by Reduction to Meridian and Prime Vertical without Logarithmic Calculation, H. B. Goodwin, 197
- Positive Charge Carried by the α Particle, the, Frederick Soddy, 438
- Positive Streams in "Crookes" Tubes, A. A. Campbell Swinton, 583
- Potonié (Prof.), Parallelism between Different Kinds of Peat and Different Kinds of Coal, 84
- Pottevin (Henri), the Purification of Sewage by Turf Filters, 600
- Potts (Edward), the North American Fresh-water Medusa of *Microhydra*, 324
- Power (F. B.), Constitution of Chaulmoogric and Hydrocarpic Acids, 503
- Power Transmission from Electric Motors, Mechanism of, Wilfred L. Spence, 591
- Poynting (Prof. J. H., F.R.S.), some Astronomical Consequences of the Pressure of Light, Discourse at Royal Institution, 90
- Prehistoric Story of Mankind, the, the Human Epic, John Frederick Rowbotham, 73
- Preservatives in Food and Food Examination, Dr. John C. Thresh and Dr. A. E. Porter, C. Simmonds, 145
- Price (T. S.), Electrolytic Preparation of Dialkyl-
- disulphides, 23; Depression of the Freezing Point of Aqueous Solutions of Hydrogen Peroxide by Potassium Persulphate and other Compounds, 503
- Price (Dr. T. Slater), Electrolytic Deposition of Zinc using Rotating Electrodes, 621
- Prince (Dr. Morton), the Dissociation of a Personality, a Biographical Study in Abnormal Psychology, 102
- Prindle (L. M.), the Gold Placers of Forty-mile, Birch Creek, and Fairbanks Regions, Alaska, 184; Rampart Gold-placer Region, Alaska, 256
- Prior (G. T.), Strüverite, a New Mineral, 574; Zinciferous Tennantite from the Binnenthal, 574
- Prizes Awarded and Proposed by the Paris Academy of Sciences, 231
- Probability: the Problem of the Random Path, Prof. Reginald A. Fessenden, 392; Vox Populi, Dr. Francis Galton, F.R.S., 450, 509; F. Perry-Coste, 509; a Problem in Chance, Geo. P. Mudge, 461; Mean or Median, R. H. Hooker, 487; G. Udny Yule, 534
- Problem of the Rhodesian Ruins, Dr. David Randall-Maclver, 369
- Problems of Applied Chemistry, Prof. George Lunge at the Royal Institution, 617
- Progressive Waves in Rivers, Dr. Vaughan Cornish, 597
- Prolegomena to Theology, some, Wilhelm Wundt, 363
- Prominence Observations (1906), 448
- Proteins, Nomenclature of the, W. S. Giles, 439
- Protozoa, Prof. Marcus Hartog, 31
- Protozoa, the Immortality of the, J. Shawcross, 320
- Protozoology, the Scope and Problems of, Prof. E. A. Minchin, Lecture at the University of London, 115
- Psychology: Dictionary of Philosophy and Psychology, 73; the Dissociation of a Personality, a Biographical Study in Abnormal Psychology, Dr. Morton Prince, 102; Crystal Gazing, its History and Practice, with a Discussion of the Evidence for Telepathic Scrying, Northcote W. Thomas, 125; les Révélations de l'Écriture d'après un Contrôle scientifique, Alfred Binet, 148; *Völkerpsychologie, eine Untersuchung der Entwicklungsgesetze von Sprache, Mythos und Sitte*, Wilhelm Wundt, 363; Sex and Character, Otto Weininger, 481
- Public Health, Prof. R. T. Hewlett, 544
- Pulsation, Rhythmical, in Scyphomedusæ, Alfred G. Mayer, 545
- Purinton (C. W.), Methods and Costs of Gravel and Placer Mining in Alaska, 184
- Purser (F.), Elementary Geometry based on Euclid's Elements, 74
- Purvis (J. E.), Influence of Spectral Colours on the Sporulation of Various Species of *Saccharomyces*, 95; Influence of a Strong Magnetic Field on the Spark Spectra of Titanium, Chromium, and Manganese, 189
- Putnam (Prof. F. W.), Recent Cave-exploration in California, 156
- Rabies, Influence of Radium on the Virus of, Dr. Bongiovanni, 15
- Racing, a Law of Record Times in, 463
- Radial Velocities, Stars with Variable, 378
- Radial Velocity of Mira, Spectrum and, J. S. Plaskett, 518
- Radiography: Absorption of the Radio-active Emanations by Charcoal, Sir James Dewar, F.R.S., 6; Influence of Radium on the Virus of Rabies, Dr. Bongiovanni, 15; the Production of Radium from Actinium, Bertram B. Boltwood, 54; Prof. E. Rutherford, F.R.S., 270; Radium and its Disintegration Products, Dr. Bertram B. Boltwood, 223; the Effect of Radium on the Strength of Threads, J. L. McKee and Prof. W. B. Morton, 224; Effect of Temperature on the Activity of Radium, Dr. Howard L. Bronson, 262; Presence of Neon in Radio-active Minerals, Hon. R. J. Strutt, F.R.S., 102; New Type of X-ray Tube, Mr. Rosenthal, 136; a New Method of regulating X-ray Tubes, G. Berlement, 624; Absorption of the Inert Gases by Charcoal, Sir James Dewar, F.R.S., 126; the Composition of Thorianite and the Relative Radio-activity of its Constituents, Dr. E. H. Büchner, 165; Radio-activity of the Alkali Metals, N. R. Campbell and A. Wood, 189; Radio-active Transformations, Prof. E. Rutherford, F.R.S., Hon. R. J. Strutt, F.R.S., 195;

- Change in Conductivity not Attributable to Change of Ionisation of Salt within the Solution, S. M. Sabat, 230; the α Rays, Prof. O. W. Richardson, 223; Measurement of the Radio-chromometric Degree by the Electrostatic Voltmeter in the Utilisation of the Röntgen Rays in Medicine, J. Bergonié, 287; Radio-telegraph Installation for Signalling Across the Wash, 377; an Occurrence of Helium in the Absence of Radio-activity, Hon. R. J. Strutt, F.R.S., 390; Retardation of Electroscopic Leak by Means of Recognised Radio-active Substances, Dr. W. S. Lazarus-Barlow, 559; Theory of the Radiation of Incandescent Mantles, M. Foix, 575; Anode Rays, Messrs. Gehrcke and Reichenheim, 614; New Glass Transparent to Rays of very Short Wave-length, F. A. Lindemann and C. L. Lindemann, 614
- Radium: Radium and Geology, Prof. J. Joly, F.R.S., 7, 294, 341; Prof. W. J. Sollas, F.R.S., 319; the Production of Radium from Actinium, Bertram B. Boltwood, 54; Prof. E. Rutherford, F.R.S., 270; Radium and Helium, Dr. B. Walter, 102; Radium, Actinium, and Helium, H. S. Allen, 126; Radium and its Disintegration Products, Dr. Bertram B. Boltwood, 223; the Effect of Radium on the Strength of Threads, J. L. McKee and Prof. W. B. Morton, 224; *see also* Radiography
- Railway Engineering, Electric, H. F. Parshall and H. M. Hobart, 531
- Rainfall, British, Dr. Hugh Robert Mill, 5
- Rainfall in German South-West Africa, 616
- Rainfall and the Sun-spot Cycle, Rothesay, Alex. B. MacDowall, 488
- Rajna (Prof.), the Bologna Observatory, 41
- Rambaud (M.), Observations of the Giacobini Comet (1907*a*), 528
- Randall MacIver (Dr. David), Mediaeval Rhodesia, 369
- Random Path, the Problem of the, Prof. Reginald A. Fessenden, 392
- Rankin (G. A.), the Transformation of Orthorhombic Sulphur, 424
- Ransom (Dr. W. H., F.R.S.), the Inflammation Idea in General Pathology, 99
- Rate of Recession of Niagara Falls, G. K. Gilbert, 607
- Rauber (A.), Occurrence of an "Intermetatarsal Bone" in the Human Foot, 84
- Ray (P. C.), the Interaction of the Alkyl Sulphates with the Nitrites of the Alkali Metals and Metals of the Alkaline Earths, 23; the Decomposition of Mercurous and Silver Hyponitrites by Heat, 575
- Reade (Mellard), Sands and Sediments, 595
- Reale Istituto Lombardo, Prize Awards of the, 540
- Record Times in Racing, a Law of, 463
- Red Spot on Jupiter, 1905-6, the, Stanley Williams, 327
- Red-light Treatment of Small-pox, Early Reference to, Alfred Sang, 560
- Redwood (Sir Boverton), Petroleum and its Products, 218
- Reed (Sir Edward J., K.C.B., F.R.S.), Death of, 134; Obituary Notice of, Dr. Francis Elgar, F.R.S., 153
- Rees (A. W.), Creatures of the Night, 76
- Rees (F. E.), Light for Intermediate Students, 436
- Rees (Prof. J. K.), Death and Obituary Notice of, 540
- Reeve (Prof. Sidney A.), the Steam-table, a Table of the Thermal and Physical Properties of Saturated Steam Vapour and of the Specific Heat of Water, 533
- Refraction, Astronomical, 538; Prof. Bakhuyzen, 539
- Reichenheim (Mr.), Anode Rays, 614
- Reid (Dr. G.), the Nitrification of Sewage, 382
- Reinisch (R.), Petrographische Beschreibung der Gausberg-Gesteine, 224
- Religion: Science and Religion, Rev. Lord William Gascoyne Cecil, 126; the Peninsular Malays, I., Malay Beliefs, R. J. Wilkinson, 245
- Rengade (E.), Protoxide of Cæsium, 24; Anhydrous Protoxides of the Alkaline Metals, 239; Properties of the Alkaline Protoxides, 600
- Renouf (N.), Action of Reducing Agents on 5-chloro-3-keto-1:1-dimethyl- Δ^4 -tetrahydrobenzene, 215
- Reveille (Dr. J.), Obituary Notice of Colonel Mannheim, 422
- An Introduction to Logic, H. W. B. Joseph, 1
- Thought and Things, or Genetic Logic, James Mark Baldwin, 1
- A Manual of Pharmacology, Dr. W. E. Dixon, 2
- Jan Ingen-Housz, sein Leben und sein Wirken als Naturforscher und Arzt, Prof. Julius Wiesner, 3
- The Chemistry of Paint and Paint Vehicles, Clare H. Hall, 4
- British Rainfall, 1905, Dr. H. R. Mill, 5
- Technical Thermometry, 6
- Astronomischer Jahresbericht, A. Berberich, 6
- Zoologischer Jahresbericht für 1905, 6
- Great Bowlers and Fielders, G. W. Beldam and C. B. Fry, 8
- The Physiography of the River Nile and its Basin, Captain H. G. Lyons, 17
- The Seven Follies of Science, John Phin, 25
- A Practical Chemistry Note-book for Matriculation and Army Candidates, S. E. Brown, 26
- Chemistry Note-books, E. J. Sumner, 26
- The Science of Common Life, J. B. Coppock, 26
- Practical Methods of Inorganic Chemistry, Dr. F. M. Perkin, 26
- Chemical Analysis, Qualitative and Quantitative, Drs. W. Briggs and R. W. Stewart, 26
- Methods of Organic Analysis, Dr. H. C. Sherman, 26
- Cotton, its Cultivation, Marketing, Manufacture, and the Problems of the Cotton World, Prof. C. W. Burkett and C. H. Poe, 27
- Illustriertes Handwörterbuch der Botanik, Drs. O. Porsch and C. K. Schneider, 28
- Dizionario di Botanica Generali, Dr. Guglielmo Bilancioni, 28
- First Steps in the Calculus, A. F. van der Heyden, 29
- A Manual of Hydraulics, R. Busquet, 29
- Guide to the Principal Families of Flowering Plants, J. Adams, 29
- The Extra Pharmacopœia of Martindale and Westcott, 29
- The Cambridge Natural History, vol. i., Protozoa, by Prof. Marcus Hartog; Porifera (Sponges), Igera B. L. Sollas; Cœlenterata and Ctenophora, Prof. S. J. Hickson, F.R.S.; Echinodermata, Prof. E. W. MacBride, F.R.S., 31
- Memoirs of the Asiatic Society of Bengal, 1905-6, A. Ernest Crawley, 41
- First Report of the Natal Government Museum for the Year ending December 31, 1904, 42
- Annals of the Natal Government Museum, 42
- Draft Board of Trade Regulations with Respect to Weights, Measures, and Weighing Instruments, 42
- Mythes et Légendes d'Australie, A. van Gennep, 49
- The Physiology of Plants, a Treatise upon the Metabolism and Sources of Energy in Plants, Dr. W. Pfeffer, 49
- Steam Turbines, with an Appendix on Gas Turbines and the Future of Heat Engines, Dr. A. Stodola, 50
- Steam Turbine Engineering, T. Stevens and H. M. Hobart, 50
- Modern Turbine Practice and Water-power Plants, John Wolf Thurso, 50
- Hydraulic Motors with Related Subjects, including Centrifugal Pumps, Pipes, and Open Channels, Prof. Irving P. Church, 50
- Turbines, W. H. Stuart Garnett, 50
- Modern Steam Turbines, vol. i., the Schulz Steam Turbine, 50
- Ueber chitinöse Fortbewegungs-Apparate einiger (insbesondere fussloser) Insektenlarven, Dr. Wilhelm Leisewitz, W. F. Kirby, 54
- Map of the British Isles, W. and A. K. Johnston, 54
- Die physikalischen Institute der Universität Göttingen, Dr. J. A. Harker, 55
- Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes, E. A. Minchin, A. C. H. Gray, and F. M. G. Tulloch, E. A. Minchin, 56
- Contributions to the Ethnology of the Haida, J. R. Swanton, Dr. A. C. Haddon, F.R.S., 69
- Dictionary of Philosophy and Psychology, 73
- The Human Epic, the Prehistoric Story of Mankind, John Frederick Rowbotham, 73

REVIEWS AND OUR BOOKSHELF.

- Symbolic Logic and its Applications, Hugh MacColl, 1
- The Development of Symbolic Logic, A. T. Shearman, 1

- Elementary Geometry based on Euclid's Elements, F. Purser, 74
- Geometry, Theoretical and Practical, W. P. Workman and A. G. Cracknell, 74
- Elementary Geometry, W. M. Baker and A. A. Bourne, 74
- A Shilling Arithmetic, S. L. Loney and L. W. Grenville, 74
- Junior Arithmetic with Answers, W. G. Borchardt, 74
- A Junior Arithmetic, C. Pendlebury and F. E. Robinson, 74
- A Preliminary Course in Differential and Integral Calculus, A. H. Angus, 74
- A College Algebra, Prof. H. B. Fine, 74
- A New Trigonometry for Beginners, R. F. D'Arcy, 74
- Elementary Descriptive Geometry, C. H. McLeod, 74
- The Complete Photographer, R. Child Bayley, 75
- Nature's Story of the Year, C. A. Wittchell, 76
- Creatures of the Night, A. W. Rees, 76
- The Life Story of a Fox, J. C. Tregarthen, 76
- The Romance of Animal Arts and Crafts, Dr. H. Coupin and John Lea, 76
- Our School Out of Doors, Hon. M. Cordelia Leigh, 76
- Hints to Travellers, Scientific and General, 77
- Sechs Vorträge über das Thermodynamische Potential, &c., J. J. van Laar, 77
- The Family, Helen Bosanquet, 78
- The Evolution of Man, a Popular Scientific Study, Ernst Haeckel, 78
- Untravelled England, James John Hissey, 78
- Physische Geographie des Balatonsees und seiner Umgebung, Dr. Moriz Staub, Dr. E. von Chohnoky, Dr. Baron Bela Harkanyi, 79
- Die Biologie des Balatonsees, Dr. Geza Entz, Dr. A. Weiss, and Theodor Kormos, Dr. Josef Pantocsek, 79
- Social- und Anthropogeographie des Balatonsees, Gyula Rhé, Dr. Johann Jankó, and Dr. Willibald Semayer, 79
- Bibliographie des Balatonsees, Julius von Sziklay, 79
- Spezialkarte des Balatonsees und seinen Umgebung, Dr. Ludwig von Loczy, 79
- Leaf-hoppers and their Natural Enemies, 82
- Report of the Consultative Committee upon Questions affecting Higher Elementary Schools, 88
- Alternating Currents, a Text-book for Students of Engineering, C. G. Lamb, 97
- Die stofflichen Grundlagen der Vererbung im organischen Reich, Eduard Strasburger, 98
- Immunity in Infective Diseases, Prof. Élie Metchnikoff, Prof. R. T. Hewlett, 99
- The Inflammation Idea in General Pathology, Dr. W. H. Ransom, F.R.S., Prof. R. T. Hewlett, 99
- The Milroy Lectures on Epidemic Disease in England, the Evidence of Variability and Persistence of Type, Dr. W. H. Hamer, Prof. R. T. Hewlett, 99
- Microbiologie Agricole, Dr. Edmond Kayser, Prof. R. T. Hewlett, 99
- Some Founders of the Chemical Industry, Men to be Remembered, T. Fenwick Allen, Dr. T. E. Thorpe, C.B., F.R.S., 100
- The Year-book of Photography for 1906-7, 101
- The Photographic Picture Post-card, E. J. Wall and H. Snowden Ward, 101
- Magnesium Light Photography, E. J. Mortimer, 101
- The Rusts of Australia, their Structure, Nature, and Classification, D. McAlpine, 101
- The Dissociation of a Personality, a Biographical Study in Abnormal Psychology, Dr. Morton Prince, 102
- The "Lloyd" Guide to Australasia, 102
- The Siege of the South Pole, the Story of Antarctic Exploration, Dr. Hugh Robert Mill, 103
- The Voyage of the *Scotia*, being the Record of a Voyage of Exploration in Antarctic Seas, 103
- Experiments on Animals, Stephen Paget, 121
- Greek Theories of Elementary Cognition from Alcmaeon to Aristotle, John I. Beare, 122
- The Collected Mathematical Works of G. W. Hill, 123
- Neolithic Man in North-east Surrey, Walter Johnson and William Wright, 124
- In the Days of the Comet, H. G. Wells, 124
- The Elements of Chemical Engineering, Dr. J. Grossman, 125
- Crystal Gazing, its History and Practice, with a Discussion of the Evidence for Telepathic Scrying, Northcote W. Thomas, 125
- The History of the Collections contained in the Natural History Departments of the British Museum, 125
- Science and Religion, Rev. Lord William Gascoyne Cecil, 126
- How to Learn on Shore the Rule of the Road at Sea, E. W. Owens, Commander H. C. Lockyer, R.N., 126
- Savage Childhood, a Study of Kaffir Children, Dudley Kidd, 128
- Preservatives in Food and Food Examination, Dr. John C. Thresh and Dr. A. E. Porter, C. Simmonds, 145
- Theoretische Grundlagen für eine Mechanik der lebender Körper, Otto Fischer, 146
- Goethes Verhältnis zur Mineralogie und Geognosie, Dr. G. Linck, 146
- Researches on Cellulose, II., C. F. Cross and E. J. Bevan, Dr. Arthur Harden, 147
- Cours d'Astronomie, H. Andoyer, 148
- Les Révélations de l'Écriture d'après un Contrôle scientifique, Alfred Binet, 148
- The Cyanide Process, Alfred S. Miller, 149
- Highways and Byways in Berkshire, James Edmund Vincent, 149
- Anwendungen des Mikrophonprinzips, Chr. Jensen and H. Sieveking, Prof. Gisbert Kapp, 153
- A History of Chemistry from Earliest Times to the Present Day, Ernst von Meyer, 169
- A History of Chemistry, F. P. Armitage, 169
- Essays upon the History of Meaux Abbey and some Principles of Mediæval Land Tenure, based upon a Consideration of the Latin Chronicles of Meaux (A.D. 1150-1400), Rev. A. Earle, 170
- Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and Tibet, Lieut.-General Sir Richard Strachey, 171
- Machine Design, Prof. Albert W. Smith and G. H. Marx, 172
- Elements of Mechanical Drawing, A. A. Tittsworth, 172
- Das Kloster Kumbum in Tibet, Wilhelm Filchner, Colonel L. A. Waddell, 172
- A Century's Progress in Astronomy, Hector Macpherson, 173
- The World's Calendar, Rev. J. P. Wiles, 173
- Artillery and Explosives, Sir Andrew Noble, Bart., K.C.B., F.R.S., 174
- The Life of Animals, the Mammals, E. Ingersoll, 176
- Nature's Carol-singers, R. Kearton, 176
- An Idler in the Wilds, T. Edwardes, 176
- I Go A-walking through the Woods and o'er the Moor, 176
- Brier Patch Philosophy, "Peter Rabbit," 176
- Birds Shown to the Children, M. K. C. Scott, 176
- The Drumlins of South-eastern Wisconsin, W. C. Aldin, 182
- Geology of the Boulder District of Colorado, N. M. Fenneman, 182
- Taconic Physiography, T. N. Dale, 183
- The Copper Deposits of the Clifton Morenci District, Arizona, W. Lindgren, 183
- Underground Water Resources of Long Island, New York, A. C. Veatch, C. S. Slichter, I. Bowman, W. O. Crosby, and R. E. Horton, 183
- Maryland Geological Survey, 183
- Miocene Foraminifera from the Mounterey Shale of California, R. M. Bagg, jun., 183
- Palæontology of the Malone Jurassic Formation of Texas, F. W. Cragin, 183
- The Configuration of the Rock Floor of Greater New York, W. H. Hobbs, 184
- The Copper Deposits of Missouri, H. O. Foster Bain and E. O. Ulrich, 184
- Mineral Resources of Elders Ridge Quadrangle, Pennsylvania, R. W. Stone, 184
- The Fairhaven Gold Placers, Seward Peninsula, Alaska, F. H. Moffat, 184
- The Gold Placers of Forty-mile, Birch Creek, and Fairbanks Regions, Alaska, L. M. Pringle, 184
- Methods and Costs of Gravel and Placer Mining in Alaska, C. W. Purington, 184
- The Geography and Geology of Alaska, A. H. Brooks, 184

- Geology of the Central Copper River Region, Alaska, W. C. Mendenhall, 184
- The Delavan Lobe of the Lake Michigan Glacier, W. C. Alden, 184
- The Lead, Zinc, and Fluorspar Deposits of Western Kentucky, E. O. Ulrich and W. S. Tangier Smith, 184
- The Southern Appalachian Forests, H. B. Ayres and W. W. Ashe, 184
- Economic Geology of the Bingham Mining District, Utah, J. M. Boutwell, 184
- The Triassic Cephalopod Genera of America, A. Hyatt and J. P. Smith, 184
- The Tertiary and Quaternary Pectens of California, R. Arnold, 184
- Geology of the Tonopah Mining District, Nevada, J. E. Spurr, 184
- Geology and Mineral Resources of Part of the Cumberland Gap Coalfield, Kentucky, G. H. Ashley and L. C. Glenn, 184
- The Annual Report of the Geological Survey of Canada for 1901, 185
- Studies on the Diurnal Periods in the Lower Strata of the Atmosphere, Prof. Frank Hagar Bigelow, Dr. Chas. Chree, F.R.S., 186
- The Theory of Sets of Points, W. H. Young and G. C. Young, 193
- Jugendform und Blütenreife im Pflanzenreich, Dr. L. Diels, 194
- Radio-active Transformations, Prof. E. Rutherford, F.R.S., Hon. R. J. Strutt, F.R.S., 195
- Lectures upon the Mechanism of Speech, Alexander Graham Bell, Prof. John G. McKendrick, F.R.S., 196
- A Treatise on the Geology of Armenia, Dr. Felix Oswald, 197
- Position-line Star Tables, for Fixing Ship's Position by Reduction to Meridian and Prime Vertical without Logarithmic Calculation, H. B. Goodwin, 197
- The Horticultural Note Book, J. C. Newsham, 198
- Funzioni poliedriche e modulari, G. Vivanti, 198
- Hermann von Helmholtz, Leo Koenigsberger, 198
- Illustriertes Handbuch der Laubholzkunde, C. K. Schneider, 199
- Old-fashioned Flowers and other Open-air Essays, Maurice Maeterlinck, 199
- Documents scientifiques de la Mission saharienne (Mission Foureau-Lamy d'Alger au Congo par le Tchad), F. Foureau, 200
- Geology, Petrography, Palaeontology, &c., 200
- Annales de l'Observatoire météorologique, physique et glaciaire du Mont Blanc, 203
- Suppression du Paludisme à Ismailia, 204
- Observations of a Naturalist in the Pacific between 1896 and 1899, H. B. Guppy, 217
- Petroleum and its Products, Sir Boverton Redwood, 218
- Mercers' Company Lectures on Recent Advances in the Physiology of Digestion, Prof. Ernest H. Starling, F.R.S., Prof. Benjamin Moore, 219
- Attrition Tests of Road-making Stones, E. J. Lovegrove, Petrographical Descriptions, Dr. John S. Flett and J. Allen Howe, 220
- Elementary Principles of Continuous Current Dynamo Design, H. M. Hobart, 221
- Irrigation with Surface and Subterranean Water and Land Drainage, W. Gibbons Cox, 221
- Through the Telescope, James Baikie, 222
- The British Journal Photographic Almanac and Photographer's Daily Companion, 1907, 222
- British Flowering Plants, W. F. Kirby, 222
- The Fauna of British India, including Ceylon and Burma, C. J. Gahan, 222
- Deutsche Südpolar-Expedition, 1901-1903, 224
- Der Gaussberg, seine Kartierung und seine Formen, E. von Drygalski, 224
- Geologische Beschreibung des Gaussberges, E. Philippi, 224
- Petrographische Beschreibung der Gaussberg-Gesteine, R. Reinische, 224
- Parallax Investigations on 163 Stars mainly of Large Proper Motion, Frederick L. Chase, Mason F. Smith, and William L. Elkin, 234
- Instituts Solway, Travaux de l'Institut de Sociologie, 236
- Climatological Atlas of India, Sir John Eliot, F.R.S., Prof. J. Hann, 241
- Einführung in die Deszendenztheorie, Prof. Karl Camillo Schneider, 244
- The Coal Question, W. Stanley Jevons, 244
- The Peninsular Malays, R. J. Wilkinson, 245
- John Dalton, J. P. Millington, 246
- Verhandlungen der deutschen zoologischen Gesellschaft, 246
- Photograms of the Year 1906, 246
- Les Nombres positifs, exposé des Théories modernes de l'Arithmétique élémentaire, M. Stuyvaert, 246
- At the Back of the Black Man's Mind, or Notes on the Kingly Office in West Africa, R. E. Dennett, 248
- The Fine Art of Jujutsu, Mrs. Roger Watts, Lady Lockyer, 250
- A Report on the Work of the Survey Department in 1905, Captain H. G. Lyons, F.R.S., 250
- Reports of the British Delegates attending the Meetings of the International Council for the Exploration of the Sea in 1903, 1904, and 1905, 251
- Conseil permanent international pour l'Exploration de la Mer, 251
- Journal of the Marine Biological Association of the United Kingdom, 251
- The Future in America, a Search after Realities, H. G. Wells, Prof. John Perry, F.R.S., 265
- Service Chemistry, a Short Manual of Chemistry and its Applications in the Naval and Military Services, Vivian B. Lewes and J. S. S. Brame, 266
- Ice Formation, with Special Reference to Anchor-ice and Frazil, Howard T. Barnes, 267
- Under the Sun, Impressions of Indian Cities, P. Landon, 268
- Species and Varieties, their Origin by Mutation, H. De Vries, 268
- Time and Clocks, a Description of Ancient and Modern Methods of Measuring Time, H. H. Cunynghame, 269
- Conduction of Electricity through Gases, Prof. J. J. Thomson, F.R.S., 269
- The New Physics and Chemistry, a Series of Popular Essays on Physical and Chemical Subjects, W. A. Shenstone, F.R.S., 269
- The Manufacture of Light, Prof. Silvanus P. Thompson, F.R.S., 269
- Lichtstrahlung und Beleuchtung, Paul Högner, 269
- A Synonymic Catalogue of Orthoptera, W. F. Kirby, 269
- The Mammals of Great Britain and Ireland, J. G. Millais, 271
- Annals of the Astronomical Observatory of Harvard College, Prof. Solon I. Bailey, 283
- Paper Technology, R. W. Sindall, 289
- Outlines of the Evolution of Weights and Measures and the Metric System, Dr. William Hallock and Herbert T. Wade, 290
- I grandi Trafori Alpini, G. B. Biadego, 291
- Opere matematiche di Francesco Brioschi, 291
- I Motori a Gaz, Vittorio Calzavara, 291
- I Motori ad Esplosione, a Gas luce e Gas Povero, Fosco Laurenti, 291
- The Electron Theory, a Popular Introduction to the New Theory of Electricity and Magnetism, E. E. Fournier d'Albe, 293
- Manual of the New Zealand Flora, T. F. Cheeseman, 293
- Side-lights on Astronomy and Kindred Fields of Popular Science, Essays and Addresses, Prof. Simon Newcomb, 294
- The Romance of an Eastern Capital, F. B. Bradley-Birt, J. F. Hewitt, 297
- How Ferns Grow, M. Slosson, 298
- The Study of Plant Life for Young People, M. C. Stopes, 298
- Plant Life, Studies in Garden and School, H. F. Jones, 298
- The Romance of Plant Life, G. F. Scott-Elliott, 298
- The Green Gateway, a Peep into the Plant World, F. G. Heath, 298
- Plant Response as a Means of Physiological Investigation, Prof. Jagadis Chunder Bose, Dr. F. F. Blackman, F.R.S., 313
- Monumenta Orcadica, the Norsemen in the Orkneys and

- the Monuments they have left, L. Dietrichson, J. W. Cursiter, 315
- Cours de Chimie organique, Fréd. Swarts, 316
- The Teaching of Elementary Mechanics, Prof. Forsyth and C. E. Ashford, 317
- What are We? Leonard Joseph, 318
- The Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings, Prof. Theodore Hough and Prof. W. T. Sedgwick, 318
- Arithmétique graphique, G. Arnoux, 319
- Familiar Trees, Prof. G. S. Boulger, 319
- The Gem-cutter's Craft, Leopold Claremont, 321
- American Fossil Cycads, G. R. Wieland, 329
- A Catalogue of 8560 Astrographic Standard Stars between Declination -40° and -52° for the Equinox 1900 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1896-99, under the Direction of Sir David Gill, K.C.B., F.R.S., 331
- Catalogues of Stars for the Equinox 1900-0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1900-1904, under the Direction of Sir David Gill, K.C.B., F.R.S., 331
- Astrographic Catalogue 1900-0, Oxford Section, Dec. $+24^{\circ}$ to $+32^{\circ}$, Prof. H. H. Turner, F.R.S., 331
- Surgical Anatomy of the Horse, John T. Share-Jones, 337
- Le Cheval, H. J. Gobert, 337
- The German Universities and University Study, Friedrich Paulsen, 338
- Text-book on Geodesy and Least Squares Prepared for the Use of Civil Engineering Students, Prof. Charles L. Crandall, 339
- Entomology, with Special Reference to its Biological and Economic Aspects, Dr. J. W. Folsom, 340
- Minerals and Metals, J. G. Goessel, 341
- Practical Exercises in Chemistry, G. C. Donington, 341
- Paradoxes of Nature and Science, Dr. W. Hampson, 341
- Seasonal Botany, a Supplementary Text-book, M. O'Brien Harris, 341
- French Readings in Science, de V. Payen-Payne, 341
- The Dawn of Modern Geography, C. Raymond Beazley, 343
- The Thompson-Yates and Johnston Laboratories Report, Prof. R. T. Hewlett, 351
- Rapport sur l'Expédition au Congo, 1903-5, J. Everett Dutton and John L. Todd, Prof. R. T. Hewlett, 351
- Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum, Andrew Balfour, Prof. R. T. Hewlett, 351
- The Scientific Papers of J. Willard Gibbs, 361
- Modern Soaps, Candles, and Glycerin, L. L. Lamborn, C. Simmonds, 362
- Völkerpsychologie, eine Untersuchung der Entwicklungsgesetze von Sprache, Mythos und Sitte, Wilhelm Wundt, 363
- The Principles and Practice of Coal Mining, James Tonge, 364
- Das Tierreich, Rev. T. R. R. Stebbing, F.R.S., 365
- Incubation, or the Cure of Disease in Pagan Temples and Christian Churches, Mary Hamilton, 366
- Manual of Wireless Telegraphy, A. F. Collins, 366
- Catalogue of the Lepidoptera Phalænæ in the British Museum, 366
- Die meteorologischen Elemente und ihre Beobachtung mit Ausblicken auf Witterungskunde und Klimalehre, Otto Meissner, 366
- The Treatment of Diseases of the Digestive System, Prof. Robert Saundby, 366
- The Plants of New South Wales, W. A. Dixon, 366
- Mediæval Rhodesia, Dr. David Randall-MacIver, 369
- The Roman Comagmatic Region, Henry S. Washington, 379
- Indian Trees, being an Account of Trees, Shrubs, Woody Climbers, Bamboos, and Palms Indigenous or Commonly Cultivated in the British Empire, Sir Dietrich Brandis, K.C.I.E., F.R.S., 385
- The Principles of Microscopy, a Handbook to the Microscope, Sir A. E. Wright, F.R.S., Thomas H. Blakesley, 387
- The Crustacea of Devon and Cornwall, Canon A. M. Norman, F.R.S., and Dr. Thomas Scott, 387
- Die Leitfossilien aus dem Pflanzen- und Thierreich in systematischer Anordnung, Dr. Johannes Felix, 388
- Applied Electricity, a Text-book of Electrical Engineering for Second-year Students, J. Paley Yorke, Maurice Solomon, 389
- The Electrician Primers, Maurice Solomon, 389
- Electricity of To-day, its Work and Mysteries described in Non-technical Language, Charles R. Gibson, Maurice Solomon, 389
- Penrose's Pictorial Annual, 390
- Einführung in die mikroskopische Analyse der Drogenpulver, Dr. L. Koch, 390
- Researches in Experimental Phonetics, the Study of Speech Curves, Dr. E. W. Scripture, Prof. John G. McKendrick, F.R.S., 392
- Extracts from Narrative Reports of Officers of the Survey of India for the Season 1903-4, 403
- Trigonometry for Beginners, J. W. Mercer, 409
- Trigonometry for Beginners, Rev. J. B. Lock and J. M. Child, 409
- Geometry, an Elementary Treatise on the Theory and Practice of Euclid, S. O. Andrew, 409
- Modern Commercial Arithmetic, G. H. Douglas, 409
- A New Shilling Arithmetic, C. Pendlebury and F. E. Robinson, 409
- Junior Arithmetic Examples, W. G. Borchardt, 409
- Clive's New Shilling Arithmetic, 409
- Junior Practical Mathematics, W. J. Stainer, 409
- A Rhythmic Approach to Mathematics, Edith L. Somervell, 409
- Camp-fires in the Canadian Rockies, Dr. William T. Hornaday, 410
- Clays, their Occurrence, Properties, and Uses, with Especial Reference to those of the United States, Dr. Heinrich Ries, 411
- On Leprosy and Fish Eating, Jonathan Hutchinson, F.R.S., 412
- The Elements of the Science of Nutrition, Prof. Graham Lusk, 413
- Physical Chemistry for Electrical Engineers, J. Livingston R. Morgan, 413
- The Technical College Set of Mathematical Instruments, 413
- A Second German Course for Science Students, Prof. H. G. Fiedler and F. E. Sandbach, 413
- Pagan Races of the Malay Peninsula, W. W. Skeat and C. O. Blagden, 415
- Plan of Selected Areas, Prof. J. C. Kapteyn and W. E. Rolston, 427
- The Life of Sir Charles J. F. Bunbury, Bart., 433
- Life and Evolution, F. W. Headley, 434
- The Health of the School Child, Dr. W. Leslie Mackenzie, 435
- Exercises in Physics for the Use of Schools, J. H. Leonard and W. H. Salmon, 436
- Introductory Practical Physics, W. F. Barrett and W. Brown, 436
- Heat, Light, and Sound, an Introductory Course of Practical Exercises, J. R. Ashworth, 436
- Light for Intermediate Students, F. E. Rees, 436
- The Tutorial Physics, vol. iii., a Text-book of Light, Dr. R. Wallace Stewart, 436
- The Elements of Physics, S. E. Coleman, 436
- Physics, Theoretical and Descriptive, H. C. Chester, 436
- A First-year Course of Practical Magnetism and Electricity, Dr. P. E. Shaw, 436
- Animal Artizans and other Studies of Birds and Beasts, C. J. Cornish, 437
- Rubber in the East, 437
- Some Modern Conditions and Recent Developments in Iron and Steel Production in America, Frank Poplewell, 438
- Burma, a Handbook of Practical Information, Sir J. George Scott, 440
- An Investigation into the Elastic Constants of Rocks, more Especially with Reference to Cubic Compressibility, Prof. Frank D. Adams and Prof. Ernest G. Coker, 451
- Motor Vehicles and Motors, their Design, Construction, and Working by Steam, Oil, and Electricity, W. Worby Beaumont, 457

- Transactions of the International Union for Cooperation in Solar Research, 458
 The Principles and Practice of Agricultural Analysis, Dr. H. W. Wiley, 458
 Introduction to the Theory of Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat, H. S. Carslaw, 459
 Museu Paraense de Historia e Ethnographia, Arboretum Amazonicum, Dr. J. Huber, 459
 Cams, and the Principles of their Construction, George Jepson, 460
 Rivetage, M. Fricker, 460
 The Todas, W. H. R. Rivers, A. E. Crawley, 462
 Bathymetrical Survey of the Fresh-water Lochs of Scotland, 470
 Sex and Character, Otto Weininger, 481
 Tableaux logarithmiques, Dr. A. Guillemin, 482
 Clive's Mathematical Tables, 482
 Five-figure Mathematical Tables for School and Laboratory Purposes, Dr. A. Du Pré Denning, 482
 Beobachtung als Grundlage der Geographie, Prof. Albrecht Penck, Prof. Grenville A. J. Cole, 483
 Text-book on the Strength of Materials, S. E. Slocum and E. L. Hancock, 484
 Nature Knowledge in Modern Poetry, Alexander Mackie, 485
 Geometrische Kristallographie, Ernst Sommerfeldt, 485
 Untersuchungen über künstlichen Parthenogenese und das Wesen des Befruchtungsvorgangs, Prof. Jacques Loeb, 486
 Handbook of Metallurgy, Dr. Carl Schnabel, 486
 Hunting and Shooting in Ceylon, H. Storey, 492
 Les Ultramicroscopes, A. Cotton and H. Mouton, Thomas H. Blakesley, 505
 Ancient and Modern Ships, Sir George C. V. Holmes, 506
 Frequency-curves and Correlation, W. Palin Elderton, 507
 La Spéléologie au XX^e Siècle, E. A. Martel, Prof. Grenville A. J. Cole, 508
 Die chemische Energie der lebenden Zellen, Prof. Oscar Loew, 508
 La Découverte de l'Anneau de Saturne par Huygens, Jean Mascart, 509
 German Science Reader, C. R. Dow, 509
 Céruse et Blanc de Zinc, M. G. Petit, 509
 Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, Dr. J. W. W. Stephens, 523
 The Anatomy and Histology of Ticks, Captain S. R. Christophers, Dr. J. W. W. Stephens, 523
 Memoir xxi. of the Liverpool School of Tropical Medicine, Dr. J. W. W. Stephens, 523
 Chemische Kristallographie, P. Groth, Dr. A. E. H. Tutton, F.R.S., 529
 The Analysis of Racial Descent in Animals, T. H. Montgomery, 530
 Electric Railway Engineering, H. F. Parshall and H. M. Hobart, 531
 L'Année technique, 1906, A. Da Cunha, 532
 Diseases of Fruit and Fruit-bearing Plants, 532
 La Mécanique des Phénomènes fondée sur les Analogies, M. M. Petrovitch, 533
 The Steam-table, Prof. Sidney A. Reeve, 533
 A Contribution to the Study of Mummification in Egypt, Prof. G. Elliot Smith, 537
 Rhythmical Pulsation in Scyphomedusæ, Alfred G. Mayer, 545
 The World Machine, the First Phase, the Cosmic Mechanism, Carl Snyder, 553
 Vorlesungen über theoretische Spektroskopie, Prof. A. Garbasso, 554
 The Origin of the English Nation, H. Munro Chadwick, W. A. Craigie, 555
 Die Niederschläge in den norddeutschen Stromgebieten, Prof. G. Hellmann, 556
 The Zoological Record, 557
 The Principles of Horticulture, Wilfred Mark Webb, 557
 Dr. Schlich's Manual of Forestry, W. R. Fisher, 558
 The Essentials of Histology, Descriptive and Practical, Prof. E. A. Schäfer, F.R.S., 558
 Actualités scientifiques, Max de Nansouty, 558
 British Birds' Nests, R. Kearton, 562
 Northern Waters, Captain Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, with a Discussion of the Origin of the Bottom-waters of the Northern Seas, Fridthjof Nansen, 563
 Seventh Report of the Woburn Experimental Fruit Farm, the Duke of Bedford, K.G., and Spencer U. Pickering, F.R.S., 569
 Geodetic Operations in the United States, 1903-6, G. H. Tittman and John F. Hayford, 573
 The Geodetic Evidence of Isostasy, with a Consideration of the Depth and Completeness of the Isostatic Compensation and of the bearing of the Evidence upon some of the Greater Problems of Geology, John F. Hayford, 573
 Meteorologische Optik, Prof. J. M. Pernter, 577
 Recent Progress in the Study of Variation, Heredity, and Evolution, R. H. Lock, 578
 Biologische und morphologische Untersuchungen über Wasser- und Sumpfpflanzgewächse, Prof. Hugo Glück, 579
 The M.P. Atlas, W. and A. K. Johnston, 580
 Notes on Qualitative Analysis, Concise and Explanatory, H. J. H. Fenton, 581
 Church's Laboratory Guide, Prof. E. Kinch, 581
 Inorganic Qualitative Chemical Analysis for Advanced Schools and Colleges, W. S. Leavenworth, 581
 Outlines of Qualitative Chemical Analysis, F. A. Gooch and P. E. Browning, 581
 Qualitative Analysis as a Laboratory Basis for the Study of General Inorganic Chemistry, W. C. Morgan, 581
 Smaller Chemical Analysis, G. S. Newth, 581
 Animal Micrology, Dr. Michael F. Guyer, 582
 Elementare kosmische Betrachtungen über das Sonnensystem und Widerlegung der von Kant und Laplace aufgestellten Hypothesen über dessen Entwicklungsgeschichte, Prof. Gustav Holzmüller, 582
 The New Hygiene, Elie Metchnikoff, 583
 Synopsis of Mineral Characters, Alphabetically arranged for Laboratory and Field Use, Ralph W. Richards, 583
 British North America, I., the Far West, the Home of the Salish and Déné, C. Hill-Tout, 584
 The Orchids of the North-western Himalaya, J. F. Duthie, 587
 First Report on the Cytological Investigation of Cancer, 1906, J. E. S. Moore and C. E. Walker, 587
 Annals of the Astronomical Observatory of Harvard College, 593
 The Habits of the Flightless Birds of New Zealand, R. Henry, 595
 Glimpses of Australian Bird Life, R. Hall, 595
 A History of Chemical Theory and Laws, M. M. Pattison Muir, 601
 The Lower Niger and its Tribes, Major Arthur Glyn Leonard, 602
 Vorlesung der Pflanzenphysiologie, eine experimentelle Einführung in das Leben der Pflanzen, Prof. L. Linsbauer and Dr. K. Linsbauer, 602
 Space and Geometry, Dr. Ernst Mach, 603
 Irrational Numbers and their Representation by Sequences and Series, Dr. Henry Parker Manning, 603
 Auslese aus meiner Unterrichts- und Vorlesungspraxis, Dr. Hermann Schubert, 603
 Leçons de Géométrie supérieure, M. E. Vessiot, 603
 La Géométrie analytique générale, H. Laurent, 603
 N. H. Abel, sa Vie et son Œuvre, Ch. Lucas de Peslöian, 603
 Theory of the Algebraic Functions of a Complex Variable, Dr. John Charles Fields, 603
 Recherches sur l'Elasticité, P. Duhem, 603
 Arboriculture Fruitière, Léon Bussard and Georges Duval, 605
 Physikalische Kristallographie vom Standpunkt der Strukturtheorie, Ernst Sommerfeldt, 605
 Rate of Recession of Niagara Falls, G. K. Gilbert, 607
 Carnegie Institution of Washington, Year-book No. 5, 1906, 607
 Bulletin de l'Institut aérodynamique de Koutchino, 609
 Comparative Histological and Bacteriological Investigations, Dr. Arthur Eastwood, 610
 Die Niederschlagsverhältnisse von Deutsch-Sudwestafrika, Dr. F. von Danczelman, 616
 The River Pilcomayo from its Discharge to Parallel 22° S., with Maps of Reference, Gunnar Lange, 617

- Die Gattung *Hausmannia*, Dunker, und einige seltene Pflanzenreste, Prof. P. B. Richter, 617
- SUPPLEMENT TO MARCH 14, 1907.
- Rudolf Virchow, Briefe an Seine Eltern, 1839 bis 1864, Supp. to March 14, iii
- Introduction to General Inorganic Chemistry, Prof. Alexander Smith, Prof. Arthur Smithells, F.R.S., Supp. to March 14, iv
- Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Dr. R. M. Caven and Dr. G. D. Lander, Prof. Arthur Smithells, F.R.S., Supp. to March 14, iv
- A Progressive Course of Comparative Geography on the Concentric System, P. H. L'Estrange, Geo. G. Chisholm, Supp. to March 14, v
- Philips' Progressive Atlas of Comparative Geography, Geo. G. Chisholm, Supp. to March 14, v
- Stanford's Octavo Atlas of Modern Geography, Geo. G. Chisholm, Supp. to March 14, v
- Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi
- A Fauna of the Tay Basin and Strathmore, J. A. Harvie-Brown, Supp. to March 14, vii
- Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Colonel S. G. Burrard, F.R.S., Supp. to March 14, viii
- Das Cerebellum der Säugtiere, Prof. Louis Bolk, Prof. J. S. Macdonald, Supp. to March 14, ix
- Theory of Differential Equations, Dr. A. R. Forsyth, F.R.S., Supp. to March 14, x
- Reynolds (Prof. S. H.), Silurian Inlier in the Eastern Mendips, 550
- Rhé (Gyulia), Social- und Anthropogeographie des Balatonsees, 79
- Rheden (Dr.), Comet 1907a (Giacobini), 544
- Rheinberg (Julius), Photography in Natural Colours, 103
- Rhodesia, Mediaeval, Dr. David Randall-Maclver, 369
- Rhythmic Approach to Mathematics, a, Edith L. Somervell, 409
- Rhythmical Pulsation in Scyphomedusæ, Alfred G. Mayer, 545
- Riccò (Prof.), Eclipse Observations, 16; Solar Observations at Catania, 498
- Rice (Prof. Wm. North), the Contributions of America to Geology, 354
- Richards (J. T.), Technical Terminology, 510
- Richards (Ralph W.), Synopsis of Mineral Characters, Alphabetically Arranged for Laboratory and Field Use, 583
- Richardson (Hugh), Gambling and Mathematics, 415
- Richardson (Prof. O. W.), the α -Rays, 23
- Richter (P. B.), Beiträge zur Flora der unteren Kreide Quedlinburgs, Teil i., die Gattung *Hausmannia*, Dunker, und einige seltene Pflanzenreste, 617
- Rideal (Dr.), the Advantages and Disadvantages of Heating Buildings with Gas Stoves, 469
- Ridley (H. N.), the Menagerie at the Botanic Gardens, Singapore, 594; Habits of the Malay Tapir, 594
- Ries (Dr. Heinrich), Clays, their Occurrence, Properties and Uses, with especial Reference to Those of the United States, 411
- Rigaud (F.), Préparation mécanique des Minerais, 509
- Ritz (W.), the Origin of Spectra in Series, 528
- River Pilcomayo from its Discharge to Parallel 22° S., with Maps of Reference, Gunnar Lange, 617
- Rivers, Progressive Waves in, Dr. Vaughan Cornish, 597
- Rivers (W. H. R.), the Todas, 462
- Rivetage, M. Fricker, 460
- Rivkind (Mlle. L.), the Distribution of Vicianine and of its Diastase in the Seeds of Leguminosæ, 191
- Road-making Stones, Attrition Tests of, E. J. Lovegrove, Petrographical Descriptions by Dr. John S. Flett and J. Allen Howe, 220
- Roberts (B. J. P.), a Compensated Micromanometer, 165
- Roberts's (the late Dr.) Celestial Photographs, 402
- Robinson (F. E.), a Junior Arithmetic, 74; a New Shilling Arithmetic, 409
- Robinson (R.), Some Derivatives of Benzophenone, 215
- Rockefeller Institute for Medical Research, the Scientific Study of Infectious Diseases, Dr. W. H. Welch, 213
- Rocks, Helium and Argon in Common, Hon. R. J. Strutt, F.R.S., 271
- Rocks, an Investigation into the Elastic Constants of, more especially with Reference to Cubic Compressibility, Prof. Frank D. Adams and Prof. Ernest G. Coker, 451
- Rogers (Anne F.), Statistical Study of Generic Characters of the Coccaceæ, 39
- Rogers (F.), Microscopic Study of Strain in Metals, 287
- Rolston (Mr.), a Bright Meteor, 86
- Rolston (W. E.), Obituary Notice of Prof. Antonio Mascari, 373; Plan of Selected Areas, Prof. J. C. Kapteyn, 427
- Roman Comagmatic Region, the, Henry S. Washington, 379
- Rosa (Mr.), New Determination of the E.M.F. of the Weston and Clark Cells by a Gray Electro-dynamometer, 233
- Rose (Dr. J. N.), New Species of Cacti, 349
- Rosenthal (Mr.), New Type of X-Ray Tube, 136
- Ross (Janet), Galileo in the Val D'Arno, 593
- Ross (Major Ronald, F.R.S.), Malaria in Greece, 61; the Inoculation Accident at Mulkowal, 486; Haffkine's Prophylactic and the Mulkowal Disaster, 588
- Rotation Period of Venus, the Markings and, Mr. Denning, 469
- Rothsay Rainfall and the Sun-spot Cycle, Alex. B. MacDowall, 488
- Round Cake, Cutting a, on Scientific Principles, 173
- Routh (Dr. Edward J., F.R.S.), the Mathematical Tripos, 320
- Rowbotham (John Frederick), the Human Epic, the Prehistoric Story of Mankind, 73
- Rowell (H. W.), the Direct Estimation of Antimony, 215
- Royal Astronomical Society, 143, 189
- Royal College of Science, London, Bursaries at the, Prof. John Perry, F.R.S., 79
- Royal Dublin Society, 190, 359, 479
- Royal Institution, the Internal Architecture of Metals, Prof. J. O. Arnold, 43; Some Astronomical Consequences of the Pressure of Light, Prof. J. H. Poynting, F.R.S., at, 90; Recent Progress in Magneto-Optics, Prof. P. Zeeman, 138, 160; Flame the Working Fluid in Gas and Petrol Engines, Dugald Clerk, 546; Problems of Applied Chemistry, Prof. George Lunge, 617
- Royal Irish Academy, Dublin, 119, 407, 552
- Royal Medical and Chirurgical Society, on De-Novo Origin of Bacteria, Bacilli, Vibriones, Micrococci, Torulæ, and Moulds in certain previously superheated Saline Solutions contained within Hermetically Sealed Tubes, Dr. H. Charlton Bastian, F.R.S., at, 425
- Royal Meteorological Society, 119, 216, 334, 454, 551
- Royal Microscopical Society, 70, 188, 287, 359, 478, 500
- Royal Society, 47, 69, 141, 165, 187, 214, 262, 309, 357, 382, 429, 476, 526, 549, 574, 598, 621; Royal Society's Medal Awards, 36; Anniversary Meeting of the Royal Society, 130
- Royal Society, Edinburgh, 190, 334, 455, 622
- Royal Society, New South Wales, 191, 287, 480
- Royal Society of Sciences, Göttingen, 336, 384
- Rubber: Rubber Cultivation in the East, and the Ceylon Rubber Exhibition, Dr. J. C. Willis, 209; the Preparation of Rubber, Dr. J. C. Willis, 377; Kelway Bamber, 377; Chemical Composition of Some Rubber-tyre Rubbers, Dr. P. Schidrowitz and F. Kaye, 383; Composition of Some New Crude Rubbers, Dr. P. Schidrowitz and F. Kaye, 383; Rubber in the East, 437
- Rudge (W. A. Douglas), Action of Radium and certain other Salts on Gelatin, 141; Specific Heat of Gases at Constant Volume and High Pressure, 189
- Ruhemann (S.), Xanthoxalanil and its Analogues, 189; Dithioxanthoxalanil and its Homologues, 551
- Russ (S.), Rate of Recovery of Residual Charge in Electric Condensers, 527
- Russell (A.), Magnetic Field and Inductance Coefficients of Circular, Cylindrical, and Helical Currents, 431;

- Minerals of the Silvermines District, co. Tipperary, 574
 Russell (H. C., F.R.S.), Death of, 420; Obituary Notice of, 442
 Russia: Russian Scientific Publications, 235; Institut aérodynamique de Koutchino, 609
 Rusting of Iron, the, Rev. Joseph Meehan, 31; Prof. Wyndham R. Dunstan, F.R.S., 390, 477; Dr. G. T. Moody, 438, 575; C. E. Stromeyer, 461
 Rusts of Australia, the, their Structure, Nature, and Classification, D. McAlpine, 101
 Rutherford (Prof. E., F.R.S.), Radio-active Transformations, 195; Production of Radium from Actinium, 270
 Ruwenzori Boundary Dispute, the, 321
 Ruwenzori Range, the Duke of the Abruzzi's Ascents in the, 282
 Ruwenzori, the Snow-peaks of, 500
 Ryves (P. M.), the Recent Maximum of Mira, 378
- Sabat (S. M.), Change in Conductivity not attributable to Change of Ionisation of Salt within the Solution, 230
 Sabatier (Paul), Application to Pyridine of the Method of Direct Hydrogenation by Nickel, 623
 Sagittarii, Observations of Nova, Prof. Barnard, 137
 Sahara: Documents scientifiques de la Mission saharienne (Mission Foureaux-Lamy d'Alger au Congo par le Tchad), F. Foureaux, 200
 Salet (P.), the Nature of the Atmospheres of Mercury and Venus, 239
 Salmon (E. S.), American Gooseberry-mildew, 247
 Salmon (W. H.), Exercises in Physics for the Use of Schools, 436
 Sammis (John L.), Relation of Chemical Activity to Electrolytic Conductivity, 350
 Sampson (Major), an Incident in Ant Life, 478
 Sand (H. J. S.), the Rapid Electro-analytical Deposition and Separation of Metals, Part i., the Metals of the Silver and Copper Groups and Zinc, 406
 Sandbach (F. E.), a Second German Course for Science Students, 413
 Sandsten (E. P.), Experiments on Tomato Seedlings, 594
 Sang (Alfred), Early Reference to Red-light Treatment of Small-pox, 560
 Sargasso Sea, Invertebrate Fauna of the, E. L. Bouvier, 591
 Satellites: a White Spot on Jupiter's Third Satellite, José Comas Solá, 281; *see* Astronomy
 Saturn: La Découverte de l'Anneau de Saturne par Huygens, Jean Mascart, 509
 Saundby (Prof. Robert), the Treatment of Diseases of the Digestive System, 366
 Saussure (M. de), Ancient Chinese Astronomy, 544
 Savage Childhood: a Study of Kafir Children, Dudley Kidd, 128
 Savaii, the Eruption of Matavanu in 1905-6, 351
 Schäfer (Prof. E. A., F.R.S.), the Essentials of Histology, Descriptive and Practical, 558
 Schäfer (Prof. H.), Nubian Antiquities, 178
 Scharbe (Herr), Search-ephemeris for Comet 1900 III. (Giacobini), 498, 544
 Schidrowitz (Dr. P.), Chemical Composition of some Motor-tyre Rubbers, 383; Composition of some New Cude Rubbers, 383
 Schlich's (Dr.) Manual of Forestry, W. R. Fisher, 558
 Schmaltz (Prof.), a Pleural Cavity lacking in the Indian Elephant, 84
 Schmidt (Emil), Death and Obituary Notice of, 135
 Schmidt (Dr. Johs.), the Life-history of the Common Eel, 252
 Schmidt (Prof. Karl), Nubian Antiquities, 178
 Schnabel (Dr. Carl), Handbook of Metallurgy, 486
 Schneider (C. K.), Illustriertes Handwörterbuch der Botanik, 28; Illustriertes Handbuch der Laubholzkunde, 199
 Schneider (Prof. Karl Camillo), Einführung in die Deszendenztheorie, 244
 School Child, the Health of the, Dr. W. Leslie Mackenzie, 435
 School Out of Doors, Our, Hon. M. Cordelia Leigh, 76
 Schoop (U.), Experiments for Determining the Lines of Flow in Electrolytes and the Distribution of Currents in Accumulators, 302
 Schorr (Prof. R.), the Recent Total Eclipse of the Sun, 326
 Schott (Dr. G. A.), Ionisation and Absorption and Anomalous Dispersion, 271; Ionisation and Anomalous Dispersion, 461
 Schubert (Dr. Hermann), Auslese aus meiner Unterrichts- und Vorlesungspraxis, 603
 Schulz Steam Turbine, the, Max Dietrich, 50
 Science: Scientific Investigation in India, 11; The Seven Follies of Science, a Popular Account of the most Famous Scientific Impossibilities and the Attempts which have been made to Solve Them, John Phin, 25; Bursaries at the Royal College of Science, London, Prof. John Perry, F.R.S., 79; Science and Religion, Rev. Lord William Gascoyne Cecil, 126; Cutting a Round Cake on Scientific Principles, 173; Scientific Fishery Investigations, 185; Scientific Study of Infectious Diseases, Dr. W. H. Welch at the Rockefeller Institute for Medical Research, 213; Men of Science in America, Prof. McKeen Cattell, 259; Science in Examinations for the Higher Civil Service, 260; Science in Higher Education, 275; the Public School Science Masters' Association, 285; the British Science Guild, 327; French Readings in Science, de V. Payen-Payne, 341; Paradoxes of Nature and Science, Dr. W. Hampson, 341, 606; the Reviewer, 606; the Scientific Papers of J. Willard Gibbs, 361; Science in India, 403; a Second German Course for Science Students, Prof. H. G. Fiedler and F. E. Sandbach, 413; Forthcoming Books of Science, 473; German Science Reader, C. R. Dow, 509; Actualités scientifiques, Max de Nansouty, 558; Scientific Work in the Straits Settlements and Ceylon, 594
 Scoble (W. A.), the Strength and Behaviour of Ductile Materials under Combined Stress, 70; Brittle Materials under Combined Stress, 382
 Scotia, the Voyage of the, being the Record of a Voyage of Exploration in Antarctic Seas, 103
 Scott (Sir J. George, K.C.I.E.), Burma, a Handbook of Practical Information, 440
 Scott (M. K. C.), Birds shown to the Children, 176
 Scott (Dr. Thomas), the Crustacea of Devon and Cornwall, 387
 Scott-Elliot (G. F.), the Romance of Plant Life, 298
 Scottish Lakes, Bathymetrical Survey of, 470
 Scottish Oceanographical Laboratory, 307
 Scripture (Dr. E. W.), Researches in Experimental Phonetics, the Study of Speech Curves, 392
 Scyphomedusæ, Rhythmical Pulsation in, Alfred G. Mayer, 545
 Sea Coast, the Upheaval of the, by Earthquakes, Dr. T. J. J. See, 224; J. M., 224
 Sea Fisheries, A. E. Shipley, F.R.S., 284
 Seares (F. H.), a Quickly Changing Variable Star, 350
 Searle (G. F. C.), Experiment with a Pair of Robison Ball-ended Magnets, 454; Method of Determining the Thermal Conductivity of India-rubber, 454
 Seasonal Botany, a Supplementary Text-book, M. O'Brien Harris, 341
 Sedgwick (Prof. W. T.), the Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings, 318
 See (Dr. T. J. J.), the Upheaval of the Sea Coast by Earthquakes, 224
 Seismology: the Upheaval of the Sea Coast by Earthquakes, Dr. T. J. J. See, 224; J. M., 224; the International Seismological Association, 274; the Kingston Earthquake, Dr. Charles Davison, 296; Earthquake at Kingston on January 18, Prof. P. Carmody, 398; Calabrian Earthquake of September 8, 1905, 398; Seismological Notes, Prof. John Milne, F.R.S., 402; the Valparaiso Earthquake, August 17, 1906, R. D. Oldham, 439; Seismogram of Valparaiso Earthquake of August 17, 613; the Earthquake at Bitlis on March 29, 565; the Study of Earthquakes, 586; the Mexican Earthquake, 610
 Seligmann (Dr. C. G.), Report on the Deaths among the Mammals and Birds in the Society's Menagerie during 1906, 478

- Semayer (Dr. Willibald), Social- und Anthropogeographie des Balatonsees, 79
- Senderens (J. B.), Reducing and Catalytic Power of Amorphous Carbon towards Alcohols, 431
- Sense-Perception in Greek Philosophy, 122
- Senter (G.), Displacement of Halogens by Hydroxyl, 477
- Serotherapy: Fundamental Differences in the Mechanism and Evolution of the Increase of Resistance to Infection according to the Methods Utilised, MM. Charrin and Lévy-Franckel, 432; Cholera Vaccine, 516; Mediterranean Fever, Staff-Surgeon E. A. Shaw, 516; the Inoculation Accident at Mulkowal, Prof. Ronald Ross, C.B., F.R.S., 486; Dr. Haffkine's Prophylactic, 514; Haffkine's Prophylactic and the Mulkowal Disaster, Prof. Ross, 588; Combining Properties of the Oposonin of an Immune Serum, Prof. Robert Muir and W. B. M. Martin, 621
- Sewage, the Nitrification of, Dr. G. Reid, 382
- Sewage, the Purification of, by Turf Filters, Henri Pottevin, 600
- Sewers: Conditions under which "Specific" Bacteria from Sewage may be Present in Drains, Major W. H. Horrocks, 599
- Sex and Character, Otto Weininger, 481
- Seyewetz (A.), a Continuous Apparatus for the Preparation of Pure Oxygen, 311
- Shafer (G. D.), the Histology and Development of the Divided Eyes of Certain Insects, 541
- Shakespeare (G. A.), Stereoscopic Lantern Slides, 199
- Share-Jones (John T.), Surgical Anatomy of the Horse, 337
- Sharpe (J. W.), Flight of an Elongated Shot, 391
- Shaw (Staff-Surgeon E. A.), Mediterranean Fever, 516
- Shaw (Dr. P. E.), a First-year Course of Practical Magnetism and Electricity, 436
- Shawcross (J.), the Immortality of the Protozoa, 320
- Shearman (A. T.), the Development of Symbolic Logic, 1
- Shenstone (W. A., F.R.S.), the New Physics and Chemistry, a Series of Popular Essays on Physical and Chemical Subjects, 269
- Shepherd (F. G.), Pinocamphylamine, 23
- Shepherd (Mr.), Recent Experiments on the Crystallisation of Minerals, 112
- Sheppard (S. E.), Photographic Processes, Part iii., the Latent Image and its Destruction, 310
- Sherman (Dr. H. C.), Methods of Organic Analysis, 26
- Sherring (C. A.), the Bhotias of Almora and British Garhwal, 41
- Shiple (A. E., F.R.S.), Sea Fisheries, 284
- Ships, Ancient and Modern, Sir George C. V. Holmes, 506
- Ships, Gyroscopic Apparatus for Steadying, G. R. Dunell, 561
- Shot, the Flight of an Elongated, P. D. Strachan, 367; Prof. A. G. Greenhill, F.R.S., 367; J. W. Sharpe, 391
- Sidereal Problem: Plan of Selected Areas, Prof. J. C. Kapteyn, W. E. Rolston, 427
- Sidgreaves (Father), Stonyhurst College Observatory, 593
- Sievekings (H.), Anwendungen des Mikrophonprinzips, 153
- Silberrad (O.), Hydrolysis of "Nitrocellulose" and "Nitroglycerine," 94
- Silicon in the Chromosphere, Mr. Fowler, 304
- Simmonds (C.), Preservatives in Food and Food Examination, Dr. John C. Thresh and Dr. A. E. Porter, 145; Modern Soaps, Candles, and Glycerin, L. L. Lamborn, 362
- Simpson (C. C.), the Habits of Birds of Paradise, 445
- Simpson (Sutherland), Functions of the Rolandic Cortex in Monkeys, 623
- Sinclair (W. J.), Marsupials or Creodonts? 498
- Sindall (R. W.), Paper Technology, an Elementary Manual on the Manufacture, Physical Qualities, and Chemical Constituents of Paper and of Paper-making Fibres, 289
- Singing Kettle, a Japanese, Prof. H. Nagaoka, 78
- Skeat (W. W.), Pagan Races of the Malay Peninsula, 415
- Sky Colour, Emerald Green, J. W. Noble, 199; F. G. Collins, 224; see Meteorology
- Sky, the Brightness of the, near the Sun's Limb, Prof. Ceraski, 569
- Slaby (Prof.), Wireless Telephony Experiments, 227
- Sleepness Sickness, *Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes, Prof. E. A. Minchin, A. C. H. Gray, and the late F. M. G. Tulloch, 56; see Morbology
- Slichter (C. S.), Underground Water Resources of Long Island, New York, 183
- Slipher (V. M.), the Spectrum of Mira, 402
- Slocum (S. E.), Text-book on the Strength of Materials, 484
- Slosson (M.), How Ferns Grow, 298
- Small-pox, Early Reference to Red-light Treatment of, Alfred Sang, 560
- Smiles (S.), Camphor- β -Sulphinic Acid and Camphoryl-sulphonium Bases, 407
- Smith (Prof. Albert), Machine Design, 172
- Smith (Prof. Alexander), Introduction to General Inorganic Chemistry, Supp. to March 14, iv
- Smith (A. E.), Perception of Relief by Monocular Vision, 321
- Smith (A. M.), Growth under Different Conditions in Ceylon, Blackman's Theory, 524
- Smith (Dr. B.), Anatomy of the Peripheral Nerves, 551
- Smith (B.), the Lower Palaeozoic Rocks of Pomeroy, 552
- Smith (E. A.), the Assay of Silver Bullion by Volhard's Ammonium Thiocyanate Method, 303
- Smith (Prof. G. Elliot), a Contribution to the Study of Mummification in Egypt, 537
- Smith (G. F. Herbert), Ilmenite from Brazil, 119; Baddeleyite from Ceylon, 574
- Smith (J. P.), the Triassic Cephalopod Genera of America, 184
- Smith (Mason F.), Parallax Investigations on 163 Stars mainly of Large Proper Motion, 234
- Smith (W. S. Tangier), the Lead, Zinc and Fluorspar Deposits of Western Kentucky, 184
- Smithells (Prof. Arthur, F.R.S.), Introduction to General Inorganic Chemistry, Prof. Alexander Smith, Supp. to March 14, iv; Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Dr. R. M. Caven and Dr. G. D. Lander, Supp. to March 14, iv
- Snyder (Carl), the World Machine, the First Phase, the Cosmic Mechanism, 553
- Soaps, Candles, and Glycerin, Modern, L. L. Lamborn, C. Simmonds, 362
- Society of Arts, Artificial Fertilisers, A. D. Hall at, 185
- Society of Chemical Industry, 215, 334, 383, 527, 622
- Sociology: Instituts Solway Travaux de l'Institut de Sociologie, 236
- Soddy (Frederick), Calcium as an Absorbent of Gases and its applications in the Production of High Vacua and for Spectroscopic Research, 309; the Positive Charge Carried by the α Particle, 438
- Sola (José Comas), Observations of Mars, 257; a White Spot on Jupiter's Third Satellite, 281
- Solar Eclipses: Observations of Total, M. le Comte A. de la Baume Pluvinel, 257; Russian Observations of the Solar Eclipse, August 30, 1905, Chas. P. Butler, 163; Micrometer Measures during the Solar Eclipse of August, 1905, J. Merlin, 350; the Recent Solar Eclipse in India, 402; Solar Eclipse of January 13, 544
- Solar Observations at Catania, Prof. Riccò, 498
- Solar Phenomena, the Causes of, Don Horacio Bentabol y Ureta, 231
- Solar Radiation, the, Ladislas Górczyński, 326
- Solar Research at Meudon, MM. Deslandres and d'Azambuja, 469
- Solar Research, Transactions of the International Union for Cooperation in, 458
- Solar Spectrum, the Helium Line, D_{β} , in the, Mr. Buss, 281
- Solar Spectrum, the Telluric Lines in the, M. Stéfánik, 64
- Solar Spectrum, Variation of Wave-lengths in the, Dr. Halm, 304
- Solid, Maximum Gravitational Attraction on a, W. E. Miller, 439; Prof. G. H. Bryan, F.R.S., 439
- Sollas (Igera B. L.), Porifera (Sponges), 31
- Sollas (Prof. W. J., F.R.S.), Radium and Geology, 319
- Solly (R. H.), Lengenbach Quarry and the Minerals found there, 1906, 119; Zinciferous Tennantite from the Binnenthal, 574
- Solomon (Maurice), the Wireless Telegraphy Conference, 59; Applied Electricity, a Text-book of Electrical

- Engineering for Second-year Students, J. Paley Yorke, 389; the Electrician Primers, 389; Electricity of Today, its Work and Mysteries described in Non-Technical Language, Charles R. Gibson, 389
- Solutions, Application of Van der Waals's Equation to, Earl of Berkeley, 549
- Solway, Instituts, Travaux de l'Institut de Sociologie, 236
- Somervell (Edith L.), a Rhythmic Approach to Mathematics, 409
- Sommerfeldt (Ernst), Geometrische Kristallographie, 485; Physikalische Kristallographie vom Standpunkt der Strukturtheorie, 605
- Soot, Electrical Method of Extracting, from Air in Flues, G. W. Walker, 606
- South Africa, Geological Research in, 115
- South African Philosophical Society, 192, 287
- Southerns (L.), Dependence of Gravity on Temperature, 142
- Southwell (T.), Arctic Whaling in 1906, 542
- Species and Varieties, their Origin by Mutation, H. de Vries, 268
- Spectroscopy: Fact and Theory in Spectroscopy, Prof. H. Crew, 353; Vorlesungen über theoretische Spektroskopie, Prof. A. Garbasso, 554
- Spectrum Analysis: the Telluric Lines in the Solar Spectrum, M. Stefánik, 64; Character and Cause of Sun-Spot Spectra, George E. Hale, Walter S. Adams, and Henry G. Gale, 113; Recent Progress in Magneto-optics, Prof. P. Zeeman at Royal Institution, 138, 160; Anode Rays, Dr. R. S. Willows, 173; Messrs. Gehrcke and Reichenheim, 614; the Spectrocomparator, Dr. J. Hartmann, 182; Measurements of the Effective Wave-lengths in Stellar Spectra, Dr. H. E. Lau, 182; Influence of a Strong Magnetic Field on the Spark Spectra of Titanium, Chromium, and Manganese, J. E. Purvis, 189; Fluorescence and Magnetic Rotation Spectra of Sodium Vapour, Prof. R. W. Wood, 230; Spectrum Lines as Light Sources, Mr. Bates, 233; Luminous Radiations and the Richness of Wheat in Nitrogen, J. Dumont, 239; Ionisation and Absorption and Anomalous Dispersion, Dr. G. A. Schott, 271; Ionisation and Anomalous Dispersion, Prof. R. W. Wood, 390, 583; G. A. Schott, 461; the Helium Line D₃, in the Solar Spectrum, Mr. Buss, 281; Ultra-violet Fluorescence of Benzene, Dr. J. Stark, 295; Line Intensity and Spectral Type, Dr. Sebastian Albrecht, 304; Silicon in the Chromosphere, Mr. Fowler, 304; Variation of Wave-lengths in the Solar Spectrum, Dr. Halm, 304; Calcium as an Absorbent of Gases and its Applications in the Production of High Vacua and for Spectroscopic Research, Frederick Soddy, 309; Measurements of the Zeeman Effect on the Blue Lines of Zinc, P. Weiss and A. Cotton, 335; the Principal Lines of the Spark Spectra of the Elements, Dr. J. H. Pollok, 359; the Spectroscopic Binary α Leonis, W. Zurhellen, 378; Improvements in Spectrophotometers, F. Twyman, 382; the Spectrum of Mira, V. M. Slipher, 402; Spectrum and Radial Velocity of Mira, J. S. Plaskett, 518; the Absorption Spectra of Phthalic, isoPhthalic, and Terephthalic acids, Phthalic Anhydride and Phthalimide, W. N. Hartley and E. P. Hedley, 406-7; the Spectroscopic Binary λ Andromedæ, Mr. Burns, 425; Stars having Peculiar Spectra, Mrs. Fleming, 448; Constitution of Hydroxyazo-compounds, W. B. Tuck, 477; Series in Spectra, Prof. A. W. Conway, 479; Phosphorescence of Uranium Salts in Liquid Air, Henri Becquerel, 479; the Origin of Spectra in Series, W. Ritz, 528; Presence of Europium in Stars, Joseph Lunt, 540; Adam Hilger's 1007 Wave-length Spectroscope, 568; Contribution to the Study of Phosphorescence, Henri Becquerel, 575; Photography of the Infra-red Solar Spectrum, G. Millochau, 599; New Glass Transparent to Rays of Very Short Wave-length, F. A. Lindemann and C. L. Lindemann, 614
- Speech, Lectures upon the Mechanism of, Alexander Graham Bell, Prof. John G. McKendrick, 106
- Speech Curves, Researches in Experimental Phonetics, the Study of, Dr. E. W. Scripture, Prof. John G. McKendrick, F.R.S., 302
- Spétiologie au XX^e Siècle, 1a, E. A. Martel, Prof. Grenville A. J. Cole, 508
- Spence (Wilfrid L.), Mechanism of Power Transmission from Electric Motors, 591
- Spencer (Prof. Baldwin), Emu Remains from King Island, Bass Strait, 228
- Sperry (E. S.), the Manufacture of Rolled Sterling-silver, 496
- Spherical Gaseous Nebula, Homer Lane's Problem of a, Lord Kelvin, O.M., F.R.S., 368
- Spiderwort, the Evolution of the Colorado, Prof. T. D. A. Cockerell, 7
- Spraying, Ionisation by, A. S. Eve, 533
- Spring (Prof. Walthère), Material obtained by Decomposing a Solution of Hydrogen Sulphide with Sulphur Dioxide is a Hydrate having the Composition S₈H₂O, 182
- Spurr (J. E.), Geology of the Tonopah Mining District, Nevada, 184
- Stainer (W. J.), Junior Practical Mathematics, 409
- Standard Electric Glow Lamps, 380
- Standards and Exact Measurement, Dr. R. T. Glazebrook at Institution of Electrical Engineers, 570
- Standards, Recent Work of the American Bureau of, Dr. J. A. Harker, 233
- Standen (R.), Mollusca collected by Mr. S. A. Neave in South-east Rhodesia, 216
- Standing (H. F.), Subfossil Prosimiæ from Madagascar, 574
- Stanford's Octavo Atlas of Modern Geography, Geo. G. Chisholm, Supp. to March 14, v.
- Stark (Dr. J.), Ultra-violet Fluorescence of Benzene, 295
- Starling (Prof. Ernest H., F.R.S.), Mercers' Company Lectures on Recent Advances in the Physiology of Digestion, 219
- Stars: the System of 61 Cygni, Prof. Barnard, 40; Designations of Newly-discovered Variable Stars, 41; the Number of the Visible Stars, Mr. Gore, 64; Stars with Peculiar Spectra, Dr. H. Ludendorff, 64; an Interesting Variable Star, Prof. Barnard, 64; Catalogue of Double Stars, Prof. Doberck, 64; Orbits of Three Double Stars, Prof. Doberck, 282; the Maximum of Mira, Prof. Nijland, 17; Mira Ceti, T. W. Backhouse, 126; the Recent Maximum of Mira, P. M. Ryves, 378; the Spectrum of Mira, V. M. Slipher, 402; Spectrum and Radial Velocity of Mira, J. S. Plaskett, 518; Observations of Nova Sagittarii, Prof. Barnard, 137; Two Stars with Variable Radial Velocities, Prof. Hartmann, 137; Stars with Variable Radial Velocities, 378; Discovery of a Nova, Miss Leavitt, 137; New Variable Stars, Prof. Max Wolf, 137; New Variable Stars, Miss Leavitt, 159; Prof. Pickering, 159; the Period of β Cephei, Prof. Frost, 159; Systematic Stellar Motions, A. S. Eddington, 182; Measurements of the Effective Wave-lengths in Stellar Spectra, Dr. H. E. Lau, 182; Two Stars with a Common Proper Motion, Mr. Bellamy, Prof. Kreutz, Prof. Millosevich, 208; Parallax Investigations on 163 Stars, mainly of Large Proper Motion, Frederick L. Chase, Mason F. Smith, and William L. Elkin, 234; the Proper Motion of Castor, Mr. Crommelin, 304; a Peculiar Short-period variable (155.1906, Cassiopeiæ), Messrs. Müller and Kemp, 327; a Catalogue of 8560 Astrographic Standard Stars between Declinations -40° and -52° for the Equinox 1900 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1896-99, under the Direction of Sir David Gill, K.C.B., F.R.S., 331; Catalogues of Stars for the Equinox 1900'0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1900-1904, under the Direction of Sir David Gill, K.C.B., F.R.S., 331; Astrographic Catalogue 1900'0, Oxford Section, Dec. $+24^{\circ}$ to $+32^{\circ}$, Prof. H. H. Turner, F.R.S., 331; a Quarterly Changing Variable Star, F. H. Seares, 350; Thirty-six New Variable Stars, Miss Leavitt, 402; the Spectroscopic Binary λ Andromedæ, Mr. Burns, 425; Photographs of Faint Stars, Prof. E. C. Pickering, 448; Stars having Peculiar Spectra, Mrs. Fleming, 448; Standard Stellar Magnitudes, Prof. Pickering, 518; Two Rapidly Changing Variable Stars, J. Baillaud, 518; the Sun as a Variable Star, Prof. Turner, 569; Radial Velocity of η Piscium, 569; a New Variable or Nova, 156.1906, Prof. E. Millosevich, 615
- Statistics: Report on Mines and Quarries, Number of Persons Employed in British Mines and Quarries, 15; Re-

- port on the Blind and Deaf (including the Deaf and Dumb) in the United States, 63; Mines and Quarries, General Report in Great Britain in 1905, 85; a Law of Record Times in Racing, 463; Frequency-curves and Correlation, W. Palin Elderton, 507
- Staub (Dr. Moriz), *Physische Geographie des Balatonsees und seiner Umgebung*, 79
- Steam: Steam Turbine Engineering, T. Stevens and H. M. Hobart, 50; Modern Steam Turbines, Vol. i., the Schulz Steam Turbine, Max Dietrich, 50; Steam Turbines, with an Appendix on Gas Turbines and the Future of Heat Engines, Dr. A. Stodola, 50; Motor Vehicles and Motors, their Design, Construction, and Working by Steam, Oil and Electricity, W. Worby Beaumont, 457; the Steam-table, a Table of the Thermal and Physical Properties of Saturated Steam Vapour and of the Specific Heat of Water, Prof. Sidney A. Reeve, 533
- Stebbing (E. P.), Indian Superstition connected with the Moon's Phases and Bamboos, 377; *Termes gestroi*, the White Ant Rubber Pest, 516
- Stebbing (Rev. T. R. R., F.R.S.), *Das Tierreich, Crustacea*, 365
- Steel: Some Modern Conditions and Recent Developments in Iron and Steel Production in America, Frank Popplewell, 438
- Steen (Dr. Aksel S.), the Frequency of Thunderstorms in Relation to the Sun-Spot Period, 67
- Stefánik (M.), the Telluric Lines in the Solar Spectrum, 64
- Stein (Dr. M. A.), Archæological Discoveries in Turkestan, 248
- Stellar Magnitudes, Standard, Prof. Pickering, 518
- Stellar Motions, Systematic, A. S. Eddington, 182
- Stellar Photometry, Researches in, J. A. Parkhurst, 498
- Stephens (Dr. J. W. W.), Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, 523; the Anatomy and Histology of Ticks, Capt. S. R. Christophers, 523; Memoir xxi. of the Liverpool School of Tropical Medicine, 523
- Stereoscopic Lantern Slides, G. A. Shakespear, 199
- Stevens (T.), Steam Turbine Engineering, 50
- Stewart (A. W.), Ketene, 510
- Stewart (R. W.), Chemical Analysis, Qualitative and Quantitative, 26
- Stewart (Dr. R. Wallace), the Tutorial Physics, Vol. iii., a Text-book of Light, 436
- Stodola (Dr. A.), Steam Turbines, with an Appendix on Gas Turbines and the Future of Heat Engines, 50
- Stokes (Dr. Alfred C.), a certain Form of Butterfly Scale, 350
- Stone (R. W.), Mineral Resources of Elders Ridge Quadrangle, Pennsylvania, 184
- Stonyhurst College Observatory, Father Sidgreaves, 593
- Stopes (M. C.), the Study of Plant Life for Young People, 298
- Story (H.), Hunting and Shooting in Ceylon, 492
- Story (the Very Rev. Robert H.), Death and Obituary Notice of, 277
- Strachan (P. D.), the Flight of an Elongated Shot, 367; Undulant (Mediterranean) Fever in South Africa, 376
- Strachey (Lieut.-General Sir Richard), Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and Tibet, 171
- Straits Settlements and Ceylon, Scientific Work in the, 594
- Strasburger (Eduard), die Stofflichen Grundlagen der Vererbung im organischen Reich, 98
- Strength of Materials, Text-book on the, S. E. Slocum and E. L. Hancock, 484.
- Stromeyer (C. E.), Position of Mendeléeff's Group of Chemical Elements, 431; the Rusting of Iron, 461
- Strömgren (Dr. E.), Comets 1906g (Thiele) and 1906h (Metcalf), 111; Comet 1906g (Thiele), 159
- Structure of Metals, the, Dr. J. A. Ewing, F.R.S., "Wilde" Lecture at Manchester Literary and Philosophical Society, 472
- Strutt (Hon. R. J., F.R.S.), Presence of Neon in Radio-active Minerals, 102; Radio-active Transformations, Prof. E. Rutherford, F.R.S., 195; Helium and Argon in Common Rocks, 271; an Occurrence of Helium in the Absence of Radio-activity, 390
- Students in German Universities, 380
- Stuyvaert (M.), les Nombres positifs, Exposé des Théories modernes de l'Arithmétique élémentaire, 246
- Sugar-cane Plants, Gumming of, N. A. Cobb, 38
- Summer (E. J.), Chemistry Note-books, 26
- Sun: the Calorific Radiation of the Sun, MM. Millochau and Féry, 40; the Telluric Lines in the Solar Spectrum, M. Stefánik, 64; the Solar Eclipse of next January, 111; the Recent Total Eclipse of the Sun, Prof. R. Schorr, 326; Sun and Planet Chart, 402; Prominence Observations (1906), 448; the Electrical Influence of the Sun, Dr. A. Nodon, 469; the Brightness of the Sky near the Sun's Limb, Prof. Ceraski, 569; the Sun as a Variable Star, Prof. Turner, 569
- Sunset Colours, Green, Arthur W. Claydén, 295
- Sunsets, the Green Tints of, Joseph Offord, 342
- Sun-spots: Sun-spots and Magnetism, William Ellis, 111; Character and Cause of Sun-spot Spectra, George E. Hale, Walter S. Adams, and Henry G. Gale, 113; Sun-spots in 1905, 378; the Recent Large Group of Sun-spots, 425; Rothesay Rainfall and the Sun-spot Cycle, Alex. B. MacDowall, 488
- Surgery: Death of Prof. E. von Bergmann, 515; the Commemoration of Lord Lister's Eightieth Birthday, 564
- Surgical Anatomy of the Horse, John T. Share-Jones, 337
- Surrey, Neolithic Man in North-east, Walter Johnson and William Wright, 124
- Surveying: Hints to Travellers, Scientific and General, 77; a Report on the Work of the Survey Department in 1905, Capt. H. G. Lyons, F.R.S., 250; Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Col. S. G. Burrard, F.R.S., Supp. to March 14th, viii
- Sutherland (William), the Chemistry of Globulin, 598
- Sutton (J. R.), Evaporation from Water Surfaces, 190; the Relationship between Diamonds and Garnets, 488
- Swanton (E. W.), Fertilisation of Flowers by Insects, 320
- Swanton (J. R.), Contributions to the Ethnology of the Haida, 68
- Swarts (Fréd.), Cours de Chimie organique, 316
- Sweet (Dr. Georgina), Anatomy of the Marsupial Mole, the Vestigial Eye, 206
- Swinton (A. A. Campbell), the Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes, 550; Positive Streams in "Crookes" Tubes, 583
- Sy (M.), Observations of the Giacobini Comet (1907a), 528
- Sylviculture: Illustriertes Handbuch der Laubholzkunde, C. K. Schneider, 199
- Symbolic Logic and its Applications, Hugh MacColl, 1
- Symbolic Logic, the Development of, A. T. Shearman, 1
- Symes-Thompson (Dr. E.), Death of, 108
- Syntonic Wireless Telegraphy, 105
- Sziklay (Julius von), Bibliographie des Balatonsees, 79
- Szillard (Béla), a Colloidal Compound of Thorium with Uranium, 239
- Taft (Hon. W. H.), Why the Lock System was Adopted for the Panama Canal, 181
- Tassin (W.), Graphitic Iron in a Meteorite, 137
- Tattersall (G.), Synthesis of Carvestrene and its Derivatives, 478
- Tay Basin and Strathmore, a Fauna of the, J. A. Harvie-Brown, Supp. to March 14, vii
- Taylor (F. W.), the Best High-speed Tool Steel Composition, 325
- Taylor (R. L.), Luminosity produced by the Rubbing or Knocking together of Various Forms of Silica, 189
- Taylor (T. Griffith), Example of River-capture in New South Wales, 72
- Teaching of Elementary Mechanics, Prof. Forsyth and C. E. Ashford, 317
- Technical Terminology, 490; J. T. Richards, 510
- Technical Thermometry, 6
- Technology, Paper, an Elementary Manual on the Manufacture, Physical Qualities, and Chemical Constituents of Paper and of Paper-making Fibres, R. W. Sindall, 289
- Technology of Soaps and Candles, L. L. Lamborn, C. Simmonds, 362

- Telegraphy: the Wireless Telegraphy Conference, Maurice Solomon, 59; Syntonic Wireless Telegraphy, 105; Measurement of Received Energy at Wireless Stations, G. W. Pickard, 281; Manual of Wireless Telegraphy, A. F. Collins, 366; Wireless Telegraphy in Longitude Determinations, Prof. Albrecht, 544; Radio-telegraph Installation for Signalling across the Wash, 377
- Telephony: Wireless Telephony Experiments, Prof. Slaby, 227; Recent Progress in Wireless Telephony, Prof. Fessenden, 378
- Telescopes: a 100-Inch Reflecting Telescope, 81; Through the Telescope, James Baikie, 222; a New Form of Cœlostast, Prof. Hale, 424
- Telluric Lines in the Solar Spectrum, the, M. Stefánik, 64
- Temperature of Mars, Prof. Lowell, 593
- Temperature of the Moon, the, F. W. Very, 281
- Temperatures, Inversion, for Air and Nitrogen, Prof. K. Olszewski, 379
- Ter-Gazarian (G.), the Density of Gaseous Hydrochloric Acid, the Atomic Weight of Chlorine, 263
- Terada (T.), Perception of Relief by Monocular Vision, 224
- Terminology, Technical, 490; J. T. Richards, 510
- Therapeutics: Influence of Radium on the Virus of Rabies, Dr. Bongiovanni, 15; Anaesthetic and Lethal Quantity of Chloroform in the Blood, Dr. George A. Buckmaster and J. A. Gardner, 142; Atoxyl an Effectual Remedy against Sleeping Sickness, Prof. Koch, 206; Early Reference to Red-light Treatment of Small-pox, Alfred Sang, 560; Anti-opium Drug, L. Wray, 613
- Thermodynamics: Sechs Vorträge über das thermodynamische Potential, &c., J. J. van Laar, 77; the Scientific Papers of J. Willard Gibbs, 361; Thermodynamics of the Internal-combustion Engine, Dugald Clerk, 446
- Thermometry, Technical, 6
- Thiele, Comet 1906g, Prof. Hartwig, 111; Dr. E. Ström-gren, 111, 159; Messrs. Aitken and Faith, 231; Ephemeris for, Georg Dybeck, 257
- Thomas (Northcote W.), Crystal Gazing, its History and Practice, with a Discussion of the Evidence for Telepathic Scrying, 125
- Thomas (V.), Molecular Combinations of Metallic Halides with Organic Compounds, 431
- Thompson (Prof. Silvanus P., F.R.S.), the Manufacture of Light, 269
- Thompson-Yates and Johnston Laboratories Report, the, Prof. R. T. Hewlett, 351
- Thomson (Prof. J. A.), the "Sea-mignonette" (*Primnoa reseda*), 566
- Thomson (Prof. J. J., F.R.S.), Conduction of Electricity through Gases, 269
- Thorpe (J. F.), Anhydride of Phenylsuccinic Acid, 118
- Thorpe (Dr. T. E., C.B., F.R.S.), some Founders of the Chemical Industry, Men to be Remembered, T. Fenwick Allen, 100; Obituary Notice of Prof. D. I. Mendeléeff, 371
- Threads, the Effect of Radium on the Strength of, J. L. McKee and Prof. W. B. Morton, 224
- Threlfall (R., F.R.S.), Five Years' Experience in Measuring and Testing Producer Gas, 527
- Thresh (Dr. John C.), Preservatives in Food and Food Examination, 145
- Thurso (John Wolf), Modern Turbine Practice and Water-power Plants, 50
- Tibet, Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and, Lieut.-General Sir Richard Strachey, 171
- Tibet, das Kloster Kumbum in, Wilhelm Filchner, Lieut.-Colonel L. A. Waddell, 172
- Ticks, the Anatomy and Histology of, Captain S. R. Christophers, Dr. J. W. W. Stephens, 523
- Tierreich, das, Crustacea, Rev. T. R. R. Stebbing, F.R.S., 365
- Tiffeneau (M.), Migration of the Phenyl Group, 48
- Tilden (W. A.), Pinocamphylamine, 23
- Tilly (Lieut.-General De), Obituary Notice of, M. P. Manson, 422
- Time and Clocks, a Description of Ancient and Modern Methods of Measuring Time, H. H. Cunynghame, C.B., 269
- Timmerman (C. E.), Physics, Theoretical and Descriptive, 436
- Tissot (C.), Utility of Resonance Phenomena in the Production of Strong Electric Sparks, 383
- Titsworth (A. A.), Elements of Mechanical Drawing, 172
- Tittman (G. H.), Geodetic Operations in the United States, 1903-6, 573
- Toad, Golden Carp attacked by a, Prof. Adrian J. Brown, 534
- Todas, the, W. H. R. Rivers, A. E. Crawley, 462
- Todd (F. H.), the Timber Tree *Padauk* in the North Andaman Island, 422
- Todd (John L.), Rapport sur l'Expédition au Congo, 1903-5, 351
- Tonge (James), the Principles and Practice of Coal Mining, 364
- Toronto, the University of, Prof. A. B. Macallum, F.R.S., 396
- Toxic Effects of Oysters, J. Baylac, 456
- Toyama (K.), Silk-worm Culture, 255
- Tram-car Brakes, the Action of, 86
- Tramways: Electric Tramways, R. N. Tweedy and H. Dudgeon, 89; Tramways and Snow, 228; Underground Conduit System for Tramways during Snowfall, 447
- Transit-circle Observations, Prof. Littell, 257
- Travers (Dr. Morris W., F.R.S.), Behaviour of Certain Substances at their Critical Temperatures, 47
- Trees, Familiar, Prof. G. S. Boulger, 319
- Trees, Indian, being an Account of Trees, Shrubs, Woody Climbers, Bamboos, and Palms Indigenous or Commonly Cultivated in the British Empire, Sir Dietrich Brandis, K.C.I.E., F.R.S., 385
- Tregarthen (J. C.), the Life Story of a Fox, 76
- Trelease (Prof. W.), Agave, 542
- Trigonometry: a New Trigonometry for Beginners, R. F. D'Arcy, 74; Trigonometry for Beginners, J. W. Mercer, 409; Trigonometry for Beginners, Rev. J. B. Lock and J. M. Child, 409
- Tropical Botany, 524
- Trouton (Prof. F. T.), Rate of Recovery of Residual Charge in Electric Condensers, 527
- Trypanosoma gambiense* and other Trypanosomes, *Glossina palpalis* in its Relation to, Prof. E. A. Minchin, A. C. H. Gray, and the late F. M. G. Tulloch, 56
- Tsetse-Flies: the Extirpation of the Tsetse-fly, a Correction and a Suggestion, Prof. E. A. Minchin, 30; Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of Infection in Trypanosomes generally, Prof. E. A. Minchin, 214
- Tswetkoff (Prof. Y. Y.), Death and Obituary Notice of, 465
- Tuberculosis: Infection of Bovines by the Avian Tubercle Bacillus, Prof. Mettam, 407; Second Interim Report of the Royal Commission appointed to inquire into the Relations of Human and Animal Tuberculosis, Part i., Comparative Histological and Bacteriological Investigations, Dr. Arthur Eastwood, 610
- Tuchoff (Dr. W. N.), Exploration of Shores of Kamchatka, 235
- Tuck (W. B.), Constitution of Hydroxyazo-compounds, 477
- Tulloch (the late F. M. G.), *Glossina palpalis* in its Relation to *Trypanosoma Gambiense* and other Trypanosomes, 56
- Turbines: Steam Turbines, with an Appendix on Gas Turbines and the Future of Heat Engines, Dr. A. Stodola, 50; Steam Turbine Engineering, T. Stevens and H. M. Hobart, 50; Modern Turbine Practice and Water-power Plants, John Wolf Thurso, 50; Turbines, W. H. Stuart Garnett, 50; Modern Steam Turbines, Vol. i., the Schulz Steam Turbines, Max Dietrich, 50
- Turkestan, Archaeological Discoveries in, Dr. M. A. Stein and Dr. von Lecoq, 248
- Turner (Dr. Dawson), the Hæmo-renal Salt Index as a Test of the Functional Efficiency of the Kidney, 334
- Turner (Prof.), Man's Place in the Universe, 544; the Sun as a Variable Star, 569
- Turner (Prof. H. H., F.R.S.), Astrographic Catalogue 1900'0, Oxford Section, Dec. +24° to +32°, 331
- Turtle's Flesh, Poisoning by, in Fiji, Dr. B. Glanvill Corney, 590

- Tutin (F.), the Conversion of Morphine and Codeine into Optical Isomerides, 23
- Tutton (Dr. A. E. H., F.R.S.), *Chemische Krystallographie*, 529
- Tweedy (R. N.), *Electric Tramways*, 89
- Twiss (D. F.), *Electrolytic Preparation of Dialkyldisulphides*, 23
- Twyman (F.), *Improvements in Spectrophotometers*, 382
- Typhoon Storms, Atmospheric See-Saw Phenomenon and the Occurrence of, Wilhelm Krebs, 560
- Ulrich (E. O.), the Copper Deposits of Missouri, 184; the Lead, Zinc, and Fluorspar Deposits of Western Kentucky, 184
- Ultra-violet Fluorescence of Benzene, Dr. J. Stark, 295
- Ultramicroscopes, les, A. Cotton and H. Mouton, Thomas H. Blakesley, 595
- United States: United States Naval Observatory Publications, 86; United States Naval Observatory, 378; Mineral Resources of the, 140; Higher Education in the United States, 510; Terrestrial Physics in the United States, 573; Geodetic Operations in the United States, 1903-6, G. H. Tittman and John F. Hayford, 573; the Geodetic Evidence of Isostasy, with a Consideration of the Depth and Completeness of the Isostatic Compensation and of the Bearing of the Evidence upon some of the Greater Problems of Geology, John F. Hayford, 573; U.S.A. Government Irrigation Project at Yuma, Prof. Oscar C. S. Carter, 591
- Universe, Man's Place in the, Prof. Turner, 544
- Universities: New Physical and Engineering Departments of the University of Edinburgh, 20; University and Educational Intelligence, 21, 45, 69, 93, 117, 141, 164, 187, 214, 237, 261, 286, 308, 332, 356, 381, 404, 428, 453, 475, 502, 525, 548, 573, 597, 620; the University Movement in Western Australia, 35; die physikalischen Institute der Universität Göttingen, Dr. J. A. Harker, 55; the Scope and Problems of Protozoology, Prof. E. A. Minchin, Lecture at the University of London, 115; Students in German Universities, 380; University of Toronto, Prof. A. B. Macallum, F.R.S., 306; the Needs of the University of Cambridge, 404; the University of the Cape of Good Hope, 461
- Untravelled England, James John Hissey, 78
- Unwin (F.), Influence of Temperature on the Photo-electric Discharge from Platinum, 623
- Upheaval of the Sea Coast by Earthquakes, the, Dr. T. J. J. See, 224; J. M., 224
- Urbain (G.), the Atomic Weight of Dysprosium, 24; Elements producing Phosphorescence in Minerals, 143
- Usher (Francis L.), Behaviour of certain Substances at their Critical Temperatures, 47
- Ussher (R. J.), Excavation of "Hyæna-dens" in the Mammoth Cave near Doneraile, 83
- Valparaiso Earthquake, August 17, 1906, R. D. Oldham, 439
- Van der Waals's Equation, Application of, to Solutions, Earl of Berkeley, 549
- Variable Stars: Designations of Newly-discovered, 41; New Variable Stars, Prof. Max Wolf, 137; Miss Leavitt, 150; Prof. Pickering, 159; Two Stars with Variable Radial Velocities, Prof. Hartmann, 137; a Peculiar Short-period Variable (155.1906 Cassiopeiæ), Messrs. Müller and Kemp, 327; a Quickly Changing Variable Star, F. H. Seares, 350; Thirty-six New Variable Stars, Miss Leavitt, 402; Two Rapidly Changing Variable Stars, J. Baillaud, 518; a New Variable or Nova 156.1906, Prof. E. Millosevich, 615; *see also* Astronomy
- Variation: Is there Determinate Variation? Prof. Vernon L. Kellogg, 237; Recent Progress in the Study of Variation, Heredity, and Evolution, R. H. Lock, 577
- Variation of Wave-lengths in the Solar Spectrum, Dr. Halm, 304
- Varley (Dr. W. Mansergh), Influence of Temperature on the Photo-electric Discharge from Platinum, 623
- Vaschide (N.), Thermal Troubles in Cases of Absolute Privation of Sleep, 144
- Vaughton (T. A.), Growing "Alumina," 281
- Veatch (A. C.), *Underground Water Resources of Long Island, New York*, 183
- Veley (V. H.), Affinity Constants of Aminocarboxylic and Aminosulphonic Acids as Determined by the Aid of Methyl-orange, 262
- Venus: Naked-eye Observations of, A. Benoit, 111; Observations of, Mr. Denning, 208; the Markings and Rotation Period of, Mr. Denning, 469
- Vererbung, die Stofflichen Grundlagen der, im organischen Reich, Eduard Strasburger, 98
- Very (F. W.), the Temperature of the Moon, 281
- Vessiot (M. E.), *Leçons de Géométrie supérieure*, 603
- Vesuvius, the Eruption of, in April, 1906, Prof. Lacroix, 163
- Vigouroux (Em.), New Modes of Formation and Preparation of Titanium Tetrachloride, 479; the Alloys of Nickel and Tin, 528; Nature of the Body Extracted from Certain Rich Alloys of Nickel and Tin, 576
- Vincent (James Edmund), *Highways and Byways in Berkshire*, 149
- Virchow (Rudolf), *Briefe an seine Eltern*, 1839 bis 1864, Supp. to March 14, iii
- Vivanti (G.), *Funzioni poliedriche e modulari*, 108
- Vivisection: Experiments on Animals, Stephen Paget, 121; the Relation of the Kidneys to Metabolism, F. A. Bainbridge and A. P. Beddard, 357; the Transplantation of Nerve Ganglia in the Frog, G. Marinesco and J. Minea, 456; Second Interim Report of the Royal Commission appointed to inquire into the Relations of Human and Animal Tuberculosis, Part i., Comparative Histological and Bacteriological Investigations, Dr. Arthur Eastwood, 610; Functions of the Rolandic Cortex in Monkeys, Drs. W. A. Jolly and Sutherland Simpson, 623
- Volcanoes: the Eruption of Vesuvius in April, 1906, Prof. Lacroix, 163; Fall of a Portion of the Crater of Vesuvius, 205; the Geology of Samoa and the Eruptions in Savaii, H. I. Jensen, 191; Eruption of Mauna Loa Volcano, Hawaii, 278; the Eruption of Matavanu in Savaii, 1905-6, 351; a New Volcanic Island, Rear-Admiral A. Mostyn Field, F.R.S., 414; a New Mud-volcano Island, F. R. Mallet, 460
- Völkerpsychologie, eine Untersuchung der Entwicklungsgesetze von Sprache, Mythos und Sitte, Wilhelm Wundt, 363
- Vote, One, One Value, Dr. Francis Galton, F.R.S., 414
- Vox Populi, Dr. Francis Galton, F.R.S., 450, 509
- Vries (H. de), *Species and Varieties, their Origin by Mutation*, 268
- Waddell (Lieut.-Colonel L. A.), *das Kloster Kumbum in Tibet*, Wilhelm Filchner, 172
- Wade (Herbert T.), *Outlines of the Evolution of Weights and Measures and the Metric System*, 290
- Wahl (A.), *Ethyl Benzoylglyoxylate*, 360
- Walker (C. E.), *Cytological Investigation of Cancer*, 1906, 587
- Walker (George W.), *Electrical Method of Extracting Soot from Air in Flues*, 606
- Wall (E. J.), the Photographic Picture Post-card, 101
- Wallace (Dr. Alfred R., F.R.S.), *Fertilisation of Flowers by Insects*, 320
- Walter (Dr. B.), *Radium and Helium*, 102
- Warburton (C.), *Collection of Oribatidæ from British Guiana*, 95
- Ward (Prof. H. B.), *Influence of Parasites on their Hosts*, 571
- Ward (H. Snowden), the Photographic Picture Post-card, 101
- Ward (John), *Death and Obituary Notice of*, 155
- Warrington (Robert, F.R.S.), *Obituary Notice of*, 511
- Warwick (G. R.), *Influence of Spectral Colours on the Sporulation of Various Species of Saccharomyces*, 95
- Washington (Dr. H. S.), *Titaniferous Basalts of the Western Mediterranean*, 143; the Roman Comagmatic Region, 379

- Watanabe (Tosio), the Distillation of Alloys of Silver and Copper, Silver and Tin, and Silver and Lead, 287
 Water, Use of Sulphate of Copper for Purifying, 280
 Water Plants, Notes on, Prof. Hugo Glück, 579
 Waterways, British Inland, 212
 Waterways, Caves and, E. A. Martel, Prof. Grenville A. J. Cole, 508
 Watson (Dr. B. P.), Effects of a Meat Diet on Fertility and Lactation, 190
 Watson (Dr. Chalmers), the Influence of an Excessive Meat Diet on the Osseous System, 190; Effects of a Meat Diet on the Minute Structure of the Uterus, 190
 Watson (E. R.), Fastness of Indigenous Dyes of Bengal and Comparison with Typical Synthetic Dyestuffs, Part i., Dyeing on Cotton, 504
 Watson (John H.), the Viscosity of the Blood, 47
 Watts (Mrs. Roger), the Fine Art of Jujutsu, 250
 Wave Action in Relation to Engineering Structures, Major D. D. Gaillard, 260
 Wave-lengths in the Solar Spectrum, Variation of, Dr. Halm, 304
 Waves, Progressive, in Rivers, Dr. Vaughan Cornish, 597
 Weather and the Crops, the, R. H. Hooker, 545
 Weather Reports of the Meteorological Office, the, 488
 Webb (Wilfred Mark), the Principles of Horticulture, a Series of Practical Scientific Lessons, 557
 Wedekind (Prof. E.), "Chemi-luminescence," 208
 Weights, Measures, and Weighing Instruments, Draft Board of Trade Regulations with Respect to, 42
 Weights and Measures, Outlines of the Evolution of, and the Metric System, Dr. William Hallock and Herbert T. Wade, 290
 Weimann (Charles), Preparation of Acylcampholic Esters, 407
 Weininger (Otto), Sex and Character, 481
 Weiss (Dr. A.), die Biologie des Balatonsees, 79
 Weiss (P.), Measurements of the Zeeman Effect on the Blue Lines of Zinc, 335
 Weiss (Prof.), Comet 1905 IV., 593
 Welch (Dr. W. H.), the Scientific Study of Infectious Diseases, Address at the Rockefeller Institute for Medical Research, 213
 Wellcome Research Laboratories at Gordon Memorial College, Khartoum, Second Report of the, Andrew Balfour, Prof. R. T. Hewlett, 351
 Wellman (Walter), North Pole Expedition, 540
 Wells (H. G.), in the Days of the Comet, 124; the Future in America, a Search after Realities, 265
 Welsbach Mantle, a Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the, Prof. R. W. Wood, 558
 Welwitschia, the Living, Prof. H. H. W. Pearson, 536
 Werner (E. A.), a Black Modification of Chromium Sesquioxide, 23
 Westcott (W. Wynn), the Extra Pharmacopoeia of Martindale and Westcott, 29
 Whaling, Arctic, in 1906, T. Southwell, 542
 Wheat Flour, a New Chemical Test for Strength in, T. B. Wood, 391; Dr. E. Frankland Armstrong, 439; A. J. Banks, 460
 Whitaker (Arthur), Breeding Habits of British Bats, 495
 Whitman (Prof. C. O.), the Problem of the Origin of Species, 109
 Wieland (G. R.), American Fossil Cycads, 329
 Wiesner (Prof. Julius), Jan Ingen-Housz, sein Leben und sein Wirken als Naturforscher und Arzt, 3
 "Wilde" Lecture at Manchester Literary and Philosophical Society, the Structure of Metals, Dr. J. A. Ewing, F.R.S., 472
 Wilds, an Idler in the, T. Edwards, 176
 Wiles (Rev. J. P.), the World's Calendar, 173
 Wiley (Dr. H. W.), the Principles and Practice of Agricultural Analysis, 458
 Wilkinson (R. J.), the Peninsular Malays, I., Malay Beliefs, 245
 Williams (Stanley), the Red Spot on Jupiter, 1905-6, 327
 Willis (Dr. J. C.), Rubber Cultivation in the East and the Ceylon Rubber Exhibition, 209; the Preparation of Rubber, 377
 Willis (Dr.), Flora of Ritigala, 524
 Willows (Dr. R. S.), Anode Rays, 173
 Wilmore (N. T. M.), Ketene, 510
 Wilson (C. T. R.), Curvature Method for Measuring Surface Tension, 454
 Wilson (F. R. L.), New Laboratory Method for the Preparation of Hydrogen Sulphide, 262
 Wilson (Prof. J. T.), the Foetal Dentition of the Australian Duckbill or Platypus (Ornithorhynchus), 566
 Wilson (R. W.), the Viscosity of Liquid Mixtures, 215
 Winnill (T. F.), the Association of Phenols in the Liquid Condition, 358
 Winslow (C. E. A.), Statistical Study of Generic Characters of the Coccaceae, 39
 Winterson (W. G.), Malacone, 23
 Wireless Telegraphy: the Wireless Telegraphy Conference, Maurice Solomon, 59; Syntonic Wireless Telegraphy, 105; Measurement of Received Energy at Wireless Stations, G. W. Pickard, 280; Manual of Wireless Telegraphy, A. F. Collins, 366; Wireless Telegraphy in Longitude Determinations, Prof. Albrecht, 544
 Wireless Telephony Experiments, Prof. Slaby, 227
 Wireless Telephony, Recent Progress in, Prof. Fessenden, 378
 Wirtz (Dr.), the Lunar Crater Linné, 231
 Wittichell (C. A.), Nature's Story of the Year, 76
 Wittichell (C. A.), Death of, 444
 Woburn Experimental Fruit Farm, Seventh Report of the, Duke of Bedford, K.G., and Spencer U. Pickering, F.R.S., 569
 Wolf (Prof. Max), New Variable Stars, 137; a Remarkable Nebula, 281
 Wolff (J.), Inequality of the Resistance of Natural Starch and Artificial Amylose towards Extract of Barley, 528
 Wood (A.), Radio-activity of the Alkali Metals, 189
 Wood (H. E.), a Brilliant Meteor, 208
 Wood (J. K.), Acidic Constants of some Ureides and Uric Acid Derivatives, 94
 Wood (Prof. R. W.), Fluorescence and Magnetic Rotation Spectra of Sodium Vapour, 230; Ionisation and Anomalous Dispersion, 390, 583; Optical Intensification of Paintings, 424; a Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the Welsbach Mantle, 558
 Wood (T. B.), a New Chemical Test for Strength in Wheat Flour, 391
 Wood's (Captain) Observations for Determining the Position of Everest, Re-computation of, 404
 Woods and o'er the Moor, I go A-walking through the, 176
 Woodward (Dr. A. S.), Vertebrate Fossils of Cretaceous Formation of Bahia (Brazil), 334; New Dinosaurian from the Trias of Lossiemouth, Elgin, 334
 Woodward (Prof. C. M.), Educational Theories, Ancient and Modern, 352
 Woolacott (Dr. D.), Raised Beach in the Cleadon Hills, 467
 Woolnough (Dr. W. G.), Example of River-capture in New South Wales, 72
 Workman (W. P.), Geometry, Theoretical and Practical, 74
 World Machine, the, the First Phase, the Cosmic Mechanism, Carl Snyder, 553
 World's Calendar, the, Rev. J. P. Wiles, 173
 Wray (L.), Anti-opium Drug, 613
 Wright (Sir A. E., F.R.S.), the Principles of Microscopy, a Handbook to the Microscope, 386
 Wright (Mr.), Minerals of the Composition MgSiO₃, 596
 Wright (William), Neolithic Man in North-east Surrey, 124
 Wundt (Wilhelm), Völkerpsychologie, eine Untersuchung der Entwicklungsgesetze von Sprache, Mythos und Sitte, 363
 Xerophilous Stems, Light Sense-Organs in, R. J. D. Graham, 535
 Yorke (J. Paley), Applied Electricity, a Text-book of Electrical Engineering for Second-year Students, 389
 Young (Dr. A. P.), Serpentine Rock from the Tarnthalea Köpfe, 405-6

Young (W. H. and G. C.), the Theory of Sets of Points, 193
 Young (W. J.), the Organic Phosphorus Compound formed by Yeast Juice from Soluble Phosphates, 477; Influence of Sodium Arsenate on the Fermentation of Glucose by Yeast-juice, 118
 Youssoufian (M.), Alcoholysis of Cocoa Butter, 143
 Yule (G. Udny), Mean or Median, 534

Zambonini (F.), Crystals of Galena deposited at Eruption of Vesuvius in April, 158; Strüverite, a New Mineral, 574
 Zammarchi (Prof.), the Perseids, 1906, 111
 Zander (Dr. Enoch), Filtering Apparatus attached to the Gill-rakers of Deep-sea Fishes, 348
 Zeeman (Prof. P.), Recent Progress in Magneto-optics, Lecture at Royal Institution, 138, 160
 Zeleny (John and Anthony), Temperatures obtainable by the Use of Solid Carbon Dioxide under Different Pressures, 230
 Zellen, die chemische Energie der lebenden, Prof. Oscar Loew, 508
 Zinc, Céruse et Blanc de, M. G. Petit, 509
 Zodiacal Light, the, Prof. Barnard, 16
 Zoology: Zoologischer Jahresbericht für 1905, 6; the Cambridge Natural History, Vol. i., Protozoa, Prof. Marcus Hartog, Porifera (Sponges), Igera B. L. Sollas, Coelenterata and Ctenophora, Prof. S. J. Hickson, Echinodermata, Prof. E. W. MacBride, F.R.S., 31; History and Origin of Zoological Gardens, J. von Pleyel, 62; the Papillary Ridges and Papillary Layer of the Skin of the Hand and Foot of Lemurs, Dr. Walter Kidd, 83; a Pleural Cavity Lacking in the Indian Elephant, Prof. Schmaltz, 84; Has the African Elephant a Pleural Cavity? Alfred Giard, 407; the History of the Collections contained in the Natural History Departments of the British Museum, 125; Indo-Malay Slow-lorises, M. W. Lyon, 135; the Great Anteater of Central America (*Myrmecophaga centralis*), M. Ward Lyon, 156; Zoological Society, 166, 238, 359, 406, 478, 527, 574; the Lesser Horseshoe Bat, *Rhinolophus hipposiderus*, T. A. Coward, 166; Skulls of Horses from the Roman Fort at Newstead, near Melrose, and Observations on the Origin of Domestic Horses, Prof. J. C. Ewart, 190; Craniometric Observations on the Skull of *Equus przewalski* and other Horses, Prof. O. Charnock Bradley, 190; Surgical Anatomy of the Horse, John T. Share-Jones, 337; le Cheval, H. J. Gobert, 337; the Origin of the Modern Horse, Prof. J. C. Ewart, 612; Coat Colour in Horses, Prof. J. C. Ewart, 622; Verhandlungen der deutschen zoologischen Gesellschaft, 1906, 246; the Mammals of Great Britain and Ireland, J. G. Millais, 271; the North American Fresh-water Medusa of Microhydra, Edward Potts, 324; the Urus or Aurochs, Prof. A. Mertens, 349; das Tierreich, Crustacea, Rev. T. R. R. Stebbing, F.R.S., 365; Origin of the Lateral Horns of the Giraffe in Fœtal Life, Prof. E. Ray Lankester, 406; Rudimentary Antlers in the Okapi, Prof. E. Ray Lankester, 406; New Amazonian Tree-frog, *Hyla resinifictrix*, Dr. E. A. Goeldi, 406; Camp-fires in the Canadian Rockies, Dr. William T. Hornaday, 410; the Forest-pig of Central Africa, Prof. Henry H. Giglioli, 414; Scottish Tardigrada, James Murray, 455; Arctic Tardigrada, James Murray, 455; English Domestic Cats, R. I. Pocock, 478; Report on the Deaths among the Mammals and Birds in the Society's Menagerie during 1906, Dr. C. G. Seligmann, 478; Marsupials or Creodonts? W. J. Sinclair, 498; on the Extinct Emeu of the Small Islands off the South Coast of Australia and Probably Tasmania, Prof. Henry H. Giglioli, 534; Meristic Homologies in Vertebrates, J. S. Kingsley, 541; the Zoological Record, 557; the Fœtal Dentition of the Australian Duckbill or Platypus (*Ornithorhynchus*), Profs. J. T. Wilson and J. P. Hill, 566; Flat-worm *Scutariella didactyla* from Montenegro, Prof. Al. Mrázek, 590; Problems of an Island Fauna, C. B. Moffat, 591; Habits of the Malay Tapir, H. N. Ridley, 594; the Menagerie at the Botanic Gardens, Singapore, H. N. Ridley, 594
 Zurhellen (W.), the Spectroscopic Binary α Leonis, 378

INDEX TO LITERARY SUPPLEMENT.

Anatomy: das Cerebellum der Säugetiere, eine vergleichend anatomische Untersuchung, Prof. Louis Bolck, Prof. J. S. Macdonald, Supp. to March 14, ix

Bolk (Prof. Louis), das Cerebellum der Säugetiere, eine vergleichend anatomische Untersuchung, Supp. to March 14, ix

Burrard (Lieut.-Colonel S. G., F.R.S.), Auxiliary Tables to Facilitate the Calculations of the Survey of India, Supp. to March 14, viii

Caven (Dr. R. M.), Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Supp. to March 14, iv

Cerebellum der Säugetiere, das, eine vergleichend anatomische Untersuchung, Prof. Louis Bolck, Prof. J. S. Macdonald, Supp. to March 14, ix

Chemistry: Introduction to General Inorganic Chemistry, Prof. Alexander Smith, Prof. Arthur Smithells, F.R.S., Supp. to March 14, iv; Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Dr. R. M. Caven and Dr. G. D. Lander, Prof. Arthur Smithells, F.R.S., Supp. to March 14, iv; Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi

Chisholm (Geo. G.), a Progressive Course of Comparative Geography on the Concentric System, P. H. L'Estrange, Supp. to March 14, v; Philips' Progressive Atlas of Modern Geography, Supp. to March 14, v; Stanford's Octavo Atlas of Modern Geography, Supp. to March 14, v

Derr (Prof. Louis), Photography for Students of Physics and Chemistry, Supp. to March 14, vi

Differential Equations, Theory of, Dr. A. R. Forsyth, F.R.S., Supp. to March 14, x

Fauna of the Tay Basin and Strathmore, a, J. A. Harvie-Brown, Supp. to March 14, vii

Forsyth (Dr. A. R., F.R.S.), Theory of Differential Equations, Supp. to March 14, x

Geodesy: Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Colonel S. G. Burrard, F.R.S., Supp. to March 14, viii

Geography: a Progressive Course of Comparative Geography on the Concentric System, P. H. L'Estrange, Geo. G. Chisholm, Supp. to March 14, v; Philips' Progressive Atlas of Comparative Geography, Geo. G. Chisholm, Supp. to March 14, v; Stanford's Octavo Atlas of Modern Geography, Geo. G. Chisholm, Supp. to March 14, v

Harvie-Brown (J. A.), a Fauna of the Tay Basin and Strathmore, Supp. to March 14, vii

India: Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Colonel S. G. Burrard, F.R.S., Supp. to March 14, viii

L'Estrange (P. H.), a Progressive Course of Comparative Geography on the Concentric System, Supp. to March 14, v

Lander (Dr. G. D.), Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Supp. to March 14, iv

- Macdonald (Prof. J. S.), das Cerebellum der Säugetiere, eine vergleichend anatomische Untersuchung, Prof. Louis Bolk, Supp. to March 14, ix
- Mathematics: Theory of Differential Equations, Dr. A. R. Forsyth, F.R.S., Supp. to March 14, x
- Morphology: das Cerebellum der Säugetiere, eine vergleichend anatomische Untersuchung, Prof. Louis Bolk, Prof. J. S. Macdonald, Supp. to March 14, ix
- Natural History: a Fauna of the Tay Basin and Strathmore, J. A. Harvie-Brown, Supp. to March 14, vii
- Pathology: Rudolf Virchow, Briefe an seine Eltern, 1839 bis 1864, Supp. to March 14, iii
- Philips' Progressive Atlas of Comparative Geography, Geo. G. Chisholm, Supp. to March 14, v
- Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi
- Physics: Photography for Students of Physics and Chemistry, Prof. Louis Derr, Supp. to March 14, vi
- Smith (Prof. Alexander), Introduction to General Inorganic Chemistry, Supp. to March 14, iv
- Smithells (Prof. Arthur, F.R.S.), Introduction to General Inorganic Chemistry, Prof. Alexander Smith, Supp. to March 14, iv; Systematic Inorganic Chemistry from the Standpoint of the Periodic Law, Dr. R. M. Caven and Dr. G. D. Lander, Supp. to March 14, iv
- Stanford's Octavo Atlas of Modern Geography, Geo. G. Chisholm, Supp. to March 14, v
- Surveying: Auxiliary Tables to Facilitate the Calculations of the Survey of India, Lieut.-Colonel S. G. Burrard, F.R.S., Supp. to March 14, viii
- Tay Basin and Strathmore, a Fauna of the, J. A. Harvie-Brown, Supp. to March 14, vii
- Virchow (Rudolf), Briefe an seine Eltern, 1839 bis 1864, Supp. to March 14, iii

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“To the solid ground
Of Nature trusts the mind which builds for aye.”—WORDSWORTH.

THURSDAY, NOVEMBER 1, 1906.

SOME RECENT WORKS ON LOGIC.

- (1) *Symbolic Logic and its Applications*. By Hugh MacColl. Pp. xi+141. (London: Longmans, Green and Co., 1906.) Price 4s. 6d. net.
- (2) *The Development of Symbolic Logic*. By A. T. Shearman. Pp. xi+242. (London: Williams and Norgate, 1906.) Price 5s. net.
- (3) *An Introduction to Logic*. By H. W. B. Joseph. Pp. vii+564. (Oxford: Clarendon Press, 1906.) Price 9s. 6d. net.
- (4) *Thought and Things, or Genetic Logic*. By James Mark Baldwin. Vol. i. Functional Logic, or Genetic Theory of Knowledge. Pp. xiv+273. (London: Swan Sonnenschein and Co., Ltd., 1906.) Price 10s. 6d. net.

(1) **W**HETHER Mr. MacColl is the Athanasius of symbolic logic or only its Ishmael, the fact remains that he seems unable to come to an agreement with other exponents of the subject. But he contends that his system “in the elastic adaptability of its notation bears very much the same relation to other systems (including the ordinary formal logic of our text-books) as algebra bears to arithmetic.” The present work contains the results of a series of researches dating from the year 1872. Portions have appeared at intervals in various magazines, English and French. Points on which he lays considerable stress, and in which he does not command the uniform assent of the other symbolic logicians, are these:—(a) that he takes statements and not terms to be in all cases and necessarily the ultimate constituents of symbolic reasoning; (b) that he goes quite beyond the ordinary notation of the symbolists in classifying propositions according to such attributes as true, false, certain, impossible, variable; (c) that in regard to the existential import of propositions, while other symbolists define the null class o as containing no members, and understand it as contained in every class, real or unreal, he, on the other hand, defines it as consisting of the null or unreal members

$o_1, o_2, o_3, \&c.$, and considers it to be excluded from every real class. A chapter is devoted to the solution of Prof. Jevons’s so-called inverse problem.

(2) The sub-title of Mr. Shearman’s work is “A Critical-Historical Study of the Logical Calculus,” and its author’s chief object is to show that during the last fifty years a definite advance has been made by symbolic logic.

“I have traced the growth of the subject,” he writes, “from the time when Boole originated his generalisations to the time when Mr. Russell, pursuing for the most part the lines laid down by Peano, showed how to deal with a vastly wider range of problems than Boole ever considered.”

He is careful to point out that the view which he expresses in his work as to the relation of mathematics to logic “is to be regarded as preferable only to the doctrines that were in vogue prior to the time of Peano’s analysis of mathematical notions.”

Mr. Shearman’s opinions on some disputed points may be noted:—(a) He can see no valid reason why symbols may not designate now classes, and now propositions. “The only thing to be remembered is that the rules of procedure are not quite the same in the two cases.” (b) He rejects all attempts to deal with any but assertoric propositions, and holds that if Mr. MacColl wishes to work with such data as probable and variable he should introduce new terms. (c) He regards it as practically impossible to elaborate a calculus based on intension.

In a footnote he directs attention to a remark of the late Prof. Adamson which seems to imply that all the intermediate processes in a solution ought to be intelligible. Our author believes, on the other hand, that “a calculus is a means of reaching correct conclusions by means of the mechanical application of a few logical rules, and it is quite possible that in the application of such rules unintelligible elements may temporarily appear.” The doctrines of Prof. Jevons and Mr. MacColl are subjected to some severe criticisms, and Mr. Shearman holds that Prof. Jevons’s actual contributions to the development of symbolic logic were few and relatively unimportant.

The last chapter contains a warm defence of the utility of symbolic logic, though the author does not claim that it can be used directly by natural science.

(3) Mr. Joseph's work is on very different lines from the two foregoing. It is an excellent and very sound exposition of the traditional logic for which Oxford has been famous ever since the days of Chaucer's Clerk. But if the matter is traditional, the manner of exposition is as fresh and independent as it could well be, and the author has entirely fulfilled the desire expressed in his preface not to teach anything to beginners which they should afterwards have merely to unlearn. Especially valuable are some of the discussions of particular topics, e.g. of the *principium individuationis* (on p. 76), or (on p. 275) of the passage from Aristotle's "Categories" which is sometimes quoted as a source of the "Dictum De Omni." We note, too, Mr. Joseph's irresistible objections to classificatory division by dichotomy, so zealously defended by Jevons and the others who won our earliest logical sympathies, and his rejection (in excellent company) of the doctrine of the inverse relation of extension and intension.

Mr. Joseph has interesting remarks to make on the relation between mathematics and logic, and a good statement of the doctrine that the principle of syllogistic inference cannot be made into the premiss of a particular syllogism without begging the question. His chapter entitled "The Presuppositions of Inductive Reasoning: the Law of Causation," is a model of clear and forcible reasoning. Mill's four methods, he finds, may be reduced to one "method of experimental inquiry," which is ultimately based on disjunctive reasoning, and the essence of which is "that you establish a particular hypothesis about the cause of a phenomenon, by showing that, consistently with the nature of the relation of cause and effect, the facts do not permit you to regard it as the effect of anything else."

There is a valuable seven-page discussion (pp. 352-8) of the inductive syllogism in Aristotle, whom the author seeks to defend—not without qualifications—from the objection that, after all, his induction rests on complete enumeration, and that thus *deduction* from any premiss so gained becomes a hollow pretence. Where the units are species, he points out, and one wants to prove something about the genus to which they belong, complete enumeration is possible and legitimate: but where the units are individuals, one does not (according to Aristotle) work by an inductive syllogism that summons all the instances; one learns the essential nature of the species to which they belong by induction, but the induction is now a psychological rather than a logical process, and we arrive at the conclusion, not through an inductive syllogism, but "in virtue of the necessary relation between the two terms which our familiarity with particulars makes possible, but which is the work of intellect or *nous*." We should have welcomed in this connection a detailed exposition of some of the difficulties in the concluding chapter of the Posterior Analytics.

(4) This volume is the first instalment of what

promises to be an important inquiry, "inductive, psychological, genetic," into the actual movement of the function of knowledge. The author distinguishes genetic logic from formal (or the logician's) logic, and metaphysical logic (or logicism), and he describes genetic logic as the physiology and comparative morphology of knowledge—physiology because it examines function, and comparative morphology because "it asks about the relation of the forms and other logical determinations of the several modes of cognitive process to one another, and aims to make out an interpretation of the series of forms as conditioned upon functions."

Prof. Baldwin's account of the process by which cognition is built up is so coherent and intricate that it is impossible to give more than a fraction of its substance here. He begins with the condition of bare awareness of an object, the a-dualistic consciousness, examines the place of interest as a factor in the determination of the object, and the meaning of various terms like *disposition*, *autonomic*, *heteronomic*, *control*, *project*, *reality coefficient*; shows how "it is the stimulation, not the response, that is the controlling factor in the construction of sense objects," and how the first distinction is made in the perception of persons and things. Then he passes to image objects and memory objects, and discusses the process by which the inner-outer dualism is reached. This leads him to an examination of play or make-believe objects, and then we have three valuable chapters on various aspects of meaning. The last two chapters deal with the mind-body dualism and the dualism of subject and object.

The terminology of the work is not of the simplest, but behind it one finds that the writer has something true and important to say. Two other volumes—one on experimental logic and one on real logic—will complete the work, which is being published simultaneously in English and French.

A MANUAL OF PHARMACOLOGY.

A Manual of Pharmacology. By Dr. W. E. Dixon. Pp. xii+451; numerous curves, diagrams, and formulæ in the text. (London: Edward Arnold, 1906.) Price 15s. net.

PHARMACOLOGICAL literature in the English language has during the last few years increased considerably, and this is true even if we exclude the copious additions to this literature emanating from America. Students of pharmacology at the present time have at least three exhaustive text-books to choose from, all up to date, and written by teachers actively engaged both in teaching and original research. In each of these works the classification of the subject adopted is markedly different, from which, perhaps, the philosophical reader would be apt to infer that in the present state of our knowledge, whether of the action of drugs or of the chemical composition of their active ingredients, no absolute classification is possible. In the book before us prominence is certainly given in determining classification to the physiological action of the drugs in question, and in the present

state of our knowledge perhaps a classification based upon such principles is the most satisfactory. The matter is, however, one of considerable difficulty, as nearly all drugs exert many physiological actions not always differing only in degree, but in some cases actually in kind. It is, from the nature of the case, therefore obligatory to take one action of a drug as determining its position in one or other group. As an instance we may cite caffeine. Dr. Dixon places this drug by virtue of its action in the group of diuretics; if we, however, follow the text we find that considerable space is of necessity devoted to the other, almost equally important, actions of this alkaloid.

It is difficult in a review of ordinary dimensions to do adequate justice to a work of this character, and in the remarks which follow we shall confine ourselves to a few salient points which strike us as being likely to interest the medical and general scientific reader. In the first place, it seems that on account of the entire absence of all reference to original literature the book is not intended to be a book of reference; further, the absence of information with regard to pharmacological technique obviously places the book in the library rather than in the laboratory. As the author states clearly in his preface, several of the facts are new, and doubtful statements have been verified by experiments performed in his own laboratory. In this connection we must say at once that the reader will have carefully to consider the magnitude of the evidence with regard to these new facts and verifications of doubtful ones. The therapeutics included in Dr. Dixon's work are only such as to illustrate the pharmacology; from this it clearly follows that the book is not intended for those engaged in the practice of medicine. *Materia medica* is only briefly dealt with, although in many cases very abstruse details and complicated formulæ with regard to the chemical composition of substances, such, for instance, as hydrastine, are given. We think such details cannot be of use to the ordinary student of pharmacology, and to be of any value to the pharmacological or chemical worker should be accompanied by a reference to the literature from which they are derived; and here we will observe that although in his preface the author mentions a list of standard works dealing with pharmacology and *materia medica* to which he is indebted, all reference, so far as we can find, to books dealing with the question of the chemical composition and reactions of, for instance, the alkaloids and their derivatives is omitted.

The first thirty-eight pages of the book are devoted to general considerations, amongst which perhaps the most attractive is a discussion of the relation between physiological action and chemical constitution. This interesting subject is treated at some length, and most of the important facts bearing upon it are carefully considered. Under the heading of the standardisation of drugs, the author discusses the question of physiological standardisation. He rightly directs attention to the extreme difficulty of standardising certain preparations according to

their chemical content, and we entirely agree that, in the case of certain drugs, standardisation of a physiological type should be adopted; that is, different preparations should be compared with regard to their action upon a constant tissue unit. Such a method has been successfully adopted, under even more complicated conditions, in the comparison of the relative toxicity of certain sera. We must confess, however, that we are in this connection somewhat surprised to read that the cardiac glucosides can be standardised by perfusing the isolated rabbit's heart with Ringer's solution and subsequently adding the drug. The author must either be under some misconception with regard to the composition of Ringer's solution or be in possession of important facts which, so far as we are aware, he has not published.

From chapter iii. on, the book is devoted to descriptions of the characters, preparations, and physiological actions of the official, and some important unofficial, remedies and drugs. The action of each drug is most exhaustively considered, and in most cases illustrated by one or more curves, the result in the vast majority of cases of the author's own experimentation. The amount of space devoted to these curves is certainly a feature of the work, and renders to it, at least from one point of view, a unique value; as, however, usually no discussion of the conditions of the experiment accompanies the curves, the reader has too often to take upon trust the conclusions based upon them.

The mass of the pharmacology of the more purely inorganic substances is prefaced by a short but complete discussion of salt action and some of the chief bearings of modern physical chemistry upon pharmacological action.

The final chapter of the book is devoted to ferments, vegetable toxins, internal secretions, serum-therapy, and antagonism. The work concludes with an exhaustive index.

Dr. Dixon's "Manual" is certainly an important addition to standard pharmacological literature, and if in our opinion its educational value, taken as a whole, is less than that of certain of its contemporaries, this is to some extent due to the curious position its subject-matter holds in the complicated medical education of to-day. We have no hesitation in saying that it should be possessed by every pharmacologist and pharmacological laboratory, if only as containing a number of original experimental results worthy of control and further investigation.

A PIONEER IN BIOLOGY.

Jan Ingen-Houss. Sein Leben und sein Wirken als Naturforscher und Arzt. By Prof. Julius Wiesner. Unter Mitwirkung von Prof. Dr. Th. Escherich, Prof. E. Mach, Prof. R. von Topy, und Prof. Wegscheider. Pp. x+252. (Vienna: C. Kowegen, 1905.)

DR. WIESNER relates that on his becoming professor of plant physiology in the University of Vienna, more than thirty years ago, he resolved to become familiar with the work of the founders of that science. Soon he became peculiarly interested in

the labours of Ingen-Housz, and found that his real worth had not been recognised. Much information was gathered that showed how many-sided his activities had been in science and in medicine, and Prof. Wiesner was induced by the meeting of the International Botanical Congress at Vienna to present the results of his labour of love in this volume. It must rank as a classic, admirable as a biography of a leader in research and as a history of scientific progress in a most important field of study.

Jan Ingen-Housz was born at Breda, in Brabant, South Holland, on December 8, 1730, and attended the higher school there until the age of sixteen, after which he continued his education in the Universities of Louvain, Leyden, Paris, and Edinburgh, even after he had graduated (at the age of twenty-two) in Louvain. From 1757 to 1765 he practised medicine in Breda, but, after the death of his father, he went to London, on the invitation of Sir John Pringle, the King's physician. Here he became acquainted with distinguished anatomists and medical men, and made a study of the method of inoculation for small-pox. From London he went to Vienna, by the wish of the Empress Maria Theresa, and introduced the use of inoculation there.

He frequently visited Switzerland, France, Holland, and England. For the last country he had an especial affection, regarding it as the land in which science was most honoured and furthered. He died in 1799, near London, while on a visit to the Marquis of Lansdowne.

Ingen-Housz approached the research which has brought him most fame—the relation of plants to the atmosphere—from the standpoints of the physicist and chemist rather than the botanist, and with a view to the value of green plants exposed to daylight as purifiers of the atmosphere from the products of animal respiration. He had busied himself with the physical problems of electricity, magnetism, optics, and heat, and had made useful contributions to their investigation. His researches in chemistry led to improvements in the preparation of matches and in other matters of practical value.

A very valuable advance in microscopical technique introduced by him was the use of a cover over the drops of water or other fluids in which the objects were included for examination. At first the covers were made of mica, but soon he employed thin glass covers, as is now the custom.

His researches into the nutrition of plants were for the most part carried on during his stay in Vienna, although his first work on the subject was published in London in 1779 under the title "Experiments upon Vegetables, discovering their great Power of Purifying the Common Air in the Sunshine, and of Injuring in the Shade and at Night." It was soon issued in German and Dutch translations.

When Ingen-Housz began the researches that led him to such great results it was generally taught that plants extracted from the soil the materials of which they were in want in the conditions in which they exist in the plant, and that nothing of importance required to, or did, pass off from plants. That gas was given off had been determined by Priestley and

by Scheele, who had investigated the relations of green plants with the atmosphere; but Priestley arrived at the conclusion that these plants always freed the atmosphere from the "fixed air" (carbon dioxide) emitted by animals and emitted "dephlogisticated air" (oxygen), and Scheele believed that they always added to the amount of the "fixed air."

Ingen-Housz succeeded in showing that both these eminent chemists were right in part, the green parts in daylight emitting "dephlogisticated air," while parts not green at all times, and even green parts in darkness, like animals, emitted "fixed air." His views were combated, even Priestley joining in attacking them, and by his authority preventing their importance from being recognised as it deserved to be.

The new foundation for chemical investigation afforded by Lavoisier's discoveries was made use of by Ingen-Housz to explain more fully the nutrition of green plants than had been possible until the recognition of the composition of the "dephlogisticated air" and the "fixed air," and he showed that the carbon contained in plants is derived from the carbon dioxide of the atmosphere instead of from the soil as had been supposed by Senebier. He also showed that the carbon could be acquired by green plants only in light, and that carbon dioxide beyond a limited degree of concentration in the atmosphere proved harmful even to plants as well as to animals. He thus distinguished between the respiration and the assimilation in plants, a distinction not fully realised or taught by botanists until many years later. The value of humus and of vegetable manure as food for plants he ascribed, not to the substance being directly employed by the plants as food, but to its effect on the mineral contents of the soil, which were rendered more easy of absorption, and he demonstrated that diluted mineral acids produced similar beneficial effects. His later views on the nutrition of plants are given in "An Essay on the Food of Plants and the Renovation of Soils," which is contained in a collection of essays (in which it is No. 3) issued under the title "Additional Appendix to the Outlines of the Fifteenth Chapter of the Proposed General Report from the Board of Agriculture on the Subjects of Manures," London, 1796.

An appendix stating the sources of information about Ingen-Housz, with extracts from letters and a bibliography of his writings, adds to the value of the volume, and supports Prof. Wiesner's claim that he must be classed among the founders of botany, and that he showed singular ability also as an investigator in physics and in medicine.

ANALYSIS OF PAINTS.

The Chemistry of Paints and Paint Vehicles. By Clare H. Hall. Pp. vi+134. (London: Constable and Co., Ltd., 1906.) Price 8s. net.

THIS book or booklet is not intended to appeal to the artist, the house-painter, or the manufacturer, but to the young analyst who has had little or no experimental acquaintance with the materials discussed in its pages. The scope of the volume is indeed extremely limited, since it deals with the ex-

amination of only a few common pigments, and by no means exhaustively even with these; about some vehicles and diluents the information to be found in these pages is less meagre.

There are five chapters in this book, an appendix containing thirteen tables, and an adequate index. Chapter i. is devoted to the determination of certain constituents of common paints, and deals with aluminium, barium, carbon dioxide, chromium, iron, lead, magnesium, manganese, silicon, sulphur, and zinc. In this chapter, which occupies only fourteen pages, we are struck with the inadequate, and even puerile, drawing of the CO₂ apparatus shown in the figure on p. 3, and with the confused nomenclature of the two oxides of chromium. For example, on pp. 4 and 5 we are told that "all chromate compounds must be changed into the chromic state which is indicated by an intense green color," and that this "green color is due to chromic salts." The omission of any caution as to the non-volatile impurities commonly occurring in the hydrofluoric solution used in ascertaining the purity of silica is unfortunate.

The properties of a few common pigments, such as Prussian blue, ultramarine, ivory-black, umber, Vandyke brown, the mixture of lead chromate and Prussian blue wrongly called chrome green, iron-red, genuine and imitative vermilion, a number of white pigments or adulterants, chrome yellow, red lead, yellow ochre, and the siennas are dealt with. This list serves to show how many of the finer and choicer pigments, namely, aureolin, cadmium yellow, viridian, and cobalt-blue, are excluded from consideration. Nor can we agree with everything we find in these pages. Ivory- and bone-black are not "combinations of carbon, hydrocarbons, water and mineral matter." Graphite does not possess a "brownish gray" colour; and there are many words wrongly spelt in this chapter, such as analine for aniline, and limionite for limonite.

The examination of actual paints, and of such as are mixed ready for use, is dealt with in the third chapter. The preliminary treatment of oil-paints necessary before they can be tested or analysed is duly described. Chapter iv. is concerned with the matching of samples, while the final chapter is devoted to vehicles. Here will be found a more adequate, detailed treatment of the subject. On pp. 89-92, for instance, the curious drying oil called Chinese wood oil is described. This oil is used largely both in China and Japan, and is imported into America and Europe in increasing quantities. It is obtained from the seeds of *Aleurites Fordii* (Hemsley) and of other species of the same genus, as *A. cordata* and *A. trisperma*. Mr. C. H. Hall states (*loc. cit.*) that this oil, if heated to 285° C. to 300° C., suddenly solidifies into a jelly which is no longer soluble in the usual solvents, and cannot be reduced again to the liquid state. Mr. Hall's statement that Chinese wood oil, even in small proportion, confers upon paints the property of drying without gloss, and may be used as a substitute for wax in painting media intended to produce a dull or matt surface, seems to merit particular attention.

The thirteen tables of constants, coefficients, and specific gravities which constitute the appendix to this volume will be found useful by the analyst. There is a full index.

This little book, with all its imperfections and its immaturity, is not destitute of merit.

OUR BOOK SHELF.

British Rainfall, 1905. (Forty-fifth annual volume.)
By Dr. Hugh Robert Mill. Pp. 271. (London: Edward Stanford, 1906.) Price 10s.

THE forty-fifth issue of this annual volume tells us better than any mere description could do of the healthy and active state of this voluntary rainfall organisation. When it is considered that more than 4000 individuals scattered over the British Isles read their rain-gauges at 9 o'clock every morning, enter their results on a form, and send in monthly returns to the central bureau at 62 Camden Square, and do all this voluntarily, it is impossible not to admire this band of enthusiasts for their united efforts in so good a cause.

The valuable collection of rainfall statistics is not, however, allowed to lie idle, for the energetic head of this organisation, Dr. H. R. Mill, with his small staff, brings all the facts together, and discusses the distribution of this rainfall both in space and time.

The present volume shows how well this work is carried out, and the observers must feel a great amount of satisfaction in seeing their united efforts so ably handled. Fronting p. 64 is a map indicating the positions of the 4096 rain-gauges at present in use, and one can see at a glance the districts where observers are urgently needed. Ireland and north and central Scotland are conspicuously in need of more volunteers, and it is hoped that many of the places mentioned in the text will soon be counted among the recording stations.

As meteorological readers of NATURE are fully acquainted with the general arrangement of the matter in these annual volumes, it is only necessary in this notice to direct attention to some of the discussions on the collected statistics. Thus, after a brief review of the recent important publication on the "Precipitation in the North German River Basins," compiled by Prof. Hellmann, we are presented with some valuable data on the relation of evaporation from a water surface to other meteorological phenomena. The section on heavy falls on rainfall days in 1905 will be found very interesting reading, and the numerous maps show at a glance the distribution of these falls over the country. After sections dealing with the distribution of rainfall in time, and a discussion of monthly rainfall, we come to the relation of the total fall of rain in 1905 to the average. To sum up in a few words the result of this discussion, it may be said that for the whole of England and Wales the general rainfall for 1905 was 16 per cent. below the average. In fact, so low was this figure that "except for 1902 and 1893 there has not been so dry a year in England since the memorable drought of 1887." It will be interesting to see how the present year's rainfall statistics compare with those of 1905. In 1905 Scotland as a whole had a deficiency of 5 per cent., while Ireland suffered to the extent of 12 per cent.

In addition to a great number of tables, the text is well supplied with numerous suitable maps and illustrations, making the volume a valuable summary of British rainfall for the past year.

W. J. S. L.

Technical Thermometry. Pp. ix+62. (Cambridge: The Cambridge Scientific Instrument Co., Ltd., 1906.)

THIS pamphlet contains detailed, illustrated descriptions of the various types of instruments for temperature measurement made or sold by the Cambridge Scientific Instrument Co., which has long been in the front rank in the manufacture of electric thermometers of all kinds.

It deals first with the well-known platinum resistance thermometers of the Callendar-Griffiths type. These are made in many different forms. Among the most interesting of the apparatus used in connection with them is the ingenious direct-reading temperature indicator, which gives without any calculation the direct centigrade or Fahrenheit temperature on the air-scale, with a sensitiveness of considerably less than 1° up to 1200° C. The various types of resistance-boxes used in accurate platinum thermometry are all arranged to be capable of self-verification. We believe that this self-testing type of resistance-box was among the first examples of a high-class physical instrument intentionally arranged by the makers to encourage periodical standardisation by the user rather than complete dependence upon the original adjustment. The Callendar recorders, in their various forms, can now be made to give with very low energy consumption continuous records of resistance, temperature, radiation, E.M.F., current or power within very wide limits.

Among the thermoelectric appliances is a new form of recording millivoltmeter, in which the galvanometer boom is depressed every half minute on to an inked thread, thereby leaving a dotted record on the paper. The instrument can be made sufficiently sensitive for recalculation curves. The radiation pyrometers of Prof. Féry are also described and illustrated. In these the radiation from the object the temperature of which is to be measured is concentrated upon a minute thermocouple at the focus of a mirror or lens, and the E.M.F. set up is measured in the ordinary way by a suitable millivoltmeter.

In an appendix are given an excellent summary of the principles of electric thermometry with tables of constants, and a list of trustworthy melting and boiling points obtained from the National Physical Laboratory; also a good bibliography of recent thermal research.

Astronomischer Jahresbericht. Band vii. Literature of 1905. By A. Berberich. Pp. xxxvii+646. (Berlin: Georg Reimer, 1906.) Price 20 marks.

THIS volume is the seventh issue of a series of most useful compilations, and it is a matter of deep regret that the founder and chief worker of such an admirable publication is no longer with us. Herr Walter Friedrich Wislicenus died last year on October 3, but, as we are told by Dr. Walter de Gruyter in a brief obituary notice, he contributed a considerable portion of the present volume. The frontispiece to this issue, therefore, fittingly presents us with an excellent portrait of the founder, whose place is now taken by Herr A. Berberich.

With regard to the book itself little need be said, except that the high standard of former years has been maintained. The 600 pages of references, with their brief and concise abstracts, cover the domain of astronomical literature for the past year, and a very complete name index concludes the volume. It may be incidentally remarked that the total solar eclipse of August, 1905, is responsible for no less than ninety-five references, which help somewhat to increase the bulk of the present volume.

Zoologischer Jahresbericht für 1905. Herausgegeben von der Zoologischen Station zu Neapel. Redigirt von Prof. Paul Mayer. (Berlin: R. Friedländer und Sohn, 1906.) Price 24 marks.

THE always welcome "Naples Jahresbericht" appears, as usual, well up to time, and its familiar features remain unchanged. Purely taxonomic papers are not included in the programme, but this limitation has been generously interpreted by some of the recorders. Where we have been able to test the lists we have found them full and accurate, and many of the summaries are models of terseness and clearness. If we look at the first section we are at once struck with the rapidly increasing number of important researches on the Protozoa; if we look at the last section we are similarly impressed with the number of papers dealing with Mendelian phenomena. The indefatigable editor, Dr. Paul Mayer, is responsible for the reports on Protozoa, Bryozoa, Brachiopoda, on part of the Arthropoda, and on general biology—truly a heavy piece of work for a man who does so much else. To him and to his *collaborateurs* we offer in the name of zoologists our hearty thanks.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Absorption of the Radio-active Emanations by Charcoal.

PROF. RUTHERFORD in his interesting letter in NATURE of October 25 (vol. lxxiv., p. 634) on the "Absorption of the Radio-active Emanations by Charcoal" has no doubt quite unintentionally mistaken the general results of my experiments, and therefore I feel that some slight addition ought to be made to his communication.

In the first paragraph of his letter Prof. Rutherford says that "the interesting property of certain kinds of charcoal, notably that of the cocoa-nut, of rapidly absorbing gases, *except the inert gases belonging to the argon family*, is now well known since the recent experiments of Sir James Dewar."

Now, the statement made in the part of the paragraph I have italicised is not accurate. In my papers entitled "The Absorption and Thermal Evolution of Gases Occluded in Charcoal" (Proc. Roy. Soc., 1904), "The Separation of the more Volatile Gases from Air without Liquefaction" (Proc. Roy. Soc., 1904), "Nouvelles Recherches sur la Liquefaction de l'Helium" (*Comptes rendus*, 1904), and "New Low Temperature Phenomena" (Proc. Roy. Inst., 1905), I have shown that all the inert gases without exception can be condensed in charcoal as effectively as ordinary gases provided corresponding conditions of temperature, pressure, and concentration are maintained.

In speaking of the "many avenues for future inquiry" opened up by the charcoal method of separating gases, I said (Proc. Roy. Soc., p. 130, 1904):—"The method I have described will be equally applicable to the treatment of the gaseous products from minerals containing helium, hydrogen, &c., and also to the radium products of the same kind. It seems even probable that the separation of the less volatile constituents in the air may be improved by a slight modification in the mode of working." As a matter of fact, at the time of these communications to the Royal Society in 1904, I had made a few experiments on the condensation of the radium emanation by charcoal *in vacua*, and also on the separation of krypton and xenon; but during the last two years my health has been so indifferent that many lines of investigation have had to be abandoned. In my Royal Institution lecture of June 6, 1905, I ex-

plained and exhibited the process of separating krypton and xenon, showing that a proportion of less than a millionth of these constituents in the atmosphere can be condensed and concentrated in charcoal cooled to the temperature of liquid air. Turning again to Prof. Rutherford's letter, his surprise about the absorption of the emanation of radium, thorium, and actinium by charcoal on the ground of being inert gases may be dismissed as nothing more than what we should anticipate; but the temperature at which the absorption by charcoal takes place raises some important questions.

To take an illustration (Proc. Roy. Inst., 1905), I have shown that charcoal cooled in solid carbonic acid at the temperature of 195° ab. is capable for a time of absorbing the carbonic acid present in air (amounting to, say, 3/1000 of an atmosphere) until the concentration rises to about 1 per cent. of the weight of the charcoal. If, on the other hand, the separation of the carbonic acid from the air had to be done by cooling alone, then the temperature of the air must be reduced below 129° ab., and about 100° ab. it would for practical purposes be nearly all removed. Thus charcoal about twice the absolute temperature required for condensation by mere cooling is for a small concentration of the gas undergoing absorption equally effective. We can compare now the behaviour of the radium emanation with that of carbonic acid. In the paper of Rutherford and Soddy on the condensation of radio-active emanation (*Phil. Mag.*, 1903) it is shown that the temperature has to be lowered below 138° ab. in order to condense the radium emanation, while it is complete by 123° ab. By analogy, therefore, we anticipate that at twice 138° ab. charcoal would still act as a condensating agent. This, then, brings us up to about the ordinary temperature, just what Rutherford has found to be sufficient. Such comparisons, however, may not necessarily mean that the radium emanation is comparable in volatility with carbonic acid at low temperatures.

The results of Rutherford and Soddy would seem to show that the radium emanation has a high latent heat of volatility, and consequently by all analogy a high boiling point. Thus they say (*Phil. Mag.*, 1903) that the radium emanation begins to volatilise at 118° ab., and by 119°·5 ab. the amount is increased four times. If we accept the view that the partial pressures of the emanation were in the ratio of one to four at the two temperatures given above, then we may apply the Rankin formula ($\log P = A - B/T$, where A and B are constants, P the pressure, and T the absolute temperature) and find the order of the value of the B which is proportional to the molecular latent heat, which in this case comes out 5662. Taking, again, the relative electrometer leaks by the static method of 5, 3 at 126°·5 ab. and 0, 74 at 124°·5 ab., this gives 6735, which is of the same order of magnitude. The following values of the B constant for different bodies are useful for comparison:—

| | B constant |
|------------------------------|------------|
| Sulphur (solid) | 4599 |
| Mercury (liquid) | 3170 |
| Phosphorus (liquid) | 2570 |
| Carbonic acid (solid) | 1353 |
| Argon (liquid) | 339 |
| Xenon (liquid) | 669 |

The calculated value of the B constant of the radium emanation is, then, twice the value for mercury and nine times the value for xenon. We need not press, however, the accuracy of the latent heat constant of the radium emanation too far, so let us divide it by two, which will make it of the order of the latent heat of mercury or phosphorus. Accepting for the moment such a value of the molecular latent heat, we cannot avoid inferring that the boiling point of the emanation may be relatively higher than one at first might anticipate. Even if we assume that the emanation represents a gas two steps higher in the periodic series than xenon, the B constant would by analogy be only a little more than 1000. The latent heat argument supports the view that the molecular weight of the emanation must also be high, and of the order of 200 or above it. Naturally the theoretical argument based on the value of the latent heat constant fails if it is not legitimate to

use the electrometer measurements of Rutherford and Soddy as being equivalent to the ratios of the partial pressures of the radium emanation. JAMES DEWAR.

Royal Institution, October 29.

Radium and Geology.

FULLER consideration of the experimental evidence on the effects of concentration on the activity of radium convinces me that, on the whole, this is certainly against the *a priori* probable assumption that a large part of the activity is not spontaneous. I refer more especially to Prof. Rutherford's experiment on dilution, as touched on in my letter in NATURE of October 25. Other considerations lead to the same view.

The conclusion at issue is, however, too important to be left on the existing experimental basis. J. JOLY.

Geological Laboratory, Trinity College, Dublin.

The Evolution of the Colorado Spiderwort.

UNTIL recently the name *Tradescantia virginiana*, of Linnaeus, was made to include a multitude of forms, without discrimination. However, as we go from east to west we observe a marked change in the spiderworts, corresponding with an equally marked change in climate. The more eastern forms of moist regions are tall and rank, with bright green foliage. The true *virginiana* has the pedicels and sepals villous, the hairs not glandular, and does not in any way suggest a xerophyte. In the middle west are two forms, *T. occidentalis* (Britton), bright green, but with narrow leaves and usually smaller flowers, the pedicels and sepals with gland-tipped hairs, and *T. reflexa*, Raf., glaucous, the pedicels glabrous, the sepals with a tuft of hairs at the apex. The latter is more especially southern, and is said to extend even to Florida. Still further west we find in New Mexico another form, *T. scopulorum*, of Rose, slender and much branched, glaucous, with glabrous pedicels and smooth sepals. Still again, we have in Colorado a distinct plant, which I have named *T. universitatis*.¹ This is strongly glaucous, robust, but not very tall, pedicels glabrous, with a very few gland-hairs, sepals glandular-pilose. The leaves are broad (the sheathing bases 12 mm. to 13 mm. wide), and the flowers are about 35 mm. across. There is no sign of any tuft of hairs at the apex of the sepals.

In all this we have a series of changes, not always simultaneous, from bright green to glaucous, and from simply villous pubescence to gland-tipped hairs. In some cases the leaves become narrower and the flowers smaller. It is easy to see in all this direct adaptation to drier conditions,² but it is not so easy to determine how it came about, or how far it may result from immediate influences modifying individuals of a plastic type. At Boulder, Colorado, the *T. universitatis* is a plant of spring and early summer, and has the characters just referred to. This year, however, a ditch was dug right through a place where the plants abounded, and many of them were covered up by the earth thrown out. To-day, September 30, I find that these plants have managed to sprout through the covering soil, and are now in full bloom. They are typical, except in one conspicuous character—the pedicels and sepals both are profusely gland-hairy. If one received these specimens, with the mere statement that they were gathered on the last day of September, noticing the profuse pilosity as well as the unusual time of flowering, one would readily take them for a distinct thing.

There seems to be some confusion about the plant originally named *occidentalis* by Britton. As first described, it was said to have narrowly linear leaves, and the first locality cited was Wisconsin. Rydberg, in his recent "Flora of Colorado," gives it a quite different range, no further east than Nebraska, and makes it include the Colorado plants. The name must go, however, with the plant originally described. T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, September 30.

¹ Type locality, the Campus of the University of Colorado, at Boulder. Also common on the Campus of Colorado College at Colorado Springs.
² And, in part, more saline soil?

THE DYNAMICS OF BOWLING.¹

FOLLOWING up their interesting volume on "Great Batsmen," the accomplished authors of "Great Bowlers and Fielders" have practically completed all that action photography can teach us regarding the methods of great cricketers. The present handsome volume with its 464 action photographs registers for all time the successive positions of the body in the act of bowling of some of the most celebrated bowlers of our day, and also certain very characteristic attitudes of a number of our best fielders. From the purely cricketing point of view the book must ever be of the most enthralling interest, not because it establishes any fundamentally new principle in the art of high-class bowling, but because it proves the wonderful variety of method by which different individual bowlers effect practically the same result. The movements of the body, arm, wrist, hand, and fingers are all coordinated to the one end of imparting to the ball a definite combination of translation and spin. It does not always happen that the bowler hits off the exact combination aimed at, but when he does the future progress of the ball through quiet air and off a good pitch is absolutely definite. There is no difficulty in understanding the dynamics of the "break"; the problem is simply that of a rotating sphere impinging obliquely on a rough surface, and is familiar to everyone who has handled a billiard cue with intelligence. The point of interest to the would-be bowler is how it is effected. This is discussed at considerable length in distinct parts of the book contributed by Messrs. F. R. Spofforth, B. J. T. Bosanquet, and R. O. Schwarz. The introductory chapter by the "Demon Bowler" (to whom the book is dedicated) is capital reading. It is, indeed, rather to be studied than read, and the same remark applies to Mr. Bosanquet's lucid and scientific discussion of the "off-breaking leg-break."

At the very outset it is obvious that no bowler can give to a cricket ball anything like the combined velocity and spin which can be so easily communicated to a golf ball, or even to a tennis ball. The comparative lightness of the latter enables the player to give it sufficient spin (with velocity) so as to call into action the differential air pressure, producing evident swerve. Tait, in his discussion of the golf-ball flight, showed that this swerving force (which acts at right angles to the plane containing the velocity and the axis of spin) may be taken as being proportional to the product of the translational and angular speeds. He estimated that it might attain a value equal to about four times the weight of the ball. In the case of the cricket ball it is doubtful if the deviating force due to air pressures acting on the progressing and rotating ball could ever become more than a small fraction of the weight. Then, as the rotation takes place in all over-hand delivery about an axis which makes at the most a small angle

with the horizontal, it is clear that there is very little chance of a cricket ball *beginning* its swerve to right or left for the same reason that a golf ball is sliced or pulled. How, then, is the swerve to be explained? The matter crops up at intervals throughout the book, and is discussed at some length by Mr. Spofforth; but with all due regard to his authority as one of the greatest bowlers of all time, it is difficult to accept his explanation as in every respect sound. He says that "a ball which has check spin (that is, under-spin) on it, loses it through friction against the air during its flight; at the moment this occurs the ball slips the cushion of air it has made, especially in between the seams. What leads me to



FIG. 1.—W. Rhodes at the beginning of his final swing. From "Great Bowlers and Fielders."

this belief is that it is almost impossible to swerve unless the seam of the ball is up and down. The check spin keeps the seam vertical until the air-resistance causes the spin to cease altogether. At this point, especially if the ball has an upward tendency and the earth's power of attraction is asserting itself, the swerve will be great. To swerve, the ball must have some spin on it, but not much. If it has great spin it will never lose it in time to swerve, and I maintain that at the actual time of swerving the ball has ceased to spin, or nearly so." Further on he says that he has "never seen any bowler swerve with the wind," that "a bowler swerves more while the ball is new," that he does

¹ "Great Bowlers and Fielders. Their Methods at a Glance. By G. W. Beldam and C. B. Fry. Pp. xv+547; illustrated. (Macmillan and Co., Ltd., 1906.) Price 21s. net.

not believe "anyone (bowling as is usual twenty-one yards or less) can get the swerve unless he over-pitches the ball." The facts seem to be that for right or left swerving it is essential to have a cross wind blowing, a long-pitched ball, and some initial spin with the seam vertical, but not too much of it. It is difficult to believe that the air's resistance can effectually destroy this spin, seeing that the air has apparently very little effect in cutting down the spin which ultimately produces the break. The very fact

the ball in addition to gravity according as there is under-spin or over-spin. Probably most bowlers have an average amount of spin which they put on the ball. This will give what the batsman regards as the normally pitched ball of that bowler. Suppose this normal spin to be over-spin. Then it is clear that if the bowler diminishes the over-spin or gives an under-spin the pitch (*other things being equal*) will be lengthened, but if the over-spin is increased the pitch will be shortened. Again,

if the normal spin is under-spin, a diminution of that will make the ball appear to drop shorter than the expected normal pitch. This is obviously one way of varying the pitch, and one which must be very deceptive to the batsman. This way of stating it might seem at first sight to be inconsistent with Spofforth's remark that "the vertical spin, unlike others, must have excessive check spin, which naturally impedes the flight of the ball from the start, and keeps it back from its true destination." It is difficult to see how check-spin can keep the ball back from the start. So far as motion through the air is concerned, there will be just as much retardation with the over-spin rotation as with the under-spin rotation. The word check-spin is, in fact, unfortunate, suggesting that it not only checks the progress of the ball after it strikes the ground—and that is the origin of the name—but also that it checks the ball as it moves through the air. In all probability the bowler, when putting on excessive check-spin, projects the ball with a somewhat smaller velocity than the motion of the arm would imply. The hand, in fact, must get ahead of the ball, as very clearly indicated in one of the photographs of R. O. Schwarz. With a pronounced under-spin a smaller velocity of projection is needed for a given length of pitch than when there is no spin, and the velocity of projection is less than what the motion of the arm would suggest. Hence the feeling of a retarded ball both to the bowler and the batsman. The direct effects of varying spins upon the trajectory as described above are true only when other conditions are the same, such as the velocity of projection and the height of the point of

projection; but in giving different amounts of spin to a ball it is evident that these other conditions cannot be always the same. The conditions of the problem are indeed difficult to state, and one great merit of Mr. Beldam's action photographs is that they throw so much light on the way in which the ball leaves the hand.

But the outstanding difficulty is to explain the right or left swerve, and the action photographs give little



FIG. 2 —J. Tunnicliffe securing a one-handed catch high up in the slips. From "Great Bowlers and Fielders."

that the ball is projected with a smaller spin to begin with will mean less effective frictional moment acting on the ball. Stokes, in fact, agreed with Tait that the frictional decay of spin in the case of a golf ball might be neglected to a first approximation, and we may assume the same for a cricket ball.

There is not the least doubt that spin with the seam vertical must produce "vertical swerve" to some extent, a downward or upward force acting on

help here. The main fact is that all swervers project the ball with the seam as nearly as possible in a vertical plane. In the grip the fingers do not touch the seam, although in some cases the thumb does. But evidently there is little purchase on the ball, which is projected with comparatively little spin. If cross wind is not absolutely essential it certainly greatly facilitates the swerve. With some bowlers the swerve is evident from the start; with others it begins to appear only during the latter half of the trajectory. The seam is really a roughened zone on which the air may be supposed to exert a greater frictional force than on the other parts of the ball, especially if the ball be new. With seam vertical and a cross wind blowing, certain definite dynamical effects will follow. One of these will be a tilting of the axis of rotation, a tilting which will, however, take place very slowly when the spin is excessive. This suggests the question, does the seam remain vertical throughout the flight of a swerving ball? The point might be settled by bowling a swerving ball against a blackened surface and finding which part of the ball first came in contact with the surface. That, however, is outside the purpose of the volume.

The questions of swerve and break have much scientific interest, but they cover only a part of the whole; and from a cricketing point of view much might be said, not only as to the excellence of the pictures, but as to the instruction conveyed by them and by the accompanying letterpress. Mr. Beldam has aimed at getting a succession of positions of each bowler, from the beginning of the final stride before delivery to the follow through after the ball is delivered. In a few cases the series begins even sooner. Where so much is excellent and characteristic it is difficult to choose, but here we have reproduced two pictures which will show to what a high degree of perfection Mr. Beldam has carried his photographic art. The one represents W. Rhodes at the beginning of his final swing, and is chosen partly because of the perfection with which the grip of the ball is indicated. The other is taken from the last quarter of the book, which treats of fielders, and is a remarkably fine picture of J. Tunnicliffe securing a "wide, high up, right-handed catch in the slips." This is one of a series showing Tunnicliffe bringing off difficult catches in most extraordinary attitudes.

Like its predecessor, "Great Batsmen," this volume is a treasure-house of portraits of many of the most conspicuous cricketers of to-day. It is further beautified by a good coloured reproduction of the portrait of F. R. Spofforth painted by H. S. Tukey, A.R.A. C. G. K.

THE POSITION OF AGATHOCLES DURING THE ECLIPSE OF B.C. 310 AUGUST 15.

ON B.C. 310 August 14 Agathocles left Syracuse by sea; at eight o'clock on the following morning he saw a total eclipse of the sun. His exact position is therefore of extreme interest to astronomers. Unfortunately, the course that Agathocles steered is not directly stated. The present paper is an attempt to piece together the various clues contained in the narratives.

We may first briefly glimpse at the way in which Airy handled this question (Phil. Trans., 1853, p. 188). It appears that on August 20, after a six days' voyage, Agathocles landed in Africa at a place that Airy identifies with Alhowareah. Supposing that he went direct, the distance travelled in six days would be 200 miles; if he went round Sicily the distance would be 330 miles. Airy therefore marks off on a map thirty-three miles in a southerly direction and fifty-

five miles in a northerly direction. He labels these positions as the "possible southern position" and "possible northern position," and he states in the text that the northern position is the more probable, partly because the distance is greater, and partly because the provision ships mentioned in the narrative probably came from Gela in the south.

To us, however, it appears totally incredible that Agathocles, after running from a superior enemy for twenty-four hours or thereabouts, should have been within fifty-five miles of his starting point. We will now proceed with our own attempt to reconstruct the situation.

The first point is that Agathocles started early in the morning, and to that extent had the more time in which to get to a distance from Syracuse. This is proved by an expression in the narrative of Diodorus:—"After six days and an equal number of nights, as dawn appeared" (*ἔξ δ' ἡμέρας καὶ τὰς ἴσας νύκτας αὐτῶν πλευσάντων, ὑποφαινούσης τῆς ἑω*). We have no wish to strain this expression to imply that he started at the exact instant of dawn on August 14. It clearly, however, implies that Agathocles was at sea for so great a part of August 14 as to render the phrase "six days and an equal number of nights" more exact than "five days and six nights."

Our second point is that Agathocles had a fair wind. We prove this as follows:—The Carthaginian fleet was blockading Syracuse, when some provision ships appeared in the neighbourhood. The Carthaginians went to attack the provision ships; Agathocles escaped from Syracuse; the Carthaginians left the provision ships and pursued Agathocles; the provision ships then entered Syracuse. It must be remembered that warships could be rowed, and that merchant vessels could only sail; and also that so late as the time of Nelson the power of beating to windward practically did not exist. The mere fact that the provision ships entered Syracuse therefore establishes the fact that the wind was favourable, both for the provision ships approaching Syracuse and for Agathocles flying from Syracuse; but other considerations will prove the same point. The Carthaginians, by leaving the provision ships when they had all but seized them (*πλησίον ἦδη τῶν φορηγῶν ὄντες*), clearly had no intention of letting Agathocles escape. Before going to attack the provision ships they probably argued that the occasion would find Agathocles utterly unprepared, and that by the time he had put his men and stores on board they would themselves be back again. Now a stern chase is proverbially a long chase (and, moreover, would have taken them out of sight of Syracuse), and the Carthaginians could not have entertained hopes of getting back in time unless the provision ships lay to windward of them. Even as it was, Agathocles was ready for his opportunity. His men, we are expressly told, had been on board for some days (*πληρώσας ἐξήκοιτα ναῖς ἐπετήρει καιρὸν οἰκείον πρὸς τὸν ἔκπλουον*), and he got to sea at exactly the right moment, that is to say, when the Carthaginians had all but reached the provision ships.

Agathocles therefore had a fair wind, and to that extent it is the more probable that he was at a considerable distance from Syracuse by the next morning.

Two minor points may here be noticed, though they are not essential to our main case. When the sixth day dawned Agathocles found himself in the vicinity of a Carthaginian fleet, not necessarily the same one. He rowed hard towards shore, and by virtue of a long start arrived first, although the Carthaginians were rapidly gaining on him, being more accustomed to rowing than the Syracusans (Justin). Possibly,

therefore, Agathocles owed his escape on August 14 to the fact that he could sail instead of row. If so, his minimum pace would be seven knots, or otherwise he would have rowed, and the Carthaginians would perhaps have caught him. Again, we are ourselves convinced that Agathocles was expecting the appearance of the provision ships. It may be that he was merely prepared for any favourable opportunity, but there is much to prove that he laid his plans very carefully. He had, for instance, put saddles and bridles on board. He could not take horses with him, but he was prepared to use any he might capture on landing. On a subsequent occasion, thinking that the appearance of owls (as birds of good omen) would encourage his soldiers, he set some free, which he had evidently provided beforehand (Grote).

We have therefore established that by 8 a.m. on August 15 Agathocles had been at sea upwards of twenty-four hours, and that he started with a fair wind. He clearly did not stand out to sea more than was necessary, for to do so would be to abandon part of his start. The last and most important question is, therefore, did Agathocles go north or south?

Our third point is that Agathocles went north. Airy has already noted that the provision ships probably came from Gela, on the south coast of Sicily, since that was the only place still, after the battle of Himera two months previously, friendly to Agathocles (Grote). Airy also notes that even 330 miles is a short voyage for six days, and therefore that the longer course is more probable. Airy also makes a third point. "It is stated by Diodorus that the troops before sailing supposed that they were to make an attack either on Italy or on the Carthaginian part of Sicily; and by Justin, that, while on the voyage, they supposed that they were going on a marauding expedition either to Italy or to Sardinia." The passage in Justin is really stronger than as quoted by Airy; the troops did not realise at the time that it was Africa where they had landed (*tunc primum exposito in Africae litore exercitu consilium suum omnibus aperit*); they appear to have thought that they were in Italy or Sardinia, and consequently they must have passed through the Straits of Messina, and subsequently kept out of sight of land until Africa was reached.

If, as we believe, Agathocles had really planned events exactly as they turned out, he would have ordered his partisans at Gela to send provision ships directly there was a strong south wind, and he probably gave them to understand that he would come to their assistance, and that there would be a naval battle, in which the provision ships might turn the scale. Agathocles must have had bitter enemies in Gela, as he had just perpetrated an atrocious massacre there, and we may assume that his partisans there were bound to him by self-interest only, and had no idea of being sacrificed to the Carthaginians merely that Agathocles might escape.

Enough of his false plans had been allowed to leak out to the Carthaginians for them to suppose that he was coming out of Syracuse to give battle; it was only at the last moment that the Carthaginians, and perhaps also the men of Gela, realised that he was merely bent on escape from Syracuse. Meanwhile he had allowed his men to think that they were bound for Sardinia. Had they steered south his men would have thought that Agathocles was not acting according to a prearranged plan, but from hand to mouth as best he could. If they steered north his men would have felt the confidence engendered by seeing everything going according to the programme. If Agathocles had laid his plans beforehand, he would probably have collected information as to

currents in the Straits of Messina, and would have known that, in the early afternoon of the day preceding new moon, there is a five-knot current running northwards (Mediterranean Pilot). This current may possibly have contributed materially to his escape, for he seems to have been hard pressed (*ἀνελεπίστου σωτηρίας ἔτυχε*). If he went northward, it certainly adds ten miles to the distance he would otherwise have traversed by the time that he saw the eclipse.

P. H. COWELL.

SCIENTIFIC INVESTIGATION IN INDIA.¹

THE Board of Scientific Advice was constituted in the year 1902 by the Government of India as a central authority for the coordination of official scientific inquiry, its object being to ensure that the work of research was distributed to the best advantage, that each investigator employed by Government should confine his researches to the subject with which he was most capable of dealing, and that energy should not be wasted by the useless duplication of work or misdirected by a lack of inter-departmental cooperation. It was, more especially, hoped by the Government that the Board would materially assist it in prosecuting research in those questions of economic or applied science which are of direct practical importance, and thus contribute towards the solution of those problems and matters on which the progressive prosperity of the country, more especially as regards its agricultural and industrial development, so largely depends.

The Board includes the Secretary to the Government in the Department of Revenue and Agriculture, which controls and administers the various scientific and semi-scientific departments, and the heads of those departments, including the Surveyor-General of India, the Director-General of Indian Observatories, the Directors of the Geological and Botanical Surveys of India, the Inspectors-General of Forests, of Agriculture, and of the Civil Veterinary Department.

It advises generally upon the operations of the departments, discusses the programmes of work and investigation of each departmental head; submits annually to Government a general programme of research embodying the proposals of departmental heads in so far as their subjects are to be exclusively dealt with in one department, and its own proposals when two or more departments are to cooperate, and also at the end of the year prepares a review stating briefly the actual results of the work of investigation carried out during the previous year in the scientific departments. The programmes and reviews are communicated through the Secretary of State to the Royal Society, which has selected suitable committees to consider the reports and advise Government chiefly on the scientific problems presented or indicated by the reports.

The necessity for some such arrangement has forced itself upon the Government of India with the rapid extension of scientific investigation during recent years. Private enterprise in such work is practically nil in India, and hence Government has to initiate all scientific investigation that is necessary for the well-being and progress of the Empire. India is at the present stage a country with limited resources, the development of which depends upon the application of modern scientific methods and knowledge to pressing economic problems. The heads of Government can gauge the requirements and initiate departments of inquiry and research, and state for

¹ Report of the Board of Scientific Advice for India for the Year 1904-5

their guidance the general problems with which they have to deal. In order to control the work of their scientific experts, and to direct it on utilitarian and practical lines, they have found out that it is desirable to obtain the opinion of their scientific officers as a whole, and of a final independent scientific authority, viz., the Royal Society. In this way the Government secures the cooperation of its whole body of scientific officers, and also the execution of the work of research in the most efficient and economical manner, and on the practical lines which it desires. Research is, in fact, directed to practical problems that require early solution, and is not wasted on inquiries which are only of importance from the theoretical standpoint.

The report is full of interest. It shows the wide range of problems with which the departments dealt in the year 1904-5, and the results of their work.

A series of experiments was carried out during the year at the Cawnpore experimental farm similar to those at Rothamsted. It was, for instance, ascertained that of the 43.3 inches of rain which fell during the monsoon period of 1904, 5 inches were required to make up the evaporation during the previous dry period; about 9 inches were taken up by evaporation during the monsoon, 4 inches ran off the surface during a very heavy fall in September, and the remainder, 25.7 inches, percolated. The records also established that the amount of percolation is proportionate to the rainfall, and that the quantity of water lost by evaporation from the soil is greater during the four months of the monsoon than during the eight months of the dry season. These results are in general accordance with the Rothamsted records, and hence probably apply to the whole of the plain of northern India.

The Geological Department issued during the year the results of a special investigation into the Dalhousie earthquake of April 4, 1905. It was one of the most destructive earthquakes which has visited India for many years. At least 20,000 human beings are estimated to have perished. The shock was sensibly appreciable over an area of 1,625,000 square miles. The main focus was at a depth of from eighteen to thirty miles below the surface in the Kangra district. The larger waves reached Bombay and Calcutta at almost exactly the same instant. As both places are at the same distance from Kangra, the rate of transmission in both directions was the same, viz. 1.98 miles per second. The seismograph records of Kodaikanal indicated a speed of 1.95 miles per second, and the Japanese seismographs 2.05 miles. The results hence apparently indicate that the earthquake waves travelled out to the east and south at a rate of almost exactly two miles per second.

The report of the Survey Department is especially interesting. The following extract gives a very brief account of the survey work carried out in Thibet during and after the expedition. "Triangulation was executed connecting Lhasa with India, and fixing all prominent peaks; the country was surveyed and charted on a scale of 4 inches to the mile; the valley of the Brahmaputra was surveyed from Shigatze to its source; the Manasarowar lake region was surveyed, as also the source of the Gartok branch of the Indus and the Thibetan source of the Sutlej. The work was carried out in the face of many difficulties in a country with an average elevation of 16,000 feet and a climate of Arctic severity." One of the interesting results of the expedition was to establish that Everest is, so far as is yet indicated by exact measurement, the highest peak in the Himalayas. Sir Richard Strachey, one of the greatest authorities on Himalayan geography, suggested many

years ago the possibility of peaks exceeding 30,000 feet awaiting discovery. All recent investigation appears to establish that it is extremely improbable that there is any peak higher than Everest. It was also ascertained during the Thibetan survey that neither in Nepal nor Thibet is Mount Everest known to the inhabitants by any native name.

The pendulum operations of the Survey of India are furnishing results of great interest. By means of pendulum observations the force of gravity can be ascertained at any place, and as conducted by the survey with the greatest care and delicacy, it can be obtained with a probable error of less than 1 part in 100,000 of its actual value. The earliest observations of this class in India were carried out by Major Basevi upwards of thirty years ago in the western Himalayas. The results of his observations indicated that the force of gravity on the lower Himalayas was considerably less than its value as deduced by geodesists from theory. The deficiency in one case, that of Moré, at an elevation of 15,400 feet, was about 1/2000th part of its theoretical value, and equivalent to the reduction of what may be termed the effective level above the sea of Moré to only 700 feet. It was hence inferred that this deficiency was due to an actual deficiency of matter below, and hence generally that the excess of matter forming the Himalayas is probably, as a whole, compensated by a deficiency of matter in the interior of the earth beneath the mountain mass.

Major Lenox Conyngham recently carried out a lengthened series of pendulum observations. The chief results of his work are that there is a deficiency of gravity (that is, the actual is less than the theoretical value) along and over the outer ranges of the Himalayas. The compensation hitherto assumed to exist as a result of Basevi's measurements is shown by Conyngham's observations to be only partial and not complete. Further south, in the Indo-Gangetic plain, the deficiency disappears and is replaced by an excess. Probably when sufficient data are available it may be possible to formulate a theory of Himalayan structure.

Much valuable work was done during the year in the field of agricultural botany. Amongst the subjects of inquiry was that of the possible deterioration of the jute plant in Bengal. It was ascertained that there is not only no proof of any deterioration, but strong evidence that the plant is now precisely as it was a century and a half ago. The best kinds now, as then, if cultivated liberally, yield excellent crops, and their fibre, if properly extracted, is also excellent. Fraudulent watering in the preparation of the fibre is resorted to with the object of fictitiously increasing its weight for sale. The deterioration of the fibre (not the plant) is due to the fact that the demand for good jute exceeds the supply, and hence that inferior fibre is readily purchased.

As showing the value of the cooperation of the Board of Scientific Advice and the advisory committee of the Royal Society, it is sufficient to mention that they both suggested the necessity for increase of officers in the Geological Department in order to carry out the survey of the geology and mineralogy of Burma. The Government of India accepted the suggestion, and recently sanctioned the addition of four officers to the strength of that department.

The Board is, as shown by the report, doing valuable service in India by coordinating and promoting scientific work, and it is much to be wished that the English Government would adopt some similar plan, and revise the scheme of operations of its chief observatories at Greenwich, Kew, and South Kensington.

NOTES.

THE Bureau des Longitudes of France has decided to send to Samarkand a scientific expedition to observe the eclipse of the sun which will be visible in Central Asia on January 13, 1907. M. Stefanik, astronomer attached to the Meudon Observatory, who accompanied the director, Dr. Janssen, in the expedition for the observation of the solar eclipse of August, 1905, has been selected as the chief of next year's expedition. M. Hansky, of the Pulkowa Observatory, will join him at Samarkand, and will be in charge of the Russian expedition for the same eclipse. M. Stefanik, who is now completing his preparations for departure, will take a kinematograph to reproduce the principal scenes of the observation of the eclipse by the French, Russian, and other missions.

WEATHER prophecy in the United States promises to make a distinct step in advance with the commencement of November. Arrangements have been made with the Central Physical Observatory at St. Petersburg for reports practically covering the great land area lying between the Russian capital and the Pacific—a region embracing nearly one-half the girth of the globe. Cable communications with Iceland, together with the facilities now afforded for weather messages by wireless telegraphy, will complete the information for the entire zone of the earth's atmosphere. These facilities will enable the U.S. Weather Bureau to extend considerably the area covered by its present forecasts, and to issue them for a longer period in advance. In winter, which is the stormy period of the year, Iceland embraces about the centre of the Atlantic low-pressure area, and the barometer changes experienced will afford much useful information. Indian meteorologists have long gauged the importance of the weather conditions over Asia for the framing of long-period forecasts, and a careful study of the minor atmospheric changes over-riding the more permanent seasonal conditions of this vast continent will doubtless aid much in advancing our knowledge of atmospheric circulation.

REFERENCE has already been made (October 11, p. 591) to the banquet given to Sir William Perkin in New York on October 6. *Science* of October 19 contains a paper read on that occasion by Dr. Hugo Schweitzer describing the influence that the discovery of the mauve dye has had upon the progress of chemical science, and a report of Sir William Perkin's own account of the discovery of this dye and the development of the coal-tar colour industry started by it.

THE *British Medical Journal* announces that a congress of practical hygiene will be held in Paris on March 26-31, 1907, under the presidency of Prof. R. Blanchard. The work of the congress, which will deal with food, alcoholism, the rearing of children, the workshop, country life, and the colonies, will be distributed among eight sections. The general secretary of the congress is M. Schær-Vézinet.

BEFORE leaving South Africa, Sir David Gill, K.C.B., F.R.S., who will retire in February next after occupying the post of Astronomer Royal at the Cape since 1879, was entertained at a farewell dinner. Science, art, politics, literature, commerce, and other spheres of human activity were represented, and many testimonies were borne to the services rendered to science and to South Africa by Sir David Gill. The Hon. E. H. Walton, in proposing the toast of "Our Guest," referred to the active part taken by Sir David Gill in founding the Association for the Advancement of Science in South Africa, his work in

laying the foundations of a complete, accurate survey of the Cape peninsula, and his contributions to the progress of astronomical science by observations at the Cape Observatory established by him. In his reply, Sir David Gill took the opportunity to insist that all progress in the arts has followed the pursuit of pure science, and incidentally directed attention to his own efforts in organising new work and in urging the Government to provide funds to carry out necessary improvements.

THE *Home and Counties Magazine* for October contains an article, with portrait, on "Peter the wild boy," who was found in the forest of Hertswold, near Hanover, in 1725, and was brought to this country by order of Queen Caroline in the following year. After ineffectual attempts had been made to get him to speak and to educate him, he was ultimately established, first at one and then at a second farm near Northchurch, Herts, where he died in 1785. The current statements as to his great climbing powers and his habit of going about on all fours were denied by the then headmaster of Berkhamsted Free School, to whom Peter was well known. Various matters connected with local history, architecture, church-plate, monumental brasses, &c., form the subjects of the other articles in the same issue.

IN the course of an address delivered at the eighteenth annual meeting of the Association of Economic Entomologists, and published in Bulletin No. 60 of the Entomological Section of the U.S. Department of Agriculture, Mr. H. Garman alluded to the prominent position now occupied by the economic entomologist. He it is, the speaker claimed, who has enlisted the attention of the public and educated it to the importance of entomology as applied to agriculture and other human concerns. "The pure science worker would never have done this, and it thus has happened that the entomologist who was at one time looked down upon by his fellow-worker with something in the nature of disdain, has taken first place in the estimation of the general public and demands attention when the recluse laboratory worker gets little consideration. And this is as it should be. The economic entomologist can claim all entomology as his." The rest of the issue is mainly devoted to an account of the work of the U.S. Bureau in fighting insects injurious to man and cattle, or harmful to crops and trees in the United States and its dependencies. The attention of those concerned may be directed to the fact that, on account of preoccupation, the generic term *Pyrosoma* (see p. 17 of the Bulletin) is not available for the organism of Montana spotted fever.

Two additions to the literature arising out of the British Association visit to South Africa have recently reached us. One is a small illustrated handbook by Dr. Haddon, F.R.S., published by the Union Castle Company, and dealing with the general features of South Africa and his impressions formed during the visit. The other is a contribution by Mr. C. F. Rousselet on the Rotifera of South Africa in the *Journal of the Royal Microscopical Society* for August. It contains lists of all the known species of South Africa. As the author points out, collecting, except at such places as the Victoria Falls, was difficult owing to the shortness of the visit and the general dryness of the country, but if one may judge from the large ratio which Mr. Rousselet's specimens bear to the total number of recorded species there must be plenty of work for any residents who will search for ponds and ditches in any part of South Africa. On the ship, going and coming, Mr. Rousselet took daily observations of the plankton contained in the hose-water.

"EDIBLE Earth in New Guinea" is the title of a communication by Mr. W. Meigen published in *Briefe der Monatsberichte der deutschen geologischen Gesellschaft* (1905, pp. 557-564). The earth in question is found on the east side of New Mecklenburg, where it is associated with decomposed coral; its main constituents are oxides of silica and aluminium; there is a smaller quantity of ferric oxide and traces of other substances, including ammonia. Mineralogically, the earth is composed of kaolin, hydrargillite, and ferric oxide; it is a fatty clay of yellowish colour, not unpleasant to the taste, and composed of very small particles. It is used for medicinal purposes, and may well counteract the laxative effects of the fish diet of dwellers on the coast. The article mentions the more important previous contributions to the discussion of the question of edible earths, of which, however, but few analyses have been published. A recent paper was noticed in *NATURE* of September 27 (p. 543); in vol. xxxiii. of the *Journal of the Royal Society of New South Wales* was published the analysis of some kaolinite from Fiji.

THE Bulletin of the Johns Hopkins Hospital for October (xvii., No. 187), in addition to articles of medical interest, contains an account by Mr. D. I. Macht of Moses Maimonides, a celebrated Jewish philosopher of the thirteenth century, who was physician to the Sultan Saladin and his successor, and the author of many religious, philosophical, and medical works. In his "Ethics" a complete system of practical hygiene is given which would well compare with the most recent text-books on the subject; lack of exercise, over-eating, alcohol, and excess are summarised as the causes of most diseases. Dr. T. R. Boggs describes a simple method for the quantitative estimation of the proteids in milk. The diluted milk is precipitated with phosphotungstic acid in hydrochloric acid solution, and the volume of the precipitate is read off in an ordinary Esbach albuminometer tube as used in wine analysis. The method is accurate to within 0.3 per cent. to 0.7 per cent., according to controls made by Kjeldahl determinations.

As agriculture in the Virgin Islands is dependent upon small cultivators, progress is hampered by the want of capital. In the annual report for 1905-6 of the experiment station maintained at Tortola, the curator, Mr. Fishlock, notes that the peasants are gradually realising the advantage of planting such permanent crops as cacao, limes, and rubber. The department also fosters cotton cultivation by supplying seed, buying seed-cotton, and preparing the lint for market.

THE July number of the Trinidad Bulletin contains the annual report for the past year, by Mr. J. H. Hart, on the Botanical Department. Seedling canes, rubber, and cacao form the largest items under plant distribution; there was also a considerable demand for young trees of Honduras mahogany, *Mimusops globosa*, that furnishes *balata*, and *Cedrela odorata*, the West Indian cedar. With the view of popularising its cultivation, a large number of plants of *Coffea robusta* was given away. In a note on the nests of Trigona bees, it is observed that the peculiar trumpet-shaped entrance is connected with the danger to returning bees of being caught by a spider that lurks near the opening.

THE second number of the Memoirs of the Department of Agriculture in India is devoted to the subject of Indian wheat rusts. Three distinct species, *Puccinia graminis*, black rust, *Puccinia glumarum*, yellow rust, and *Puccinia triticina*, orange rust, are commonly found. It was observed in 1904 that the first was most rampant in Central

India, while the latter two predominated further north, and therefore nearer the district where barberries are found. The authors, Mr. E. J. Butler and Mr. J. M. Hayman, have at present no explanation to offer for the origin of the disease year by year. The results obtained by inoculating barley with rust spores taken from wheat plants and *vice versa* show a considerable degree of specialisation, as very few of the inoculations succeeded.

THE superintendent of the Indian Museum, Calcutta, mentions in his annual report for the year 1905-6 that a number of Tibetan and Bhutanese specimens, chiefly robes, brass ware, and religious objects, was added to the art and ethnological collections, also various agricultural instruments from Assam. The report of laboratory work by Mr. D. Hooper contains, as usual, several interesting analyses. From the shoot of the common bamboo a food product is prepared, known in Assam as *gass-tenga*, that is eaten with rice; this contains an acid similar to aspartic acid that is probably derived from asparagin. Specimens of the bark of *Picrasma javanica*, used by the Karens as a febrifuge, yielded a bitter principle allied to quassia. The analyses of latices from a number of different species of Ficus show that of those examined *Ficus elastica* alone furnishes rubber of commercial importance.

ATTENTION is directed in the *Journal of the Society of Arts* (vol. liv., No. 2812) to the soda lakes of Mexico on the great desert south of Yuma. These vast lakes of crystals of carbonate of soda are within 3000 yards of the sea. They are the property of the Mexican Government, and it is believed that they may become sources of enormous income to the country.

THE British Commercial Agent in the United States reports that the plan of storing coal under water is being adopted at a new plant west of Chicago. Twelve large cement-lined pits have been constructed with a bottom of clay soil. Their storage capacity is 14,000 tons. A 12-inch water pipe opens to the pits near the top, so that the coal can be flooded when required.

In the *Engineering Magazine* (vol. xxxii., No. 1) Mr. Alfred Sang urges the practical value of industrial museums as exemplified by the Conservatoire des Arts et Métiers in Paris, and what was originally the Patent Office Museum at South Kensington. While satisfactory results must depend upon a board of management composed of experts in the various branches of science and of industry represented, the author gives examples of exhibits that would prove of special benefit to students.

In the *Journal of the Franklin Institute* (vol. clxii., No. 4) Prof. Alfred J. Henry, of the U.S. Weather Bureau, gives an account of weather forecasting by synoptic charts. The method is based on two well-established facts, the general eastward drift of the atmosphere in temperate latitudes in the northern hemisphere, and the close relation that subsists between the weather and the distribution of atmospheric pressure. Within recent years there has been an appreciable gain in the accuracy of the forecasts. The period covered by the forecasts has been extended from eight to forty-eight hours, and instead of forecasts expressed in very general terms for large areas, definite forecasts are now made for all the larger towns and for each of the States and territories. The most important gain however, is in the adaptation of the forecasts to the needs of special industries, the perfection of the system of flood warnings, and the general improvement in the warnings of severe storms and cold waves.

THE second part, dealing with labour, of the General Report on Mines and Quarries, has been issued by the Home Office as a parliamentary paper (Cd. 3179, price 10d.). It shows that the total number of persons employed at British mines and quarries in 1905 was 982,343, of whom 887,524 were employed at mines and 94,819 at quarries. During the year, 1103 separate fatal accidents occurred at mines and quarries, causing the loss of 1304 lives. Compared with the previous year, there is a decrease of fifty-five in the number of fatal accidents, and an increase of 102 in the number of lives lost. The general death-rate from accidents at mines was 1.358 per 1000 persons employed. Of the fatal accidents at mines, 44.0 per cent. were caused by falls of ground. Five fatal accidents were caused by the use of electricity underground. A very unusual accident is reported at Llanhilleth Colliery, where one man was killed and six men injured by the sudden blast of air caused by a fall from the side of a cavity. Some interesting statistics are given showing that gunpowder constituted more than 67 per cent. of the total weight of explosives used in collieries. About 30 per cent. of the weight used consisted of permitted explosives, those most largely used being bobbinite, saxonite, ammonite, roburite, and westfalite. Other statistics show that there were 295 collieries where coal-cutting machines were at work, the total number of machines being 946. The total quantity of coal obtained by the aid of these machines in 1905 was 8,102,197 tons.

WE have received from the director of the Geological Commission, Cape Town, South Africa, the first separately issued sheet of the geological map of Cape Colony. The geology is by the director, Mr. A. W. Rogers, Mr. E. H. L. Schwartz, and Mr. A. L. Du Toit. The colour printing is clear, and there is not too much detail. The size of the imprint is 21½ inches by 27 inches; the scale is 1 inch = 1600 Cape rods, which is equivalent to about 3.7 miles to the inch. The commission is to be congratulated upon the production of an excellent map.

PART I., vol. xxxiv., of the Records of the Geological Survey of India contains two reports upon occurrences of coal, one in the foothills of Bhutan, by G. E. Pilgrim, the other in the Kotli Tehsil of the Jammu State (Dandli coalfield), by C. M. P. Wright. Mr. Pilgrim contributes also some notes on the geology of Bhutan; Dr. Diener supplies notes on some fossils from the Halorites limestone of Bambanag Cliff, in which he describes a new genus, Martolites, near to Celtites of Mojsisovics, and a new species of Halorites, *H. trotteri*. He also describes the Upper Triassic fauna of Pishin. In the appendix, analyses are given of three samples of muds from the Travancore coast.

THE *Rendiconto* of the Bologna Academy is sometimes rather late in appearance, but the three last numbers (1902-5) contain one or two papers of more than passing interest. Prof. Guido Tizzoni, in the name of Dr. Bongiovanni, read a note on the influence of radium on the virus of rabies. It was shown that radium rays rapidly destroyed the virus, both when contained in tubes and when applied to animals within an hour or so of their infection, and methods were found by which animals already suffering could be cured with certain results. The previous number (vol. viii.) contains an account of the botanical results of the two scientific expeditions to Montenegro organised by the Italian Government in 1902 and 1903.

A PAPER by M. Edouard Collignon on the solution of the cubic equation is published in abstract in the Proceedings of the Edinburgh Mathematical Society, xxiv. (1906). It is based on the property that every cubic can be reduced to one of the three forms $x^3 = \text{constant}$ or $x^3 \pm x = \text{constant}$. By tabulating the values of $x^3 + x$ and $x^3 - x$ for different values of x , the roots may be found in the same way that antilogarithms are taken from a table of logarithms. The properties of the roots are discussed in connection with the graphs of $x^3 \pm x$, and it will be noticed without going further into the details of the paper that the turning points of the curves determine very simply the conditions for three or one real roots. The author examines how far a similar method is applicable to curves of higher degree.

WE have often directed attention to the excellent series of monthly volumes entitled the *Practical Photographer*, edited by the Rev. F. C. Lambert, and published by Messrs. Hodder and Stoughton. It was found that the size of page was rather too small to show off effectively the fine reproductions from well-known photographs which were a distinct feature of the series. In April last the size of page was doubled, and since that date we have received the monthly issues, which indicate the wise policy of such a change. The present series is now termed the *Practical and Pictorial Photographer*, and is issued as a library series, the price being the same as the previous volumes, namely, one shilling. The October number is full of interesting matter, and is illustrated by seventeen reproductions.

FROM Messrs. Newton and Co. we have received a simple convex lens of 2.5 inches diameter, having a focal length of about 6 feet. On a small portion of the periphery of the lens is firmly sealed a metal base carrying a small screw, which enables the lens to be easily fixed to the end of a walking-stick or umbrella. The lens and attachment are enclosed in a neat leather case, which can be comfortably carried in the waistcoat pocket. This "unilens," which has recently been patented by Major Baden-Powell, serves the purpose of a low-power pair of opera-glasses without the trouble of carrying them. The use of such a lens in this manner is not new, but the present form of mounting will make it of more general service than hitherto. Those who possess approximately normal eyesight would find great comfort in having ready at hand such an easy means of magnifying distant objects. When placed on the end of a stick, and the latter held out at arm's length, the object observed is seen at the greatest magnification, and even at less distances the object is always in focus, but not so much enlarged. The simplicity and portability of this "unilens" should find favour with many who are in search of a pocket telescope.

THE first part, comprising no less than 1437 titles, of a valuable catalogue of important works, chiefly old and rare, on mathematics, astronomy, physics, chemistry, and kindred subjects, has just been issued by Messrs. H. Sotheran and Co. This "Bibliotheca Chémico-mathematica" will be completed in three or four parts, which will be issued at intervals of a few months each. The part just received has on the first page works by Ernst Abbe, Abel, and Abercromby, and the last titles are of works by Galileo. Among numerous other volumes and memoirs included in the catalogue are a copy of the very rare first edition of the great work of Copernicus, "*De Revolutionibus Orbium Cœlestium*" (1543), which commenced a new epoch in the history of astronomy; the first

printed edition of Euclid's "Elementa Geometriæ" (1482); the first edition of de Caus's "Les Raisons des Forces mouvantes" (1615), to which, according to Arago, is due the invention of the steam engine; Daguerre's description of his invention of the Daguerreotype process of photography (1839), and the earliest works on ballooning. Bibliophiles and librarians looking out for scientific works of great rarity and interest, or for volumes of Proceedings of scientific societies and standard books on the exact sciences, will find it an advantage to consult the interesting catalogue the first part of which Messrs. Sotheman have just published.

MESSRS. GEORGE PHILIP AND SON, LTD., will shortly issue a novel perpetual calendar invented by the Rev. J. W. Wiles. It is claimed that by a simple arrangement the calendar will show the day of the week of any day in any year from the beginning of the Christian era to the end of time.

MR. W. A. SHENSTONE, F.R.S., has revised, and in some instances amplified, the essays he recently contributed to the *Cornhill Magazine*, and they will be published by Messrs. Smith, Elder and Co. to-morrow under the title of "The New Physics and Chemistry: a Series of Popular Essays on Physical and Chemical Subjects."

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., will publish very shortly a volume by Prof. E. Ray Lankester, F.R.S., entitled "The Kingdom of Man," containing a statement of the present position of scientific knowledge and the promise of the future.

THE second quarterly number of *Science Progress in the Twentieth Century* has now been published by Mr. John Murray. The ten articles included in this issue of the new scientific quarterly review range over many departments of science, and should appeal to a wide circle of readers.

THE first parts of two works of science which are being published serially by Mr. Fritz Lehmann, Stuttgart, have been received. "The Macrolepidoptera of the World," by Dr. Adalbert Seitz, is to be completed in 100 parts, and "Das Mineralreich," by Dr. Reinhard Brauns, in seventy-five parts. Both works are illustrated by excellently produced coloured plates. Messrs. Williams and Norgate are the agents of the publishers in this country.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER:—

- Nov. 5. 11h. 24m. to 12h. 34m. Moon occults ν Geminorum (mag. 4.1).
 9. 9h. Mercury at greatest elongation (E. $23^{\circ} 0'$).
 10. 12h. 17m. to 13h. 33m. Transit of Jupiter's Sat. IV. (Callisto).
 11. 7h. 15m. to 10h. 15m. Transit of Jupiter's Sat. III. (Ganymede).
 15. Saturn. Major axis of outer ring = $41'' 27$; minor $4'' 64$.
 " 9h. 33m. Minimum of Algol (β Persei).
 15. Venus. Illuminated portion of disc = 0.070 ; of Mars = 0.959 .
 15-16. Epoch of November Leonids (Radiant $151^{\circ} + 23^{\circ}$).
 17-21. Epoch of November Andromedids (Radiant $25^{\circ} + 43^{\circ}$).
 18. 6h. 21m. Minimum of Algol (β Persei).
 18. 10h. 45m. to 13h. 46m. Transit of Jupiter's Sat. III. (Ganymede).
 19. 5h. 30m. to 6h. 34m. Moon occults σ Sagittarii (mag. 3.9).
 25. 14h. 11m. to 17h. 12m. Transit of Jupiter's Sat. III. (Ganymede).

NO. 1931, VOL. 75]

GREENWICH OBSERVATORY AND THE POWER STATION.—At the meeting of the Astronomische Gesellschaft recently held in Jena (September 12-15) Dr. Foerster directed attention to the erection of the large generating station near to Greenwich Observatory, and the consequent interference with the work of the institution. After Prof. Dyson had described the unfavourable position in which the observatory is situated, a resolution having the following effect was passed:—That the convention of the International Astronomische Gesellschaft, meeting in Jena, in view of the communication made in the latest report of the Greenwich Observatory, expresses the hope that the loss which would be occasioned if the observatory were removed may be averted. The resolution also expressed the hope that, as Greenwich has succeeded in establishing itself as the standard place, all future proposals to remove it may likewise be averted (*Astronomische Nachrichten*, No. 4127).

LUNAR CHANGES.—In No. 588 of the *Astronomical Journal* Prof. W. H. Pickering discusses Mr. Stebbins's observations of the lunar crater Linné, made during the eclipse of the moon which took place on February 8, 1906, and compares them with the similar observations made at the same time by Prof. Frost. Although some slight doubt exists as to the precision of one or two of Mr. Stebbins's measures, the curve showing the change in diameter of the spot surrounding Linné, according to his observations, agrees in general with the similar one obtained by Prof. Frost. Both show a substantial increase in the diameter immediately after the passing of the earth's shadow. Prof. Pickering ascribes this increase of diameter to the deposition of hoar-frost, or something analogous to it, caused by the drop in temperature consequent upon the screening off of the sun's rays by the opaque body of the earth. This phenomenon has now been observed by six observers working quite independently, several of whom were originally prejudiced against it, therefore Prof. Pickering considers that it may be accepted as confirmed.

The variation of the diameter of the spot during the ordinary course of lunation has similarly been confirmed by several observers, one of whom, Dr. C. W. Wirtz, discusses his observations at some length in No. 4118 of the *Astronomische Nachrichten*.

ECLIPSE OBSERVATIONS.—In No. 9, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani*, Prof. Riccò concludes his account of the eclipse observations made by the Italian expedition to Alcalá de Chivert in August, 1905. Among other matters he discusses "white prominences," and describes those seen during the eclipse in question as faint and indistinct, especially in the lower parts, and appearing as little more than a whitish shadow projected on to the background of the corona. He also suggests that these objects are in nature somewhat of an intermediate stage between the prominences and the true coronal streamers.

Estimating the height of the various layers of the solar atmosphere by two independent methods, Prof. Riccò found that that which he calls the "reversing layer," or the stratum producing the so-called "flash spectrum," extends to some 3" or 2000 km. (1250 miles). That part of the chromosphere which emits D₃ and F especially has a height of about 7" to 9", whilst the calcium vapours of the chromosphere extend to about 15" from the base. Photographs taken on special plates with a prismatic camera show that the maximum brightness of the continuous spectrum of the corona occurs in the yellow and red regions.

THE ZODIACAL LIGHT.—During the past summer Prof. Barnard, at the Yerkes Observatory, made a number of observations of the zodiacal light, the results of which he now publishes in No. 2, vol. xxiv., of the *Astrophysical Journal*. On June 22 he paid special attention to the phenomenon, and found it to be much more extensive than he had previously supposed. He concludes that the light extends at least 65° north and south of the sun (assuming the southern extent to be the same as the northern), a value considerably larger than that arrived at by Prof. Newcomb, observing in Switzerland, in the summer of 1905.

THE MIRA MAXIMUM OF 1906.—In No. 4110 of the *Astronomische Nachrichten* Prof. Nijland publishes the results of his observations of Mira made during the period August 24, 1905, to February 24, 1906. The curve accompanying the paper shows that a sharp maximum occurred on January 3, when the star's magnitude was 3.9. This was preceded by a very flat minimum of about the ninth magnitude, extending from the commencement of the observations until November 9, 1905, and then a steep ascent to the maximum. The lowest magnitude, 9.05, occurred on September 23, 1905.

METEOROLOGY OF THE NILE VALLEY.¹

THE Egyptian Survey Department, constituted some years ago, is adding largely and rapidly to our knowledge of the hydrography, geology, and meteorology of the Nile basin. The director-general, Captain Lyons, R.E., has prepared and issued a monograph dealing very fully with the physiography of the Nile basin. In this work, which was reviewed in NATURE of September 6 (vol. lxxiv., p. 461), he combines the results of former observers and investigators with the data accumulated during the past ten or twelve years by his department. It is a storehouse of information relating to that most remarkable, and until recent years most mysterious, of rivers.

We propose to give a brief statement, based on the information contained in the monograph, of the more important features of the meteorology of the Nile Valley and their relations to the physiography of the whole area.

The river obtains its supplies from two collecting areas, one the equatorial lake plateau (between lat. 5° S. and lat. 5° N., and long. 28° and 35° E.), and the second the Abyssinian mountain and plateau area (between lat. 7° N. and 14° N., and long. 35° and 40° E.).

The former is the larger catchment basin, and includes the Victoria, Albert Edward, and Albert Lakes, which serve as reservoirs to store the rainfall of the whole region. The Victoria Lake (equal in area to Scotland) is about 4000 feet above the sea, and is slightly lower than the mean level of the plateau. The ground rises slightly to the south and east, and rapidly to the west to the elevated peaks of Ruwenzori, which separate it from the rift valley, in which are situated the Albert Edward and Albert Lakes connected by the Semliki River. The catchment area of the Victoria Lake is only of comparatively small extent, not more than twice the area of the lake, the level of which hence varies very slightly with the season. The Victoria Nile, which issues from the north of the lake, is precipitated over the Ripon Falls, and thence passes over flat, marshy ground to the Choga Lake Swamp, and descends by a series of rapids, and finally by the Murchison Falls, to the lower level of the Albert Lake at its northern extremity in lat. 2½° N.

The Albert Edward and Albert Lakes, with their tributaries, appear to collect a larger volume of water than the Victoria Lake. The Victoria Lake discharges by the Victoria Nile a nearly constant amount, averaging 500 cubic metres per second, and the Albert Lake amounts varying between 500 and 1100 cubic metres per second.

The discharge of the lake system is carried off northwards from the Albert Lake by the Bahr-el-Jebel, or Albert Nile, as it is called by Sir William Willcocks. It descends rapidly from a level of 2300 feet to 1500 feet at Gondokoro (lat. 5° N.), in a narrow channel with numerous falls and rapids, and thence to Lake No (lat. 9½° N.) through an extensive flat and swampy region. It is joined at Lake No by the Bahr-el-Gazal, and about eighty miles further down stream by the Sobat. The former drains a large portion of the Soudan, its head-waters being chiefly in the equatorial belt. The Sobat is formed partly by drainage from the same belt and partly from the southern face of the Abyssinian plateau.

Between Lake No and Khartoum, the main stream is now known as the White Nile. The discharge of this river below Lake No varies to a slight extent during the year, and averages only 350 cubic metres per second, and hence considerably less than the supply passing into the

¹ "The Physiography of the River Nile and its Basin." By Captain H. G. Lyons, R.E., Director-General Egyptian Survey Department.

river from the Albert Lake. The difference represents the loss by evaporation in the extensive swamp region through which these streams flow. That of the Sobat is only considerable during the rainy season, from April to December, ranging between 380 cubic metres and 1470 cubic metres per second. The White Nile below the junction of the Sobat (lat. 9½° N.) to Khartoum (lat. 15½° N.) receives no affluent, and flows in a broad valley as a wide stream of moderate velocity. This part of the Nile plays a subordinate but important rôle with respect to the Nile floods. From May to September the flood water brought down by the Sobat River is ponded up or held back in this reach of the Nile, and hence does not contribute to the Lower Nile flood. Captain Lyons states that this action stores up an average of about 1500 million cubic metres from the Sobat flood, which is supplied to the Nile in October, November, and December, thus prolonging the period of the Nile flood, and delaying the fall of the Nile to its low-water stage.

The main flood water of the Nile is brought down by the Blue Nile and the Atbara from the Abyssinian plateau. The rainfall occurs between June and September, and is immediately discharged down the hills into the valleys, the greatest portion down the Blue Nile, which joins the White Nile (there forming the Nile) at Khartoum. The maximum flood of the Blue Nile is about 12,500 cubic metres, and of the Atbara 5000 cubic metres, per second.

The Nile flood proper is hence due solely to rainfall in the Abyssinian and adjacent Soudan area. It commences in June, and reaches its maximum about the end of August or beginning of September. The maximum height of the Nile flood, or the total discharge during the flood period, may hence be accepted as a measure of the total rainfall over that area, just as the variations of the Victoria and Albert Lakes represent the seasonal variations of the rainfall in their catchment areas.

The Nile below the junction of the Atbara (lat. 18° N. to lat. 34° N.) receives no affluents, and flows in a comparatively narrow valley, over which the flood waters, with their rich alluvial contents, are distributed by means of a vast system of canals.

The Nile basin may hence be divided into three areas or regions, not differing greatly in breadth from south to north. The most southerly is the equatorial lake belt between lat. 5° S. and 5° N., an intermediate region between lat. 5° N. and lat. 18° N. includes the Soudan and Abyssinia, and the northerly region comprises the lower Nile basin from lat. 18° N. to the Mediterranean in lat. 34° N. The low river supply (January to May) is chiefly due to discharge from the equatorial lake area, and the summer flood supply to discharge from the Abyssinian region.

The following gives a sketch of the more important features of the meteorology of the Nile basin, based on the important information and data of Captain Lyons's monograph.

Temperature is remarkably uniform in the equatorial lake region. Thus at Entebbe, on the north shore of the Victoria Nyanza, it ranges only between a mean of 72°·7 in January and 70° in July. In the Nile basin north of about lat. 5° N. temperature is lowest in January, and attains its maximum in May in the southern half of the valley south of Khartoum, and in July in Nubia and Egypt. The annual range of temperature increases northwards from the equatorial belt to northern Egypt. The greater part of the Nile basin is within the tropics, and is throughout the whole year characterised by high temperature. That portion of it between lat. 15° N. and lat. 18° N. (in which are the meteorological stations of Khartoum, Berber, and Dongola) is the hottest and driest area in the Nile basin. It has an elevation of about 1200 feet. To the south is the comparatively damp and cooler region of the Bahr-el-Gazal, the Albert Nile, and the lake plateau, whilst to the north the valley descends slowly to the relatively cool Mediterranean coast. This—the Soudan hot area—is one of the hottest regions in the world. The following gives a comparison of the mean monthly maximum temperature of Berber in that area, and of Jacobabad, the hottest station in India, and also of Massawa, on the Red Sea, in the same latitude as Berber:—

Mean Maximum Temperature.

| | Berber, Lat. 15° N. | Jacobabad, Lat. 28° N. | Massawa, Lat. 15° N. |
|------------------|------------------------|---------------------------|-------------------------|
| January | 86.7 | 73.6 | 84.2 |
| February | 90.0 | 77.9 | 85.3 |
| March | 96.6 | 91.1 | 87.1 |
| April | 106.0 | 103.1 | 90.5 |
| May | 110.5 | 111.6 | 94.5 |
| June | 112.1 | 112.7 | 99.5 |
| July | 108.5 | 107.8 | 101.6 |
| August | 110.3 | 103.8 | 101.5 |
| September | 108.5 | 103.5 | 97.7 |
| October | 104.0 | 98.6 | 95.0 |
| November | 96.0 | 86.8 | 89.6 |
| December | 89.6 | 76.7 | 86.9 |

The data show that at the hottest period, from May to September, the high-temperature conditions are as intense in the Soudan hot area as in Upper Sind, and are more prolonged and persistent. This hot area plays a very important part in the meteorology of the Nile basin. It is throughout the whole year much hotter than Lower Egypt. The difference between the mean day temperature at Berber and Alexandria increases from 8° in January to 16° in April and May. It thence diminishes under the influence of the monsoon rainfall in the Soudan region to 8° in August, and increases to a second maximum (12°) in November. It is undoubtedly due to the presence of this permanent hot area in the central Nile basin that northerly winds prevail almost continuously in the northern half of the basin (*i.e.* north of Berber). The Massawa data also indicate that the hottest portion of the Red Sea is from 10° to 16° cooler during the day hours from March to October than the land area to the west. As the width of the Red Sea in lat. 15° to 20° N. is about 300 miles, it is evident that the presence of this relatively cool area will modify considerably the air movement and pressure distribution in the adjacent land areas, more especially the Soudan comparatively low-lying area.

Much less is known of the pressure distribution than of temperature in the Nile basin. Barometric observations are being taken at a considerable number of stations. When the elevations of the observing stations have been accurately determined by the Survey Department, it will then be possible to give, for the first time, a satisfactory statement of the changes of the distribution of pressure during the year. It is to be hoped that this information will be available in Captain Lyons's monograph on the meteorology of the Nile basin, which we believe he has under preparation. Comparison of the temperature conditions of northern India and of the Nile basin suggest the probable pressure scheme. Pressure in January and the following three or four months is probably lowest in the interior regions of Africa to the south of the equator. An independent local low pressure begins to form in the Soudan hot area in March, and intensifies to some extent in April and May. This low-pressure area limits the advance of the monsoon winds in that region in the same manner that the low-pressure area in Baluchistan and Sind, and the Himalayan mountain barrier, limit the northward extension of the south-west monsoon winds in India. During the period from June to September, an extensive low-pressure area extends from the Soudan across south-west Asia to Upper India, but it is probable that the Soudan depression, due to the local thermal conditions, maintains an independent existence from the Upper India depression, and is separated by a belt of somewhat higher pressure across the Red Sea. This is not confirmed as yet by observation. Captain Lyons, however, indicates in the chart of the mean distribution of pressure in northern and central Africa in July his conviction that a local belt of low pressure stretches across central Africa between lat. 12° N. and 18° N. This either fills up in October and November or is transferred southwards.

The air movement in the Nile basin is on the whole comparatively simple. It is almost continuously from north to the north of lat. 17° or 18° N. (Berber), and is hence a drift up the valley due to permanent temperature and pressure differences between the east Mediterranean and Upper Nile valley. Also in the extreme south of the

basin (in the basin of the Victoria and Albert Lakes) it is, so far as is indicated by the available data, almost equally persistent, but from the opposite direction, that is, from south and south-east. That region is hence, during nearly the whole year, within the sphere of the south-east trades. The movement is apparently for a short period in the early months of the year light, variable, and irregular, but chiefly from north.

The air movement in the intermediate region between the equator and lat. 16° N. to 18° N. is typically monsoon. During one period of the year dry land winds (from the north) prevail, followed during the remainder of the year by humid oceanic winds (from south or west). The influence of the Soudan hot area begins to be shown in March, and winds alternate between northerly and southerly directions in April and May. Thus at Khartoum the percentage of steadiness decreases from about 90 per cent. in January to 40 per cent. in May. In the beginning of June a change similar to that occurring in India in that month is initiated. Steady winds, the continuation of the south-east trade winds, which have previously given heavy rain to the equatorial lake area, prevail during the next three months. The direction of the air movement rapidly changes in proceeding northwards from south to west, determined by the position of the Soudan low-pressure area and action due to the earth's rotation. The current hence advances directly to the Abyssinian mountain or plateau area, the axis of which runs due north and south, its forced ascent over which gives rise to the heavy precipitation over the greater part of the plateau. No rain falls at this time in the Red Sea coast districts on the lee side of the plateau. The plateau hence plays (but much more completely) the same part for the Abyssinian branch of the south-west monsoon current that the West Ghats play with respect to the Bombay branch. This movement holds steadily until September, when the monsoon current contracts southwards, and light, northerly winds extend slowly to the neighbourhood of the equator. There is hence a clearly marked monsoon alternation of winds and of season (dry and wet) in the intermediate area between lat. 5° N. and lat. 18° N.

The distribution of the rainfall in the Nile basin is very clearly exhibited in a series of monthly charts in Captain Lyons's monograph. A chart showing the amount and distribution of the average annual rainfall would have been a useful and valuable addition to the series. Charts of annual or seasonal rainfall are, as a rule, even more valuable for comparison than charts of monthly rainfall.

The air movement has shown that the Nile basin may be divided meteorologically into three areas, *viz.* the area of dominant northerly winds (north of lat. 17° N.), the area of alternating monsoon winds between lat. 17° N. and the equator, and the area of dominant south-easterly winds south of the equator. The rainfall differs greatly in its characteristic features in these three areas. In the northerly region it occurs during the winter months, as in Syria, the Euphrates valley, and the Iran plateau, and is small and very variable in amount. The average annual fall at Alexandria and Suakim is about 5 inches, at Port Said 2 inches, and at Suez $\frac{1}{2}$ inch. In the intermediate monsoon region practically no rain falls from November to April. Thunderstorms occur in May, chiefly in the southern districts, and frequent heavy rain from June to September or October, according to position. The rainfall is heaviest on the western and central portions of the plateau. In the Himalayas the rainfall is, as a rule, heaviest at an elevation of about 4000 feet. The Abyssinian data are too scanty to show whether there is any line of maximum rainfall lower than the level of the interior plateau or higher mountain ranges, where the highest elevations exceed 15,000 feet.

The precipitation in the equatorial lake region has a double maximum and minimum in its annual variation, related, as Captain Lyons points out, to the apparent movement of the sun. The rainfall is small in amount during the period of heavy rainfall in the monsoon region from June to September. It is heavy from October to December, and again in March and April, and is light to moderate during the intervening months of January and February, and moderate in May.

The following summary of the annual rainfall in the Upper Nile basin is taken from Sir William Willcocks's "Nile in 1904." In the catchment basin of the Victoria and Albert Lakes, the mean annual rainfall may be taken as 50 inches, with large fluctuations between good and bad years; over the Albert Nile region it is about 40 inches, with severe droughts occasionally and excessive rain in some years. In the catchment basin of the Sobat River it probably averages 40 inches, and in that of the Bahr-el-Gazal region 30 inches. The rainfall over the Abyssinian plateau may be taken as 50 inches, and in the lower reaches of the Blue Nile and Atbara 30 inches. These are undoubtedly rough estimates, but, so far as can be judged from the exact data given for a number of individual stations in Captain Lyons's work, they are approximately correct values. They also indicate that the mean annual rainfall over the Upper Nile basin differs little from 40 inches. This is a somewhat remarkable result, as it agrees closely with the average rainfall in India, which, according to Blanford, is 42 inches.

The rainfall in the equatorial lake belt resembles in its seasonal distribution that of Ceylon, and that of the intermediate region (the Soudan and Abyssinia) that of western India. In western India, as in the East African monsoon region, the cool and dry season is rainless, with clear skies and light to moderate land winds. The rains in each agree in period, in the comparative suddenness of the change from the dry to the wet season, in the occurrence of almost daily heavy rainfall, and also in the rapid withdrawal of the humid currents at the end of the season. The meteorological data indicate clearly that the rainfall in both areas is due to the rapid extension of the south-east trade winds northwards from the equatorial belt at the same critical epoch, and probably under the same general conditions. There is one very important difference. The monsoon current in the Nile basin does not extend beyond lat. 16° to 18° N., being bounded to the north, not by a range of mountains, but by an area of permanent low pressure during the season, due to thermal actions. It curves rapidly from south to west, and is hence determined directly to the western face of the Abyssinian plateau and mountain masses, which in their highest points attain an elevation of 15,000 feet. The Bombay current in India extends as far northwards as the East Punjab (lat. 30° to 35° N.), where its further progress is barred by the Himalayas. The Abyssinian plateau exhausts the humid current much more completely than the West Ghats, as the rainfall at Massowa and other towns on the Red Sea to the east of the plateau is practically nil.

It would be interesting to determine whether the humid current is converted into a vertical movement over the plateau or whether it continues to march eastwards, and perhaps to contribute to the monsoon rainfall (of the same period) in the mountain region of Yemen, in south-west Arabia.

Captain Lyons has devoted considerable attention to the question of the variations of the Nile flood, and hence of the rainfall in the Nile basin, from year to year. The data show that very large variations occasionally occur amounting to ±35 per cent. of the mean. He infers from the data of years that they do not exhibit any regular cyclical variation, and hence that they cannot be directly correlated with the eleven-year sun-spot period or the thirty-five-year Bruckner period.

It is now, we believe, fully established that Abyssinia, India, and Burma, with the Malay Peninsula, receive nearly the whole of their rainfall from the same vast reservoir and evaporating area, the Indian Ocean and seas, and under the same general meteorological conditions, and by means of the same general air movement. These facts, on the one hand, indicate a probable similarity or parallelism of the seasonal variation of rainfall in all three areas due to general conditions in the contributing oceanic area, and, on the other, an unequal and unlike variation due to variation of local conditions in the three large areas of distribution; also as the rainfall of the Abyssinian plateau is due to the same branch of the monsoon current as that of western India, any parallelism of variation is more likely to be exhibited by these two regions than by either compared with Burma or north-eastern India (dependent on the Bay monsoon current).

The actual variation in any one year will hence be due to the resultant of the general and of the local conditions. It is also probable that the largest variations will be due to the general variation over the whole area of supply. The data furnished by Captain Lyons are, on the whole, in full agreement with these inferences. The most remarkable case of similarity of seasonal variation is exhibited by the data of the past fourteen years. The following gives comparative data of the rainfall of India and of the Nile floods from 1892 to 1905. The former data are obtained from the Indian meteorological publications, and the latter from Captain Lyons's memoir:—

| Year | Ratio of mean actual to normal rainfall in India | Ratio of normal actual to normal Nile flood |
|----------------------------|--|---|
| 1892 | 1'12 | 1'20 |
| 1893 | 1'21 | 0'99 |
| 1894 | 1'15 | 1'22 |
| 1895 | 0'95 | 1'15 |
| 1896 | 0'88 | 1'06 |
| 1897 | 0'99 | 0'89 |
| 1898 | 1'01 | 1'07 |
| 1899 | 0'73 | 0'63 |
| 1900 | 0'99 | 0'89 |
| 1901 | 0'90 | 0'87 |
| 1902 | 0'95 | 0'63 |
| 1903 | 1'05 | 0'89 |
| 1904 | ? below | 0'75 |
| 1905 | much below normal | 0'65 |
| Period 1892-4 | 1'16 | 1'14 |
| " 1895-8 | 0'94 | 1'05 |
| " 1899-1903 } or 1905 } | 0'93 | 0'78 |

It is a noteworthy fact that the Abyssinian rainfall, as indicated by the Nile floods, is subject to much larger range of variation than the rainfall of India, as might perhaps have been anticipated. The data show that from 1892-4 the rainfall in India and in Abyssinia (assumed to be roughly proportional to the total Nile flood) was in considerable excess from 1892-4, about normal from 1895-7, and more or less in defect from 1898 to 1905. The parallelism would have been more exact if the rainfall of western India had been given instead of that for the whole of India. The 1896 drought in India was due chiefly to the weakness of the Bay current, and not of the Arabian Sea current. It may be noted that the data for the variations of the level of the Victoria Lake agree generally with those of the Abyssinian rainfall, as indicated by the Nile floods. Thus, according to Captain Lyons, 1892-5 was a period of high level, 1896-1902 a period of falling level, and 1903 a year of rising level. This remarkable parallelism, strictly in accordance with the general simple inferences stated above, suggests two problems for the consideration of meteorologists. These are, first, the causes of the large variations from year to year of the rain supply over the immense land area of India, the Soudan, and Abyssinia, and, secondly, the determination of any invariable antecedent conditions which may serve as indications and be utilised for forecasting these variations. Captain Lyons in the last chapter of his memoir takes up both of these problems, but acknowledges that his investigations are only in the introductory stage. It is, however, interesting that his present conclusions on the whole agree with those of Indian meteorologists. He shows, for example, that pressure in the Egyptian region is below the normal in seasons of good Nile floods and *vice versa*. This is the usual relation between pressure and rainfall in India, and is also in accordance with theory. Captain Lyons also points out that the monsoon variations of pressure are frequently, if not invariably, the continuation of similar conditions which have prevailed for some time previously. This is also in accordance with Indian experience. He also points out that they are probably in some cases related to the widely distributed variations of pressure studied by Sir Norman Lockyer and Dr. Lockyer, and also to the long-period variations in India. The latter are marked by or accompany prolonged abnormal variations or anomalies of the Indo-oceanic air movement. He also considers that they are occasionally determined by variations in the position and intensity of north-east Atlantic anticyclones. This is by no means improbable, but until more is known

of the actions that determine the displacement of the more or less permanent anticyclones, it is doubtful whether an occasional coincidence could be accepted as sufficient evidence to establish a relation. Some meteorologists, we believe, consider anticyclones to be comparatively inert masses, and others, on the contrary, as sources of action. They are remarkably persistent in position and character, and their variation of position from one period to another in south-western Europe is closely related to the abnormalities of weather. Where theoretical opinions differ so largely it is almost certain that it will require twenty-five to fifty years' data at the least to test the relation between the Abyssinian rainfall and the position of the anticyclone in south-western Europe or the adjacent Atlantic.

NEW PHYSICAL AND ENGINEERING DEPARTMENTS OF THE UNIVERSITY OF EDINBURGH.

THE new buildings for the natural philosophy (Prof. MacGregor) and engineering (Prof. Hudson Beare) departments of the University of Edinburgh were opened

century—a movement which he believed would be conducted with ever-increasing acceleration through the earlier years of the present century. He was glad also to have an opportunity of saying to Lord Elgin that the work he had done as chairman of the Carnegie Trust was a work for which he had earned the gratitude of every man interested in the fate of the Scottish universities, and in the maintenance of the position which Scotland had held for more than 150 years in the world of learning. Proceeding, the Chancellor referred to Dr. Carnegie, whose munificent beneficence to many great causes, and so far as they were concerned, especially to the Scottish universities, was known, and was destined to leave a permanent mark and do permanent good in Scotland.

Sir William Turner, in seconding the motion, referred to the great kindness of Sir Donald Currie, who, he said, had taken a great weight off his mind when he told him he need not be under any difficulty in finding the money to hand over to the municipality for the site on November 11 two years ago. He also desired to thank Sir John Jackson for his generous gifts, and stated that before long he hoped they would be in a position to receive from him a very handsome addition to the Tait memorial fund.

Natural Philosophy Buildings.

The accompanying illustration (Fig. 1) shows the south front of this block of buildings. The building which has been transformed into a physical institute—the old surgical hospital of the infirmary—consisted of a main block 107 feet by 43 feet running nearly east and west, with wings at both ends 62 feet by 38 feet, and a block 71 feet by 51 feet running north towards the new engineering buildings, this north block including at its junction with the main building a tower 89 feet in height. The outer walls have been almost entirely utilised as they stood, with one important exception—on the southern side of the main building, by terracing the ground and piercing the lower part of the wall with large windows, the old dark basement rooms have been converted into lofty, well-lighted laboratories. The interior has been largely reconstructed, and all the floors are now concrete, supported on east and west steel girders.

The principal floor, entered directly from Drummond Street, contains the lecture theatre, apparatus rooms, library, professor's research rooms, &c. The lecture theatre, 45 feet long, 46 feet wide, and 32 feet in height, with seating accommodation for 250 students, is lit entirely from an opening in the roof, and is ventilated by an electric fan. The lecture table is 30 feet long, standing in an experimental area 15 feet wide; it is supplied with hot and cold water, high-pressure water, steam, gas, vacuum, air-blast, oxygen, and a number of electric circuits, and a heliostat has been placed in a window of the apparatus room so as to send a beam of sunlight along it. Opening off the lecture theatre is a preparation room with the necessary work benches; this room contains also the main switchboard, from which current will be distributed throughout the building from the town mains and from the accumulators. The apparatus room has a corridor entrance immediately opposite that of the preparation room; it is intended only for lecture apparatus. On the west side of the apparatus room provision has been made for a smaller lecture room, capable of accommodating about eighty students, and on the ground floor there is another small lecture room for the department of applied mathematics. The library and reading room is 37 feet by 29 feet, with a southern exposure, and opens off the entrance hall.

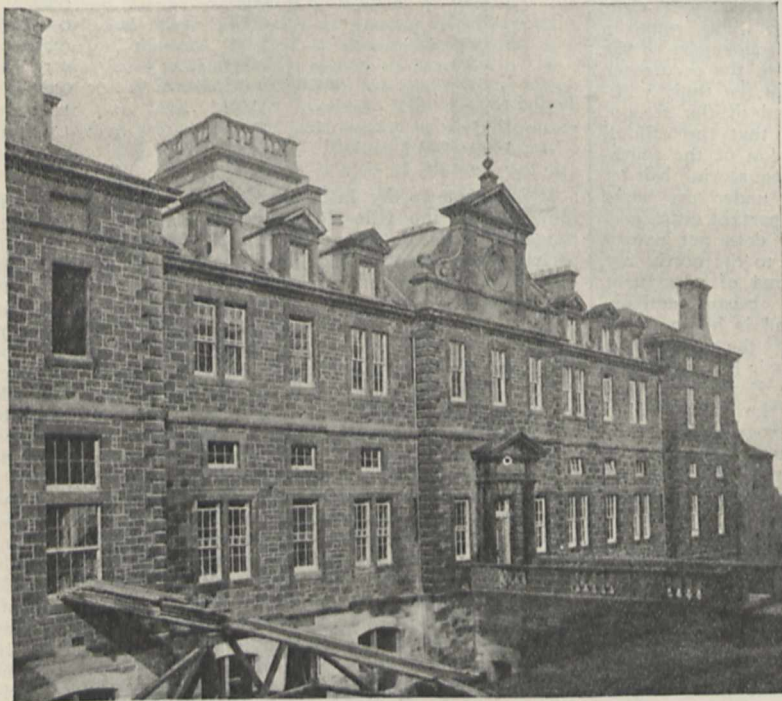


FIG. 1.—South front of new Natural Philosophy Buildings, University of Edinburgh.

on October 16 by Dr. Andrew Carnegie in the presence of a large and influential gathering. The proceedings took place in the large lecture theatre of the natural philosophy department, and were presided over by the Chancellor, the Right Hon. A. J. Balfour. Part of an address entitled "A Plea for Science Teaching," delivered by Dr. Carnegie before declaring the buildings open, was printed in last week's NATURE (vol. lxxiv., p. 648).

The Chancellor then moved a vote of thanks to the benefactors. He was glad to have the opportunity of mentioning the work of the friends and admirers of the late Prof. Tait, who had instituted a fund to encourage research, which he hoped would make these walls illustrious to all time. No more fitting tribute to Prof. Tait's memory could possibly have been contrived. Though Prof. Tait worked in what he could hardly call a laboratory, ill-equipped and wholly inadequate to the work of modern research, yet he left a name which for all time would be associated with the great development of physical knowledge which marked the last fifty years of the recent

The upper floor and the ground floor are devoted to the laboratories and research rooms; the east wing of the upper floor is reserved for arts and science students, and the west wing for medical students. The junior arts and science laboratory has accommodation for forty-five students, and is fitted with tables, benches, and wall apparatus for introductory experimental work; on one side is a long gallery for optical work. The senior laboratory will accommodate forty students, and consists of three rooms for mechanical, thermal, and electrical work, two rooms for optical work, and two for sound. Between these two sets of laboratories is a research room for the chief laboratory assistant, and adjoining them is a small workshop with benches, lathe, glass-blowing table, &c.

On the ground floor are the research rooms; at present only five are to be fitted up; the remainder will be equipped and brought into use as funds permit. These rooms have firm concrete floors, have stone shelves built into the thick, solid walls, and are supplied with high- and low-pressure water, gas, electric currents, &c., and in certain of the rooms, by the use of copper and brass piping, and by other precautions, provision has been made for work with delicate electrical instruments. On this floor are also the accumulator room, a large workshop and forge room, and a constant-temperature room.

The tower, 89 feet in height, has been utilised for suspension of long wires, mercurial pressure-gauge, and other purposes requiring considerable height, and, lastly, on the roof a floor space, 24 feet by 12 feet, has been arranged for open-air experiments.

Engineering Buildings.

The accompanying illustration (Fig. 2) shows the west end of the block of buildings for the engineering department.

The building is T-shaped, the head of the T facing west. In the head of the T, on the ground floor, are provided large laboratories for the testing of materials (42 feet by 30 feet) and for hydraulics (51 feet by 30 feet). The first floor is devoted mainly to a laboratory for experimental work, which does not require heavy machinery (73 feet by 25 feet). On this floor are also a small lecture room, the departmental library, and the private rooms for the staff.

The back block of the building is also divided into two floors—the lower forms the lecture theatre and the upper the drawing office. The lecture theatre will seat about 120 students, and on the lecturer's table are all the needful appliances for experimental demonstrations, there being steam, gas, and electrical connections. There are also the necessary appliances for darkening the room in order to allow of the free use of lantern demonstrations. The drawing office is a fine room, about 45 feet square, lit entirely from the north and east, the roof being of the saw-tooth pattern, the floor space giving room for about sixty independent drawing tables. Special rooms have also been set aside for blue-print work and photography.

A workshop and heat laboratory (48 feet by 42 feet) has been provided for by roofing in and connecting to the main building a piece of ground lying in the north-east angle between the front and back blocks. The workshop and laboratory contains examples of all the ordinary machine-tools, gas-engines, steam-engines, and other plant for experimental research in connection with thermodynamics.

The building is heated by hot water and by steam; an independent boiler house has been constructed for this purpose, with two large boilers.

A considerable amount of additional apparatus has been installed in these new buildings. The testing laboratory

now contains a 100-ton Buckton machine, with the necessary electric motor, pump, and accumulator; a 60,000-lb. Riehle machine; an Amsler 100-ton machine, specially designed for compression and bending work; and a complete installation for the testing of cements, mortars, &c.

In connection with the hydraulic laboratory, a water tower has been constructed at the south-east corner of the building; at the top of this tower is a large cast-iron tank holding about 10,000 gallons, and giving a head of 65 feet above the floor-level of the laboratory. The floor of the laboratory is on two different levels; on the upper level are placed the various turbines, water-wheels, and other hydraulic machines on which experimental investigations will be carried out. The water discharged from these machines passes into one or other of three rectangular channels formed in the floor, and the quantity is measured by allowing the water to pass over weirs. The water then flows into one or other of two large rectangular tanks, each 11 feet square by 5 feet deep, sunk below the lower floor-level of the laboratory, where it is measured again by floats, with rods moving in front of carefully graduated vertical scales. From these lower measuring tanks the water is lifted by an electrically driven 20 h.p. centrifugal pump back to the storage tank in the water tower. The



FIG. 2.—Entrance and West Front of new Engineering Department, University of Edinburgh.

hydraulic equipment includes a Venturi meter and other forms of meters, and a considerable amount of other apparatus for experimental work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The geographical scholarship for 1906 has been awarded to Mr. N. de Lancey Davis, Jesus College.

Mr. J. A. Brown, New College, has been appointed demonstrator in the laboratory of the Wykeham professor of physics.

The following elections have been made at Jesus College:—to scholarships in natural science, G. I. Wishart, Wilson's Grammar School, London, S.E., and H. E. Jones, County School, Towyn; to exhibitions in natural science, R. Atkin, Nottingham High School, and A. D. Phoenix, Grove Park School, Wrexham.

CAMBRIDGE.—The following recommendations, contained in a report of the special board for mathematics on the mathematical tripos, received the sanction of the Senate at a congregation held on October 25:—(1) A student may be a candidate for part i. of the mathematical tripos

at a date not earlier than his second term and not later than his seventh term. (2) A student who fails to obtain honours in part i. of the mathematical tripos may be a candidate on a second occasion, provided he then be otherwise qualified. (3) The examination for part i. shall comprise the subjects in the schedule annexed to the report. (4) The list of successful candidates in part i. shall be arranged in three classes, the names in each class to be arranged alphabetically. (5) The examination for part ii. shall comprise the subjects in the Schedules A and B annexed to the report, together with certain questions partly on the subjects of the schedule for part i. (6) The list of successful candidates in part ii. shall be arranged in the three classes of wranglers, senior optimes, and junior optimes, the names in each class to be arranged alphabetically. (7) In the examination for part ii. the class in which a candidate is placed shall be in general determined by his performance in the papers on the subjects of Schedule A, a mark of distinction and a mark of proficiency being awarded to those candidates who acquire themselves with sufficient credit in the subjects of Schedule B.

The Senate will be asked on Saturday, November 3, to assign a site in Free School Lane for the proposed extension of the Cavendish Laboratory, and to appoint a syndicate to consider the assignment of a site for the extension of the chemical laboratory. Lord Rayleigh's munificent gift of 500*l.* out of the Nobel prize will go toward the cost of the new building for physics. It will be remembered that the balance of the prize was given by Lord Rayleigh to the University library fund. The extension of the chemical laboratory is called for because Gonville and Caius College are proposing to close their chemical laboratory at the end of the academic year.

The Cairo correspondent of the *Times* states that considerable interest has been aroused there by a proposal to found a national university, modelled on European lines, and independent both of the Ministry of Public Instruction and of the mediæval foundation of Al Azhar. A committee, which includes the leaders of the progressive Mohammedan school of thought, has been formed to draft a programme of courses and to raise the sum of at least £500,000 which will be required to make the university a reality. In an appeal for public support, Kassim Bey and the other promoters of the scheme outline its features. The courses of the proposed foundation are to be literary and scientific, open to all without distinction of nationality or creed. Diplomas will be granted to students fulfilling conditions of attendance and passing the requisite examinations, and no attempt will be made at the outset to encroach upon the primary, secondary, and technical instruction imparted by the various Government schools.

LORD ROSEBERY, as Chancellor of the University of London, on October 26 performed the ceremony of opening the library of the University. After expressing the gratitude of the University to the Goldsmiths' Company, which spent 15,000*l.* in securing and supplementing Prof. Foxwell's library, and explaining the growth of the University library as a whole, Lord Rosebery, among many other subjects of wide interest, spoke of the functions of a library. He said there is no greater misconception of a library than to think that it can take the place of a university. "No doubt a student must be fed by books; it is impossible for the student to proceed far without books; but I will urge a further consideration which I should think the experience of those of my age who are present will tend to confirm—that the mere habit of reading, and often of reading copiously, without any exercise or output for their knowledge, is injurious rather than beneficial to the mind. It is apt to produce a condition of mental debility, if not of mental paralysis. I hope that no students will ever believe that the library of this University is intended as more than a staff and an assistance, and not in any degree as the object of their training at this University."

MR. HALDANE, as is appropriate to the president of the British Science Guild, avails himself of every opportunity to insist upon the value of knowledge and of scientific habits

of thought in every sphere of human activity. Distributing the prizes and certificates to the students of Birkbeck College on October 26, Mr. Haldane said there is a danger which is inseparable from a college such as the Birkbeck College. It is largely attended by those who have their bread to win, and whose main concern must be to win it and to win the leisure for learning. The temptation becomes very strong in such a case to look upon learning as being what the Germans call a *brotwissenschaft*—a scientific means of increasing the opportunities for earning a living. That is a very cramping view, and one fatal to the higher learning. But it is the higher learning that pays in these times—not the learning which is a means to an end, but the learning which is an end in itself. Learning for learning's sake, that is the key to a career. Not every person who has learning is necessarily successful in his career; but, other things being equal, the man who is penetrated with the spirit of the scholar has a far better chance in the race of life than the man who is not so penetrated. What is true of individuals is true of nations. A few years ago Japan was reckoned with those who were not civilised. To-day, by singleness of purpose, by concentration upon science, by the dominant purpose of the nation to fashion its national character according to the highest ideas, Japan has leapt, at a bound almost, into the front rank. Germany, too, has gone forward stride after stride on the basis of scientific re-organisation. These are lessons that we do well to bear in mind.

A NEW hall and buildings in connection with University College, Reading, were opened on October 27 by Mr. Haldane, Secretary of State for War. As has been noted in these columns, the new site was secured as a gift of Mr. Alfred Palmer, and the new buildings now opened bring the council an important step nearer the completion of its scheme for a fully-equipped college. The principal feature of the new buildings is the great hall in which the ceremony took place. The science laboratories and art studios consist of seven separate buildings, and accommodation is provided for theoretical and practical work in biology, agriculture, physics, chemistry, and geography. Mr. Haldane, in the course of his speech declaring the new hall open, said:—"It is impossible to set up technical education successfully on anything but the broadest basis of culture. It is distressing to consider, not only how small a part the State has played in higher education in this country, but how misplaced its intervention at times has been. The present Government proposes to spend an extra 1,000,000*l.* a year on elementary instruction, and the late Ministry spent more than that sum additionally for the same purpose, but these payments arose out of controversies which had little to do with education. The Government is doing something for the higher teaching, but its capacity is limited by what the people will allow. There is already a great awakening in this country with reference to higher instruction, but it is due to private donors far more than to the public generally. The War Department wants several things dependent on education. It desires a great reserve of officers, and one thing that it is considering at this moment is how to get the universities and university colleges to assist it. A great misfortune has come to the Army of late through the revelation, in relation to the South African War, of an altogether inadequate organisation and training, inadequate to cope with the great business of supply in time of war and the period following war. Supply is a science by itself, which requires high training if the country is not to be victimised by contractors and everything is to be placed where it is needed. The Army has organised its General Staff, which requires officers with the highest class of instruction for strategy, tactics, and general command. This is one side of military education, but there is an administrative side also, and up to now no steps have been taken to give the highest education to administrative officers. The Government has decided to train a school of administrative officers up to the high level that it is trying to attain for staff officers. A certain number of officers will study at the London School of Economics, and it is hoped that they will form the nucleus of an administrative staff as capable as the general staff, whether of our Army or any other.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, October 18.—Sir W. Ramsay, K.C.B., F.R.S., in the chair.—The Longstaff medal was presented to Prof. W. Noël Hartley, F.R.S., of Dublin, for his researches in spectrochemistry.—The description and spectrographic analysis of a meteorite stone: W. N. Hartley. This stony meteorite was seen to fall in the Kangra Valley, Northern Punjab, in 1897. The principal constituents of the metallic portion are iron, nickel, cobalt, and chromium, with small quantities of copper, lead, silver, and gallium. Manganese, calcium, potassium, and sodium are only present in minute proportions.—Malacone, a silicate of zirconium containing argon and helium: S. Kitchin and W. G. Winterson. This mineral, found at Hitteroe and Arendal, Norway, is radio-active, and gives off a mixture of helium and argon when heated. The analysis, discounting ferric oxide, uranium oxide, &c., points to the ratio $3\text{ZrO}_2 : 2\text{SiO}_2$ between the zirconia and the silica.—The relationship of colour and fluorescence to constitution, part i., the condensation products of mellitic and pyromellitic acid with resorcinol: O. Silberrad. One of the chief interests of this work lies in its bearing on the quinone theory of the structure of the phthaleins. Many of the compounds described do not admit of formulation on the quinone type, but are nevertheless intense colouring matters, and strongly fluorescent.—Separation of $\alpha\alpha$ - and $\beta\beta$ -dimethyladipic acids: A. W. Crossley and Miss N. Renouf.—Action of alcoholic potassium hydroxide on 3-bromo-1:1-dimethylhexahydrobenzene: A. W. Crossley and Miss N. Renouf.—The conversion of morphine and codeine into optical isomerides, preliminary communication: F. H. Lees and F. Tutin. The facts obtained permit of the following conclusions respecting the constitution of morphine:—(1) the isomeric codeines are the result of the racemisation of two asymmetric carbon atoms in a molecule which must necessarily contain a third asymmetric system; (2) the carbon atoms which undergo racemisation are most probably those in the reduced phenanthrene nucleus to which the alcoholic hydroxyl group and the nitrogen atom are respectively attached; (3) The possible isomeric codeines must be represented by the configurations $++-$, $+-$, $-+-$, $---$.—The aminodicarboxylic acid derived from pinene: W. A. Tilden and D. F. Blyther. Details are given for the preparation of the acid and its hydrochloride, nitrate, acid oxalate, copper salt, ethyl ester and its hydrochloride, and the acetyl derivative.—The preparation and properties of dihydropinylamine (pinocamphylamine): W. A. Tilden and F. G. Shephard. Dihydropinylamine is the chief product of the reduction of nitrosopinene by means of boiling amyl alcohol and sodium. The hydrochloride, platinumchloride, picrate, nitrate, oxalate, also the acetyl and benzoyl derivatives and the carbamide, have been prepared and analysed.—Determination of nitrates: F. S. Sinnatt. It is shown that Knecht and Hibbert's method for the estimation of picric acid (*Ber.*, 1903, xxxvi., 1549) may be applied to the estimation of nitrates.—The nature of ammoniacal copper solutions: H. M. Dawson. The experimental data obtained indicate the existence in solution of a dissociating complex compound containing four molecules of ammonia per atom of copper.—The colouring matters of the stilbene group, part iii.: A. G. Green and P. F. Crossland. It is shown that all the dyestuffs of the stilbene series are true azo-compounds. Their chromophore being an azo-group, their dyeing properties are now satisfactorily explained. They differ, however, from most other azo-dyestuffs in the entire absence of auxochrome groups.—Interaction of succinic acid and potassium dichromate. Note on a black modification of chromium sesquioxide: E. A. Werner. When a mixture of finely powdered potassium dichromate (1 mol.) and succinic acid (6 mols.) is heated, a compound having the composition $\text{Cr}_4(\text{C}_4\text{H}_4\text{O}_4)_3 \cdot 7\text{H}_2\text{O}$ is formed which has not the properties of a chromo-organic acid. The chromium hydroxide produced from it by decomposition with sodium hydroxide leaves a jet-black modification of the sesquioxide after ignition.—Derivatives of polyvalent iodine. The action of chlorine on organic iodo-derivatives, including the sulphonium and tetra-substituted ammonium iodides: E. A. Werner.—The so-

called "benzidine chromate" and allied substances: J. Moir. This substance, which resembles cœrulignone, results on mixing solutions of benzidine and chromium trioxide. It is the chromate, not of benzidine, but of a complex oxidation product of the latter.—New derivatives of diphenol (4:4'-dihydroxydiphenol): J. Moir. By the sulphonation of diphenol the author has prepared the 3:3'-disulphonic acid, the 3:5:3'-trisulphonic acid, and the 3:5:3':5'-tetrasulphonic acid.—The interaction of the alkyl sulphates with the nitrites of the alkali metals and metals of the alkaline earths: P. C. Rây and P. Neogi. By the interaction of the sodium, potassium, barium, and calcium salts of ethyl sulphuric acid and the nitrites of the alkali metals and metals of the alkaline earths, both ethyl nitrite and nitroethane were formed.—The electrolytic preparation of dialkyldisulphides. Preliminary note: T. S. Price and D. F. Twiss. By the electrolysis of a concentrated aqueous solution of ethyl sodium thiosulphate, commonly known as Bunte's salt, diethyldisulphide is formed at the anode. Similar results were obtained by electrolyzing solutions of benzyl sodium thiosulphate, dibenzyl disulphide being produced.—The direct union of carbon and hydrogen at high temperatures: J. N. Pring and R. S. Hutton.—The action of nitrogen sulphide on certain metallic chlorides: O. C. M. Davis. When nitrogen sulphide dissolved in dry chloroform is added to the tetrachlorides of tin and titanium, the pentachlorides of antimony and molybdenum, and also tungsten hexachloride dissolved in the same solvent, interaction readily takes place. The compounds formed are represented by the formulæ $\text{SnCl}_4 \cdot 2\text{N}_2\text{S}_4$, $\text{SbCl}_5 \cdot \text{N}_2\text{S}_4$, $\text{MoCl}_5 \cdot \text{N}_2\text{S}_4$, $\text{WCl}_6 \cdot \text{N}_2\text{S}_4$, and $\text{Ti}_2\text{Cl}_6 \cdot \text{N}_2\text{S}_4$.—The determination of halogen: J. Moir.

PARIS.

—Academy of Sciences, October 22.—M. H. Poincaré in the chair.—The work stored up in the trochoidal wave: Emile Bertin.—Distillation and desiccation in a vacuum with the aid of low temperatures: MM. d'Arsonval and Bordas. The vapours given off pass into a condensation tube cooled either with liquid air or a mixture of solid carbon dioxide and acetone, according to the vacuum required. After a preliminary exhaustion with a water-pump, the exhaustion is completed by a tube filled with charcoal immersed in liquid air or acetone and carbon acid snow, a Crookes's tube being used as a manometer. The vacuum is maintained by the charcoal tube in spite of any slight leakages through the connections. A diagram of the apparatus is given, together with full details for its use. The following advantages are claimed for the method:—the evaporated liquid can be weighed directly, the evaporation taking place at the ordinary temperature, and in the absence of air the dried substance is obtained without alteration, and the time required for the whole operation is much reduced. Thus to obtain the dry residue from wine, which required three days when evaporated in a vacuum by the ordinary method, three hours are sufficient.—Contribution to the study of the calorific emission of the sun: G. Millochou and C. Féry. Details are given of the calibration of the apparatus described in a previous paper. Basing the constant of the instrument on the calibration with an electric furnace, the temperature of which was taken as 1673° absolute, and correcting for atmospheric absorption, the temperature of the sun as given by observations at the summit of Mt. Blanc is 5620° C.—Researches on atmospheric lines: Milan Štefánik. By the application of the method of coloured screens, the author has been able to study the telluric lines in the infra-red. A description is given of the instruments employed, observations being made at the Observatory of Meudon, Chamonix, Grands-Mulets, and the summit of Mt. Blanc.—Isothermal surfaces of the first class: L. Raffy.—Isothermal surfaces: R. Rothe.—The conditions of complete integrability of certain differential systems: M. Riquier.—The liquefaction of air by expansion with external work: Georges Claude.—A safety apparatus for providing against accidental sparks in the effects of wireless telegraphy: Édouard Branly.—The aurora borealis. A reply to M. Störmer: P. Villard.—The existence of chloride of bromine: Paul Lebeau. The author has repeated the experiments of earlier workers under varying

conditions on the so-called chloride of bromine, and comes to the conclusion that no such compound really exists. The crystals which can be obtained by cooling sufficiently a solution of bromine in liquefied chlorine have a composition depending on the temperature at which they are formed, and are mixed crystals of the two halogens.—Protoxide of caesium: E. **Rongade**. It is possible to prepare the oxide of caesium Cs_2O in a pure and well-crystallised condition by admitting a limited quantity of oxygen to a weighed amount of the metal. When about two-thirds the amount of oxygen necessary to form the Cs_2O has been admitted, the excess of the metal is slowly distilled off in a vacuum at 200°C . The oxide remains in the form of orange-red crystals, reacting violently with water, and decomposing at about 500°C . in contact with silver, and in the cold in the presence of liquefied ammonia, the latter giving a mixture of the amide and hydrate of caesium.—The pure alloys of tungsten and manganese, and the preparation of tungsten: G. **Arrivaut**. In the reduction by aluminium a suitably high temperature of reaction is obtained by using Mn_3O_4 , WO_3 , MnO_2 , and WO_2 in varying proportions. Manganese-tungsten alloys can be prepared containing from 12 per cent. to 60 per cent. of tungsten. By preparing an ingot containing 45 per cent. of tungsten and submitting this to the action of hydrochloric acid, the residue was nearly pure tungsten, 99.5 per cent.—The products of condensation of acetylenic esters with amines: Ch. **Moureu** and I. **Lazennec**. The products of the condensation of the acetylenic esters $\text{R}-\text{C}\equiv\text{C}-\text{CO}_2\text{R}'$ with amines are non-basic bodies, easily hydrolysed by acids. Hydrolysis regenerates the amine, with formation of the ketonic ester $\text{R}-\text{CO}-\text{CH}_2-\text{CO}_2\text{R}'$. The reaction furnishes a new method of passing from the acetylenic esters to the β -ketonic esters.—The atomic weight of dysprosium: G. **Urbain** and M. **Demenitroux**. A set of determinations, carried out on the products of different fractions, gave 162.54 ($O=16$) as a mean of twelve very concordant results.—The presence of formol in certain foods: G. **Perrier**. By applying the very sensitive reaction proposed by Voisenet for the detection of minimal proportions of formol, the author has proved the presence of this substance in various articles of food, the formaldehyde arising from the mode of preparation, and not having been specially added. In view of these results the author discusses the advisability of altering the existing law, which absolutely prohibits the presence of formaldehyde in food, substituting a maximum limit.—The azo colouring matters: heat of combustion and constitutional formulæ: P. **Lemoult**.—The liquid crystals of cholesteryl propionate: Fred. **Wallerant**.—The action of copper salts on the germination of *Penicillium*: M. **Le Renard**.—The variations of assimilation with light and temperature: W. **Lubimenko**.—The swimming mechanism of *P. maximus*: Fred **Vies**.—*Mesoglicola Delagei*, a parasite of *Corynactis viridis*: A. **Quidor**.—The unity of the hamatozoa of paludism: M. **Thiroux**.—The Dolichopodidae of amber from the Baltic: Fernand **Meunier**.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY, at 4.30.—On Intravascular Coagulation in Albinoes and Pigmented Animals, and on the Behaviour of the Nucleo-proteins of Testes in Solution in the Production of Intravascular Coagulation: G. P. Mudge.—Nitric Oxide of Sewage: Dr. G. Reid.—A General Consideration of the Subaerial and Freshwater Algal Flora of Ceylon: Dr. F. E. Fritsch.—The Anaesthetic and Lethal Quantity of Chloroform in the Blood of Animals: Dr. G. A. Buckmaster and J. A. Gardner.

CHEMICAL SOCIETY, at 8.30.—A Development of the Atomic Theory which correlates Chemical and Crystalline Structure and leads to a Demonstration of the Nature of Valency: W. Barlow and W. J. Pope.—The Explosive Combustion of Hydrocarbons, ii.: W. A. Bone, J. Drugman and G. W. Andrew.—Contributions to the Theory of Solutions: (1) The Nature of the Molecular Arrangement in Aqueous Mixtures of the Lower Alcohols and Acids of the Paraffin Series; (2) Molecular Complexity in the Liquid State; (3) Theory of the Intermiscibility of Liquids: J. Holmes.—The Hydrolysis of Nitro-cellulose and Nitro-glycerol: O. Silberrad and R. C. Farmer.—The Determination of the Rate of Chemical Change by Measurement of Gases Evolved: F. E. E. Lamplough.—Experiments on the Synthesis of the Terpenes Part IX. The Preparation of δ -Ketohexahydrobenzoic Acid (δ -Ketocyclohexanecarboxylic Acid) and of γ -Ketocyclopentanecarboxylic Acid: F. W. Kay and W. H. Perkin, jun.—Experiments on the Synthesis of the Terpenes, Part X., Synthesis of Δ^2 -menthenol (8) and of Carvestrene: W. H. Perkin, jun., and G. Tattersall.—Some Derivatives of Catechol, Pyrogallol, Benzo-pentene and of Other Substances allied to the Natural Colouring Matters: W. H. Perkin, jun., and C. Weizmann.

LINNEAN SOCIETY, at 8.—The Structure of Bamboo Leaves: Sir Dietrich Brandis, K.C.I.E., F.R.S.—On a Collection of Crustacea Decapoda and Stomatopoda, chiefly from the Inland Sea of Japan, with Descriptions of New Species: Dr. J. G. de Man.—On *Hectorella caespitosa*, Hook. f., with Remarks on its Systematic Position: Prof. A. J. Ewart.—Exhibitions: Young Plaice Hatched and Reared in Captivity: the President.—Abnormal Specimens of *Equisetum Telmateia*, Ehrh.: George Talbot.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Bridge Work Design: P. J. Waldram.

FRIDAY, NOVEMBER 2.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione.

MONDAY, NOVEMBER 5.

SOCIOLOGICAL SOCIETY, at 8.—Psychological Factors in Social Transmission: Dr. J. W. Slaughter.

LONDON INSTITUTION, at 5.—Earthquakes and Volcanoes: Sir Robert Ball, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Advantages of Investigating the Unlikely: Sir William Ramsay, K.C.B., F.R.S.

TUESDAY, NOVEMBER 6.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Address by the President, Sir Alexander B. W. Kennedy, and Presentation of Medals and Prizes Awarded by the Council.

WEDNESDAY, NOVEMBER 7.

ENTOMOLOGICAL SOCIETY, at 8.—A Permanent Record of British Moths in their Attitude of Rest: A. H. Hamm.

GEOLOGICAL SOCIETY, at 8.—On the Upper Carboniferous Rocks of West Devon and North Cornwall: E. A. Newell Arber.—The Titaniferous Basalts of the Western Mediterranean: H. S. Washington.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Analyst and the Medical Man: Dr. F. Gowland Hopkins, F.R.S.

THURSDAY, NOVEMBER 8.

ROYAL SOCIETY, at 4.30.—Probable Papers: Note on the Continuous Rays observed in the Spark Spectra of Metalloids and some Metals: Prof. W. N. Hartley, F.R.S.—The Composition of Thorianite, and the Relative Radio-activity of its Constituents: Dr. E. H. Büchner.—On a Compensated Micro-manometer: B. J. P. Roberts.—Experimental Investigation as to the Dependence of Gravity on Temperature: L. Southern.—A Numerical Examination of the Optical Properties of Thin Metallic Plates: Prof. R. C. Maclaurin.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Presidential Address: Partial Differential Equations; some Criticisms and some Suggestions: Prof. A. R. Forsyth.—Harmonic Expansions of Functions of Two Variables: Prof. A. C. Dixon.—The General Solution of Laplace's Equation in n Dimensions: G. N. Watson.—On Sub-groups of a Finite Abelian Group: H. Hilton.—On Bäcklund's Transformation and the Partial Differential Equation $s=F(x, y, z)$.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation of Premiums awarded for Papers Read or Published during 1905-06.—Inaugural Address by the President, Dr. R. T. Glazebrook, F.R.S.

FRIDAY, NOVEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—Exhibition and Description of Experiments Suitable for Students in a Physics Laboratory: G. F. C. Searle.

MALACOLOGICAL SOCIETY, at 8.—Description of a New Species of Calliostoma from S. Formosa: E. A. Smith, I.S.O.—Description of a New Sub-genus and Species of *Alyceus* from Kelan-tan: H. B. Preston.—Description of Six New Species of Shells and of *Leptomys lineata*, Hutton, from New Zealand: H. Suter.—Descriptions of some Tertiary Shells from New Zealand: H. Suter.

CONTENTS.

PAGE

| | |
|--|----|
| Some Recent Works on Logic | 1 |
| A Manual of Pharmacology | 2 |
| A Pioneer in Biology | 3 |
| Analysis of Paints | 4 |
| Our Book Shelf:— | |
| Mill: "British Rainfall, 1905."—W. J. S. L. | 5 |
| "Technical Thermometry" | 6 |
| Berberich: "Astronomischer Jahresbericht" | 6 |
| "Zoologischer Jahresbericht für 1905" | 6 |
| Letters to the Editor:— | |
| Absorption of the Radio-active Emanations by Char- | |
| coal.—Sir James Dewar, F.R.S. | 6 |
| Radium and Geology.—Prof. J. Joly, F.R.S. | 7 |
| The Evolution of the Colorado Spiderwort.—Prof. | |
| T. D. A. Cockerell | 7 |
| The Dynamics of Bowling. (<i>Illustrated</i>). By C. G. K. | 8 |
| The Position of Agathodes during the Eclipse of | |
| B.C. 310 August 15. By P. H. Cowell, F.R.S. | 10 |
| Scientific Investigation in India | 11 |
| Notes | 13 |
| Our Astronomical Column:— | |
| Astronomical Occurrences in November | 16 |
| Greenwich Observatory and the Power Station | 16 |
| Lunar Changes | 16 |
| Eclipse Observations | 16 |
| The Zodiacal Light | 16 |
| The Mira Maximum of 1906 | 17 |
| Meteorology of the Nile Valley | 17 |
| New Physical and Engineering Departments of the | |
| University of Edinburgh. (<i>Illustrated</i>). | 20 |
| University and Educational Intelligence | 21 |
| Societies and Academies | 23 |
| Diary of Societies | 24 |