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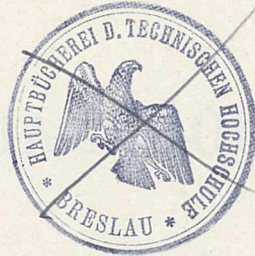
*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.



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Nature



INDEX.

NAME INDEX.

- Abbot (Dr. C. G.), F. E. Fowle, and L. B. Aldrich, *Annals of the Astrophysical Observatory of the Smithsonian Institution*. Vol. iv., 608
- Abel (Prof. O.), awarded the D. G. Elliot Gold Medal of the National Academy of Sciences of the U.S.A., 188
- Abercrombie (L.), elected Professor of English Language and Literature in Leeds University, 530
- Abetti (Prof. G.), *The Mass and Proper Motion of 40 Eridani*, 854
- Achariyar (Rai Bahadar K. Ranga), assisted by C. T. Mudaliyar, *A Handbook of some South Indian Grasses*, 376
- Adair (E. W.), *Origin of the Name of the Genus Masaris*, 574
- Adami (Dr. J. G.), *Eugenics and the Improvement of the Human Race*, 853
- Adams and Joy, *Spectroscopic Parallaxes for Type A*, 584
- Adams (Prof. R. L.), *Farm Management: a Text-book for Student, Investigator, and Investor*, 404
- Adrian (Dr. E. D.), *On the Reality of Nerve-energy*, 447
- Aitchison (Dr. L.), *Engineering Steels*, 537
- Alcock (Lt.-Col. A.), *Discoveries in Tropical Medicine*, 114
- Algué (Rev. J.), *The Manila Typhoon of May 23, 1922*, 795
- Allbutt (Sir T. Clifford), presented with the Gold Medal of the British Medical Association, 294
- Allcut (Prof. E. A.) and C. J. King, *Engineering Inspection*, 730
- Allen (Dr. E. J.), *The Progression of Life in the Sea*, 353, 448
- Allen (Dr. F. J.), *Seasonal Incidence of the Births of Eminent People*, 40
- Allen (H. N.), *Periodic Structure of Atoms and Elements*, 415
- Allen (Dr. H. S.), *An Atomic Model with Stationary Electrons*, 310; appointed Professor of Natural Philosophy in St. Andrews University, 653
- Allis, Jr. (E. P.), *The Cranial Anatomy of Polypterus*, 748
- Alverdes (Dr. F.), *Studien an Infusorien über Flimmerbewegung, Lokomotion und Reizbeantwortung*, 509
- Ameghino (Florentino), *Obras completas y correspondencia científica de*. Vol. 3: *Dirigida por A. J. Torcelli*, 540
- Amenomiya (Y.), *The Devitrification caused upon the Surface of Sheet Glass by Heat*, 63
- Andant (A.), *The Variations of Critical Opalescence with the Filling of the Tubes and the Nature of the Liquids studied*, 63
- Andrade (Prof. E. N. da C.), *Action of Cutting Tools*, 876; *Occult Phenomena and After-images*, 843
- Andrade (J.), *Three Classes of Non-maintained Isochronal Vibrations and three Types of Timepieces*, 63
- André (G.), *The Filtration of Plant Juices*, 300
- Andrew (J. H.) and R. Higgins, *Grain-size and Diffusion*, 407
- Andrews (E. C.), *The Coral-bearing Limestones of the Cainozoic within the Pacific*, 168
- Annandale (Dr. N.) and Maj. R. B. S. Sewell, *An Indian Pond-snail*, 855
- Annett (H. E.), and M. N. Bose, *The Estimation of Narcotine and Papaverine in Opium*, 722; and R. R. Sanghi, *The Estimation of Codeine*, 722
- Appleton (Dr. A. B.), awarded the Raymond Horton-Smith prize of Cambridge University, 828; *The Interpretation of the Pelvic Region and Thigh of Monotremata*, 862; and F. Goldby, *The Innervation of the Pubi-tibialis (sartorius) Muscle of Reptilia*, 862; D. G. Reid, A. Hopkinson, and V. C. Pennell appointed demonstrators in anatomy in Cambridge University, 530
- Arber (E. A. Newell), *Critical Studies of Coal-measure Plant Impressions*, 27
- Aristotle, *The Works of*, translated into English: De Caelo, J. L. Stocks; De Generatione et Corruptione, Prof. H. H. Joachim, 174
- Arkwright (J. A.), *Virus Diseases in Animals and Man*, 622
- Armellini (Prof. G.), *The Orbital Distances of Satellites and Minor Planets*, 260
- Armitage (F. P.), *Diet and Race: Anthropological Essays*, 308
- Armstrong (Dr. E. F.), *A Monument to a Master Chemist*, 142; and T. P. Hilditch, *A Study of Catalytic Actions at Solid Surfaces*. Parts viii. and ix., 62
- Armstrong (G. M.), *Sulphur Nutrition*, 128
- Armstrong (Prof. H. E.), *A New Worship?* 700; *Chemical Change and Catalysis (Messel Lecture)*, 367; *Rhapsodies culled from the Thionic Epos*; presented with the Messel Medal, 130; *The British Association*, 341; *The Peril of Milk*, 648
- Arnold (Sir T. W.), *Indian Painting and Mohammedan Culture*, 228
- d'Arsonval, Bordas, and Touplain, *The Glacial Waters of Argentiére and Bossons*, 27
- Artschwager (Dr. E.) and E. M. Smiley, *Dictionary of Botanical Equivalents: French-English, German-English*, 177
- Ashworth (Prof. J. H.), *On Rhinosporidium seeberi*, with special reference to its sporulation and affinities, 723
- Ashworth (Dr. J. R.), *An Experimental Confirmation of the Kinetic and Molecular Theories of Magnetism*, 10
- Aston (Dr. F. W.), awarded the Hughes Medal of the Royal Society, 674, 788; awarded the Nobel Prize for Chemistry for 1922, 674; *The Atoms of Matter: their Size, Number, and Construction*, 702; *The Isotopes of Antimony*, 732; *The Isotopes of Selenium and some other Elements*, 664; *The Mass-spectrum of Iron*, 312
- Athanasiu (G.), *An Actinometer with Electrodes of Mercury covered with a thin layer of Mercurous Chloride, Bromide, Fluoride, or Sulphide*, 299
- Atkins (W. R. G.), *The Hydrogen Concentration of Natural Waters and some Etching Reagents in relation to Action of Metals*, 758
- Atkinson (R. d'E.), *Gas Pressures and the Second Law of Thermodynamics*, 112
- Aubry (A.) and E. Dormoy, *An Arsenical Glucoside: Diglucosidodioxydiamino-arsenobenzene*, 759
- Auger (P.) and F. Perrin, *The Shocks between α -particles and Atomic Nuclei*, 400
- Austen (Major E. E.), *Attack on a Drone-fly by a Wasp*, 323
- Austin (L. S.), *The Metallurgy of the Common Metals: Gold, Silver, Iron (and Steel), Copper, Lead, and Zinc*. Fifth edition, 71

- B. (F. A.), Origin of the Name of the Genus *Masaris*, 574
 Baade (Dr.), A New Comet, 584; Variable Stars near M. 53, 364
 Backhurst (I.), Variation of the Intensity of reflected X-radiation with the Temperature of the Crystal, 654
 Baeyer (Prof. A. von), a statue of, unveiled at Munich, 820
 Bagshawe (T. W.) and M. C. Lester, Wintering in the Antarctic, 50
 Bailey and Bremer, Experimental Diabetes Insipidus, 748
 Bailey (Dr. G. H.), Edited by Dr. W. Briggs, *The Tutorial Chemistry. Part 2: Metals and Physical Chemistry. Twelfth impression (fourth edition)*, 663
 Bailey (K. C.), The Direct Synthesis of Urea starting with Carbon Dioxide and Ammonia, 300
 Baillaud (J.), The Paris Astrographic Catalogue, 160
 Bairdston (Prof. L.), elected Chairman of the Royal Aeronautical Society, 50; S. P. Langley's Pioneer Work in Aviation, 637
 Baker (G. A.), elected President of the Birmingham and Edgbaston Debating Society, 554
 Baker (G. F.), gift to the American Museum of Natural History, 126
 Baker (H. A.), Geological Investigations in the Falkland Islands, 861
 Baker (Prof. H. B.), A Modern Text-book of Chemistry, 374
 Baker (H. B.), *Radula of the Helicinidae*, 396
 Baker (R. T.) and H. G. Smith, The Melaleucas and their Essential Oils. Pt. vi., 468
 Bale (W. M.), Two new Species of Bryozoa, 563
 Balfour (H.), Fishing and Fishing Lore, 534; The Early Metal Ages in South America, 141
 Balfour (Sir I. Bayley), [death], 781; [obituary article], 816
 Baly (Prof. E. C. C.), Prof. I. M. Heilbron, and D. P. Hudson, Photosynthesis of Nitrogen Compounds, 129
 Banting (Dr.) and others, "Insulin" and the Oxidation of Sugar, 713
 Barber (Prof. F. D.) and others, First Course in General Science, 406
 Barcroft (J.), awarded a Royal Medal of the Royal Society, 674, 787; Physiology of Life in the Andes, 152; Physiology of Respiration, 803
 Barger (Prof. G.), Chemistry and Medicine, 69
 Barker (Prof. A. F.) and others, Textiles. Revised edition, 272
 Barker (A. H.), Tests on Ranges and Cooking Appliances, 434
 Barker (T. V.), Graphical and Tabular Methods in Crystallography as the Foundation of a New System of Practice: with a Multiple Tangent Table and a 5-Figure Table of Natural Cotangents, 629
 Barnard (K. H.), Maps illustrating the Zoological Aspects of Wegener's Disruption Hypothesis, 332
 Barnard (Prof. R. J. A.), Elementary Statics of Two and Three Dimensions, 243
 Barratt (Dr. Katie), appointed Principal of the Swanley Horticultural College, 828
 Barrington (F. J. F.), awarded the William Julius Mickle fellowship of the University of London, 720
 Barry (Sir J. W. Wolfe), a memorial window of, in Westminster Abbey, 820
 Barthel (Dr. C.), The Bacterial Flora of Greenland, 366
 Barthoux (J.), Minerals of the Oudjda Region (Morocco), 332
 Barton (Prof. E. H.), Colour Vision and Syntony, 357; The Resonance Theory of Audition, 316
 Barton (R. F.), Social Economics in the Philippine Islands, 90
 Bartsch (Dr. P.), Formation of Marine Deposits above Sea-level, 396
 Barus (Prof. C.), Displacement Interferometry applied to Acoustics and to Gravitation, 7; Static Deflection, Logarithmic Decrement and First Semi-period of the Vacuum Gravitation Needle, 687
 Bateson (Dr. W.), Interspecific Sterility, 76
 Bathellier (J.), The Rôle of the Soldiers in *Eutermes matangensis*, 591
 Bathur (Dr. F. A.), Black Coral, 344
 Batson (R. G.) and J. H. Hyde, Mechanical Testing: a treatise in two volumes. Vol. i.: Testing of Materials of Construction, 804
 Battermann (Prof. H.), [obituary article], 258
 Bauer (Dr. L. A.) and others, Researches of the Department of Terrestrial Magnetism [Carnegie Institution]. Vol. IV.: Land Magnetic Observations, 1914-1920, 94
 Bausch and Lomb Optical Co., Ltd., Catalogue of Microscopes and Microtomes, 363
 Baxter (Evelyn V.) and Leonora J. Rintoul, Some Scottish Breeding Duck: Their Arrival and Dispersal, 476
 Bayliss (L. E.), elected Michael Foster Student in Physiology in Cambridge University, 25
 Bayliss (Sir W. M.), Internal Secretion, 658; The Cause of Rickets, 212; The Mechanism of the Cochlea, 632
 Bazy (P. and L.), Vaccination before Operation, 167
 Beare (Prof. T. Hudson), Railway Problems of Australia, 354
 Beccari (Dr. O.), Annals of the Royal Botanic Garden, Calcutta. Vol. 12, Parts 2 and 3, 372
 Becher (Prof. S.), Untersuchungen über Echtfärbung der Zellkerne mit künstlichen Beizenfarbstoffen und die Theorie des histologischen Färbeprozesses mit gelösten Lacken, 33
 Beck (C.), The Microscope: a Simple Handbook, 147
 Beck (Prof. R.), bearbeitet durch Dr. G. Berg, Abriss der Lehre von den Erzlagertstätten: In Anlehnung an die dritte Auflage des Lehrbuches und unter Benützung hinterlassener Aufzeichnungen, 205
 Bedeau (M.), The Determination of the Specific Inductive Capacity of Mercury Vapour, 268
 Beebe (W.), A Monograph of the Pheasants. In four volumes. Vol. III., 105; The Edge of the Jungle, 211
 Béhal, Haller, and Moureu (Profs.), protective measures to prevent German chemicals entering France, 820
 Beilby (Sir George), awarded the medal of the Institution of Mining and Metallurgy, 553
 Belin (E.), The Transmission of Handwriting and Drawings by Wireless Telegraphy, 136
 Bell (Dr. Alexander Graham), [obituary article], 225; the work of, F. De Land, 427
 Bell (Prof. F. Jeffrey), Coral in Medicine, 481
 Bell (Dr. L.), The Telescope, 627
 Bellasis (E. S.), Hydraulics with Working Tables. Third edition, 34
 Bellingham and Stanley, Ltd., A Differential Refractometer, 91; A Direct-reading Spectrometer, 129; A New Spectro-polarimeter, 526
 Bemmelen (Prof. J. F. van), The Dutch Zoological Society, 589
 Benedicks (C.), The Deformability of the Photographic Layer, 723
 Bengough (Dr. G. D.) and J. M. Stuart, report on Corrosion and Colloids, 651
 Benham (Prof. W. B.), Oligochæta in the Antarctic, 823
 Bennet (Rev. Abraham), inventor of the Gold-leaf Electrometer, 126
 Benson (W. N.) and S. Smith, Some Rugose Corals from the Burindi Series (Lower Carboniferous) of N.S.W., 62
 Bent (A. C.), Life-histories of North American Gulls and Terns. Order Longipennes, 339
 Bequaert (J.), Ants in their Diverse Relations to the Plant World, 822
 Berg (Dr. G.), concerning the review of his work on Ore Deposits, 583
 Berger (E.), A Formal Lamp, 28
 Bergson (Prof. H.), Durée et Simultanéité: A propos de la théorie d'Einstein, 503
 Bernstein (H.), the proceeds of a performance of "Judith" devoted to science, 553
 Bernthsen (Dr. A.), new edition revised by Prof. J. J. Sudborough, A Text-book of Organic Chemistry, 602
 Berry (C. W.), The Flora of the Dakota Series, 291
 Berry (Dr. S. S.), Molluscs of the Colorado Desert, 887
 Berthollet (C. L.), centenary of the death of, 611
 Bertrand (G.), The Law of Riemann, the Perihelion of Mercury, and the Deviation of Light, 167; and Mokragantz, The Presence of Cobalt and Nickel in Arable Soil, 235; The Presence of Cobalt and Nickel in Plants, 532
 Best (E.), The Maori Mode of Drilling, 679
 Beveridge (H.), Perseid Meteors in July 1592, 667

- Beveridge (Sir W. H.), Periodicities, 511; and others, Weather Cycles in Relation to Agriculture and Industrial Fluctuations, 889
- Bigourdan (G.), The Observatory of Paris on the 200th Anniversary of its Construction, 895
- Bisacre (F. F. P.), Applied Calculus: An Introductory Text-book, 411
- Bjerknes (Prof.), elected an honorary member of the Royal Institution, 784
- Blackett (P. M. S.), elected Charles Kingsley Bye fellow of Magdalene College, Cambridge, 25; The Analysis of α -ray Photographs, 721
- Blackman (Dr. F. F.) and others, Photosynthesis, 856
- Blackman (Prof. V. H.), Some Similarities and Dissimilarities in the Micro-biology of Plant and Animal Diseases, 293
- Blagden (J. W.) and A. Wechsler, Micro-chemical Methods in the Practical Teaching of Chemistry, 447
- Blair (E. W.) and T. S. Wheeler, The Estimation of Form- and Acet-aldehydes, 894
- Blaise (E. E.) and Mlle. Montagne, The Action of Thionyl Chloride on the α -acid Alcohols, 64
- Blakely (W. F.), The Lorantheaceæ of Australia. Part ii., 300; Part iii., 759
- Blanchard (Dr. Phyllis), The Care of the Adolescent Girl: a Book for Teachers, Parents, and Guardians, 411
- Blattner (Dr. E.), Lehrbuch der Elektrotechnik. Erster Teil. Vierte Auflage, 176
- Blayre (Christopher), Human Blood Relationships and Sterility, 846
- Bledisloe (Lord), Landowners and the State, 392, 501
- Blegrad (H.), Bottom-living Communities in the Sea, 887
- Bloch (Dr. L.), Le Principe de la relativité et la théorie d'Einstein, 568; and E. Bloch, Spark Spectra in Water, 27
- Blumberg (H.), New Properties of all Real Functions, 687
- Bodenstein (Prof.), invited to succeed Prof. Nernst in the Physical-Chemical Institute of Berlin University, 720
- Bohn (G.) and Dr. Anna Drzewina, La Chimie et la vie, 173
- Böhnecke (Dr. G.), New Charts of the Currents of the North Sea, 885
- Bohr (Prof. N.), awarded the Nobel Prize for Physics for 1922, 674; elected a corresponding member of the Prussian Academy of Sciences, Berlin, 158
- Boiry (F.), Vulcanising Rubber in Solution, 235
- Bonacina (L. C. W.), A Rainbow Peculiarity, 160
- Bond (Dr. C. J.), Sex of Irish Yew Trees, 810
- Bone (Mrs. W. A.), [obituary], 225
- Bonnier (M.), The Estimation of Alkaline Carbonates in Presence of Phenolphthalein, 723
- Booth (E. H.), The Photographic Work of the Sydney University Eclipse Expedition, Goondiwindi, Queensland, 896
- Booth (H.), Aeroplane Performance Calculations, 110
- Bordet (Prof.), conferment upon, of an honorary doctorate by Paris University, 754
- Boscovich (R. J.), A Theory of Natural Philosophy. Latin-English edition, 870
- Bostwick (J. A.), gift by, to Wake Forest College School of Medicine, 166
- Boswell (Prof. P. G. H.), The Petrography of the Cretaceous and Tertiary Outliers of the West of England, 62
- Bouchet (L.), An Absolute Plane-cylinder Electrometer, 831
- Boulanger (Ch.) and G. Urbain, The Composition and Chemical Characters of Thortveitite from Madagascar, 27
- Boulenger (E. G.), The Zoological Society, 314
- Boulenger (Dr. G. A.), Monograph of the Lacertidæ; Vol. II., 410
- Bouty (Prof. E.), [obituary], 883
- Bouvier (Prof. E. L.), translated by Dr. L. O. Howard, The Psychic Life of Insects, 402
- Bower (Prof. F. O.), elected President of the Royal Society of Edinburgh, 612
- Bower (W. R.) and Prof. J. Satterly, Practical Physics. Eighth Impression (second edition), 445
- Bowie (E. H.), Anomalous Storm Tracks, 429; West Indian Hurricanes, 614
- Bowley (Prof. A. L.), The Need of an Interpreter for Science, 320
- Bowring (H. I.), conferment upon, of an honorary degree by Leeds University, 561
- Boycott (Prof. A. E.), Histological Stains, 114; The Smoke of Cities, 413
- Braecke (Mlle. Marie), The Presence of Aucubine and of Melampyrite (Dulcite) in several Species of Melampyrum, 831
- Brachet (Prof. A.), The Properties of the Germinal Localisations of the Egg, 622; Traité d'embryologie des vertébrés, 275
- Bradbrooks (W.) and Prof. F. G. Parsons, Anthropology in the Chiltern Hills, 526
- Brady (F. L.), The Structure of Eutectics, 531
- Bragg (Sir William H.), elected a corresponding member of the Paris Academy of Sciences, 820; The Structure of Organic Crystals, 115
- Bragg (Prof. W. L.) and R. W. James, The Intensity of X-ray Reflection, 148
- Brammall (A.) and H. F. Harwood, The Dartmoor Granite: its Accessory Minerals and Petrology, 99
- Brearley (H.), The Case-hardening of Steel: an Illustrated Exposition of the Changes in Structure and Properties induced in Steels by Cementation and Allied Processes. Second edition, 537
- Breit (G.), Radio Direction-finding in Flying Machines, 59, 188; Skin Effect in Solenoids, 668
- Brepson (Mlle. F.), The Rôle of the Phenomena of Solifluxion in the Model of the Region of Saulieu (Morvan), 686
- Bridel (M.) and Mlle. Marie Braecke, Rhinanthine and Aucubine, 655; The Presence of Aucubine and of Saccharose in the Seeds of *Rhinanthus Crista-Galli*, 623; and C. Charaux, Centaureine, a New Glucoside, extracted from the Roots of *Centaurea jacea*, 759, 895
- Brierley (S. S.), An Introduction to Psychology, 872
- Bright (Sir Charles), Pioneer Work in Submarine Cable Telegraphy, 195
- Brioux (Ch.), The Comparative Assimilability of Calcium Phosphate and the Phosphates of Iron and Alumina, 864
- British Drug Houses, Ltd., Catalogue of Chemical Products, 653
- Broadbent (B.), conferment upon, of an honorary degree by Leeds University, 561
- Brochet (A.), The Preparation of Active Nickel for Organic Catalysis, 759; The Preparation of Cyclohexanol, 623
- Brodetsky (Dr. S.), Laplace's Essai philosophique sur les probabilités, 6; Motorless or Wind Flight, 483; Statics, Dynamics, and Hydrodynamics, 243; The Line of Action of the Resultant Pressure in Discontinuous Fluid Motion, 794
- de Broglie (Duc), X-ray Electrons, 681
- de Broglie (L.) and A. Dauvillier, Analogies of Structure between the Optical Series and Röntgen Series of Lines, 723; The Spectral System of the X-rays, 686
- Bromehead (C. E. M.), The Site and Growth of London, 494
- Brooks (C. E. P.), Spell of Warm Winters in Europe, 557; and J. Glasspoole, The Drought of 1921, 55
- Brooks (Prof. C. F.), Local or Heat Thunderstorms, 615
- Brooks (E. E.), Polarisation of Diffused Light under the Sea, 114
- Brooks (F. T.), Some Present-day Aspects of Mycology, 563
- Brooks (H. Jamyn), Universal Problems, 804
- Brooks (S.), A British Oil Victory, 401
- Brown (Prof. A. Crum), [death], 610; [obituary article], 673
- Brown (A. R.), The Andaman Islanders: a Study in Social Anthropology, 106; the review of "The Andaman Islanders," 554
- Brown (E. O. Forster), Underground Waters in the Kent Coalfield and their Incidence in Mining Development, 822
- Brown (Prof. F. D.), [obituary article], 490
- Brown (Dr. R. N. Rudmose), O. J. R. Howarth, and J. Macfarlane, The Scope of School Geography, 245
- Browne (Rev. H. C.), Einstein's Paradox, 668
- Browning (Prof. K. C.), German Book Prices, 845
- Bruce (Sir David), awarded the Buchanan Medal of the Royal Society, 674, 787

- Brunhes (J.) and C. Vallaux, La Géographie de l'histoire : Géographie de la paix et de la guerre sur terre et sur mer, 175
- Brunschvicg (Prof. L.), L'Expérience humaine et la causalité physique, 471
- Brunt (Dr. D.), Waterspouts, 414
- Bryant (C. L.), Science Primers, 406
- Bryant (F. B.), [obituary article], 882
- Bryant (Dr. Sophie), [death], 361; [obituary article], 458
- Buchanan (A.), Exploration of Air: Out of the World North of Nigeria, 35
- Buchanan (Miss M. M.), Attack on a Moth by a Wasp, 323
- Buckman (S. S.), Critical Research on Fossil Brachiopoda, 262
- Budge (Sir E. Wallis), The Discoveries of Lord Carnarvon and H. Carter in Egypt, 783
- Buller (Prof. A. H. R.), Luminosity in *Panus stypticus*, 563
- Bulloch (Prof. W.), The Influence of Pasteur on the Development of Bacteriology and the Doctrines of Infection and Immunity. Supplement (December 23), vi.
- Bunting (Martha), Preliminary Note on Tetramitus, a Stage in the Life Cycle of a Coprozoic Amœba, 687
- Burkill (J. C.), elected a fellow of Trinity College, Cambridge, 561
- Burr (Prof. W.), Rural Organization, 404
- Burton (W.), King's Chelsea Porcelain, 871
- Burt-Davy (Dr. J.), A Revision of the South African Species of *Dianthus*, 27
- Bury (Lt.-Col. C. K. Howard) and others, Mount Everest: The Reconnaissance, 1921, 139
- Butler (C. P.), The Systematic Distribution of Solar Calcium Flocculi, 20
- Butler (E. J.), Virus Diseases in Plants, 622
- C. (C.), A Relativity Paradox, 844
- Cabannes (J.), The Polarisation and Intensity of the Light diffused by Transparent Liquids, 795
- Cabaud (R.), Installations électriques industrielles: choix du matériel, 474
- Cabot (E. L.), Seven Ages of Childhood, 872
- Cadness (H.), appointed Special Lecturer in Textile Design in Manchester University, 653
- Cajal (Prof. S. Ramón y), retirement of, 492
- Cambage (R. H.), Acacia Seedlings. Pt. viii., 592
- Cambier (R.) and E. Aubel, Culture of Bacteria in a Medium of Definite Chemical Composition, with Pyruvic Acid as a Base, 200
- Cameron (Dr. A. E.), The Structure and Biology of *Simulium simile*, 396
- Cameron (H. S.), Volcanic Activity in Nigeria, 497
- Campbell (D.), In the Heart of Bantuland, 246
- Campbell (Dr. D.), Galen's work on Anatomical Administration, 296
- Campbell (Dr. N. R.), Modern Electrical Theory. Supplementary Chapters. Chapter XV.: Series Spectra, 767; The Dimensions of Area, 9; What is Science? 728
- Cannon (H. G.), Surface Tension and Cell-division, 181
- Cannon (W. A.), Plant Habits and Habitats in the Arid Portions of South Australia, 365
- Cano (Juan Sebastian del), fourth centenary of the circumnavigation of the world by, 426
- Capen (Dr. S. P.), installed as Chancellor of the University of Buffalo, 793
- Capparoni (Dr.), "Magistri Salernitani nondum cogniti," 296
- Capstick (Dr. J. W.), Sound: an Elementary Text-book for Schools and Colleges. Second edition, 510
- Carey (Prof. F.), impending retirement of, from Liverpool University, 754
- Carey (G. V.), appointed Educational Secretary to the Cambridge University Press, 530
- Carnarvon (Lord) and H. Carter, Excavations in Egypt, 783
- Carnot (P.) and M. Tiffeneau, A New Hypnotic in the Barbituric Series: Butyl-ethyl-malonylurea, 299
- Carpenter (Dr. G. D. Hale), Waterspouts, 414
- Carpenter (Prof. G. H.) and Miss K. C. J. Phillips, The Collembola of Spitsbergen and Bear Island, 100
- Carpenter (Miss K.), Lead and Animal Life, 543
- Carr (Prof. H. Wildon), Bergson and Einstein, 503; Dialectic, 208; Einstein's Paradox, 669; The New Way of Thinking Physical Reality, 471
- Carrere (L.), The Sphincter of the Iris in the Selacians, 468
- Carroll (J. A.), elected a Fellow of Sidney Sussex College, Cambridge, 25
- Carshaw (Prof. H. S.), Advanced Mathematical Study and Research at Cambridge, 8
- Carter (F. W.), Railway Electric Traction, 338
- Casanowicz (I. M.), Religious Ceremonial of the Parsis, 161
- Castiglioni (Prof.), Art in the Italian Pharmacy of the 15th Century; Dante and Averrhoism, 296
- Castle (W. E.), Genetic Studies of Rabbits and Rats, 463
- Cathcart (Prof. E. P.), Basal Metabolism, 294; The Efficiency of Man and the Factors which Influence it, 354, 453
- Cator (G.), The One and the Many, 894
- Caulery (Prof. M.), translated by J. H. Woods and E. Russell, Universities and Scientific Life in the United States 72
- Cave (Capt. C. J. P.), The Green Ray at Sunset and Sunrise, 604; Winter Thunderstorms, 877
- Cawston (F. G.), South African Larval Trematodes and the Intermediary Hosts, 832
- Cesáro (C.), The Blue Crystals of Disthene found at Katango, 864
- Chadwick (Dr. J.), Radioactivity and Radioactive Substances, 412
- Chamberlain (Prof. J. S.), A Text-book of Organic Chemistry, 805
- Chambers (C. D.), Fewness of Dovecots in the Roman Period, 748
- Chambers (R.), New Apparatus and Methods for the Dissection and Injection of Living Cells, 722
- Chapman (A. Chaston), The Use of the Microscope in the Brewing Industry, 99
- Chapman (F.), New or Little-known Victorian Fossils in the National Museum. Pt. xxvi., 168
- Chapman (Prof. H. H.), Forest Mensuration, 407
- Charcot (Dr. J. B.) and A. Lacroix, The Structure of Rockall, 90
- Chatterji (K. P.), elected to the Anthony Wilkin studentship in Cambridge University, 828
- Chattock (Prof. A. P.) and L. F. Bates, The Richardson Gyro-magnetic effect, 721
- Chaudron (G.) and L. Blanc, The Estimation of Oxygen in Steel, 795
- Chautard (J.), Les Gisements de pétrole, 474
- Chauveau (B.), Électricité atmosphérique. Premier Fasc.: Introduction historique, 406
- Cheel (E.), *Melaleuca linariifolia* and *Melaleuca trichostachya*, 236; The Species of *Darwinia Homoranthus*, and *Rylstonea* in the States of N.S.W., Victoria, South Australia, and Queensland, 236
- Cheshire (Prof. F.), Rotary Polarisation of Light, 807
- Chevenard (P.), Nickel Alloys retaining their Rigidity over an Extended Temperature Range, 592
- Chick (Dr.) and others, The Cause of Rickets, 137
- Child (C. H.), appointed an Honorary Clinical Tutor in Dental Surgery in Leeds University, 621
- Chipp (Major T. F.), appointed Assistant Director of the Royal Botanic Gardens, Kew, 189
- Chittenden (Dr. R. H.), retirement from the directorship of the Sheffield Scientific School, Yale University, 60
- Chopard (M.), Orthoptera and Dermaptera of France, 822
- Chree (Dr. C.), The Magnetic Work of the Carnegie Institution, 94
- Church (Major A. G.), Science and the Empire, 876
- Cisáň (J.) and F. Pokorný, The Czechoslovak Republic, 839
- Cisotti (Prof. U.), Idromeccanica Piana. Parte Prima and Parte Seconda, 243
- City Sale and Exchange, Catalogue of Koristka Microscopes and Accessories, 52
- Clapham (C. B.), Metric System for Engineers, 340
- Claridge (G. C.), Wild Bush Tribes of Tropical Africa, 340
- Clark (C. H. D.), A Sliding Scale for the Convenient Titration of Strong Liquids by Dilution and Use with Aliquot Parts, 894
- Clark (J. E.), H. B. Adames, and I. D. Margary, Report on Phenological Observations for the year 1921, 27

- Clark (J. McClare), The Effect of Post-war Conditions on Agriculture, 743
- Clarke (A.), Coal-tar Colours in the Decorative Industries, 768
- Clarke (Dr. Lilian J.), The Botany Gardens of the James Allen's Girls' School, Dulwich, 329, 512
- Clarke (W. G.), Our Homeland Prehistoric Antiquities, and how to study them, 510
- Claxton (T. F.), Report of the Royal Observatory, Hong-Kong, 1921, 229
- Clay (Dr. R. S.), The Photographic Lens from the Historical Point of View, 675, 739
- Cleland (Prof. J. B.), A Second Bird Census, 236; Ball Lightning, 40
- Clements (F. E.), Aeration and Air Content: the Rôle of Oxygen in Root Activity, 58
- Clemesha (Lt.-Col.), Methods of Collection and Disposal of Excreta suitable for Small Tropical Villages, 232
- Clelland (J. E.), The Oxide Method of determining Aluminium, 499
- Clerk (Sir Dugald), conferment upon, of an honorary degree by Leeds University, 561; presented with the Albert Medal of the Royal Society of Arts, 50
- Cluzet (J.) and A. Chevallier, The Radioactivity of the Springs of Echaillon, 895
- Cobb (Prof. J. W.), Fuel in Relation to Health, 232; Low Temperature Carbonisation, 718; Report of the Department of Coal Gas and Fuel Industries (with Metallurgy) of Leeds University, 26; The Thermal Basis of Gas Supply, 671
- Coblentz (Dr. W. W.), Stellar Temperatures and Planetary Radiation, 886; Tests of Stellar Radiometers, etc., 367
- Cochrane (J. A.), Readable School Physics, 340
- Cockerell (Prof. T. D. A.), An Ancient Wasp, 313; Rudbeckia and Aquilegia, 278; and Dorothy Young, A Mutation of the Columbine, 701
- Codrington (Dr. R. H.), [obituary article], 425
- Cohen (Prof. J. B.), The New Smoke Abatement Bill, 269; The Smoke of Cities, 414
- Coker (Prof. E. G.), The Action of Cutting Tools, 118, 700; presented with the Howard N. Potts gold medal of the Franklin Institute, 288; Recent Photo-elastic Researches on Engineering Problems, 41
- Cole (Prof. G. A. J.), Rocks and their Origins. Second edition, 768; The Oldest known Rocks of the Earth's Crust, 39; The Primitive Crust of the Earth, 249; The Reopening of Europe, 599; Volcanic Shower in the N. Atlantic, 635; Water Underground, 242; Wegener's Drifting Continents, 798
- Collett (A.), The Changing Year, 410
- Collingwood (R. G.), Prof. A. E. Taylor, and Dr. F. C. S. Schiller, Are History and Science different Kinds of Knowledge? 231
- Collins (H. F.), Some Crystallised Sulphates from the Province of Huelva, Spain, 100
- Collins (S. H.) and B. Thomas, The Sugars and Albuminoids of Oat Straw, 887
- Colwell (Dr. H. A.), An Essay on the History of Electro-therapy and Diagnosis, 32
- Coman (S.), bequest to Chicago University, 166
- Combes (R.) and Mlle. Denise Kohler, The Disappearance of Hydrocarbons in Dying Leaves, 623; The Rôle of Respiration in the Diminution of the Carbohydrates in Leaves during the Autumnal Yellowing, 468
- Compton (Prof. A. H.) and N. L. Freeman, The Intensity of X-ray Reflection from Powdered Crystals, 38
- Comstock (Prof. G. C.), Observations of Double Stars, 1907-1919, 7
- Constantin, Joessel, and Daloz, A Boat which moves against the Wind, using the Wind itself as Motive Power, 686
- Conway (Sir Martin), appointed to the Board of Trustees of the National Portrait Gallery, 394
- Cook (H. D.) and Dr. A. H. Gibson, Hydro-electric Engineering. Vol. i.: Civil and Mechanical, 108
- Cook (M.), The Antimony-bismuth system, 531
- Cooke, jr. (C. M.), Hawaiian Zonitidae and Succineidae, 365
- Cooke and Sons, Ltd. (T.), list of Surveying Instruments, 324
- Cooper (Dr. E. Ashley), appointed Lecturer in Public Health Chemistry, 684
- Cooper (P. A.), The X-ray Structure of Potassium Cyanide. 544
- Cooper (W. R.), appointed Editor of *Science Abstracts*, 493; The Electrochemical Effects produced by superimposing Alternating Currents upon Direct Currents, 135
- Cornish (Dr. Vaughan), The Isothermal Frontier of Ancient Cities, 558
- Cornthwaite (H. G.), Climate and Photography, 429
- Corrêa (Prof. A. A. M.), Homo (Os Modernos Estudos sobre a Origem do Homem), 510
- Cortie (Rev. A. L.), The Influence of Science, 180, 378
- Costantin (J.), Acquired Heredity, 167
- Costerus (Dr. J. C.), Median Proliferation of Flowers of *Hemerocallis*, 494
- Cousen (A.), Selenium in the Production of Colourless Glass, 830
- Coward (T. A.), Manchester Birds, 1822-1922, 563
- Crabtree (J. H.), Rocks and Fossils and How to Identify Them, 74
- Craig (E. H. Cunningham), Carbonaceous Material in Oil-shale, 55
- Crawford (O. G. S.), Harpoons under Peat at Holderness, Yorks, 481; Long Barrows in the Cotswolds and Welsh Marches, 585
- Crehore (Prof. A. C.), The Hydrogen Molecule, 587
- Crewe (Marquess of), acceptance of the Presidency of the British Science Guild, 611
- Crommelin (Dr. A. C. D.), Lt.-Col. G. L. Tupman, 742; Prof. J. C. Kapteyn, 48; The Origin of Worlds, 660; The reported Nova in Lyra, 821; The Total Solar Eclipse of September 21, 389, 457; W. H. Wesley, 609
- Crommelin (Dr. C. A.) and others, Generation and Utilisation of Cold, 618
- Cronshaw (Dr. H. B.), Oil Shales, 307; Silver Ores, 477
- Crook (C. W.), elected to the Senate of London University, 562
- Crook (T.), The Earth's "Crust" and its Composition, 253
- Crowther (Prof. C.), appointed Principal of the Harper-Adams Agricultural College, 399
- Crowther (Dr. J. A.), Ions, Electrons, and Ionising Radiations. Third edition, 340; The Principles of Radiography, 35
- Cuénot (L.) and L. Mercier, The Loss of the Faculty of Flight in Parasitic Diptera, 532; and R. Poisson, The Development of some Coaptations of Insects, 591
- Cummer (Prof. C. L.), A Manual of Clinical Laboratory Methods, 731
- Cunningham (Dr. Brysson), Empire Water-power, 767; Reservoir and other Dams, 661
- Cunningham (E.), Prof. Eddington's Romanes Lecture, 568; The Measurement of Intervals, 698
- Cunningham (J. T.), Medical Education, 846
- Curie (Mlle. Irène), The Determination of the Velocity of α -rays of Polonium, 299
- Curie (M.), The Refractive Indices of the Phosphorescent Sulphides, 655
- Curtis (Dr. H. D.), Absolute Magnitudes of Stars, 395
- Cushman (J. A.), Foraminifera of the Atlantic Ocean, 365; Philippine Foraminifera, 261
- Cutler (D. W.), L. M. Crump, and H. Sandon, A Quantitative Investigation of the Bacterial and Protozoan Population of the Soil, 26
- Dakin (A.), Practical Mathematics. Part 1, 375
- Dakin (Prof. W. J.), Medical Education, 845
- Dalby (Prof. W. E.), The Internal Combustion Engine, 122
- Dalton (Prof. J. P.), The Mathematics of the Homogeneous Balanced Action, 468
- Damiens (A.), The Absorption of Ethylene by Sulphuric Acid, 623; The Crystallisation of Amorphous Tellurium, 63
- Dana (Prof. E. S.), Third edition, revised and enlarged by Prof. W. E. Ford, A Text-book of Mineralogy: with an extended Treatise on Crystallography and Physical Mineralogy, 210
- Dangeard (L.), The Geological Study of the Bottom of the English Channel, 895

- Dangeard (P. A.), The Structure of the Cell in the Iris, 167, 200
- Danois (E. Le), The Prediction of the Value of the Herring Catch in Winter, 864
- Danysz-Michel (Mme.) and W. Koskowski, Some Digestive Functions in Normal Pigeons, fed with Polished Rice or kept without Food, 200
- Dart (Dr. R. A.), appointed Professor of Anatomy in the University of Witwatersrand, 720
- Darwin (C. G.), appointed Tait Professor of Natural Philosophy in Edinburgh University, 720; A Quantum Theory of Optical Dispersion, 841
- Datta (S.), An Exception to the Principle of Selection in Spectra, 39; The Absorption Spectrum of Potassium Vapour, 655
- Daval (M.), Construction des réseaux d'énergie, 731
- Davenport (C. B.), Inheritance of Stature, 463
- David (Dr. W. T.), appointed Professor of Civil and Mechanical Engineering in Leeds University, 25
- Davidge (H. T.) and R. W. Hutchinson, Technical Electricity. Fourth edition, 840
- Davidson (Mr.), Skjellerup's Comet, 89
- Davies (Dr. A. Morley), Bloomsbury, 250
- Davis (R.) and F. M. Walters, jr., Sensitometry of Photographic Emulsions, etc., 430
- Davis (Prof. W. M.), Coral Reefs of the Louisiana Archipelago, 56
- Dawkins (Prof. R. M.), elected to an honorary fellowship at Emmanuel College, Cambridge, 590
- Dean (Prof. H. R.), appointed Professor of Pathology in Cambridge University, 368; elected to a professorial fellowship at Trinity Hall, Cambridge, 590
- Deb (H. K.), The Swastika, Gammadion, Fylfot, 365; The Origin of the Swastika Symbol, 228
- Deecke (Prof. W.), Phytopaläontologie und Geologie, 375
- Deeley (R. M.), Capillarity, 543; Density of Adsorbed Films, 313
- Deerr (N.), Cane Sugar: A Text-book on the Agriculture of the Sugar Cane. The Manufacture of Cane Sugar, and the Analysis of Sugar-house Products. Second edition, 4
- Defant (A.), Turbulence on a Large Scale, 495
- Degen (E.), [obituary], 883
- Deguide (C.) and P. Baud, Recovery of Sugar from Beet Molasses, 22
- Déjardin (G.), The Production of the Spectrum of Mercury, 831
- Delaby (R.), The Alkyl-glycerols, 895
- Delambre (J. B. J.), centenary of the death of, 259
- De Land (F.), the work of Dr. A. Graham Bell, 427, 746
- Delury (Prof. A. T.), appointed Dean of the Faculty of Arts of Toronto University, 684
- Demolon (A.), The Accessory Elements in Thomas Slag, 168
- Denbigh (Earl of), The Rat and its Repression, 278
- Denning (W. F.), Large Fireballs, 821; Large Meteor on October 17, 645; Recent Meteors, 613; The Leonid Meteor Shower, 712
- Densmore (Miss Frances), Music of the Ute Indians, 646
- D'Erasmus (Prof. G.), Fossil Fish from Southern Italy, 190
- Dervin and Olmer, Ammoniacal Silver Fluoride, 863
- Desch (Prof. C. H.), Metallography. Third edition, 305; The Metallurgical Chemist, 710; The Metallurgy of Iron and Steel, 537; The Nitrogen Industry, 670
- Desgrez (A.), H. Bierry, and F. Rathery, Diabetes, β -oxybutyric Acid, and Levulose, 623
- Deslandres (Dr. H.), Emission of Cathode and X-rays by Celestial Bodies, 847; The Emission of X-rays, Ultra X-rays, and Corpuscular Rays by the Celestial Bodies, 622; and V. Burson, The Atmospheres of the Stars, 268
- Devanesan (D. W.), The Development of the Calcareous Parts of the Lantern of Aristotle in *Echinus miliaris*, 26
- Dibble (S. E.), Plumbers' Handbook, 602
- Dickenson (J. H.), The Flow of Steels at a Low Red Heat, 776
- Dienert (F.) and P. Etrillard, The Possibility of the Existence of Organisms in Rocks capable of Reviving after Sterilisation by Heat, 591
- Dillon (Dr. T.), Dr. Rosalind Clarke, and V. M. Hinchy, A Chemical Method of separating the Isotopes of Lead, 167, 430
- Dines (J. S.), The Effect of a Coast Line on Precipitation, 235
- Dines (W. H.), retirement of, from the directorship of the Aerological Observatory at Benson, 188; The Cause of Anticyclones, 845
- Dingle (H.), The Deflection of Light in a Gravitational Field, 389
- Ditisheim (P.), A New Balance for compensating the Temperature Error of Watches and Chronometers, 830
- Dix (Rev. G. H.), the degree of D.Lit. conferred upon, by London University, 860
- Dixey (F.), The Geology of Sierra Leone, 757
- Dixon (Prof. H. B.), the impending retirement of, from the chair of Chemistry in Manchester University, 621
- Dixon (Prof. H. H.), Practical Plant Biology: A Course of Elementary Lectures on the General Morphology and Physiology of Plants, 274; Transport of Organic Substances in Plants, 355, 547
- Dodd (S.), Poisoning of Sheep by *Solanum cinereum*, 592
- Dodgson (R. W.), Noctiluca as an Enemy of the Oyster, 343
- Doherty (W. M.), The Food Value of the Snapper (*Pagrosomus auratus*), 896
- Donders (F. C.), Reden gehalten bei der Enthüllung seines Denkmals in Utrecht, am 22. Juni 1921, Prof. C. A. Pekelharing, and others, 147
- Doublet (E.), Histoire de l'astronomie, 600
- Douglas (C. K. M.), Observations of Upper Cloud Drift as an Aid to Research and to Weather Forecasting, 235
- Dover (A. T.), Industrial Motor Control: Direct Current, 805
- Downing (E. R.), A Naturalist in the Great Lakes Region, 444
- Downs (Dr. C. R.) and J. M. Weiss, awarded the Howard N. Potts Medal of the Franklin Institute, 643
- Drew (Dr.), The Growth of Normal and Malignant Tissues *in vitro*, 266
- Drew (Dr. C.) and Dr. Mottram, Vitamin Deficiencies, 266
- Dreyer (Dr. J. L. E.), Flamsteed's Letters to Richard Towneley, 525
- Druce (J. G. F.) and A. Glazunov, Transcription of Russian Names, 512
- Drummond (Dr. J. C.), appointed Professor of Biochemistry at University College, London, 165; and Watson, Testing for Vitamins, 557; and others, Vitamins, 652
- Drummond (Dr. W. B.), The Miraculous Draught of Fishes, 666
- Dubois (E.), The Minimum Potential of Electric Discharge in Gases at Low Pressures, 831
- Dubois (R.), The Destruction of Mosquitoes by Eels, 468
- Dubrisay (R.), The Action of Boric Acid on Mannite in Alkaline Solution, 723
- Dudgeon (G. C.), The Agricultural and Forest Products of British West Africa. Second edition, 210
- Duerden (Dr. J. E.), Problems of Race and Nationality in South Africa, 21
- Duff (Prof. A. W.), The Teaching of Physics to Engineering Students, 792
- Duffieux (M.), The Mass of the Particles which give the Spectrum of Carbon Monoxide, 268
- Dumas (J.), D. Combiesco, and J. Baltiano, The Action of the Tetanic and Diphtheric Toxins administered by the Mouth, 724
- Duncan (J.), An Introduction to Engineering Drawing, 476
- Dunk (J. L.), Hyperacoustics. Division II.: Successive Tonality, 411
- Dunkerly (J. S.), Medical Education, 846
- Dunn (Prof. J. S.), appointed Procter Professor of Pathology and Pathological Anatomy in Manchester University, 133
- Durand (Jean), The Thermal Modifications of some Cast Irons, 623
- Durham (Earl of), elected President of the University of Durham Philosophical Society, 784
- Dwerryhouse (Dr. A. R.), The Glaciation of the Counties of Antrim, etc., 167
- Dyson (Sir Frank), conferment upon, of an honorary degree by Leeds University, 561; speech at the unveiling of a portrait medallion of Sir Norman Lockyer, 192

- Earland (A.), Extraction of Radiolaria from Oozes, 216
 Eastman Kodak Coy., List of Organic Chemicals. New edition, 653
 Eblé (L.), Magnetic Measurements in the Paris Basin, 592
 Eddington (Prof. A. S.), A Relativity Paradox, 844 ;
 Ouvrage traduit de l'anglais, par J. Rossignol, Espace, Temps et Gravitation : La théorie de la relativité généralisée dans ses grandes lignes, 410 ;
 The Measurement of Intervals, 697 ; The Propagation of Gravitational Waves, 721 ; The Romanes Lecture, 1922 : The Theory of Relativity and its Influence on Scientific Thought, 568
 Edgeworth (Prof. F. Y.), Equal Pay for Equal Work, 533
 Edman (I.), Human Traits and their Social Significance, 146
 Edridge-Green (Dr. F. W.), Colour Vision and Syntony, 513 ; The Movement of the Positive After-image, 772
 Edwards (D. L.), Spectroscopic Parallaxes of B Stars, 886
 Edwards (F. W.), *Plastosciara perniciososa*, 396
 Edwards (R. E.), appointed Demonstrator in Agricultural Botany in Leeds University, 621
 Edwards (W. C.), Roman Remains in London, 556
 Efront (J.), The Absorption of Pepsin and Hydrochloric Acid by Foods, 758
 Egerton (A. C.), Separation of the Isotopes of Zinc, 773
 Ehrenfest (Prof.), elected an honorary member of the Royal Institution, 784
 Eichhorn (Dr. G.), Drahtloser Übersee-Verkehr, 374
 Eikenberry (Prof. W. L.), The Teaching of General Science, 731
 Einstein (Prof. A.), awarded the Nobel Prize for Physics for 1921, 674 ; and Prof. H. Minkowski, translated by M. N. Saha and S. N. Bose, The Principle of Relativity, 275
 Eldridge (J. A.), Energy Losses accompanying Ionisation and Resonance in Mercury Vapour, 563
 Elles (Dr. Gertrude), The Graptolitic Faunas of the British Isles, 262
 Elmhirst (R.), Habits of *Echinus esculentus*, 667
 Elwell, Ltd. (C. F.), Wireless Telephony Receiving Sets, 127
 Elwes (H. J.), [obituary article], 780
 Emmons (Prof. W. H.), General Economic Geology : a Text-book, 210
 Eno (A. F.), bequest to Columbia University, 26
 Enos (C. L.), Identification of Cows by Pattern Prints, 646
 Erdman (Dr. H. E.), The Marketing of Whole Milk, 570
 Eredia (Prof. F.), Mount Etna and Upper Air Currents, 291 ; Rainfall in Southern Italy and Tripoli, 60
 Ernie (Lord), English Farming : Past and Present. Third edition, 204
 Evans (Sir Arthur), New Discoveries at Knossos, 125
 Evans (Prof. C. Lovatt), Mustard Gas Poisoning, 32
 Evans (E. A.), Lubricating and Allied Oils, 75
 Evans (E. J.), Building Contracts : The Principles and Practice of their Administration, 110
 Evans (H. M.), The Defensive Spines of Fishes, etc., 26
 Evans (Dr. I. B. Pole) and Mary Pole Evans, Rise in Temperature of Living Plant Tissue when infected by Parasitic Fungus, 480
 Evans (I. H.), Among Primitive Peoples in Borneo : a Description of the Lives, Habits and Customs of the Piratical Head-hunters of North Borneo, 146
 Evans (L.), Exhibition of Historical Scientific Instruments at Oxford, 783 ; offer to Oxford University of a collection of early scientific instruments, 828
 Everett (Miss Alice), Unit Surfaces of Cooke and Tessar Photographic Lenses, 829
 Evers (N.) and H. J. Foster, The Sulphuric Acid Test for Fish Liver Oils, 894
 Evershed (J.), Optical Definition and Resolving Power, 179 ; Spectroscopic Parallaxes for Type A, 584
 Evershed and Vignoles, Ltd., The "Meg" Insulation Tester, 586
 Ewing (Sir J. A.), The Atomic Process in Magnetisation : further notes, 862 ; and others, The New Magnetic Atom and its Properties, 162
 Fabre (H.), Hovering Flight in the Mediterranean, 863
 Fabre (Prof. L.), La Séparation industrielle des solides en milieu liquide, 872
 Faillebin (M.), The Hydrogenation of Aldehydes and Ketones in the Presence of Pure and Impure Platinum Black, 863
 Fairbourne (A.), Gas Pressures and the Second Law of Thermodynamics, 113
 Fallaize (E. N.), The Piltown Skull, 161
 Fantham (Prof. H. B.), Some Protozoa found in Soils in South Africa, 831
 Farmer (Prof. J. B.), The West Indian College of Tropical Agriculture, 775
 Farmer (Dr. R. C.), appointed Deputy Director of Explosives Research at the War Office Research Department, 460
 Favé (L.), [obituary article], 361
 Fawsitt (C. E.) and C. H. Fischer, The Miscibility Test for Eucalyptus Oils, 468
 Fenton (Dr. H. J. H.), Notes on Qualitative Analysis : Concise and Explanatory. Supplement, 840
 Ferens (T. R.), presentation of a site for advanced technical departments at Hull, 530
 Ferguson (D.) and others, Geology of Antarctic Lands, 96
 Ferguson (E. W.) and G. F. Hill, Australian Tabanidæ. Part ii., 500
 Fernald (Prof. H. T.), Applied Entomology : an Introductory Text-book of Insects in their Relations to Man, 35
 Fewkes (Dr. J. W.), Pipe Shrine House, 819
 Field (G. C.), Dr. F. Aveling, and Prof. J. Laird, Is the Unconscious Conception of Value in Psychology ? 231
 Findlay (Dr. L.), The Cause of Rickets, 137 ; and Prof. Mellanby, Etiology of Rickets, 294
 Firth (Violet M.), The Machinery of the Mind, 146
 Fischer (E.), Untersuchungen über Kohlenhydrate und Fermente II. (1908-1919). Herausgegeben von M. Bergmann, 142
 Fischer (Prof. M. H.) and others, Soaps and Proteins : Their Colloid Chemistry in Theory and Practice, 70
 Fishenden (Dr. Margaret W.), The Efficiency of Low Temperature Coke in Domestic Appliances, 434
 Fisher (Dr. K.), appointed Headmaster of Oundle School, 330
 Fisher (R. A.), Problems of Mendelian Ratios, 786 ; The Dominance Ratio, 100
 Fisher (Dr. W. J.), Waterspouts, 669
 Flattely (F. W.) and C. L. Walton, The Biology of the Seashore, 540
 Fleming (A.) and V. D. Allison, Further Observations on a Bacteriolytic Element found in Tissues and Secretions, 686
 Fleming (A. P. M.), Broadcasting in America, 294 ; Radiotelephony and Broadcasting, 858 ; Wireless Telephony, 852
 Fleming (Dr. J. A.), elected an honorary member of the Institution of Electrical Engineers, 745
 Fletcher (C.) and H. McLean, The Link between the Practitioner and the Laboratory : a Guide to the Practitioner in his Relations with the Pathological Laboratory, 376
 Fletcher (Sir Walter), Medical Research and the Nation, 50
 Fleure (Prof. H. J.), The Peoples of Europe, 768
 Fleury (P.), An Electrical Furnace with Molybdenum Resistance *in vacuo*, 795
 Florence (Miss L.), The Structure and Biology of the Hog Louse, 396
 Flynn (Prof. T. T.), Occurrence of the Rare Whale, *Mesoplodon Layardi*, on the Tasmanian Coast, 379
 Ford (Prof. W. E.), appointed Curator of Mineralogy in the Peabody Museum of Natural History, 675
 Ford (W. K.), Capture of a Large Common Viper in Epping Forest, 461
 Forster (Dr. M. O.), appointed Director of the Indian Institute of Science, Bangalore, 258
 Forsyth (Prof. A. R.), Differential Invariants and other Concomitants of Quadratic Differential Forms in Four Variables, 27
 Forsyth (Dr. D.), The Technique of Psycho-analysis, 246
 Foster (Sir Gregory), The University of London (History, Present Resources and Future Possibilities), 240
 Fountain (Dr. E. O.), Roche's Limit for Satellites, 89 ; The Colour of the Martian Deserts, 364
 Fournéau (Prof. E.), Préparation des médicaments organiques, 69

- Fournier (E.), The Guidance of Dirigible Balloons through Fog by the Method of W. A. Loth, 863; The Nature and Structure of the Substratum of the Jura Chain, 592
- Fowler (Prof. A.), The Physical Society of London. Report on Series in Line Spectra, 690
- Fowler (Sir Henry), The Effect of Superheated Steam on Non-ferrous Metals used in Locomotives, 467
- Fox (Howard), [obituary article], 851
- Francé (Dr. R. H.), Das Edaphon. Untersuchungen zur Ökologie der bodenbewohnenden Mikroorganismen. Zweite Auflage, 206; Süd-Bayern, 246
- Francis (E. C.), elected Fellow and Mathematical Lecturer at Peterhouse, Cambridge, 653
- Franklin (C. S.), Short-wave Directional Wireless Telegraph, 220
- Franklin (P.), The Meaning of Rotation in the Special Theory of Relativity, 563
- Frazer (Sir James), conferment upon, of an honorary doctorate by Strasbourg University, 754
- Frazer (R. A.), Surveys in Spitsbergen, 786
- Frederick (Mrs. C.), Scientific Management in the Home: Household Engineering, 177
- Fredericq (L.), New Belgium, 864
- French (Dr. J. Weir), Durability of Optical Glass, 97; The Telescope, 627
- Friend (Rev. H.), The Annelids of Iceland and the Faroes, 342
- Friend (Dr. J. Newton), The Corrosion of Iron, 731
- Froggatt (W. W.), A New Plasma belonging to the Genus *Extatosoma*, 759
- Fukuta (Sin-iti), Electrical Resistivity of Steels under Stress, 430
- Fulcher (G. S.), The Indexing of Scientific Articles, 679
- Fulton, jr. (J. F.), Animal Chlorophyll, 429
- Gagnebin (E.), The Flotation of Continents, 262
- Gain (E.), The Comparative Resistance to Heat of the Growing Points of the Embryo of the Sunflower, 64
- Gallenkamp and Co., Ltd., Catalogue of General Chemical Apparatus, 712; Rectangular Glass Jars, 89
- Gamble (J. S.), A Manual of Indian Timbers: an Account of the Growth, Distribution, and Uses of the Trees and Shrubs of India and Ceylon, with Descriptions of their Wood-Structure. Reprint, 276
- Gard (M.), The Withering of Young Walnut Trees in 1922, 686
- Garner (W. E.), Polar and Non-polar Valency in Organic Compounds, 543
- Garnett (Dr. W.), A Little Book on Water Supply, 275
- Garrett (Dr. F. C.) and Hilda Garrett, The Effect of a Lead Salt on Lepidopterous Larvae, 380
- Garstang (Prof. W.), Songs of the Birds, 209; The Lesser Whitethroat's Fanfare, 319
- Gaschet (H.), Manuel de tournage du bois, 510
- Gatenby (Prof. J. Brontë), Sex Change in Mollusca, 544
- Gates (Prof. R. R.), Interspecific Sterility, 179, 447; Vegetative Segregation in a Hybrid Race, 463
- Gault (H.) and R. Guillemet, The Chlorination of Normal Butyl Alcohol, 436
- Gaumont (L.), A New Sound Amplifier, 863
- Gayler (Mary L. V.), The Constitution and Age-hardening of Alloys of Aluminium with Copper, Magnesium, and Silicon in the Solid State, 499
- Geddes (A. E. M.), The Structure of the Hydrogen Lines H_{α} and H_{β} , 862; and C. A. Clarke, Turbulence, as exhibited by Anemometer Records, Smoke and Cloud Formation, 235
- Gheury de Bray (M.), an offer of NATURE volumes, 737
- Giacobini (M.), Observations of the Baade comet, made at the Paris Observatory, 723
- Gibb (Dr. A. W.), appointed Kilgour Professor of Geology in Aberdeen University, 754
- Gibbs (Dr. W. E.), The Fishing Industry, 840
- Gibson (H.), Life in Russian Universities To-day, 755
- Giddings (Prof. F. H.), Studies in the Theory of Human Society, 571
- Gilchrist (Miss G.), Bark Canker Disease of Apple caused by *Myxosporium corticolum*, 794
- Gill (E. L.), appointed an assistant in the Natural History Dept. of the Royal Scottish Museum, Edinburgh, 427
- Gill (F.), Long Distance Telephony, 718
- Gill (Rev. H. V.), Relativity and Space, 854
- Gilmore (C. W.), Redescription of an Eocene Lizard, 190
- Gilmour (J. B.), An Historical Sketch of Pharmacy in Great Britain and Ireland, 296
- Gire (G.), The Dissociation of Barium Chloroplatinate, 168
- Glazebrook (Sir R. T.), The Dictionary of Applied Physics, 699; The Legal Equivalent of the Metre, 446
- Gleichen (Maj.-Gen. Lord Edward), Transcription of Russian Names, 78, 635
- Goddard (H. H.), Juvenile Delinquency, 477
- Goddard (T. R.), appointed Curator of the Hancock Museum, Newcastle-upon-Tyne, 583
- Godlewski (Prof. T.), [obituary article], 361
- Goldie (A. H. R.), Circumstances determining the Distribution of Temperature in the Upper Air under Conditions of High and Low Barometric Pressure, 795
- Goodchild (J. H.), The Distribution of Sodium and Calcium, 589
- Goodman (Prof. J.), conferment upon, of the title of Emeritus Professor by Leeds University, 893
- Goodwin (Eng. Vice-Admiral Sir George), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 321
- Goodwin (J. C.), The Forging of Finger-prints, 190
- Gordon (G. B.), Arab Art in America, 429; The Walls and other Antiquities of Constantinople, 89
- Gordon (Dr. M.), Bacteriology of Influenza, 293
- Gordon (Mary), Penal Discipline, 692
- Gordon (S.), Amid Snowy Wastes: Wild Life on the Spitsbergen Archipelago, 597
- Goris (A.) and P. Costy, Urease and Urea in Fungi, 623
- Gowland (Prof. W.), [obituary article], 16
- Goy (P.), Microbial Physiology and the Accessory Growth Factor, 64
- Grabau (Prof. A. W.), A Text-book of Geology. 2 parts, 143
- Grafe (Prof. V.), Chemie der Pflanzenzelle, 403
- Graham (R. B. Cunninghame), W. H. Hudson Memorial, 846
- de Gramont (A.), Quantitative Researches on the Line Spectrum of Vanadium in Fused Salts, 895
- Granger (A.), The Baking of Ceramic Products in Electrically Heated Furnaces, 235
- Gray (Dr. R. C.), appointed Lecturer in Physics in the Queen's University, Belfast, 792
- Gray (T. H.), The Historical Development of the Distillation of Glycerine, 130
- Greaves (W. M. H.), elected to a fellowship at St. John's College, Cambridge, 684
- Green (Prof. A. G.), The Isolation of a New Series of Colouring Matters for Dyeing Acetate Silk, 743
- Greenhill (Sir G.), The Influence of Science, 78
- Greenish (Prof. H. G.), Pharmacognosy and the Pharmaceutical Curriculum, 233
- Greenly (Dr. E.), appointed special lecturer in Geology at the University College of North Wales, Bangor, 198
- Gregg (W. R.), Upper Air Research in America, 397
- Gregory (Prof. J. W.), awarded the Gold Medal of the Royal Scottish Geographical Society, 675; Evolution of the Essex Rivers and of the Lower Thames, 308; presented with a Gold Medal of the Société de Géographie of Paris, 820; and C. J. Gregory, Expedition to Chinese Tibet, 719; The Alps of Chinese Tibet and their Geographical Relations, 826
- Gregory (Sir Richard), conferment upon, of an honorary degree by Leeds University, 561; Educational and School Science, 355, 420; The Metric System, 744; speeches at the unveiling of a portrait medallion of Sir Norman Lockyer, 192, 194
- Gregory (Prof. W. K.), The Origin and Evolution of the Human Dentition, 834
- Grey (Prof. E. C.), Micro Methods in the Practical Teaching of Chemistry, 309
- Grier (Miss L.) and Miss A. Ashley, British Labour: Replacement and Conciliation, 1914-21. Part 1, On Replacement, 145
- Griffiths (E. A.), Generation and Utilisation of Cold, 618

- Griffiths (H.), The General Principles of Chemical Engineering Design, 726; Materials of Chemical Plant Construction—Non-metals, 726
- Grignard (V.) and A. C. Purdy, α - β '-dichlorethyl Ether, 299
- Grove-Hills (Col. E. H.), [death], 522; [obituary article], 551
- Gudger (Prof. E. W.), The Miraculous Draught of Fishes—An Explanation, 572
- Guillaume (A.), The Limits of Vegetation in the North and East of France, 686
- Guillaume (J.), Observations of the Sun made at the Lyons Observatory, 235
- Guillet (L.) and M. Ballay, The Vapour Pressure of some Copper-Zinc Alloys in the Solid State, 863
- Günther (H.), (W. de Haas), Technische Träume, 663
- Gupta (Hem Chandra Das), Neolithic Script in India, 365
- Gurney (J. H.), [obituary article], 781
- Guye (Prof. C. E.), The Tendencies of Modern Physics and the Conception of Matter, 558
- Haag (Prof. J.), Cours complet de mathématiques spéciales. Tome 2: Géométrie, 375
- Haddon (Dr. A. C.), Ceremonial Exchange, 472
- Hadfield (Sir Robert), gift for the purchase of books for scientific workers, 522; gift to the Metallografiska Institutet, Stockholm, for a Research Scholarship, 18; The Metallurgy of Iron and Steel, 507; The Work and Position of the Metallurgical Chemist, 51
- Haigh (T.), Determination of the Durability of Optical Glass, 97
- Haldane (J. B. S.), Sterility in Species-crosses, 748
- Haldane (Dr. J. S.), Respiration, 803
- Haldane (Viscount), The Philosophy of Humanism and of other Subjects, 471
- Hale (Dr. G. E.), A Fifty-foot Interferometer Telescope, 482; "A National Focus of Science and Research," 676; Invisible Sunspots, 395; resignation from the Committee on Intellectual Co-operation of the League of Nations, 460; The New Heavens, 2
- Hall (A. L.), A Bibliography of South African Geology to the End of 1920, 677
- Hall (Sir Daniel), Potato Wart Disease, 431
- Hall (E. H.), An Electron Theory of Electric Conduction in Metals, 687
- Hall (H. U.), The Art of the Marquesas Islanders, 128
- Halliday (Prof. W. R.) and Prof. McLean Thompson, Honey that drove Men Mad, 462
- Hallimond (A. F.) and E. G. Radley, Glauconite from the Greensand near Lewes, Sussex: the Constitution of Glauconite, 100
- Hallwachs (Prof. W.), [obituary], 158
- Halm (Dr.), The Law of Solar Rotation, 427
- Hamburg (H. E.), The Distribution of Temperature in Scandinavia, 557
- Hamy (M.), The Measurement of Small Diameters by Interference, 895
- Handley (Prof. W. S.), Cancer of the Breast and its Treatment. Second edition, 376
- Hanna (Dr. G. D.) and A. W. Anthony, Leading an Expedition to the Islands off the West Coast of Lower California, 321
- Hansen (Mdlle. V.), Baade's Comet, 613
- Harden (Prof. A.), Pasteur's Early Research in Pure Chemistry and Fermentation. Supplement (Dec. 23), xi; Vitamin Problems, 14
- Hardenburg (W. E.), Mosquito Eradication, 838
- Hardy (Prof. G. H.), Mersenne's Numbers, 542; The Theory of Numbers, 352, 381
- Hardy (G. H.), Some Australian Asilidæ (Diptera) in the National Museum, 168
- Hardy (W. B.), appointed to the Board of Trustees of the National Portrait Gallery, 394; Fishery Research, 865
- Harmer (Sir Sidney F.), elected an Honorary Fellow of King's College, Cambridge, 828; The Present Position of the Whaling Industry, 827
- Harries (Dr. A. J.), [obituary], 187
- Harries (H.), The Miraculous Draught of Fishes, 666
- Harring (H. K.), Arctic Rotifera, 55
- Harris (Prof. D. Fraser), On the Reality of Nerve-energy, 342, 666
- Harris (F. W.), The Hardness of the Brasses, etc., 532
- Harris (G. T.), Mimicry among Birds, 161
- Harrison (the late Lt.-Col. E. F.), Memorial to, at the Chemical Society, 717
- Harrison (H. T.) and others, Street Lighting, 888
- Harrison (Dr. J. W. H.), Interspecific Sterility, 312
- Harrow (Dr. B.), Glands in Health and Disease, 658
- Hartridge (Dr. H.), The Resonance Theory of Hearing, 9; and F. J. W. Roughton, Determinations of the Velocity with which Carbon Monoxide displaces Oxygen from its Combination with the Blood Pigment Hæmoglobin, 758; The Velocity with which Carbon Monoxide displaces Oxygen from its Combination with Hæmoglobin. 2 Parts, 685
- Harwood (Miss), Variability in the Light of Iris, 584
- Hastings (Dr. J.), [obituary], 610
- Hastings (S.), *Anellaria separata* growing in the Alps, 563
- Haswell (Prof. W. A.), Astacocroton, a New Type of Acarid, 759
- Hatschek (E.), Adhesives, 528
- Haughton (J. L.) and G. Winifred Ford, The Systems in which Metals Crystallise, 136
- Haughton (S. H.), Some Upper Beaufort Therapsida, 236
- Haward (L.), National and Provincial Museums, 320
- Hawley (Prof. R. C.), The Practice of Silviculture: with Particular Reference to its Application in the United States, 407
- Hayasaka (Prof. I.), Palæozoic Brachiopoda from Eastern Asia, 161; Some Permian Brachiopods from the Kitakami Mountains, 749
- Hayes (Dr.), Measuring the Depth of the Ocean by Sound Waves, 159
- Hayes (Dr. C. W.), Handbook for Field Geologists. Third edition, revised and enlarged by S. Paige, 412
- Hayes (S. Q.), Switching Equipment for Power Control, 373
- Heaviside (O.), presented with the Faraday Medal of the Institution of Electrical Engineers, 460
- Hebard (M.), Orthoptera and Dermaptera of Hawaii, 822
- Hedin (Dr. Sven), Southern Tibet: Discoveries in Former Times compared with my own Researches in 1906-1908, 170
- Hegner (Prof. R. W.) and Prof. W. W. Cort, Diagnosis of Protozoa and Worms Parasitic in Man, 694
- Hele-Shaw (Dr. H. S.), Education, Research, and Invention, 715
- Henderson (T.), appointed Demonstrator in Inorganic Chemistry in Leeds University, 621
- Henderson (Prof. W. D.), appointed Ray Lankester Investigator at the Marine Biological Laboratory, Plymouth, 98
- Henri (V.) and P. Steiner, Absorption of the Ultraviolet Rays by Naphthalene, 468
- Henry (Prof. A. J.), J. E. Lockwood, and D. A. Seeley, Glaze Storm in America, 91
- Henry (M.), The Incidence of Anthrax in Stock in Australia, 236
- Herdman (Lady), [obituary article], 708
- Herdman (Sir W. A.), H.S.H. Prince Albert of Monaco, 156
- d'Herelle (Dr. F.), The Theory of Bacteriophage, 293
- Heron (Dr. A. M.), Geology of the Mount Everest District, 22; The Rocks of Mount Everest, 462
- Heron-Allen (E.) and A. Earland, British Museum (Natural History). British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report. Zoology. Vol. 6, No. 2. Protozoa, Part 2: Foraminifera, 241
- Herschel (William), Centenary of the Death of, 255
- Hertwig (Prof. R.), elected President of the Deutsche Gesellschaft für Vererbungswissenschaft, 583
- Hesse (Prof. A.) and Prof. H. Grossmann, Englands Handelskrieg und die chemische Industrie. Band 1; 2: Neue Folge; 3, Herausgegeben von A. Hesse, H. Grossmann, und W. A. Roth, 337
- Hevesy (Dr. G.), An Attempt to Influence the Rate of Radioactive Disintegration by Use of Penetrating Radiation, 216
- Hewlett (Prof. R. T.), Books on Microbiology, etc., 694
- Heywood (F.), appointed Vulcan Fellow in Manchester University, 653

- Hickman (Miss E. M.), appointed Demonstrator in the Department of Pathology and Bacteriology in Leeds University, 621
- Hicks (Prof. W. M.), *A Treatise on the Analysis of Spectra*: based on an Essay to which the Adams Prize was awarded in 1921, 690; *Spectra on the Quantum-orbit Theory*, 292; *Spectrum Lines of Neutral Helium*, 309
- Hickson (Prof. S. J.), *Black Coral*, 217
- Hilditch (Dr. T. P.), *A Concise History of Chemistry*. Second edition, 305
- Hilger, Ltd. (Adam), *A Chemical Spectrometer*, 191; *An Optical Sonometer*, 464; *List of Interferometers*, 229
- Hill (Prof. A. V.), *Athletics and Oxygen Supply*, 588; and W. E. L. Brown, *The Oxygen-dissociation Curve of Blood and its Thermodynamical Basis*, 685
- Hill (G. F.), *A New Species of Mordellistena (Coleoptera, Mordellidæ) Parasitic on Termites*, 759; *Some North Australian Termites*, 236; *A New Australian Termite*, 500
- Hill (Prof. L.), *Ventilation and Atmosphere in Factories and Workshops*, 644
- Hilton (Prof. H.), *Crystallographic Notation*, 100; *The Graphical Construction of the Constants of a Shear*, 100
- Hilton-Simpson (M. W.), *Folklore among the Algerian Tribes*, 161
- Hinchley (Prof. J. W.), *Evaporation*, 130
- Hind (Prof. A. M.), *Processes of Engraving and Etching*, 583
- Hinshelwood (C. N.), *The Structure and Chemical Activity of Copper Films and the Colour Changes Accompanying their Oxidation*, 62
- Hirayama (Dr. K.), *Origin of the Asteroids*, 53
- Hirst (S.), *Mites Injurious to Domestic Animals (with an Appendix on the Acarine Disease of Hive Bees)*, 410
- Hitchcock (A. S.), *The Grasses of Hawaii*, 614
- Hoare (C. A.), *Transcription of Russian Names*, 279
- Hobbs (Prof. W. H.), *Earth Evolution and its Facial Expression*, 270
- Hobday (Prof.) and Prof. Lang, *Animal and Vegetable Pathology in Relation to Human Disease*, 293
- Hobson (B.), *The Local Handbook of the British Association*, 605
- Hodge (A. E.), *The Freshwater Winkle*, 380
- Hoerber (Prof.), *Effect of the Ions on Physiological Surfaces*, 751
- Hoernlé (Prof. R. F. A.), *The Treatment of "Existence" in Recent Philosophical Literature*, 830
- Hofmann (Prof. K. A.), *Lehrbuch der anorganischen Chemie. Vierte Auflage*, 695
- Hogan (Dr. M. A.), *Current Meters for Use in River Gauging*, 292
- Hogben (L. T.), *Studies on Internal Secretion, I.*, 686; and F. R. Winton, *Studies on Internal Secretion, II.*, 686
- Holland (J. H.), *The Useful Plants of Nigeria. Part iv.*, 323
- Holleman (Prof. A. F.), awarded the honorary degree of D.Sc. by Leeds University, 399; *Recent Researches on Substitution in the Benzene Nucleus*, 19
- Holmes (M.), *Orientation of Molecules in a Magnetic Field*, 635
- Holmyard (E. J.), *Arabic Chemistry*, 573
- Holst (G.) and F. Oosterhuis, *The Explosive Potential of a Gas*, 623
- Holt (E. W. L.), [obituary article], 17
- Honda (Prof. K.), *Bohr's Model of the Hydrogen Molecules and their Magnetic Susceptibility*, 664
- Hooper (C. H.), *Fruit Farming: Practical and Scientific for Commercial Fruit Growers and Others. Second edition*, 601
- Hopfield (J. J.), *New Spectra of Water Vapour, Air, and Hydrogen in the Extreme Ultra-violet*, 732
- Horstmann (Prof. A.), [obituary], 851
- Hough (C. D.), appointed Leech Fellow in Manchester University, 653
- Houstoun (Dr. R. A.), *An Investigation of the Colour Vision of 527 Students by the Rayleigh Test*, 794
- Howard (C. P.), *The Orbit of Sirius*, 461
- Howarth (O. J. R.), *The British Association for the Advancement of Science: a Retrospect, 1831-1921*, 302; *The World About Us: a Study in Geographical Environment*, 376
- Howes (H. W.), presented with the Frank Wood Medal of the Society of Glass Technology, 784
- Hrdlička (Dr. A.), *The Peopling of Asia*, 54
- Hudson (W. H.), [obituary article], 319; bequest to the Royal Society for the Protection of Birds, 711
- Hughes (W.), *A Possible Reconciliation of the Atomic Models of Bohr and of Lewis and Langmuir*, 37
- Hughes (W. E.), *On the Electro-deposition of Iron*, 445
- Hughesdon (R. S.), H. G. Smith, and J. Read, *The Stereoisomeric Forms of Menthone*, 895
- Hulme (E. W.), *An Empire Patent*, 633
- Humberstone (T. Ll.), *Bloomsbury and the University of London*, 150; *Bloomsbury, 250*; *Science and Education at South Kensington*, 79; *The New University of London*, 435
- Humbert (Prof. P.), *Introduction à l'étude des fonctions elliptiques à l'usage des étudiants des facultés des sciences*, 308
- Humphrey (J.), *Drugs in Commerce: their Source, Preparation for the Market, and Description*, 7
- Hurley (Capt. F.), *Expedition to New Guinea*, 393
- Hurry (Dr. J. B.), *Poverty and its Vicious Circles. Second edition*, 177
- Hurst (E.), H. G. Smith, and J. Read, *The Chemistry of the Phellandrenes*, 895
- Hutchinson (A.), proposed creation of a Lectureship in Crystallography for, in Cambridge University, 792
- Hutton (L. H.), *Head-hunting in Assam*, 322
- Hyman (L. H.), *A Laboratory Manual for Comparative Vertebrate Anatomy*, 571
- Ilchester (Earl of), appointed to the Board of Trustees of the National Portrait Gallery, 394
- Imms (Dr. A. D.), *New Social Coleoptera*, 95; *Royal Society: Reports of the Grain Pests (War) Committee, Nos. 1 to 10*, 145
- Inge (Dean), elected an Honorary Fellow of King's College, Cambridge, 828; *The Victorian Age: The Rede Lecture for 1922*, 104
- Ingham (A. E.), elected a Fellow of Trinity College, Cambridge, 561
- Innes (R. T. A.), conferment upon, of the honorary degree of D.Sc. by the University of Leyden, 675
- Irvine (Principal J. C.), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 321; *Chemistry of the Sugars*, 352; *St. Andrews*, 498; *The Development of Research in Universities*, 131; *The Organisation of Research*, 385;
- Irwin-Smith (Vera), *A New Nematode Parasite of a Lizard*, 759; *Nematodes of the Genus Physaloptera. Part iii.*, 300; *Part iv.*, 864
- Ishino (Dr.), *Separation of Isotopes of Chlorine*, 647
- Ives (Dr. H. E.), *Phosphorescent Light of Fireflies*, 679
- Jack (Col. E. M.), appointed Director-General of the Ordnance Survey, 158
- Jack (R. L.), *Iron Ore in South Australia*, 129
- Jackson (Dr. B. Daydon), *The Use of the Name Forstera or Forsteria*, 756
- Jackson (H.), *A Short Manual of Forest Management*, 407; *The Trend of Human Development*, 554
- Jackson (Dr. Josephine A.) and Helen M. Salisbury, *Outwitting our Nerves: a Primer of Psychotherapy*, 477
- Jaggar (T. A.), a plea for geophysical and geochemical observatories, 884
- Jameson (H. L.), J. C. Drummond, and K. H. Howard, and others, *Sources of Vitamin A*, 429
- Janet (Prof. P.), *A Particular Class of Batteries*, 235; *Problèmes et exercices d'électricité générale*, 147; *The Standard Reproduction of the International Ohm*, 235

- Jarry-Desloges (R.), Observations of Mars at Sétif, Algeria, 160; Study of the Surface of Planets, 200
- Jears (Dr. J. H.), The Propagation of Earthquake Waves, 794; The Theory of the Scattering of α - and β -rays, 721
- Jeffcott (H. H.), The Electrical Design of A.C. High Tension Transmission Lines, 167
- Jefferson (A.), The Cause of Red Stains on Silver-plated work, 531
- Jeffreys (Dr. H.), Geology and the Primitive State of the Earth, 148
- Jenkin (C. F.), The Fatigue Failure of Metals, 794
- Jenkins (R.), Early History of the Sussex Iron Industry, 893
- Jennens (D.), The Life of the Copper Eskimos, 245
- Joachim (Prof. H. H.), Aristotle's De Generatione et Corruptione, 174
- Joerg (W. L. G.), Recent Geographical Work in Europe, 530
- Johannsen (Prof.), Heredity, 750
- Johnson (F.) and W. G. Jones, New Forms of Apparatus for determining the Linear Shrinkage and for Bottom-pouring of Cast Metals and Alloys, etc., 531
- Johnson (M. C.), elected to the Arnold Gerstenberg Studentship, Cambridge University, 620
- Johnson (N. K.), and S. N. Sen, Wind-speed from Sea and Land, 462
- Johnson (Prof. T.) and Miss J. G. Gilmore, The Lignite of the Lough Neagh Clays, 586; The Lignite of Washing Bay, Co. Tyrone; Libocedrus and its Cone in the Irish Tertiary, 167
- Johnston (Sir Harry H.), A Comparative Study of the Bantu and Semi-Bantu Languages. Vol. 2, 67
- Johnstone (S. J.), Potash. New edition, 307
- Jolibois (P.) and R. Bossuet, The Precipitation of Uranyl Nitrate by Soda, 136
- Jolly (Prof. W. A.), The Electrogram of the Frog's Gastrocnemius reflexly excited, 236; The Rhythm of Discharge of the Spinal Centres in the Frog, 468
- Joly (Prof. J.), Cosmical Theory and Radioactivity, 112; Geology and the Nebular Theory, 76; Roche's Limits for Satellites, 179
- Jones (J. H.), The Kinetic Energy of Electrons emitted from a Hot Tungsten Filament, 722
- Jones (Ll.) and F. I. Scard, The Manufacture of Cane Sugar. Second edition, 4
- Jones (Dr. O. T.), Lead and Zinc, 476
- Jones (R. Ll.), Vibration Galvanometers with Asymmetric Moving Systems, 829
- Jordan (Dr. D. S.) and J. Z. Gilbert, Cainozoic Fishes of California, 397
- Jouast (R.), Comparisons of the Standard Reproductions of the International Ohms, 235; The Application of Pyrometers to High Frequency Measurements, 863
- Joubin (L.), The Geographical Distribution of Some Deep-sea Corals in Western European Seas, 831
- Joy (A. H.), RS Canum Venaticum, 461
- Jussieu (B. de), the work of, 320
- Justesen (P.), A Remarkable Parasite, 128
- Kaburaki (T.), Some Indian Leeches, 822
- Kamensky (Prof.), The Perturbations of Wolf's Periodic Comet, 290, 525
- Kamita (K.), The Influence of Alumina in preventing the Devitrification of Sheet Glass during the Drawing Process, 63
- Kapp (Prof. G.), [obituary article], 257
- Kapteyn (Prof. J. C.), [obituary article], 48; The Arrangement and Motion of the Sidereal System, 163
- Karny (H. H.), A Remarkable New Gall-thrips from Australia, 500
- Karper (V.), A Particular Class of Batteries, 235
- Kasakov (M.), Perrine's Comet, 613
- Kaye (Major G. W. C.), Industrial Physics, 439
- Keatinge (G.), Agricultural Progress in Western India, 442
- Keen (Dr. B. A.), Position of Agriculture in India, 442
- Keen (Dr. W. W.), Science and the Scriptures, 726
- de Keghel (M.), Les Encres, les cirages, les colles et leur préparation, 731
- Keith (Sir Arthur), elected Secretary of the Royal Institution, 784; Our Nearest Living Relatives, 834; The Present Position of Darwinism as applied to the Problem of Man's Origin, 393; The Stature of the Scottish People, 8; and Prof. Karl Pearson, The Skull of Sir Thomas Browne, 149
- Kellner (Dr. W.), [death], 491; [obituary article], 522
- Kellogg (R.), Humpback Whale from the Miocene of California, 322
- Kemp (Dr. S.), Animal Associations of Some Crustacea, 888
- Kempton (P. H. S.), Industrial Nitrogen: The Principles and Methods of Nitrogen Fixation and the Industrial Applications of Nitrogen Products in the Manufacture of Explosives, Fertilizers, Dyes, etc., 805
- Kendall (Prof. P. F.), conferment upon of the title of Emeritus Professor by Leeds University, 893; Physiography of the Coal Swamps, 353, 811; and others, Geology of the North Sea Basin, 890; Man and the Ice Age, 617
- Kendrew (W. G.), The Climates of the Continents, 630
- Kennard (A. S.), given the Foulerton Award of the Geologists' Association, 885
- Kennedy (B.), Thought-coin, 147
- Kenneth (J. H.), Bibliography on the Subject of the Organs and Sense of Smell and of Odorous Substances, 427
- Keogh (Sir Alfred), awarded the Gold Medal of the Institution of Mining and Metallurgy, 553
- Kesteven (Dr. H. L.), The Bones in the Palate and Upper Jaw of Bony Fishes, 748
- Kewley (J.), The Petroleum and Allied Industries: Petroleum, Natural Gas, Natural Waxes, Asphalts and Allied Substances, and Shale Oils, 866
- Keynes (Dr. G.), Blood Transfusion, 871
- Kidd (B.), A Philosopher with Nature, 836
- Kieran (A. J.), The Electrical Conductivity of Hydrochloric Acid and Potassium Chloride in Presence of Sucrose, 136
- Kimmins (Dr. C. W.) and others, Psycho-analysis and Education, 650
- King (Dr. H.), Muscarine, 526
- King (W.), Chelsea Porcelain, 871
- King (W. B. R.), elected Fellow and Lecturer in Natural Sciences at Magdalene College, Cambridge, 25
- King (W. J.), Exhibition of Leaf-pictures, 709
- Kipling (Rudyard), elected Rector of St. Andrews University, 684
- Kirkby (Rev. Dr. P. J.), Peculiarities of the Electric Discharge in Oxygen, 249
- Kirkpatrick (R.), Ouramœba, 40
- Kirkwood (J.), Farm Book-keeping: The Principles and Practice of Book-keeping applied to Agriculture: for Agricultural Colleges, Extension Classes, Evening Classes, and Practical Farmers, 768
- Kling (A.) and D. Florentin, The Spontaneous Formation of Sulphate on Limestone in Urban Centres, 831
- Klingstedt (F. W.), The Ultra-violet Absorption Spectra of the Diphenols, 436
- Knaggs (Miss I. E.), The Connexion between Crystal Structure and Chemical Constitution of Carbon Compounds, 756
- Knott (Dr. C. G.), [death], 610; [obituary article], 640; C. A. Stevenson and the "Cable Guide," 88
- Knowles (J. A.), Processes and Methods of Medieval Glass Painting, 687
- Knox-Shaw (H.), Observations of Solar Radiation, 1915-1921, 790
- Knudsen (Prof.), elected an honorary member of the Royal Institution, 784
- Koch (L.), R. C. Wilson, and E. de Margerie, The Geological Mapping of the Globe, 91
- Kodak, Ltd., Photomicrography. Sixth edition, 679
- Koehler (Prof. R.), New Antarctic Brittle-stars, 713
- Kraus (Prof. C. A.), The Metallic State, 165
- Kuonen (Prof. J. P.), [death], 491; [obituary article], 673
- Kugelmass (I. N.), A New Apparatus, the Nephelectrometer, 400
- Kuhlbrodt (Dr. E.), New Theory of Cyclones, 91

- L. (J.), A Type of Ideal Electric Atoms, 873
 Lacoste (J.), New Radiogoniometric Observations of Atmospherics, 686
 Lake (P.), Wegener's Displacement Theory, 77
 Lamb (C. G.), appointed Reader in Electrical Engineering in Cambridge University, 653
 Lambert (P.) and A. Andant, An Arrangement for Depositing Films of Metal on Large Surfaces by Cathodic Projection, 268
 Lang (Dr. W. D.), Catalogue of the Fossil Bryozoa (Polyzoa) in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa (Polyzoa). Vol. 4: The Cribrimorphs. Part 2, 445
 Lange (C. G.) and W. James, The Emotions, 730
 Langley (G. J.), appointed Honorary Assistant Lecturer in Physiology in Manchester University, 653
 Langmuir (Dr. I.), elected an Honorary Member of the Royal Institution, 784
 Langton (Dr. H.), [death], 742
 Lapage (Dr. G.), Ourameba, 114
 Lapique (L.), Mechanism of the Exchanges between the Cell and the Surrounding Medium, 28
 Laplace (Pierre-Simon), Essai philosophique sur les probabilités, 6
 Larbaud (Mlle. Marguerite), The Anatomy of Flowers of the Same Species at Different Altitudes, 64
 Larmor (Sir Joseph), Prof. H. Rubens, 741
 Larsen (E. S.), The Microscopic Determination of the Non-opaque Minerals, 261
 Lassar-Cohn (Prof.), [death], 641
 Laue (Prof. von), The Theory of Relativity, 750
 Laurie (Prof. A. P.), Chemical Combination and Sir Alfred Ewing's Magnetic Atom, 100; The Preservation and Cleaning of Pictures, 710; The Preservation from Decay of Stone on Buildings, 746
 Lavington (F.), elected a Fellow of Emmanuel College, Cambridge, 25
 Lea (Prof. F. C.), Effect of Temperature on Some Properties of Metals, 41; Elementary Hydraulics for Technical Students, 839
 Leahy (Prof. A. H.), appointed Emeritus-Professor of Mathematics in Sheffield University, 562
 Lebeau (P.) and M. Picon, The Reactions furnished by Sodammonium with Hydrocarbons, 299
 Leblanc (M.), A New Freezing Machine with Air as the Working Fluid, 136; Lamps with Three Electrodes, Anode, Cathode, and Intermediate Grid where the Current is carried by Ions, and their Applications, 268; The Use of Air as a Cooling Agent, 63
 Lecher (Dr. H.), appointed Professor of Organic Chemistry in Freiburg University, 466
 Le Danois (E.), The Hydrology of the North Atlantic, 655
 Ledingham (Prof. J. C. G.), Pasteur and Preventive Medicine. Supplement (Dec. 23), viii
 Le Gavrian (Prof. P.), Les chaussées modernes, 272
 Legendre (J.), The Tropic Rôle of Birds as regards the Culicines, 655
 Legendre (R.), Diurnal Variations of the Hydrogen Ion Concentration of Sea Water near the Coast, 724
 Leger (M.) and A. Baur, Healthy Carriers of the Plague Bacillus, 687
 Legrain (L.), The Oldest-dated Seal Cylinders, 462
 Leith (C. K.), The Economic Aspects of Geology, 143
 Lemay (P.) and L. Jaloustre, Some Microbiological Consequences of the Oxidising Properties of Thorium-X, 863
 Lemoine (Prof. G.), [obituary article], 850
 Lenoir (M.), Somatic Kinesis in the Aerial Stem of *Equisetum arvense*, 64
 Lenox-Conyngham (Sir G. P.), Gravity Variations, 874
 Lenz (Dr.), Heredity in the Human Race, 750
 Lertes (Dr. P.), Die drahtlose Telegraphie und Telephonie, 273
 Lesage (P.), The Comparative Action of Sylvinit and its Components on the First Development of Plants, 831
 Lescarboura (A. C.), edited by R. L. Smith-Rose, Radio for Everybody, 695
 Leslie (J. C.), appointed District Lecturer in Agriculture in Leeds University, 621
 Lethaby (W. R.) and others, Town Theory and Practice, 307
 Levene (Dr. P. A.), Hexosamines and Mucins, 292
 Levi-Civita (Prof. T.), awarded the Sylvester Medal of the Royal Society, 674, 788
 Lewis (Prof. W. C. McC.), Colloid Chemistry, 892
 Lewkowitz (Dr. J.), Sixth edition, revised by G. H. Warburton, Chemical Technology and Analysis of Oils, Fats, and Waxes. Vols. i. and ii., 109
 Lidstone (F. M.), Molecular Viscosity, 733
 Lindemann (Prof. F. A.) and G. M. B. Dobson, A Theory of Meteors and the Density and Temperature of the Outer Atmosphere to which it leads, 794
 Lindet (L.), The Coagulation of Latex, 758
 Lindh (A.), The Absorption Spectrum of Sulphur for the X-rays, 200
 Lindsay (A. D.), appointed Professor of Moral Philosophy in Glasgow University, 25
 Line (J.), elected a Fellow of Emmanuel College, Cambridge, 25
 Lineham (J.), awarded the degree of Ph.D. by Bristol University, 466
 Ling (Prof. A. R.), Pasteur and the Fermentation Industries. Supplement (Dec. 23), xii; Sugar Technology, 4
 Lingen (J. S. van der), A Cystoscopic Irradiator and an Ultra-violet Light Illuminator, 236
 Little (E. M.), Artificial Limbs and Amputation Stumps: a Practical Handbook, 805
 Lloyd (J. A. T.), The Problem of Laughter, 396
 Lockyer (Lady), Biography of Sir Norman Lockyer, 481
 Lockyer (the late Sir Norman), Unveiling of a Portrait Medallion of, at the Norman Lockyer Observatory: Speeches by Sir Frank Dyson and others, 192
 Lockyer (Dr. W. J. S.), Report of the Norman Lockyer Observatory, 1921-22, 53; Solar Prominences and the Corona, 20; Spectroscopic Studies of Stellar Velocities, 95; The Determination of Stellar Distances, 219; The Sun's Activity, 1890-1920, 465
 Locquin (R.) and S. Wouseng, The Preparation of the Dialkylvinyl-carbinols, 63
 Lodge (Sir Oliver), Bohr and Langmuir Atoms, 341; One Possible Cause for Atmospheric Electric Phenomena—A Query, 512; Relativity and the Æther, 446; Science and Philosophy, 887; Speculation concerning the Positive Electron, 696; The Influence of Science, 277
 Loisel (P.), The Radioactivity of the Springs of the Region of Bagnoles-de-l'Orne and its Relation to the Geological Structure, 795; and Michailesco, The Radioactivity of the Springs of the Baths of Hercules in Roumania, 863
 Longchambon (H.), The Tritoluminescence Spectrum of Saccharose, 136
 Longman (H. A.), *Dicrostichus magnificus*, Rainbow, 495
 Lorimer (Sir William), bequest to Glasgow University, 26
 Lotsy (Prof. J. P.), Interspecific Sterility, 843
 Louis (Prof. H.), Ore Deposits, 205
 Love (Prof. A. E. H.), Theoretical Mechanics: an Introductory Treatise on the Principles of Dynamics, with Applications and Numerous Examples. Third edition, 243
 Love (E. F. J.), Gravity Determinations in Australia, 563
 Lowe (E. E.), Presidential Address to the Museums Association, 163
 Lowndes (A. G.), The Pigeon Tick, 380
 Lowry (Prof. T. M.), Inorganic Chemistry, 374; Intramolecular Ionisation, 757; The Manufacture of Acids during the War, 777; and L. P. McHatton, The Powdering of Minerals by Decrepitation, 135; and E. E. Walker, Expansion and Shrinkage during Caking of Potassium Carbonate, 135
 Lugeon (Prof. M.), conferment upon, of an honorary doctorate by Paris University, 754
 Lull (Prof. R. S.), appointed Director of the Peabody Museum of Natural History, 675
 Lundbeck (W.), Diptera Danica: Genera and Species of Flies hitherto found in Denmark. Part VI.: Pipunculidæ and Phoridae, 602
 Lundberg (G. C.) and the late W. P. Maycock, "Lektrik" Lighting Connections. Seventh edition, 176
 Lundegårdh (Dr. H.), Handbuch der Pflanzenanatomie: Zelle und Cytoplasma, 176

- Lundmark (K.), *Nova T Coronæ* (1866), 493
Lundsgaard (C.) and D. D. Van Slyke, The Quantitative Influences of certain Factors involved in the Production of Cyanosis, 564
Lyman (Prof. T.), Acoustic Research, 773; The Spectrum of Helium in the Extreme Ultra-violet, 278
Lyons (Col. H. G.), Science in Egypt, 283
- MacAdam (Dr. W.), appointed Medical Tutor and Registrar of Leeds University, 133
Macalister (Prof. R. A. S.), Rock Carvings and Inscribed Symbols of the Neolithic and Bronze Ages, 852
MacFarland (Sir J. H.), The Melbourne University Bill, 39
MacGarr (L.), The Rural Community, 412
MacGregor (A. M.), The Matrix of Diamond, 262
MacIntire (Prof. H. J.), The Principles of Mechanical Refrigeration, 36
Mackenzie (D. A.), Colour Symbolism, 261
Mackie (T. J.), The Protective Action of Normal Serum in Experimental Infection with *Bacillus diphtheriae*, 236; The Serum Constituents responsible for the Sachs-Georgi and the Wassermann Reactions, 832
MacLeod (Prof. J. J. R.) and others, Physiology and Biochemistry in Modern Medicine. Fourth edition, 872
MacMahon (Major P. A.), Repeating Patterns as Decorations, 162
Macmichael (H. A.), Pottery-making on the Blue Nile, 713
MacNaughten (H.), Émile Coué: The Man and his Work, 376
Maggini (M.), drawings of Mars, 364; The Rôle of Anomalous Dispersion in the Spectra of Stars, 723
Mair (Prof. A.), Research, 134
Maistre (C. le), elected an honorary member of the Royal Dutch Institute of Engineers, 188
Malan (H. L.) and A. I. Robinson, The Weighing and Measuring of Chemical Substances, 726
Malet (H.), Étude géométrique des transformations birationnelles et des courbes planes, 276
Malinowski (Dr. B.), Argonauts of the Western Pacific: an Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea, 472
Mallik (Prof. D. N.), The Elements of Astronomy, 731
Mallock (A.), Action of Cutting Tools, 277, 603; Dampier's "Discourse of the Winds" and the Distribution of Wind on the Earth's Surface, 478; Divided Composite Eyes, 770; Metallic Coloration of Chrysalids, 344
Mallory (G. L.), The Mount Everest Expedition, 582
Mangin (L.) and N. Patouillard, The Destruction of the Woodwork on the Château of Versailles by *Phellinus cryptarum*, 467
Mann (F. G.), appointed Assistant to the Professor of Chemistry in Cambridge University, 590
Mann (J. C.), appointed Assistant Lecturer in Agricultural Chemistry in Leeds University, 621
Mann (Dr. J. D.), Sixth edition, revised throughout by Dr. W. A. Brend, Forensic Medicine and Toxicology, 571
Manson (Sir Patrick), a commemorative medal of, presented to Lady Manson, 492
Mansuri (Q. A.), Intermetallic Actions, 531
Maquenne (Prof. L.), Précis de physiologie végétale, 177; and E. Demoussy, The Influence of Calcium on the Utilisation of the Reserves during the Germination of Seeds, 299
Marage (M.), Phonation and Telephonic Audition, 687
Marchal (Mlle. G.), The Dissociation of Beryllium Sulphate, 299
Marchant (W. H.), Marine Wireless Pocket Book for the Practical Operator and Student, 273
Mariller (C.) and Van Ruymbeke, A Method for the Preparation of Commercial Absolute Alcohol and its Application to the Preparation of a National Motor Fuel, 623
Marion (C. F.), plea for a 13-month calendar, 747
Marks (P. L.), the duties of secretaries, 51
Marsh (S.) and A. E. Evans, Measurements of Electrode Potential Drop with Direct Current and Alternating Current Electrolysis, 722
- Martel (E. A.), *Nouveau Traité des eaux souterraines*, 242
Martin (Prof. A. S.) and Dr. C. V. Weller, The Medical Aspects of Mustard Gas Poisoning, 32
Martin (Dr. G.), assisted by J. M. Dickson and Maj. J. W. Christelow, Modern Chemical Lecture Diagrams, with Uses and Applications fully described, 571
Martin (Dr. L. C.), A Florentine School of Physics and Optics, 496; A Physical Study of Coma, 591
Martin-Leake (Lt.-Col. A.), presented with the gold medal of the British Medical Association, 294
Marvin (F. S.), Unified Human History, 867; and others, The Correlation of the Social Sciences, 682
Mascart (J.), The Proportion of Successes in Weather Prediction, 655
Mason (Dr. J. A.), Discovery of the Ruins of an Ancient City in Colombia, 459
Mason (T. G.), Growth and the Transport of Organic Substances in Bitter Cassava (*Manihot utilisima*), 831
Massart (Prof. C.), leading a biological expedition to Brazil, 126
Masters (F. H.), A Question of Nomenclature, 543
Mathias (E.), Dr. C. A. Crommelin, and Prof. H. Kamerlingh Onnes, The Rectilinear Diameter of Neon, 831
Matignon (C.) and M. Fréjacques, Transformation of Gypsum into Ammonium Sulphate, 200
Matley (Dr. C. A.), Cretaceous Fossil Reptiles in India, 90
Matthew (W. D.) and B. Brown, American Cretaceous Dinosaurs, 21
Matthews (L. H.) and A. D. Hobson, The Pigeon Tick, 313
Maudslay (Dr. A. P.), elected an Honorary Fellow of Trinity Hall, Cambridge, 893
Mavrogordato (A.), Experimental Silicosis of the Lungs, 366
Maw (Dr. W. H.), Progress in Engineering, 857
Mawer (Prof. A.), A Survey of English Place-names, 133
Maxwell (Sir Herbert), Defoliation of Oaks, 344; The Miraculous Draught of Fishes, 666
Mayer (Prof. A.), [death], 491
Mayer (Prof.), "Bayer 205," 751
Mayor (Dr. A. G.), [obituary article], 224
Mazé (P.), The Practical Conditions for using Calcium Cyanamide as a Manure, 864
McAdie (Prof. A.), Monsoons as Rain Makers, 324
McCall (Prof. W. A.), How to Measure in Education, 601
McCandlish (Prof. A. C.), The Feeding of Dairy Cattle, 695
McClellan (Lt.-Col. F. K.), speech at the unveiling of a portrait medallion of Sir Norman Lockyer, 192
McClellan (Capt. W. N.), Land and Sea Speed Reckoner, 308
McClure (Canon E.), [obituary], 781
McCready (J. A.), a new height record, 87
McCreath (H. M.), elected Principal of the East Anglian Institute of Agriculture, 530
McHargue (J. S.), Manganese in Plant Nutrition, 396
McKechnie (Lt.-Col. W. E.), The Sense of Smell in Birds, 784
McKeehan (L. W.), Crystal Structure of Beryllium and Beryllium Oxide, 563
McLaren (H.), conferment upon, of an honorary degree by Leeds University, 561
McLean (Prof. R. C.), A Broadcast "Rainbow," 605
McLeod (Dr. J. W.), elected to the Sir Edward Brotherton Chair of Bacteriology in Leeds University, 25
McLintock (W. F. P.) and F. R. Ennos, The Structure and Composition of the Strathmore Meteorite, 99
McLuckie (J.), Studies in Symbiosis. Part ii., 500
McMichael, Ltd. (L.), Catalogue of Wireless Telegraph and Telephone Apparatus, 427
McRobert (Sir Alexander), [obituary], 17
McTaggart (Dr. J. McT. E.), Studies in the Hegelian Dialectic. Second edition, 208
McVail (Dr. J. C.), presented with the Stewart Prize of the British Medical Association, 294
Mechan (H.), gift by, to Glasgow University, 859; acceptance of, 893
Meek (Prof. A.), Sense of Smell in Birds, 279
Mees (Dr. C. E. K.) and G. Gutekunst, Sensitisers for the Extreme Red, 366
Meggett (F. J.), appointed Professor of Biological Science at Rangoon University, 720
Meidell (B.), A Problem of the Calculus of Probabilities and of Mathematical Statistics, 758

- Meisenheimer (Prof.), Results of Experiments in crossing Flowers, Insects, and Guinea-pigs, 750
- Mellanby (Prof.) and others, Alcohol as a Beverage in its Relation to certain Social Problems, 294; and W. Kerr, The Supersaturated Condition as shown by Nozzle Flow, 41
- Mellor (Dr. J. W.), A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vols. i. and ii., 801
- Mendel (Gregor), the centenary of the birth of, 362
- Mendiola (N. B.), Relation of Transpiration to Dry Weight in Tobacco Plants, 679
- Mengel (O.), The Fall of Dust called a "Rain of Blood," 299
- Menzel (D. H.), New Nebulae, 364
- Menzies (A. C.), The Secondary Spectrum of Hydrogen, 876
- Mercanton (P. L.), The Glacial System of the Beerenberg of Jan Mayen, 28
- Merton (G.), Skjellerup's Comet, 160
- Merton (Prof. T. R.), The Structure of the Red Lithium Line, 632; and D. N. Harrison, Errors arising in the Measurement of Unsymmetrical Spectrum Lines, 62
- Merz (A.), Surface Temperatures in German Lakes, 229; and G. Wüst, Vertical Circulation in the Atlantic, 262
- Mestrézat (W.), P. Girard, and V. Morax, The Elective Ionic Permeability of the Cellular Elements, 168
- Metcalf (L.) and H. P. Eddy, Sewerage and Sewage Disposal: a Textbook, 510
- Metropolitan Vickers Co., Ltd., a Wireless Receiving Set, 324, 428
- Meyer (Sir W. Stephenson), bequests to University College, London, and Madras University, 754; acceptance by London University of a bequest by, 859
- Michaelis (Prof. L.), Die Wasserstoffionen-Konzentration: ihre Bedeutung für die Biologie und die Methoden ihrer Messung. Zweite Auflage. Teil i., 305
- Michelson (Prof. A.), conferment upon, of an honorary doctorate by Paris University, 754
- Micklem (E. R.), Miracles and the New Psychology: a Study in the Healing Miracles of the New Testament, 630
- Middleton (G. G.), presented with the Frank Wood Medal of the Society of Glass Technology, 784
- Migeod (F. W. H.), Desiccation in the Lake Chad Region, 786
- Miller (A.), Oil-drilling in Galicia, 749
- Miller, jr. (G. S.), Mammals from Haitian Caves, 855
- Miller (H. W.), [obituary], 851
- Miller (J. A.) and J. H. Pitman, The Masses of Visual Binary Stars, 555
- Milligan (H. N.), The Horniman Museum: a Handbook to the Collections illustrating a Survey of the Animal Kingdom. Second edition, 412
- Millikan (Dr. R. A.), appointed a member of the Committee on Intellectual Co-operation of the League of Nations, 460
- Mills (J.), Within the Atom: a Popular View of Electrons and Quanta, 246
- Milne (E. A.), Radiative Equilibrium, 62
- Milner (H. B.), An Introduction to Sedimentary Petrography: with special reference to loose Detrital Deposits and their Correlation by Petrographic Methods, 804; Natural Gas Gasoline: The Production of Light Oils from Natural Gas, 791; The Petroleum Industry, 474
- Minton (J. P.), Some Cases of Nerve-deafness and their Bearing on Resonance Theories of Audition, 563
- Mirande (M.), The Influence of Light on the Formation of Anthocyanine in the Scales of the Bulbs of Lilies, 592; The Morphological Origin of the Internal Liber of the Nolanaceae and the Systematic Position of this Family, 436
- Mitchell (C. Ainsworth), Inks, 426; The Colorimetric Estimation of Pyrogallol, Gallotannin, and Gallic Acid, 722
- Mitchell (J.), A New Gasteropod (fam. Euomphalidae) from the Lower Marine Series of N.S.W., 300
- Mitchell (Dr. S. A.), Parallaxes of 22 Cepheids, 493
- Mitchell (Dr. T. W.), The Psychology of Medicine, 412
- Mittell (B. E. G.), Continuous Wave Wireless Telegraphy: a Non-mathematical Introduction to the Subject of Wireless Telegraphy from the Engineer's Point of View, 273
- Mitzakis (M.), The Oil Encyclopedia, 474
- Moir (J.), Colour and Chemical Constitution. Pt. xvii., 64; Pt. xviii., 832
- Moir (J. Reid), The Red Crag Flints of Foxhall, 188
- Moir (P. J.), appointed a Clinical Assistant in Surgery in Leeds University, 133
- Möller (Prof. A.), [death], 781
- Monaco (Albert, Prince of), [death], 17; [obituary article], 156; bequests by; resolution concerning, by the Marine Biological Association of the United Kingdom, 88; bequests for scientific purposes, 524
- Monier-Williams (G. W.), Power Alcohol: Its Production and Utilisation, 172
- Monkhouse (Dr. A. C.), appointed Research Assistant in the Fuel Industries Department of Leeds University, 621
- Moon (F. W.) and H. Sadek, Topography and Geology of Northern Sinai, 175
- Moore (A. S.), A New Textile Fibre, 679
- Moore (C. N.), Generalised Limits in General Analysis, 687
- Moore (Miss E. S.), The Physiology of the Dry-rot Disease of Potatoes in Storage caused by *Fusarium cæruleum*, 795
- Moore (Dr. G. E.), Principia Ethica, 74
- Moore (Sir Norman), [death], 781; [obituary article], 817
- Moore (T. F.), [obituary], 641
- Moreux (l'Abbe Th.), Origine et formation des mondes, 660; Pour comprendre Einstein, 568
- Morris (R. L.), Further Notes on the Estimation of Potassium, 723
- Morrison (F. R.), The Essential Oil of *Kunzea corifolia*, 896
- Mortensen (Prof. Th.), Echinoderm Larvæ and their Bearing on Classification, 806
- Moss (Asst. Prof. K. N.), appointed Professor of Coal and Metal Mining in Birmingham University, 368
- Mossman (R. C.), Recent Remarkable Temperatures, 126
- Mouat-Biggs (Major C. E. F.), Scorpions and their Venom, 250
- Moureu (C.) and C. Dufraisse, Auto-oxidation, 268
- Mukherjee (Prof. J. N.), Experiments on the Theory of Soil-acidity, 732
- Mulder (Prof. M. E.), The "Green Ray" or "Green Flash" (Rayon Vert) at Rising and Setting of the Sun, 370
- Munby (A. E.), American Research on Acoustics, 575
- Mundey (A. H.), C. C. Bissett, and J. Cartland, White Metals, 467
- Murke (Dr. F.), Condensed Description of the Manufacture of Beet Sugar, 4
- Murray (Miss), Excavations at Borg en Nadur, Malta, 859
- Murray (Miss M. M. A.), elected to the London University Studentship in Physiology for 1922-23, 25
- Musgrave (H.), bequest to the Queen's University, Belfast, 828
- Musgrave (J. L.), Heating and Ventilation in Passenger Ships, 586
- Myers (Dr. C. S.), The Influence of the late W. H. R. Rivers on the Development of Psychology in Great Britain, 392, 485; The Various Factors involved in the Appreciation of Music, 232
- Nakano (H.), Ecology of "Floating Islands," 646
- Nanji (D. R.), appointed Assistant Lecturer and Demonstrator in Brewing and Fermentation in Birmingham University, 684
- Narayana (Prof. A. L.) and D. Gunnaiya, Absorption of Potassium Vapour in the Associated Series, 250
- Nash (A. W.), appointed Lecturer in Oil Mining in Birmingham University, 684
- Natanson (Prof. L.), University Education in Poland, 828
- Needham (N. J. T. M.), elected to the Benn W. Levy Research Studentship in Biochemistry, Cambridge University, 620
- Nernst (Prof.), Photo-chemical Processes, 751
- Neuhausen (Dr. B. S.), Condition of Electrolytes in the Blood, 8; The Sense of Smell in Birds, 677
- Newbegin (A. M.), Solar Prominence Observations, 1921, 20
- Newbiggin (Dr. Marion), Human Geography, 353, 416; Frequented Ways: a General Survey of the Land Forms and Vegetation of Western Europe, considered in their Relation to the Life of Man, including a Detailed Study of Some Typical Regions, 599

- Newcombe (Dr. C. F.), The Kwakiutl Indians, 190
 Newman (Sir George), Maternity and Child Welfare, 232
 Newnham (E. V.), Formation of Thunderstorms, 129
 Newsholme (Sir Arthur), Compulsion and Education in Public Health Work, 232; Relative Values in Public Health, 820, 853
 Newton (R. B.), E. Heron-Allen, and A. Earland, Eocene Mollusca and Foraminifera from Nigeria, 322
 Nicholls (J. R.), The Estimation of Morphine, 722
 Nicholson (Prof. J. W.), The Difference between Series Spectra of Isotopes, 37
 Nicloux (M.) and G. Welter, Does Cyanic Acid exist in the Blood? 168
 Nicolas (G.), A New Host of Phyllosiphon, 200
 Nicoresti (C. A. C.), Heat and Light in Chemical Combination with other Elements, 524
 Nierenstein (Dr. M.), Black Coral, 313; Tinctorial Chemistry and Histology, 33
 Nishimura (M.), Meadow Grasses, 855
 Nobbe (Prof. F.), [death], 610
 Nobécourt (P.), The Mechanism of the Parasitic Action of *Penicillium glaucum* and of *Mucor stolonifer*, 168
 Noddack (Dr.), appointed Director of the Physikalisch-Technische Reichsanstalt, 554
 Nodon (Dr. A.), Earth Currents in France, 888
 Noel (Capt. J. B. L.), a film record of the Mount Everest Expedition, 743
 Noelting (Prof. E.), [obituary], 425
 Nordenskiöld (Baron E.), The Copper and Bronze Ages of South America, 141; The Roman Balance in South America, 526
 Nordmann (C.) and Le Morvan, Observations of Stars of the N Type, 167
 Normand (Dr. C. W. B.), Dust-raising Winds, 262
 Norris (Prof. J. F.) and Prof. K. L. Mark, Laboratory Exercises in Inorganic Chemistry, 602
 Norris (K.), an Albino Crested Newt, 188
 Norrish (R. G. W.), awarded the Gordon Wigan Prize of Cambridge University, 828
 Norton (L. E.), The Apparent Swelling of Sand on the Addition of Water, 63
 Noyes (A. A.) and H. A. Wilson, Thermal Ionisation of Gaseous Elements at High Temperatures, 687
 Nuthall (A. W.), to be the Ingleby Lecturer in Birmingham University for 1924, 60
 Nys (Prof. D.), La Notion d'espace, 471
- Occhialini (A.), Elettrotecnica elementare con numerosi problemi. Vol. i., 474
 O'Connell (Marjorie), Phylogeny of Ochotoceras, 322
 O'Dwyer (Margaret H.), Protein Precipitation in Grasses, 759; The Nutritive Value of Certain Australian Grasses, 759
 Ogden (C. K.), I. A. Richards, and J. Wood, The Foundations of Æsthetics, 375
 Oldham (R. D.), Gravity Observations in India, 665; The Earthquake of August 7, 1895, in Northern Italy, 757
 Ollivier (Prof. H.), Cours de physique générale à l'usage des candidats au certificat de Physique générale, au diplôme d'Ingénieur-Électricien et à l'Agrégation des Sciences physiques. Tome ii. Deux. édition, 405
 Olufsen (Prof.), leader of a Danish expedition to the Sahara, 643
 Oman (Sir Charles W. C.), appointed Creighton Lecturer in the University of London for 1922-23, 25
 Omori (Prof.), Earthquakes in the Region around Tokyo, 162
 O'Neill (H.) and Dr. F. C. Thompson, A Curious Feature in the Hardness of Metals, 773
 Onnes (Prof. H. Kamerlingh), elected a Corresponding Member of the Prussian Academy of Sciences, Berlin, 158; Prof. J. P. Kuenen, 673
 Onslow (Hon. V. A. H. H.), [obituary article], 85
 Orr (J.), A Short History of British Agriculture, 204
 Orton (Dr. J. H.), Occurrences of a Crystalline Style in the American Slipper Limpet (*Crepidula fornicata*) and its Allies, 149; Occurrence of the Archiannelids, Saccocirrus and Protodrilus on the South and West Coasts of England, 574; The Hermit-crab (*E. bernhardus*) and the Anemone (*C. (Sagartia) parasitica*), 877; The Mode of Feeding of the Jelly-fish, *Aurelia aurita*, on the Smaller Organisms in the Plankton, 178; The Phenomena and Conditions of Sex-change in the Oyster (*O. edulis*) and *Crepidula*, 212; The Relationship between the Common Hermit-crab (*Eupagurus bernhardus*) and the Anemone (*Sagartia parasitica*), 735
 Osborn (Prof. H. F.), Fossil Vertebrates in Central Asia, 646; Plesiosaurus, the Anthropoid Primate of Western Nebraska, 281; The American Museum Ideal, 880; The Ethnology of Scandinavia, 190
 Osborne (G. D.), The Geology and Petrography of the Clarendon-Paterson District. Part i., 236; Part ii., 864
 Ostenfeld (Prof. C. H.) and Dr. O. Paulsen, A List of Flowering Plants from Inner Asia, collected by Dr. Sven Hedin, determined by various authors, 170
 Ostwald (Prof. W.), New Methods of Quantitative Determination of Colours, 751
 Owen (Dr. E. A.), The Sphere-gap Voltmeter, 615
- Page (Prof. L.), An Introduction to Electrodynamics: from the Standpoint of the Electron Theory, 509
 Paget (S.), Pasteur. Supplement (Dec. 23), iii
 Palmer (L. S.), appointed Assistant Lecturer in Electrical Engineering in Manchester University, 653
 Panisset (L.) and J. Verge, The "donneurs de sang" in Veterinary Medicine, 136; and E. Grasset, The Fixation-reaction in the Diagnosis of Tuberculosis in Cattle, 268
 Parcot (Abbé L.), the work of B. de Jussieu, 320
 Paris (Capt. E. T.), The Production of a Standard Source of Sound, 378
 Parker (the late Prof. T. J.) and Prof. W. A. Haswell, A Text-book of Zoology. In two volumes. Third edition, 765
 Parker (Dr. W. R.), offer for the preservation of fossils found in the United Kingdom, 460
 Parkhouse (A. W.), Practical Polishing and Staining, 147
 Parkin (Sir George R.), [obituary article], 49
 Parkinson (J.), The Primitive Crust of the Earth, 413
 Parrish (P.), The Design of Ammoniacal Liquor Stills, 130
 Parsons (A. C.) and others, Ministry of Health. Reports on Public Health and Medical Subjects. No. 11: Report on Encephalitis Lethargica, 626
 Parsons (Sir Charles), elected an Honorary Member of the Royal Dutch Institute of Engineers, 188
 Parsons (Sir J. Herbert), Physiological Aspects of Physical Measurement, 824
 Partington (Prof. J. R.), Research and Razors, 415
 Pascal (P.), Magnetic Analysis of Silicates and the Silicic Acids, 758; Magnetic Analysis of the Stannic Acids, 863
 Pascoe (Dr. E. H.), Geology of Mesopotamia, 21
 Pasquier (Prof. L.-G. du), Le Principe de la relativité et les théories d'Einstein, 568
 Pasteur (Louis), Supplement (Dec. 23), iii to xiv
 Pastorelli and Rapkin, Ltd., list of Thermographs and Hydrographs, 52
 Patrick (Dr. Dorothy M.), appointed Assistant Lecturer in Physiology in Birmingham University, 859
 Patton (R. T.), The Drying of Timber, 332
 Patton (Major W. S.), the genus *Musca*, 396
 Payton (C. G.), appointed Demonstrator in Anatomy in Birmingham University, 60
 Peacock (A. D.), Pairing and Parthenogenesis in Saw-flies, 215
 Peacock (D. H.), appointed Professor of Chemistry at Rangoon University, 720
 Peacock (H. A.), The Presence of Sulphur Dioxide in Cattle Foods after Fumigation, 894
 Peake (H.), The English Village: the Origin and Decay of its Community. An Anthropological Interpretation, 371
 Peake (H. J. E.), The Study of Man, 354, 516
 Pearl (Prof. R.) and T. J. Le Blanc, Further Note on the Age Index of a Population, 687
 Pearsall (Dr. W. H.), appointed Reader in Botany in Leeds University, 893

- Pearson (E. S.), Variations in Personal Equation, 827
 Pearson (Prof. Karl), Francis Galton, 1822-1922: a Centenary Appreciation, 335; Health and Weight Probabilities, 228; Tables of the Incomplete Gamma-function, 669; and E. S. Pearson, How to find a General Polychoric Coefficient of Correlation, 827
 Pease (R. N.), Atoms and Electrons, 379
 Peddie (Prof. W.), Self Light, Fatigue, Inhibition, and Recurrent Visual Images, 100
 Peel (R.), An Elementary Text-book of Coal-mining. Revised and enlarged by Prof. D. Burns. Twentieth edition, 628
 Peirce (J. D.), The Giant Trees of Victoria, 830
 Penard (E.), Flagellates, 228
 Penfold (A. R.), Some Essential Oils from *Leptospermum Liversidgei*, 300; The Essential Oil from *Bachhousia myrtifolia*. Part i., 468; The Essential Oils of two Myrtaceous Shrubs, *Homoranthus virgatus* and *H. flavescens*, 896; The Essential Oils of two Varieties of *Leptospermum flavescens*, 759; The Isolation and Identification of the Acid Bodies produced by the Oxidation of Piperitone by Means of Potassium Permanganate, 236; and F. R. Morrison, A New Stearoptene (probably a Phenol Ether) occurring in some Essential Oils of the Myrtaceæ, 300
 Penzer (N. M.), The Mineral Resources of Burma, 74; The Tin Resources of the British Empire, 5
 Pereira (Gen. Sir George), Journey from Peking to India, 852
 Péringuey (Dr.), Bantu Throwing-stones and Brass, 494
 Perkins (H. A.), The Resistance of Thin Electrified Conducting Layers, 436
 Perot (A.), A Rapid Method of determining the Elements of Terrestrial Magnetism, 795
 Perrett (Dr. W.), The Mechanism of the Cochlea, 633
 Perrier (A.) and B. de Mandrot, The Elasticity and Symmetry of Quartz at High Temperatures, 655
 Perrot (Prof. E.), presented with the Hanbury Medal of the Pharmaceutical Society, 554
 Perucca (E.), The Surface Properties of Mercury: Voltaic Character, Surface Tension, Photo-electric Effect, 623
 Petavel (Capt. J. W.), Co-operation and the Problem of Unemployment, 298
 Petersen (Dr. C. G. J.), The Fauna of the Sea-bottom, 527
 Petrie (Prof. W. M. Flinders), The Green Ray at Sunset and Sunrise, 604
 Petronievics (Dr. B.), Jurassic Birds, 261
 Pexton (S.), awarded a Gas Research Fellowship in Leeds University, 98
 Pézard (A.), The Idea of the "seuil différentiel" and Humoral Interpretation of the Gynandromorphism of the Bipartite Birds, 64; The Idea of the "seuil différentiel" and Progressive Masculinisation of Certain Female Birds, 299; and F. Caridroit, Sex-linked Heredity in the Gallinaceæ, 796
 Phisalix (Dr. Marie), Animaux venimeux et venins. Tome premier et tome second, 691; The Hedgehog and Virus of Rabies, 796
 Piaggio (Prof. H. T. H.), Space-time Geodesics, 699; Summary of the Theory of Relativity, 432
 Picard (É.), Discours et mélanges, 629
 Pick (W. H.), Visibility as a Sign of Coming Rain, 713
 Pickering (Prof. W. H.), Mars, 427
 Pickworth (A.), The Corrosion of Ferrous Metals, 83
 Picon (M.), The Action of Sodammonium on Hexamethylenetetramine, etc., 686
 Pilling (G. F.), appointed Assistant Lecturer and Demonstrator in Agriculture in Leeds University, 621
 Pippard (Dr. A. J. S.), appointed Professor of Engineering at the University College of South Wales and Monmouthshire, 562
 Pittard (Prof. E.), Recent Investigations of the Lake Dwellings of Switzerland, 12
 Planck (Prof. Max), Einführung in die Theorie der Elektrizität und des Magnetismus. Zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht, 474; Vorlesungen über Thermodynamik. Sechste Auflage, 207; The Development of German Science, 750
 Plaskett (Dr. J. S.), A Very Massive Star, 364; and others, The Radial Velocities of 594 Stars, 95
 Platt (R.), appointed Demonstrator in Pathology and Bacteriology in Sheffield University, 562
 Plimmer (Violet G.) and Prof. R. H. A. Plimmer, Vitamins and the Choice of Food, 336
 Pogson (W.), The Establishment of the Kodaikanal Observatory, 711
 Pogue (J. E.), The Economics of Petroleum, 474
 Poirée (J.), Précis d'arithmétique, 445
 Poivilliers (M.), A New "Stereo-autograph," 723
 Policard (A.), The Mechanism of Working of the Adipose Cells, 623
 Pollard (Prof. A.), Action of Cutting Tools, 875
 Pollock (Prof. J. A.), [obituary article], 359
 Pons and Rémy, The Reddish-brown Coloration shown in March 1922 by the Briançon Snow, 28
 Poole (H. E.), Switching and Switchgear, 805
 Poole (Dr. H. H.), α -Particles as Detonators, 148; The Detonating Action of α -Particles, 830
 Pope (Amy E.), Pope's Manual of Nursing Procedure, 445
 Pope (Sir William), elected President of the International Union of Pure and Applied Chemistry, 126, 197
 Popesco (J. G.), The Relation between Photo-electric Phenomena and the Surface Tension of Mercury, 299; The Variation of the Surface Tension of Mercury in Gases, 268
 Porter (Prof. A. W.), The Green Ray at Sunset and Sunrise, 513; and J. J. Hodges, The Law of the Distribution of Particles in Colloidal Suspensions with Special Reference to Perrin's Investigations, 135
 Porter (Dr. E. C.), appointed Demonstrator in the Department of Leather Industries of Leeds University, 621
 Portier (P.) and M. Duval, Osmotic Pressure of the Blood of the "Wiped" Eel as a Function of Modifications of the Salinity of the External Medium, 864; Variation of the Osmotic Pressure of the Blood of the Cartilaginous Fishes, etc., 28; The Variation of the Osmotic Pressure of the Blood of the Eel as a Function of Modifications of the Salinity of the External Medium, 332
 Potter (Prof. M. C.), Wart Disease of Potatoes, 563
 Potts (F. A.), reappointed Demonstrator of Comparative Anatomy in Cambridge University, 530
 Pouissote and Lautier, Child Sacrifice at Carthage, 322
 Powell (H. J.), Modern Developments in the Making of Stained and Painted Glass, 687; [obituary article], 742
 Powers (W. L.) and T. A. H. Teeter, Land Drainage, 211
 Prescott (F. C.), The Poetic Mind, 443
 Preston (F. W.), Comparison of the Structure of Sand-blasted and Ground Glass Surfaces, 591; Structure of Abraded Glass Surfaces, 162
 Price (Dr. T. Slater), Gelatin, 286; The Desensitising of Silver Bromide-Gelatin Plates, 849
 Priestley (A. H.), appointed Lecturer in Bacteriology in Leeds University, 720
 Priestley (G.), appointed Assistant Lecturer in Cloth Analysis in Leeds University, 720
 Priestley (Prof.) and others, Absorption of Water by Root and Stem Tips, 786
 Priestley (R. E.), elected a Fellow of Clare College, Cambridge, 620
 Prior (Dr. G. T.), The Meteoric Iron of Karee Kloof, etc., 757
 Procopiu (S.), The Variations in the Arc Spectrum of Mercury with the Conditions of Emission, 299
 Punnett (Prof. R. C.), awarded the Darwin Medal of the Royal Society, 674, 787; and P. G. Bailey, Genetic Studies in Rabbits: I., Inheritance of Weight, 463; Inheritance of Weight in Poultry, 463
 Purvis (J. E.) and T. R. Hodgson, The Chemical Examination of Water, Sewage, Foods, and other Substances. Second edition, 571
 Pycraft (W. P.), The Nebraska Tooth, 707
 Quayle (E. T.), Rain-producing Influences in South Australia, 586
 Quayle (P. P.), Photography of Bullets in Flight, 514
 Quennell (M. and C. H. B.), Everyday Life in the Old Stone Age, 443

- R. (S.), A Curious Luminous Phenomenon, 481
 Rabe (W.), The System of Castor, 189
 Radcliffe (W.), Fishing from the Earliest Times, 534
 Raman (Prof. C. V.), Molecular Elotropy in Liquids, 11 ;
 Molecular Diffraction of Light, 505 ; Opalescence
 Phenomena in Liquid Mixtures, 77 ; The Spectrum
 of Neutral Helium, 700 ; Transparency of Liquids
 and Colour of the Sea, 280
 Ramanathan (K. R.), The Molecular Scattering of Light
 in Vapours, etc., 655
 Ramsay (the late Sir William), The Memorial to, in
 Westminster Abbey, 636
 Rankine (Prof. A. O.), The Origin of Magnetism, 616 ;
 X-ray Electrons, 681
 Ransome (Dr. A.), [death], 225 ; [obituary article], 256
 Rasmussen (K.), Researches in Baffin Land and the
 Hudson Bay Region, 643 ; Work in Melville Peninsula
 and Fox Basin, 18
 Rassow (Prof. B.), The Centenary Celebrations of the
 Society of German Men of Science and Physicians, 750
 Rateau (Prof. A.), General Theory of the Turbo-compressor
 for Aviation Motors, 63 ; Rapid High-altitude
 Flying, 41
 Raven (Sir Vincent), The Electric Locomotive, 41
 Ray (R. C.), Heat of Crystallisation of Quartz, 62
 Ray (Satyendra), Some Significant Relations in the
 Quantum Theory of Spectra, 215
 Rayleigh (Lord), Polarisation of the Light scattered by
 Mercury Vapour near the Resonance Periodicity,
 654 ; Spectrum of the Night Sky, 769
 Rayner (M. C.), Calluna " Cuttings," 794
 Read (Sir Hercules), Far Eastern Archaeology, 161
 Reading (A. A.), Volcanic Activity in Nigeria, 97
 Recoura (A.), Some New Properties of the Green Sulphate
 of Chromium, 28
 Redgrove (H. S.) and I. M. L. Redgrove, Joseph Glanvill
 and Psychical Research in the Seventeenth Century,
 36
 Reed (Dr. F. R. Cowper), Devonian Fossils from Chitral
 and the Pamirs, 291 ; The Geology of the British
 Empire, 5
 Reeves (J.), The World-story of 3,000,000,000 (?) Years,
 443
 Rehn (J. A. G.), Dermaptera and Blattidæ of the Transvaal
 and Natal, 822
 Reichenbach (H.), G. Cerf, E. Goblot, and Richardson-
 Foy, Einstein's Theories, 398
 Reid (Sir G. Archdall), Medical Education, 769
 Reinach (T.), The Statue of Sophocles in the Lateran
 Museum, 494
 Rendle (Dr. A. B.), Seedlings of Horse-chestnut from
 which the Terminal Bud had been removed by
 cutting through the Epicotyledonary Stem, 26
 Rettger (Prof. L. F.) and H. A. Cheplin, A Treatise on
 the Transformation of the Intestinal Flora, with
 Special Reference to the Implantation of Bacillus
 Acidophilus, 694
 Reyburn (Prof. H. A.), The Ethical Theory of Hegel :
 a Study of the Philosophy of Right, 70
 de Reynold (Prof.), The Condition of Intellectual Life
 in Austria, 755
 Reynolds (F. D.), appointed Osborne Reynolds Fellow
 in Manchester University, 653
 Reynolds (J. H.), Transcription of Russian Names, 635
 Rhodes (R. C.), The Stageroy of Shakespeare, 36
 Richards (H.), New Weights and Measurements for
 India, 734
 Richardson (E. C.), International Co-operation in Intel-
 lectual Work, 883
 Richardson (E. G.), The Theory of the Singing Flame, 829
 Richardson (L. F.), Weather Prediction by Numerical
 Process ; Forms whereon to write the Numerical
 Calculations described in " Weather Prediction by
 Numerical Process," 762 ; A. Wagner and R. Dietzius,
 an Observational Test of the Geostrophic Approximation
 in the Stratosphere, 27
 Richardson (W. A.), The Frequency-distribution of
 Igneous Rocks in relation to Petrogenic Theories,
 756
 Richmond (B.), conferment upon, of an honorary degree
 by Leeds University, 561
 Ricket (Prof. Ch.), translated by Dr. J. N. y López, Die
 Anaphylaxie, 694 ; and Mme. A. G. Le Ber, Studies
 on Lactic Fermentation, 863
 Ridgeway (Sir William), Cambridge and the Royal
 Commission, 689, 873
 Riesenfeld (Prof. E. H.), The Preparation and Properties
 of Pure Ozone, 615
 Rinne (Prof. F.), Das feinbauliche Wesen der Materie
 nach dem Vorbilde der Kristalle, 2 und 3 Auflage, 839
 Riou (P.), The Velocity of Absorption of Carbon Dioxide
 by Ammoniacal Solutions, 591
 Ripon (the Bishop of), conferment upon, of an honorary
 degree by Leeds University, 561
 Rishbeth (O. H. T.), Water-supply in Central Australia,
 822
 Ritchie (Dr. J.), appointed an additional member of the
 Committee to advise the Secretary for Scotland
 respecting the Wild Birds Protection Acts, 461 ;
 Naturalisation of Animals and Plants, 868
 Ritchie (Dr. W.), appointed Assistant Lecturer in Biology
 at Bradford Technical College, 233
 Rivers (the late Dr. W. H. R.), Plea for Closer Co-operation
 between Scientific Societies, 493 ; and others, The
 Relations between Sentiments and Complexes, 231
 Robb (Dr. A. A.), Relativity and Physical Reality, 572 ;
 Space-time Geodesics, 809
 Roberts (Dr. Ff.) and T. R. Parsons reapointed Demon-
 strators in Physiology in Cambridge University, 530
 Robertson (Dr. G. Scott), Basic Slags and Rock Phosphates,
 306
 Robertson (Sir Robert), elected President of the Faraday
 Society, 784
 Robinson (Dr. J. H.), The Humanising of Knowledge, 298
 Robinson (R. L.), Forestry Practice and Available Timber
 Supplies throughout the Empire, 159
 Rockefeller, jr. (J. D.), gift to the American Museum of
 Natural History, 126
 Rodier (W.), The Rat Problem, 612
 Roe-Thompson (E. R.), Wegener's Displacement Theory,
 214
 Roger (E.), The Periodic Return of Severe Winters, 863
 Rogers (Dr. A.), Practical Tanning, partly based on the
 third edition of " Practical Tanning," by L. A.
 Flemming, 840
 Rogers (A. F.), Collophane, 292
 Rogers (Dr. A. W.), The Geology of the Country around
 Heidelberg : Geological Map of the Country around
 Heidelberg, 662
 Rogers (R. A. P.), The Time-triangle and Time-triad
 in Special Relativity, 698
 Rohr (Dr. M. von), rendered into English by Dr. A. H.
 Levy, Eyes and Spectacles, 376
 Romieu (M.), A Method of Selective Coloration of the
 Nervous System in some Invertebrates, 532 ; and
 F. Obaton, Comparative Spectroscopic Study of the
 Green Pigment of the Chetoptera and the Chlorophyll
 of the Green Alga, *Ulva lactuca*, 200
 Roper (R. E.), The Individual and the Community, 340
 Roscoe (Rev. J.), Twenty-five Years in East Africa, 36
 Rosenhain (Dr. W.) and J. D. Grogan, The Effects of
 Over-heating and Melting on Aluminium, 500
 Rosny aîné (J.-H.), Les Sciences et le Pluralisme, 541
 Ross (Sir Ronald), Discoveries in Tropical Medicine, 38
 Rouch (J.), Le Pôle Sud : Histoire des voyages antarctiques,
 540
 Rouch (Prof. J.), Manuel d'océanographie physique, 840
 Roughton (F. J. W.), awarded the Gedge Prize of Cam-
 bridge University, 590
 Rougier (Prof. L.), Authorised Translation by Prof. M.
 Masius, Philosophy and the New Physics : an Essay
 on the Relativity Theory and the Theory of Quanta,
 568
 Roussilhe (H.), Results obtained in 1921 and 1922 by the
 Application of Aerial Photography to Precision
 Plans on the Large Scale, 831
 Rowell (H. S.), Action of Cutting Tools, 413, 771 ; Animal
 Mechanism, 542 ; The Elliptic Logarithmic Spiral,
 214
 Rowley (F. R.), Ouramœba, 40
 Rübel (Prof. E.), Geobotanische Untersuchungsmethoden,
 208

- Rubens (Prof. H.), [obituary articles], 740 and 741
 Rueff (J.), Theory of the Phenomena of Exchange, 863
 Rushworth (G. M.N.), The Painted Glass of Gloucester Cathedral, 585
 Russell (Dr. A. S.), An Introduction to the Chemistry of Radio-active Substances, 477
 Russell (E. S.), The Work of the Fisheries Laboratory at Lowestoft, 757
 Russell (G. H. H.), appointed an honorary clinical tutor in Dental Surgery in Leeds University, 621
 Russell (Prof. H. N.), Dark Nebulae, 81; presented with the Draper Gold Medal of the National Academy of Sciences of the U.S.A., 820
 Russell (Sir John), The History of British Agriculture, 204
 Rutherford (Sir Ernest), awarded the Copley Medal of the Royal Society, 674, 787; Electricity and Matter, 182
 Rutten (Prof. R. F.), Some Aspects of Scientific and Industrial Research, 130
 Ryland (H. S.), Colour Vision and Syntony, 668
- S. (T. R. R.), The Miraculous Draught of Fishes, 665
 Sabine (Prof. P. E.), Research Work on Acoustics, 575
 Sacerdote (P.) and P. Lambert, A New Method for Detecting the Presence of a Submarine, 299
 Saint (S. J.), appointed Assistant Lecturer in Agriculture in Leeds University, 621
 Salaman (Dr.), Address to the Potato Conference, 884
 Salet (P.), The Law of Dispersion of Prismatic Spectra in the Ultra-violet, 895
 Salisbury (Dr. E. J.), The Methods of Ecological Investigation, 208
 Salmon (Dr. E. H.), Columns: A Treatise on the Strength and Design of Compression Members, 210
 Salomonson (Prof. J. K. A. W.), [obituary], 552
 Sampson (H. C.), Prairie Vegetation in Illinois, 823
 Sampson (Prof. R. A.), presented with the Keith Prize of the Royal Society of Edinburgh, 19
 Sanfourche (A.), The Reactions between the Gaseous Oxides of Nitrogen and Alkaline Solutions, 591
 Satô (M.), "Electrets," the Analogues of Magnets, 714
 Saunders (Miss E. R.), two cuckoos reared together in the same nest, 160
 Sauvage (Prof. E.), Feed-water Heaters for Locomotives, 41
 Savage (Dr. W. G.), Methods used for the Inspection of Canned Foods, 366; R. F. Hanwicke and R. B. Calder, Bacteriology of Canned Meat and Fish, 614
 Schafer (Sir E. Sharpey), elected President of the International Physiological Congress, 711; presented with the Neill Prize of the Royal Society of Edinburgh, 19; presentation to, 882
 Schanz (Dr. F.), A New Theory of Vision, 557
 Schaumasse (A.), Observations of the Baade Comet made at Nice Observatory, 723; Observations of the Skjellerup Comet (1922*d*) made with the Equatorial of Nice Observatory, 895
 Schidrowitz (Dr. P.), Recent Progress in Rubber Chemistry and Technology, 726
 Schilowsky (P.), Some Applications of the Gyroscope, 829
 Schlich (Sir William), Schlich's Manual of Forestry. Vol. i.: Forest Policy in the British Empire. Fourth edition, 407
 Schlick (Prof.), The Philosophical Importance of the Theory of Relativity, 750
 Schmidt (Dr. Johs.), Live Specimens of Spirula, 788; The Life History of the Eel, 716
 Schoneboom (C. G.), Diffusion and Intertraction, 62
 Schramm (Dr. J. R.), The Abstracting and Indexing of Biological Literature, 745
 Schubert (A.), The Semi-Diesel Engine, 191
 Schuster (Sir Arthur), The Acoustics of Enclosed Spaces, 247, 341; The Green Flash at Sunset, 370
 Schwartz (B.), Philippine Cattle Round-worm, 823
 Schweitzer (Prof. A.), translated by C. T. Champion, On the Edge of the Primeval Forest: Experiences and Observations of a Doctor in Equatorial Africa, 308
 Scott (Dr. D. H.), The Early History of the Land Flora, 606, 638
 Scott (H. H.) and C. Lord, Turbinoid Bones of *Nototherium Mitchelli*, 228
 Scott (J. W. R.), The Foundations of Japan: Notes made during Journeys of 6000 Miles in the Rural Districts as a Basis for a Sounder Knowledge of the Japanese People, 538
 Scott (Dr. W. E.), The Prehistoric Relations between Spain and Ireland, 228
 Scripture (Prof. E. W.), Physical Nature of Verse, 494
 Seagrave (F. E.), Pons-Winnecke's Comet, 712
 Sears (Prof. G. W.), A Systematic Qualitative Chemical Analysis: a Theoretical and Practical Study of Analytical Reactions of the more Common Ions of Inorganic Substances, 477
 See (Prof. T. J. J.), The Sunspot Periodicity, 525
 Seely (Maj.-Gen. J. E. B.), Presidential Address to the Congress of the Royal Sanitary Institute, 232
 Seigle (M.), The Possibilities of the Commercial Use of Mild Steel Bars hardened by Extension, 623; The Principal Characteristics of Mild Steel Bars previously broken by Traction, 591
 Selbie (C. M.) and Dr. S. W. Kemp, British and Irish Paguridea, 191
 Seligman (R.) and P. Williams, Cleaning Aluminium Utensils, 500
 Sellars (Prof. R. W.), Evolutionary Naturalism, 631
 Senter (Dr. G.), elected to the Senate of London University, 562; selected as candidate for the vacancy in the representation of Science Graduates on the Senate of London University, 233
 Seward (Prof. A. C.), Palaeobotany and Earth-history, 585; and W. French, the state of the tombstone of the grave of Sir Richard Owen's parents, 611; and J. Walton, A Collection of Fossil Plants from the Falkland Islands, 861
 Shafer (R.), Progress and Science: Essays in Criticism, -662
 Shain (G.), The Meteors of the Pons-Winnecke Comet, 678
 Shakespear (Dr. G. A.), instrument for measuring differences in composition of similar gas mixtures, 615
 Shand (Dr. S. J.), The Origin of Igneous Rocks rich in Alkalies, 323
 Shann (E. W.), First Lessons in Practical Biology, 601, 736
 Shann (G.), The Evolution of Knowledge, 471
 Shapley (Prof. H.), The Distance of the Cepheid Variables, 645; The Galactic System, 545, 578; and Miss A. J. Cannon, Distribution of Stars of same Spectral Class, 854
 Sharp (Dr. D.), [death], 361; [obituary article], 521
 Shaw (A. E.), New Australasian Blattidæ, with a note on the Blattid Coxa, 500
 Shaw (Sir Napier), Meteorological Theory in Practice, 762; The Weather Map: an Introduction to Modern Meteorology. Fifth Issue (reprint of Fourth), 768; Transmission of Sound of Explosions, 415
 Shear (Dr. L.), Coins of Croesus, 54
 Sheppard (T.), elected President of the Museums Association for 1924, 163; Harpoons under Peat in Holderness, Yorks, 735; The Hull Municipal Museum, 291
 Sherborn (C. D.), Index Animalium. Sectio secunda 1801-1850. Part i., 3
 Sherman (Prof. H. C.) and S. L. Smith, The Vitamins, 6
 Sherrington (Sir C. S.), Some Aspects of Animal Mechanism, 346; The Foulerton Studentship, 787; The Use of a Pancreatic Extract in Diabetes, 774
 Shield (A. M.), bequest to the Cambridge Medical School, 621
 Shipley (Sir Arthur), *Furia infernalis*, 27
 Shirley (J.) and C. A. Lambert, *Coprosma Bauveri*, End., 168
 Shuttleworth (Dr. G. E.) and Dr. W. A. Potts, Mentally Deficient Children: Their Treatment and Training. Fifth edition, 663
 Sidebotham (E. J.), appointed Honorary Lecturer in Public Health in Manchester University, 653
 Sievers (E. G.), Carbon-black in the United States, 397; Natural Gas Gasoline in 1920, 791
 Silberrad (C. A.), The Weights and Measures of India, 325, 735
 Silberstein (Dr. L.), Some Spectrum Lines of Neutral Helium derived theoretically, 247, 248

- Silvester (N. L.), an unusual Scabious, 188
- Simmons (A. T.) and A. J. V. Gale, A First Book of General Science: an Introduction to the Scientific Study of Animal and Plant Life, 406
- Simon (E. D.) and Marion Fitzgerald, The Smokeless City, 269
- Simon (L. J.), Oxidation by Mixtures of Sulphuric Acid and Chromates, 168; The Chromic Oxidation of the Homologues of Acetic Acid, 268; The Direct Oxidation by Oxygen or Air of the Esters of the Alcohol Acids, 592; The Influence of the Structure of Organic Compounds on their Oxidation by Chromic and Sulphuric Acids, 863; and A. J. A. Guillaumin, The Quantitative Determination of Carbon and of Hydrogen by the use of Chromic and Sulphuric Acids, 623; and L. Zivy, The Neutralisation of Tartaric Acid by Potash in Presence of the Chlorides of the Alkaline Earths, 655
- Simpson (Dr. G. C.), One Possible Cause for Atmospheric Electric Phenomena: a Reply, 604
- Simpson (Prof. S.), The Body Temperature of Birds, 566
- Sinclair (Prof. W. J.), American Oligocene Mammals, 888; Entelodonts from the Oligocene of South Dakota, 21; The "Turtle-Oreodon Layer" in S. Dakota, 128
- Singer (Dr. C.), Greek Biology and Greek Medicine, 631; The Discovery of the Circulation of the Blood, 602; The Earliest Drawings made by Means of the Microscope, 829
- Sirks (Dr. M. J.), Handboek der Algemeene Erfelijheidsleer, 111; on the review of, 394
- Skene (Dr. M.), Common Plants, 177
- Slipher (E. C.), Mars, 428
- Smillie (Dr. W. G.), Studies on Hookworm Infection in Brazil, 1918-20, 169
- Smith (Prof. Alexander), [obituary article], 457
- Smith (A. J.), appointed University Frank Smart Student in Botany in Cambridge University, 530
- Smith (Dr. C. F.), The Testing of Transformers and Alternating Current Machines, 805
- Smith (C. J.), The Viscosity and Molecular Dimensions of Hydrogen Selenide, 758
- Smith (Prof. C. Michie), [death], 491; [obituary article], 610
- Smith (Col. D. J.), The Design of Motor Cars, 644
- Smith (E. A.), resignation of the Secretaryship of the Non-ferrous Metals Research Association, 321
- Smith (Eng.-Capt. E. C.), Scientific and Industrial Pioneers, 846
- Smith (Maj.-Gen. Sir Frederick), Veterinary Anatomy in England during the 16th, 17th and 18th Centuries, 296
- Smith (F. E.), awarded the John Winbolt Prize in Cambridge University, 530
- Smith (H. G.), awarded the David Syme Research Prize of Melbourne University, 259; Occurrence of Laevophellandrene in the Oil of *Melaleuca acuminata*, 759; The Chemistry of certain Australian Plant Products. Part i., 895
- Smith (H. M.), Gaseous Exchange and Physiological Requirements for Level and Grade Walking, 728
- Smith (Prof. J. G.), Organised Produce Markets, 404
- Smith (Dr. Kirstine), The Standard Deviation of a Co-efficient of Correlation, 827
- Smith (K. M.), Mosaic Disease in Plants, 668; and J. C. M. Gardner, Insect Pests of the Horticulturalist: Their Nature and Control. Vol. i.: Onion, Carrot, and Celery Flies, 694
- Smith (Sir Ross), 14,000 Miles through the Air, 631
- Smith (S. P.), [obituary article], 187
- Smith (T.), A Large Aperture Aplanatic Lens not corrected for Colour, 895; The Optical Cosine Law, 895
- Smith (W. B.), Smokeless Methods in Glasgow Housing Schemes, 232
- Smith (Dr. W. D.), Petroleum in the Philippines, 21
- Smithells (Prof. A.), impending retirement of, 641; recognition of the services of, by the Court of Leeds University, 893
- Smith-Rose and Barfield, Effect of Local Conditions on Radio Direction-finding, 753
- Smyth (H. D.), A New Method for Studying Ionizing Potentials, 654
- Snodgrass (R. T.) and V. F. Camp, Radio Receiving for Beginners, 411
- Soddy (Prof. F.), awarded the Nobel Prize for Chemistry for 1921, 674
- Solvay (E.), [obituary article], 84
- Somerville (Rear-Admiral B. T.), The Date of Stonehenge, 429
- Sommerfeld (Prof. A.), to lecture in the University of Wisconsin in 1922-23, 368
- Sommerville (D. M. Y.), Division of Space by Congruent Triangles and Tetrahedra, 862
- Sonnefeld (Dr. A.), Telescopes versus Field Glasses, 292
- Spärck (Dr. R.), The Conditions of Sex-change in the Oyster (*Ostrea-edulis*), 480
- Spath (Dr. L. F.), The Cretaceous Marine Transgression in the African Region, 291
- Speller (F. N.), The Corrosion of Ferrous Metals, 84
- Spence (Dr. J.), award to, by the Carnegie Hero Fund, 524
- Spiro (Prof.), The Electrolyte and the Organism, 751
- Sprague (T. A.), The Identification of *Sison Ammi*, Linn., 27; Twin-leaves and other Abnormalities in the Common Ash, *Fraxinus excelsior*, 757
- Springer (F.), *Balanocrinus mexicanus*, n.sp., 262
- Sprott (W. J. H.), appointed Demonstrator in Experimental Psychology in Cambridge University, 561
- Stanton (Dr. T. E.), The Characteristics of Cylindrical Journal Lubrication at High Values of the Eccentricity, 794
- Starling (Prof. E. H.), appointed to the Foulerton Professorship, 787
- Starling (S. G.), Electricity, 176
- Stevenson (Dr. W. H.), Skjellerup's Comet, 1922b, 20
- Steel (T.), Chemical Notes: General, 759
- Steiner (P.), The Ultra-violet Absorption Spectra of the Alkaloids of the Isoquinoline Group, 895
- Stekel (Dr. W.), Translated by R. Gabler, The Beloved Ego: Foundations of the New Study of the Psyche, 805
- Stephen (K.), The Misuse of Mind: a Study of Bergson's Attack on Intellectualism, 541
- Stephenson (Dr. J.), Some Scottish Oligochæta, with a note on Encystment in a Common Freshwater Oligochæte, *Lumbriculus variegatus* (Müll.), 723; The Pharyngeal Glands of the Microdrili (Oligochæta), 100
- Stephenson (L. W.), New Radiolites, 261
- Stephenson (T. A.), appointed Assistant in the Department of Zoology and Comparative Anatomy at University College, London, 435
- Steuart (D. W.), The Unsaponifiable Matter of Fats, 894
- Stevens (Miss Catharine O.), Telescopic Observation of Atmospheric Turbulence, 280
- Steward (G. C.), elected to a Fellowship at Gonville and Caius College, 684
- Stewart (J. Q.), An Electrical Analogue of the Vocal Organs, 311
- Stewart (L. M.), A Coincidence in Values, 279
- Stiles (Prof. W.), The Preservation of Food by Freezing with special reference to Fish and Meat, 101
- Stillman (Prof. J. M.), Theophrastus Bombastus von Hohenheim, called Paracelsus: His Personality and Influence as Physician, Chemist, and Reformer, 202
- Stockdale (D.), The Copper-rich Aluminium-copper Alloys, 499
- Stocks (J. L.), Aristotle's De Cælo, 174
- Stokes (Prof. A.), appointed Dunn Professor of Pathology at Guy's Hospital Medical School, 165
- Stoklasa (J.), The Respiration of the Roots, 831
- Stone (E. H.), The Age of Stonehenge, 291
- Stone (H.), A Guide to the Identification of our more Useful Timbers: being a Manual for the Use of Students of Forestry, 276; A Text-book of Wood, 73
- Stone (H. E.), a large specimen of *Datwa Stvamonium*, 525
- Stoneley (R.), appointed Curator of the Sheffield University Observatory, 684
- Stopes (Dr. Marie C.), Constructive Birth Control, 612
- Störmer (Prof. C.), Auroral Measurements, 162
- Storror (B.), The Herring Fishery and its Fluctuations, 705
- Strachan (J.), The Microscope in Paper-making, 99

- Strasser (Prof. H.), Die Grundlagen der einstein'schen Relativitätstheorie: Eine kritische Untersuchung, 568
- Stratton (Dr. S. W.), elected President of the Massachusetts Institute of Technology, 641
- Straus (Dr. F.), appointed Professor of Chemistry at the Breslau Technische Hochschule, 720
- Sturley (Dr. A. A.), [death], 674
- Sudeley (Lord), [obituary article], 851
- Sumner (F. B.) and R. R. Huestis, Bilateral Symmetry in its Relation to certain Problems of Genetics, 463
- Sussmilch (C. A.), elected President of the Royal Society of N.S.W., 126
- Sutton (J. R.), The Control of Evaporation by the Temperature of the Air, 64; The Propagation of Heat in Water, 832
- Swann (H. Kirke), A Synopsis of the Accipitres (Diurnal Birds of Prey). Parts 1, 2, 3. Second edition, 339
- Swanton (E. W.), Defoliation of Oaks, 250
- Swanton (I. R.), The Creek Indians, 646
- Swift (H. W.), appointed Demonstrator in Engineering in Leeds University, 621
- Swindells (Rev. B. G.), Kalocsa Observations of Prominences, 678
- Swindin (N.), Pumping in the Chemical Works, 726; The Flow of Liquids in Pipes, 726
- Swinton (A. H.), Ancient Observations of Aurora, 785
- Symons (H. W.), appointed a Clinical Assistant in Surgery in Leeds University, 133
- Szilard (B.), A New Electrometer with Rigid Pointer designed for the Measurement of Radiations, 136; The Direct Estimation of very small Quantities of Radium by the Penetrating Rays, 168.
- Tabor (R. J.), A New Fungal Disease of Cacao and Coffee, 794
- Taggart (W. Scott), Cotton Spinning. Vol. ii. Sixth edition with Appendix, 75
- Takamine (Dr. J.), [obituary], 361
- Tasker (R. B.), appointed Honorary Demonstrator in Anatomy for Dental Students and an Honorary Clinical Tutor in Dental Surgery in Leeds University, 621
- Tawney (C. H.), [obituary], 225
- Taylor (Dr. Griffith), Distribution of Future White Settlement, 526
- Taylor (G. I.), The Motion of a Sphere in a rotating Liquid, 62
- Taylor (J. K.), A Chemical and Bacteriological Study of a Typical Wheat Soil of N.S.W., 300
- Taylor (Dr. Monica), Water Snails and Liver Flukes, 701
- Taylor (W. T.), Electric Power Systems, 506; High Voltage Power Transformers, 506
- Taylor (Wilson), Capillarity, 377
- Tedley (C. F.), conferment upon, of an honorary degree by Leeds University, 561
- Teichert (Dr. K.), Die chemische Analyse. VIII.-IX. Bände: Methoden zur Untersuchung von Milch und Molkereiprodukten, 110
- Telford (E. D.), appointed Professor of Systematic Surgery in Manchester University, 26
- Temple (Bishop), Symbolism as a Basis for Metaphysics, 231
- Terroine (E. F.) and H. Barthélemy, Avitaminosis and Inanition, 687; and R. Wurmser, The Utilisation of Ternary Substances in the Growth of *Aspergillus niger*, 299
- Thiébaud (M.), The Composition of the Iridescent Marls, 532
- Thoday (Prof. D.), appointed Professor of Botany at the University College of North Wales, Bangor, 60
- Thom, jr. (W. T.), The Rocky Mountain Oil-field, 714
- Thomas (H. L.), Extraction of Radiolaria from Oozes, 216
- Thomas (Dr. J. S. G.), A Recording and Integrating Gas Calorimeter, 251
- Thompson (C. J. S.), The History of "Hiera Picra," 296
- Thompson (F. C.) and E. Whitehead, The Changes in Iron and Steel at Temperatures below 280° C., 794
- Thompson (Prof. McLean), Flower Structure in the Lecythidaceæ, 614
- Thompson (R. R.), elected Professor of Petroleum-mining in Birmingham University, 590
- Thompson (T. W.), Gypsy Folklore, 556
- Thomson (A. D.), bequest to Minnesota University, 166
- Thomson (Hon. G. M.), The Naturalisation of Animals and Plants in New Zealand, 868; and the late T. Anderton, Work of the Marine Biological Station and Fish Hatchery, Portobello, N.Z., 266
- Thomson (G. P.), appointed Professor of Natural Philosophy in Aberdeen University, 399; The Scattering of Hydrogen Positive Rays and the Existence of a Powerful Field of Force in the Hydrogen Molecule, 654
- Thomson (Sir Joseph J.), presented with the Franklin Gold Medal of the Franklin Institute, 188
- Thorpe (Prof. J. F.), awarded the Davy Medal of the Royal Society, 674, 787
- Thorpe (Sir T. Edward), A Dictionary of Applied Chemistry. Vol. 3. Revised and enlarged edition, 305; Prof. G. Lemoine, 850; Paracelsus, 202
- Thoulet (Prof. J.), L'Océanographie, 541
- Tian (A.), Thermostats with Multiple Jackets, 27
- Tilby (A. W.), The Evolution of Consciousness, 147, 279
- Tilden (Sir William) and others, The Teaching of Science in Schools and Colleges, 754
- Tilley (C. E.), The Petrology of the Metamorphosed Rocks of the Start Area (South Devon), 167
- Tillyard (Dr. R. J.), Life-history of *Ithone fusca*, 495; Mesozoic Insects of Queensland. No. 9, 864; Some New Permian Insects from Belmont, N.S.W., in the Collection of Mr. John Mitchell, 300
- Timbie (Prof. W. H.) and Prof. V. Bush, Principles of Electrical Engineering, 506
- Tischler (Prof. G.), Handbuch der Pflanzenanatomie: Allgemeine Pflanzenkaryologie, 176
- Topley (W. W. C.), appointed Professor of Bacteriology in Manchester University, 134
- Tóvey (S. R.) and P. F. Morris, Contributions from the National Herbarium of Victoria. No. 2, 332
- Towler (E. E.), An Empire Patent, 772
- Trelease (Prof. W.), Plant Materials of Decorative Gardening: the Woody Plants. Second edition, 177
- Trillat (A.), The Influence of Humidity and Vesicular State on the Diffusion in Air of Drops containing Micro-organisms, 332
- Trivelli (A. P. H.), F. L. Righter, and S. E. Sheppard, Photographic Experiments, 397
- Troland (L. T.), Psychophysics as the Key to the Mysteries of Physics and Metaphysics, 24
- Trouton (Prof. F. T.), [death], 459; [obituary article], 490
- Troxell (E. L.) and others, American Vertebrate Palaeontology, 585
- Truffaut (G.) and N. Bezssonoff, A New Bacillus capable of fixing Nitrogen, 623
- Tschugaeff (Prof. L.), [death], 781
- Tudsbery (Dr. J. H.), elected an Honorary Member of the Royal Dutch Institute of Engineers, 188
- Tupman (Lt.-Col. G. L.), [obituary article], 742
- Turnbull (H. W.), Double Binary Forms, 862
- Turner (A. J.), Australian Lepidoptera, 168; Revision of Australian Lepidoptera: Saturniadae, Bombycidae, Eupterotidae, Notodontidae, 759; Some Australian Moths from Lord Howe Island, 864
- Turner (Prof. H. H.), Focal Depths of Earthquakes, 55
- Turner (S.), The Conquest of the New Zealand Alps, 872
- Turner (Prof. W. E. S.), The British Glass Industry, 833; The Glass Industry and Methods of Manufacture in Czecho-Slovakia, 830; The Mixing of Batch, 63; and others, Glass Research, 430
- Tutton (Dr. A. E. H.), Crystallography and Practical Crystal Measurement. Second edition. In 2 vols., 303; Pasteur in Crystallography. Supplement (Dec. 23), viii; Rotary Polarisation of Light, 809; Ten Years of X-ray Crystal Analysis, 47
- Tweedie (C.), James Stirling: A Sketch of his Life and Works along with his Scientific Correspondence, 111
- Tye (L. M.), Illuminating Engineering in Relation to the Architect, 746
- Underhill (Dr. J.), Mineral Land Surveying. Third edition, 541

- Unstead (Dr. J. F.), appointed Professor of Geography in the University of London, 198; The Belt of Political Change in Europe, 529
- Urban (Prof.), elected an Honorary Member of the Royal Institution, 784
- Urquhart (J. W.), Steel Thermal Treatment, 837
- Uvarov (B. P.), Grasshoppers of the Genus Hieroglyphus and their nearest Allies, 822
- Van Buskirk (E. F.) and E. L. Smith, The Science of Everyday Life, 406
- Vaney (C.) and J. Pelosse, Origin of the Natural Coloration of the Silk of *Bombyx mori*, 64
- Varignon (F.), Bicentenary of the death of, 782
- Varley (T.), Hampshire, 339
- Vaulx (Dr. R. de la), Recent Work on Intersexuality, 54
- Vavon (G.) and A. Husson, Catalysis by Platinum Black, 299
- Vayson (A.), The Development of Flint Implements, 128
- Veal (T. H. P.), appointed Assistant Lecturer in Civil Engineering in Birmingham University, 368
- Verdier (J. W.), Statistics of Shipping Casualties and Loss of Life at Sea, 51
- Vernadsky (Prof. W.), Chemical Composition of the Earth's Crust, 229; Nickel and Cobalt in the Biosphere, 436; The Problem of the Decomposition of Kaolin by Organisms, 532
- Vernet (G.), The Rôle of Calcium Chloride in the Coagulation of the Latex of *Hevea Brasiliensis*, 686
- Vila (M.), Separation of the Globulins of Horse Serum, 687
- Vilmorin (J. de) and Cazaubon, The Catalase of Seeds, 200
- Vincent (G. E.), Work of the Rockefeller Foundation for 1921, 52
- Vincent (Prof. Swale), Internal Secretion and the Ductless Glands. Second edition, 658
- Vines (Dr. H. W. K.), awarded the Raymond Horton-Smith Prize of Cambridge University, 828
- de Virville (A. D.) and F. Obaton, Observations and Experiments on Ephemeral Flowers, 655; The Opening and Closing of Persistent Meteoric Flowers, 759
- Visger (Mrs. J. A. Owen), [obituary article], 257
- Visher (Dr. S. S.), Tropical Cyclones in Southern Hemisphere, 647
- Viullemin (P.), Disjunction and Combination of the Characters of the Parents in a Hybrid, 436
- Voicu (J.), The Influence of Humus on the Sensibility of *Azotobacter Chroococcum* towards Boron, 332
- Volonakis (Dr. M. D.), The Island of Roses and her Eleven Sisters: or, the Dodecanese from the Earliest Time down to the Present Day, 146
- Vournazos (A. Ch.), Mixed Complex Anti-mercuriodobromides, 268
- Vulliamy (C. E.), A Long Barrow in Breconshire, 614
- Wade (E. B. H.), Improved River Discharge Measurements, 495
- Wagstaff (J. E. P.), elected to a Fellowship at St. John's College, Cambridge, 684
- Wait (W. E.) and others, Birds and some Invertebrates of Ceylon, 228
- Wakefield (Miss E. M.), Fungus-hunting in the West Indies, 563
- Walcott (Dr. C. D.), Geological Explorations in the Canadian Rocky Mountains, 18; The New Building of the National Academy of Sciences, U.S.A., 120
- Wales (Prince of), conferment of the Honorary Degree of LL.D. of St. Andrews University upon the, 498; presented with the Gold Medal of the Ramsay Memorial Fund, 745
- Walker (Dr. G. T.), Periodicities, 511; The Probable Amount of the Monsoon Rainfall in 1922, 159
- Walker (J. E.) and R. B. Foster, Patents for Inventions, 663
- Wall (Col. F.), Ophidia Toprobanica, or the Snakes of Ceylon, 538
- Wall (Dr. T. F.), A New Type of Electrical Condenser, 810, 885
- Wallace (R. Hedger), Vegetable Rennet, 543; Water Snails and Liver Flukes, 845
- Waller (Mrs. A. D.), [obituary article], 708
- Walmsley (W. A.), Tar Distillation, 130
- Walston (Waldstein) (Sir Charles), Harmonism and Conscious Evolution, 443
- Walter (L. H.), [death], 459
- Walton (Lt.-Col. H. J.), Mosquito Control, 838
- Walton (J.), appointed Junior Demonstrator of Botany in Cambridge University, 530
- Ward (J.), [obituary article], 49
- Ward (Prof. R. De C.), Precipitation in the United States, 366
- Waring (H. J.), elected Vice-Chancellor of the University of London, 25
- Warman (W. H.), Agricultural Co-operation in England and Wales, 404
- Warren (Dr. C. H.), appointed Director of the Sheffield Scientific School, Yale University, 60
- Warren (Dr. E.), Inheritance in the Foxglove, 827
- Warren (Prof. H. C.), A History of the Association Psychology, 75
- Warren (S. H.), The Red Crag Flints of Foxhall, 54
- Warth (A. F.), Colour Observations of the Moon, 605
- Washburn (Prof. E. W.), An Introduction to the Principles of Physical Chemistry from the Standpoint of Modern Atomistics and Thermodynamics. Second edition, 305
- Waterhouse (Major-Gen. J.), [death], 491; [obituary article], 552
- Watkins (A.), Early British Trackways, Moats, Mounds, Camps, and Sites, 176
- Watson (J. A. S.), appointed Professor of Agriculture and Rural Economy in Edinburgh University, 133
- Watson (W.), Textile Design and Colour: Elementary Weaves and Figured Fabrics. Second edition, with an Appendix on Standard Yarns, Weaves, and Fabrics, 74
- Watt (R. A. Watson), The Origin of Atmospherics, 680
- Watts (J. I.), Ernest Solvay, 84
- Weaver (Prof. J. E.), F. C. Jean, and J. W. Crist, Development and Activities of Roots of Crop Plants, 887
- Weaver (Sir Lawrence), impending retirement from the Post of Second Secretary and Director-general of Land Settlement of the Ministry of Agriculture, 461
- Webb (R. W.), Germination of the Spores of certain Fungi in Relation to Hydrogen-ion Concentration, 128
- Weber (Prof. Max), Celebration of Seventieth Birthday, 780
- Webster (Prof. A. G.), Absolute Measurement of Sound, 42
- Wedderburn (Dr. E. M.), appointed Professor of Conveyancing in the University of Edinburgh, 198
- Wegerer (Dr. A.), Die Entstehung der Kontinente und Ozeane. Dritte Auflage, 798
- Wegmann (E.), The Design and Construction of Dams: including Masonry, Earth, Rockfill, Timber, and Steel Structures, also the Principal Types of Movable Dams. Seventh edition, 661
- Weiss (Prof.), The Origin of Magnetism, 616
- Welch (M. B.), Occurrence of Oil-glands in the Barks of certain Eucalypts, 759; Relationship between Oil-glands and Oil Yields in the Eucalyptus, 592
- Wells (H. G.), Acceptance of Labour Candidature for Member of Parliament for the University of London, 166; adopted as Parliamentary Candidate for London University by the University Labour Party, 530; A Short History of the World, 867
- Wells (S. H.), retirement of, 134
- Wells (E. R.), Waterspouts and Centrifugal Force, 644
- Wendt (Dr.) and Dr. Irion, The Decomposition of Tungsten, 529
- Werner (Miss A.), More Light on the Bantu Languages, 67
- Werth (Prof. E.), Der fossile Mensch: Grundzüge einer Paläanthropologie. Erster Teil, 508
- Wesley (W. H.), [death], 583; [obituary article], 609
- West (C. J.) and H. Gilman, Organomagnesium Compounds in Synthetic Chemistry, 853
- Weston (S.), A Constant Bubble, 895
- Wetherell (E. W.), The Track of a Flat Solid Falling through Water, 845

- Wetmore (A.), A Study of the Body Temperature of Birds, 566; Birds from Haitian Caves, 855; Owl from the Eocene of Wyoming, 190
- Wheeler (Prof. W. M.), A Study of some Social Beetles in British Guiana and of their Relations to the Ant-Plant *Tachigalia*, 95
- Wherry (E. T.), The Statement of Crystal-symmetry, 586
- Whiddington (Prof. R.), X-ray Electrons, 681
- Whitaker (W.), The Water Supply of Cambridgeshire, Huntingdonshire, and Rutland from Underground Sources, 7
- White (E. G.), The Voice Beautiful in Speech and Song: A Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. Third edition, 871
- Whitehead (Prof. A. N.), elected President of the Aristotelian Society, 126; presented with the James Scott Prize of the Royal Society of Edinburgh, 50; The Relatedness of Nature, 63; Uniformity and Contingency, 756; and Prof. H. Wildon Carr, The Philosophical Aspects of the Principle of Relativity, 231
- Whiteley (B.), Iron-founding, 537
- Whiteley (J. H.), The Effect of Deformation on the Ar 1 Change in Steels, 682
- Whitney (P. C.), An Experimental Towing-tank used by Benjamin Franklin, 10
- Whittaker (Prof. E. T.), elected a Foreign Member of the Reale Accademia dei Lincei, Rome, 188; Quantum Mechanism in the Atom, 23
- Wieland (Prof.), appointed to the Editorial Board of *Liebig's Annalen*, 554
- Wightman (E. P.), A. P. H. Trivelli, and S. E. Shepard, Studies in Photographic Sensitivity, 714
- Wightman (W. A.), appointed Demonstrator in Organic Chemistry in Leeds University, 621
- Wilckens (Dr. O.), Upper Cretaceous Gastropods of New Zealand, 556
- Wilkins (V. E.), Agricultural Research and the Farmer: A Record of Recent Achievement, 93
- Wilkinson (Dr. G.), The Mechanism of the Cochlea, 560, 737
- Williams (A. M.), Two Properties of Powders, 135
- Williams (C. B.), Sense of Smell in Birds, 149
- Williams (H.), The Lavas of Snowdonia, 888
- Williamson (H. B.), An Addition to the Flora of Victoria, 168; Revision of the Genus *Pultenæa*. Part iii., 563
- Willis (Dr. A. R.), [obituary article], 86
- Willis (Dr. J. C.), Age and Area, 710; and others, The Present Position of Darwinism, 751
- Willoughby (C. C.) and E. A. Hooton, Earthworks in America, 585
- Willson (Dr. R. W.), [death], 851
- Wilmott (A. J.), *Orchis latifolia* Linn. (marsh orchis) from the Island of Öland, Sweden, 757
- Wilson (C. B.), Parasitic Copepods, 54
- Wilson (C. T. R.), awarded a Royal Medal of the Royal Society, 674, 787; Some α -ray Tracks, 861
- Wilson (Prof. G. H.), appointed Professor of Pathology in Birmingham University, 368
- Wilson (G. V.) and others, Special Reports on the Mineral Resources of Great Britain. Vol. 2: Barytes and Witherite, 211
- Wilson (Prof. J.), Variation of Milk Yield with the Cow's Age and the Length of the Lactation Period, 830
- Wilson (J. S.) and others, The Design of Railway Bridges, 825
- Wilson (R. M.), appointed Principal of the South-Eastern Agricultural College, 134
- Wilson (W.), The Quantum Theory and Electromagnetic Phenomena, 722
- Wilson-Smith (Miss M. J.), awarded the Lindley Studentship in the University of London for 1922, 25
- Winge (Dr. O.), Chromosomes of the "Millions" Fish, 748
- Winstedt (E. O.), English Gypsy Christian Names, 90
- Wirtz (C.), The Brightness and Rotation of Uranus, 747
- Wislicenus (Prof. W.), [death], 50; [obituary article], 223
- Witherby (H. F.) and W. L. Sclater, Birds marked in Europe recovered in South Africa, 323
- Wolbach (Prof. S. B.), New Growths and Cancer, 766
- Wolfe (W. S.), Graphical Analysis: A Text-book on Graphic Statics, 412
- Wollaston (T. R.), Filtration: An Elementary Treatise on Industrial Methods and Equipment for the Filtration of Liquids and Gases for those concerned with Water Supply, Ventilation, and Public Health; Chemists, Mechanical Engineers, and others, 663
- Wollman (E.) and M. Vagliano, The Influence of Avitaminosis on Lactation, 136
- Wood Comet, 1922 *a*, 555; 1922 *d*, 785
- Woodger (J. H.), appointed University Reader in Biology at Middlesex Hospital Medical School, 25
- Woodward (A. M.), A Decorative Bronze Silenus Mask found at Ilkley, 748
- Woodward (B. B.), Giantism among Gastropods, 128
- Wootton (Mrs. Barbara), Sex Economics, 533
- Wray (D. A.), The Geology and Mineral Resources of the Serb-Croat-Slovene State: Being the Report of the Geologist attached to the British Economic Mission to Serbia, 33
- Wren (Sir Christopher), the Bi-centenary of the death of, 226
- Wright (C. E.), The Elliptic Logarithmic Spiral, 40
- Wright (C. S.), Gravity Variations, 875
- Wright (Prof.), Leonardo da Vinci's Work on the Structure of the Heart, 296
- Wright (W. B.), Geology and the Nebular Theory, 76
- Wrightson (F. B.), awarded the J. S. Fry and Sons, Ltd., Colston Research Fellowship in the University of Bristol, 25
- Wrinch (Dr. Dorothy) and Dr. H. Jeffreys, The Variable Depth of Earthquake Foci, 310
- Wurmser (Mlle.), The Preparation of Ammonium Nitrate, 28
- Wybergh (W. J.), Coal in South Africa, 786
- Yabe (Prof. H.) and S. Hanzawa, Uhligena, a New Type of Foraminifera found in the Eocene of Japan and West Galicia, 749
- Yokoyama (Prof. M.), Japanese Pliocene Fossils, 646
- Yorke (J. Paley), Magnetism and Electricity. New edition, 630; Technical Education, 24
- Young (Miss J. M.), Periodical Comets, 89
- Young (Prof. K.), Immigrant Groups in America, 713
- Young (Prof. S.), Azeotropic Mixtures, 758
- Young (Prof. W. H.), elected President of the London Mathematical Society, 711
- Younghusband (Sir Francis), presented with the Charles P. Daly Medal of the American Geographical Society, 158
- Youngman (W.), Germination of Indian Barley, 585
- Yovanovitch (D.), The Chemical Properties of Mesothorium-2, 332; and Mlle. Chamié, The Preparation of a Standard Radium Salt, 299
- Yule (G. U.), elected to a fellowship at St. John's College, Cambridge, 684
- Zeeman (Prof. P.), awarded the Rumford Medal of the Royal Society, 674, 787; elected a Corresponding Member of the Prussian Academy of Sciences, Berlin, 158
- Zivy (R.), An Unpublished Method of Preparing Vaccine, 687

TITLE INDEX.

- α -particles: and Atomic Nuclei, The Shocks between, P. Auger and F. Perrin, 400; as Detonators, Dr. H. H. Poole, 148; The Detonating Action of, Dr. H. H. Poole, 830
- α -ray Photographs, The Analysis of, P. M. S. Blackett, 721; Tracks, Some, C. T. R. Wilson, 861
- α - and β -rays, The Theory of the Scattering of, Dr. J. H. Jeans, 721
- Aberdeen University: Conferment of degrees, 133; G. P. Thomson appointed Professor of Natural Philosophy, 399; Dr. A. W. Gibb appointed Kilgour Professor of Geology, 754
- Aberwrach, Tests for the Utilisation of Tidal Power at, 492
- Absorption of Water by Root and Stem Tips, Prof. Priestley and others, 786
- A.C. High Tension Transmission Lines, The Electrical Design of, H. H. Jeffcott, 167
- Acacia Seedlings, Part viii., R. H. Cambage, 592
- Accipitres (Diurnal Birds of Prey), A Synopsis of the Parts 1, 2, and 3, H. Kirke Swann. Second edition, 339
- Acids, The Manufacture of, during the War, Prof. T. M. Lowry, 777
- Acoustic Research, 565; Prof. T. Lyman, 773
- Acoustics: American Research on, A. E. Munby; Prof. P. E. Sabine, 575; of Enclosed Spaces, The, Sir Arthur Schuster, 247, 341
- Actinometer, An, with Electrodes of Mercury, G. Athanasiu, 299
- Adhesives, E. Hatschek, 528; Research Committee, First Report of the, 528
- Adipose Cells, Mechanism of Working of the, A. Policard, 623
- Adolescent Girl, The Care of the: a Book for Teachers, Parents, and Guardians, Dr. Phyllis Blanchard, 411
- Adsorbed Films, Density of, R. M. Deeley, 313
- Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, Eng. Vice-Admiral Sir George Goodwin and Dr. J. C. Irvine appointed members of the, 321
- Aeration and Air Content: the Rôle of Oxygen in Root Activity, F. E. Clements, 58
- Aerial Photography, Results obtained in 1921 and 1922 by the Application of, to Precision Plans on the Large Scale, H. Roussilhe, 831
- Aeroplane Performance Calculations, H. Booth, 110
- Aesthetics, 443; The Foundations of, C. K. Ogden, I. A. Richards, and J. Wood, 375
- Afforestation, State, The Progress of, 369
- After-image, Positive, The Movement of the, Dr. F. W. Edridge-Green, 772
- "Age: and Area," Dr. J. C. Willis, 710; Index of a Population, The, Prof. R. Pearl and T. J. Le Blanc, 687
- Agricultural: Co-operation in England and Wales, W. H. Warman, 404; Industry, The Proper Position of the Landowner in relation to the, Lord Bledisloe, 392; Progress in Western India, G. Keatinge, 442; Research: and the Farmer: a Record of Recent Achievement, V. E. Wilkins, 93; in Great Britain, 93
- Agriculture: British, A Short History of, J. Orr, 204; The History of, Sir John Russell, 204; Effect of Post-war Conditions on, J. McClare Clark, 743; Ministry of, Educational Work of the, 398; Second Secretary and Director-General of Land Settlement at the, Resignation of Sir Lawrence Weaver of the post of, 461; and Industrial Fluctuations, Weather Cycles in relation to, Sir William Beveridge and others, 889; in India, Position of, Dr. B. A. Keen, 442
- Air, Exploration of: Out of the World North of Nigeria, A. Buchanan, 35
- Air: 14,000 Miles through the, Sir Ross Smith, 631; as a Cooling Agent, The Use of, M. Leblanc, 63
- Alcohol: Acids, The Direct Oxidation by Oxygen or Air of the Esters of the, L. J. Simon, 592; Commercial Absolute, A Method for the Preparation of, and its Application to the Preparation of a National Motor Fuel C. Mariller and Van Ruymbeke, 623; Power, its Production and Utilisation, G. W. Monier-Williams, 172; as a Beverage in its relation to certain Social Problems, Prof. Mellanby and others, 294; as a Fuel, 172
- Aldebaran, Occultation of, 613
- Aldehydes and Ketones, The Hydrogenation of, in the Presence of Pure and Impure Platinum Black, M. Faillebin, 863
- Algemeene Erfelijkheidssleer, Handboek der, Dr. M. J. Sirks, 111
- Algerian Tribes, Folklore among the, M. W. Hilton-Simpson, 161
- Algal Variable, An Interesting, A. H. Joy, 461
- Alkaline Carbonates, The Estimation of, in Presence of Phenolphthalein, M. Bonnier, 723
- Alkaloids of the Isoquinoline Group, The Ultra-violet Absorption Spectra of the, P. Steiner, 895
- Alkyl-glycerols, The, R. Delaby, 895
- Aluminium: Alloys of, The Constitution and Age-hardening of, with Copper, Magnesium, and Silicon in the Solid State, Marie L. V. Gayler, 499; -copper Alloys, The Copper-rich, D. Stockdale, 499; Experiments on the Oxide Method of determining, J. E. Clennell, 499; The Effects of Over-heating and Melting on, Dr. W. Rosenhain and J. D. Grogan, 500; Utensils, Cleaning, R. Seligman and P. Williams, 500
- Ameghino, Florentino, Obras completas y correspondencia científica de, vol. 3, 540
- America: Broadcasting in, A. P. M. Fleming, 294; Immigrant Groups in, Prof. K. Young, 713
- American: Biological Societies, a Federation of, Proposed Formation of, 394, 582; British and, Fine Chemicals, 653; Council on Education, The Work of the, 330; Cretaceous Dinosaurs, W. D. Mathew and B. Brown, 21; Dyestuff Industry, The, 426; Ethnology, Thirty-fifth Annual Report of the Bureau of, 1913-1914. In 2 Parts. Part 2, 176; Museum of Natural History, Gifts to, by J. D. Rockefeller, Jr., and G. F. Baker, 126, 880; Oligocene Mammals, W. J. Sinclair, 888; Research on Acoustics, A. E. Munby; Prof. P. E. Sabine, 575; Universities, Relative Support given to the Arts and the Sciences in the Graduate Schools of, 234; Vertebrate Palæontology, E. L. Troxell and others, 585
- Americanists, The International Congress of, at Rio de Janeiro, 523
- Ammoniacal: Liquor Stills, The Design of, P. Parrish, 130; Silver Fluoride, Dervin and Olmer, 863
- Ammonium Nitrate, The Preparation of, Mlle. Wurmser, 28
- Amundsen Expedition, The, 87
- Analysis, General, Generalised Limits in, C. N. Moore, 687
- Anaphylaxie, Die, Prof. Ch. Richet. Translated by Dr. J. Negrin y López, 694
- Andaman Islanders, The: a Study in Social Anthropology, A. R. Brown, 106; concerning the review of, A. R. Brown, 554
- Andes, The Physiology of Life in the, J. Barcroft, 152
- Anellaria separata* growing in the Alps, S. Hastings, 563
- Animal: and Vegetable Pathology in relation to Human Disease, Profs. Hobday and Lang, 293; Associations of some Crustacea, Dr. S. Kemp, 888; Mechanism, 333; Some Aspects of, Sir C. S. Sherrington, 346; H. S. Rowell, 542
- Animals: and Plants: in New Zealand, The Naturalisation of, Hon. G. M. Thomson, 868; Dr. J. Ritchie, 868; Diseases of, Collected Leaflets on, 427
- Animaux venimeux et venins, Dr. Marie Phisalix, Tome Premier et Tome Second, 691
- Annelids of Iceland and the Faroes, The, Rev. H. Friend, 342
- Annual Register, The, 1921, 75
- Antarctic: Lands, Geology of, D. Ferguson and others, 96; Wintering in the, T. W. Bagshawe and M. C. Lester, 50
- Anthrax in Stock in Australia, Incidence of, M. Henry, 236

- Anthropology in the Chiltern Hills, W. Bradbrooks and Prof. F. G. Parsons, 526
- Anticyclones, The Cause of, W. H. Dines, 845
- Anti-mercuriodibromides, Mixed Complex, A. Ch. Vournazos, 268
- Antimony: -bismuth System, The, M. Cook, 531; The Isotopes of, Dr. F. W. Aston, 732
- Ants in relation to Plants, J. Bequaert, 822
- Aplanatic Lens, A Large Aperture not corrected for Colour, T. Smith, 895
- Arab Art in America, G. B. Gordon, 429
- Arabic Chemistry, E. J. Holmyard, 573
- Arc Spectrum of Mercury, The Variations in the, with the Conditions of Emission, S. Procopiu, 299
- Archæology: Far-Eastern, Sir Hercules Read, 161; The Year's Work in, 523
- Arctic: Foraminifera, 241; Rotifera, H. K. Harring, 55
- Area, The Dimensions of, Dr. N. R. Campbell, 9
- Argonauts of the Western Pacific: an Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea, Dr. B. Malinowski, 472
- Aristotelian Society, Prof. A. N. Whitehead elected President of the, 126
- Aristotle: in English, 174; The Works of, translated into English. De Cælo, J. L. Stocks; De Generatione et Corruptione, Prof. H. H. Joachim, 174
- d'Arithmétique, Précis, J. Poirée, 445
- Arsenical Glucoside, An, A. Aubry and E. Dormoy, 759
- Artificial Limbs and Amputation Stumps: a Practical Handbook, E. M. Little, 805
- Asia: Central, Fossil Vertebrates in, Prof. H. F. Osborn, 646; The Peopling of, Dr. A. Hrdlička, 54
- Asiatic Society and the Discovery of the Secret of the Egyptian Hieroglyphs, Centenary of the, 125
- Aspergillus niger*, The Utilisation of Ternary Substances in the Growth of, E. F. Terroine and R. Wurmser, 299
- Asphalt and Related Bitumens in 1921 in the U.S., 749
- Association Psychology, A History of the, Prof. H. C. Warren, 75
- Astacocroton, a New Type of Acarid, Prof. W. A. Haswell, 759
- Asteroids, Origin of the, Dr. K. Hirayama, 53
- ASTRONOMICAL NOTES.
- Comets: Skjellerup's Comet, 1922 (*b*), 20, 53, 89; Periodical Comets, Miss J. M. Young, 89; Skjellerup's Comet, G. Merton, 160; Perturbations of Wolf's Comet, M. Kamensky, 290, 525; Comets, 555; A New Comet, Dr. Baade, 584; Comets, Mdle. V. Hansen; M. Kasakov, 613; Comets, 785
- Instruments: The Frye Reflecting Telescope, 364
- Meteors: Large Fireball on July 26, 189; August Meteors, 364; September Meteors, 395; October Meteor Showers, 493; Recent Meteors, W. F. Denning, 613; Possible Recurrence of a Meteor Shower, 747; Large Fireballs, W. F. Denning, 821; Great Meteor of December 6, 886
- Observatories: Norman Lockyer Observatory (1921-1922), Report by Dr. W. J. S. Lockyer, 53; The Paris Observatory, 127; Cambridge University Observatory, 127; Harvard College Observatory, 127; The Dominion Astrophysical Observatory, Victoria, 189
- Planets: Origin of the Asteroids, Dr. K. Hirayama, 53; Roche's Limit for Satellites, Dr. E. O. Fountain, 89; Observations of Mars at Sétif, Algeria, R. Jarry-Desloges, 160; Conjunction of Venus and Jupiter, 260; The Orbital Distances of Satellites and Minor Planets, Prof. G. Armellini, 260; Mars, M. Maggini; Dr. Fountain, 364; Mars, E. C. Slipper; Prof. W. H. Pickering, 428; Mercury visible as a Morning Star, 555; Variability in the Light of Iris, 584; The Brightness and Rotation of Uranus, C. Wirtz, 747
- Stars: Prof. Plaskett's Massive Star, 53; The System of Castor, W. Rabe, 189; Variable Stars near M. 53, Dr. Baade, 364; Abbreviations of Constellations' Names, 364; New Nebulæ, D. H. Menzel, 364; A Very Massive Star, Dr. J. S. Plaskett, 364; Absolute Magnitudes of Stars, Dr. H. D. Curtis, 395; The Orbit of Sirius, C. P. Howard; An Interesting Algol Variable, A. H. Joy, 461; Parallaxes of 22 Cepheids, Dr. S. A. Mitchell, 493; Nova T Coronæ (1866), K. Lundmark, 493; The Masses of Visual Binary Stars, J. A. Miller and J. H. Pitman, 555; Spectroscopic Parallaxes for Type A, Adams and Joy, 584; Globular Clusters in the Large Magellanic Cloud, 584; Occultation of Aldebaran, 613; A Bright New Star, 785; The Reported Nova in Lyra, Dr. A. C. D. Crommelin, 821; The Mass and Proper Motion of 40 Eridani, Prof. G. Abetti, 854; The Distribution of Stars of same Spectral Class, Dr. H. Shapley and Miss A. J. Cannon, 854; Stellar Temperatures and Planetary Radiation, Dr. W. W. Coblentz, 886; Spectroscopic Parallaxes of B Stars, D. L. Edwards, 886
- Sun: Solar Atmospheric Changes, Dr. W. J. S. Lockyer; A. M. Newbegin; C. P. Butler, 20; Invisible Sunspots, Dr. G. E. Hale, 395; The Law of Solar Rotation, Dr. Halm, 428; Sunspots in High Latitude, 428; The Sunspot Periodicity, Prof. T. J. J. See, 525
- Miscellaneous: The Paris Astrographic Catalogue, J. Baillaud, 160; The Problem of Three Bodies, 290; Flamsteed's Letters to Richard Towneley, 525; Calendar Reform, C. F. Marion, 747; Misconceptions about Relativity, 747; Publications of the Astronomical Society of the Pacific, 785; Ancient Observations of Aurora, A. H. Swinton, 785; Relativity and Space, Rev. H. V. Gill, 854
- Astronomical Society of the Pacific, Publications of the, October, 785
- Astronomie, Histoire de l', E. Doublet, 600
- Astronomy: History of, 600; The Elements of, Prof. D. N. Mallik, 731; The New, 2
- Athletics and Oxygen Supply, Prof. A. V. Hill, 588
- Atlantic: Hurricanes, 324; Vertical Circulation in the, A. Merz and G. Wüst, 262
- Atmosphere, The Standard, W. R. Gregg, 366
- Atmospheric: Electric Phenomena, One Possible Cause for: a Query, Sir Oliver Lodge, 512; a Reply, Dr. G. C. Simpson, 604; Electricity, 406; Turbulence, Telescopic Observation of, Miss Catharine O. Stevens, 280
- Atmospherics: New Radiogoniometric Observations of, J. Lacoste, 686; The Origin of, R. A. Watson Watt, 680
- Atom, Within the: a Popular View of Electrons and Quanta, J. Mills, 246
- Atomic: Model, An, with Stationary Electrons, Dr. H. S. Allen, 310; Models of Bohr and of Lewis and Langmuir, A Possible Reconciliation of the, W. Hughes, 37
- Atoms: and Electrons, R. N. Pease, 379; and Elements, Periodic Structure of, H. N. Allen, 415; of Matter, The: their Size, Number, and Construction, Dr. F. W. Aston, 702
- Aucubine, The Presence of, and of Melampyrite (dulcine) in several Species of Melampyrum, Mlle. Marie Braecke, 831
- Audition: Resonance Theories of, Some Cases of Nerve-deafness and their Bearing on, J. P. Minton, 563; The Resonance Theory of, Prof. E. H. Barton, 316
- Aurelia aurita*, The Mode of Feeding of the Jelly-fish, on the Smaller Organisms in the Plankton, Dr. J. H. Orton, 178
- Aurora, Ancient Observations of, A. H. Swinton, 785
- Auroral Measurements, Prof. C. Störmer, 162
- Australasian Blattidæ, New, with a Note on the Blattid Coxa, A. E. Shaw, 500
- Australia: Gravity Determinations in, E. F. J. Love, 563; New Gall-thrips from, A Remarkable, H. H. Karny, 500; Railway Problems in, Prof. T. Hudson Beare, 354; The Lorantheaceæ of, Part iii., W. F. Blakely, 759
- Australian: Asilidæ (Diptera) in the National Museum, G. H. Hardy, 168; Grasses, The Nutritive Value of Certain, Margaret H. O'Dwyer, 759; Lepidoptera,

- Revision of, A. J. Turner, 759; Plant Products, The Chemistry of Certain, Part i., H. G. Smith, 895; *Science Abstracts*, Impending Publication of, 259; Tabanidæ, Notes on, Part ii., E. W. Ferguson and G. F. Hill, 500; Termite, A New, G. F. Hill, 500
- Austria: The Condition of Intellectual Life in, Prof. de Reynold, 755, 792
- Auto-oxidation, C. Moureu and C. Dufraisse, 268
- Aveline's Hole, An Upper Palæolithic Station, 54
- Avian Minstrelsy, 209
- Aviation, S. P. Langley's Pioneer Work in, Prof. L. Baird-stow, 637
- Avitaminosis: The Influence of, on Lactation, E. Wollman and M. Vagliano, 136; and Inanition, E. F. Terroine and H. Barthélemy, 687
- Azeotropic Mixtures, Prof. S. Young, 758
- Azotobacter Chroococcum*, The Influence of Humus on the Sensibility of, towards Boron, J. Voicu, 332
- Baade Comet, Observations of the, M. Giacobini; A. Schaumasse, 723
- Bacillus diphtheriæ*, The Protective Action of Normal Serum in Experimental Infection with, T. J. Mackie, 236
- Backhousia myrtifolia*, The Essential Oil from. Part i., A. R. Penfold, 468
- Bacteria, Culture of, in a Medium of Definite Chemical Composition, with Pyruvic Acid as a Base, R. Cambier and E. Aubel, 200
- Bacteriolytic Element found in Tissues and Secretions, A. Fleming and V. D. Allison, 686
- Bacteriophage, The Theory of, Dr. F. d'Herelle, 293
- Bangalore, Indian Institute of Science, 649
- Bangor, University College of North Wales, Prof. D. Thoday appointed Professor of Botany at the, 60
- Bantu: and Semi-Bantu Languages, A Comparative Study of the, Sir Harry H. Johnston. Vol. 2, 67; Languages, More Light on the, Miss A. Werner, 67; Throwing-stones and Brass, Dr. Péringuey, 494
- Bantuland, In the Heart of, D. Campbell, 246
- Barcelona, Underground Railways in Course of Construction in, 290
- Barium Chloroplatinate, The Dissociation of, G. Gire, 168
- Bark Canker Disease of Apple caused by *Myxosporium corticolum*, Miss G. Gilchrist, 794
- Basic Slags and Rock Phosphates, Dr. G. Scott Robertson, 306
- Batch, The Mixing of, Prof. W. E. S. Turner, 63
- Batteries, A Particular Class of, V. Karper; P. Janet, 235
- Battersea Polytechnic, Calendar of, 368
- Bayer 205, Prof. Mayer, 751
- Beaufort Therapsida, Some Upper, S. H. Haughton, 236
- Bedford, A History of the County of. Part 1: Geology and Palæontology, 339
- Beerenberg of Jan Mayen, The Glacial System of the, P. L. Mercanton, 28
- Beit Memorial Fellowships, Junior, for Medical Research, Award of, 158
- Belfast, Queen's University: Dr. R. C. Gray appointed Lecturer in Physics in, 792; Bequest by H. Musgrave, 828
- Belgium, New, L. Fredericq, 864
- Benson Aerological Observatory, Retirement of W. H. Dines from the Directorship of the, 188
- Benzene Nucleus, Substitution in the, Recent Researches on, Prof. A. F. Holleman, 19
- Bergson and Einstein, Prof. H. Wildon Carr, 503
- Berlin University, Physical-Chemical Institute of, Prof. Bodenstein invited to succeed Prof. Nernst in the, 720
- Beryllium Sulphate, The Dissociation of, Mlle. G. Marchal, 299
- Binary Forms, Double, H. W. Turnbull, 862
- Biological: Literature, Abstracting and Indexing of, Dr. J. R. Schramm, 745; Station, A new, established at the Lake of Trasimeno, 258; Studies in Madeira, Dr. M. Grabham, 45
- Biologischen Arbeitsmethoden, Handbuch der, Herausgegeben von Prof. E. Abderhalden. Lief. 55, Abt. v., Teil 6, Heft 3, 509
- Biology, Practical, First Lessons in, E. W. Shann, 601, 736; The Reviewer, 737
- Biometric Studies, Dr. Kirstine Smith and others, 827
- Bird Census, A Second, Prof. J. B. Cleland, 236
- Birds: Jurassic, Dr. B. Petronievics, 261; marked in Europe recovered in South Africa, H. F. Witherby; W. L. Sclater, 323; Mimicry among, G. T. Harris, 161; Sense of Smell in, C. B. Williams, 149; Songs of the, Prof. W. Garstang, 209; the Bipartite, the Gynandromorphism of, The Idea of the "*seuil différentiel*" and Humoral Interpretation of, A. Pézard, 64; the Body Temperature of, A Study of, A. Wetmore; Prof. S. Simpson, 566; The Krophic Rôle of, as regards the Culicines, J. Legendre, 655
- Birmingham: A Third-century, 614; and Edgbaston Debating Society, Annual Meeting of the, G. A. Baker elected President, 554; University: Conferment of degrees; C. G. Payton appointed Demonstrator in Anatomy; A. W. Nuthall appointed Ingleby Lecturer for 1924, 60; Appointments in, 368, 684; The War Memorial of, 561; R. R. Thompson elected Professor of Petroleum-mining in, 590; Lectures on Town-planning at, 720; Dr. Dorothy Margaret Patrick appointed Assistant Lecturer in Physiology, 859
- Birth Control, Constructive, The Ideals and Present Position of, Dr. M. C. Stopes, 612
- Births of Eminent People, Seasonal Incidence of the, Dr. F. J. Allen, 40
- Bishop Museum: The Bernice Pauahi, 322; Fellowships, Award of, 288
- Blood: Circulation of the, The Discovery of the, Dr. C. Singer, 602; Relationships, Human, 738; and Sterility, Christopher Blayre; The Writer of the Article, 846; Transfusion, Dr. G. Keynes, 871; The Oxygen-dissociation Curve of, and its Thermodynamical Basis, Prof. A. V. Hill and W. E. L. Brown, 685
- Blood? Does Cyanic Acid exist in the, M. Nicloux and G. Welter, 168
- Bloomsbury, Dr. A. Morley Davies; T. Ll. Humberstone, 250; and the University of London, T. Ll. Humberstone, 150
- Boat which moves against the Wind using the Wind itself as Motive Power, A. Constantin, Joessel, and Daloz, 686
- Bohr and Langmuir Atoms, Sir Oliver Lodge, 341
- Bohr's Model of the Hydrogen Molecules and their Magnetic Susceptibility, Prof. K. Honda, 664
- Bombyx mori*, the Silk of, Origin of the Natural Coloration of, C. Vaney and J. Pelosse, 64
- Borg en Nadur, Malta, Excavations at, Miss Murray, 859
- Borneo, Among Primitive Peoples in: A Description of the Lives, Habits and Customs of the Piratical Head-hunters of North Borneo, I. H. Evans, 146
- Borough Polytechnic Institute, Prospectus of the, 368
- Boscovich and Modern Science, 870
- Botanic Society's Gardens, The Royal, 185
- Botanical: Equivalents, Dictionary of, French-English, German-English, Dr. E. Artschwager and E. M. Smiley, 177; Serials, New Japanese, 891
- Botany: Gardens of the James Allen's Girls' School, Dulwich, The, Dr. Lilian J. Clarke, 329; School Instruction in, 329; Dr. Lilian J. Clarke, 512; Systematic, 190
- Bottom-living Communities in the Sea, H. Blegrad, 887
- Brachiopoda, Fossil, Critical Research on, S. S. Buckman, 262
- Bradford Technical College: Prospectus of the, 199; Dr. W. Ritchie appointed Assistant Lecturer in Biology at, 233
- Brasses, The Hardness of the, F. W. Harris, 532
- Braun Tube, The New, 786
- Brazil, A Biological Expedition to, under Prof. C. Massart, 126
- Brazilian Climatology, 291
- Breconshire, A Long Barrow in, C. E. Vulliamy, 614
- Breslau Technische Hochschule, Dr. F. Straus appointed Professor of Chemistry at the, 720
- Brewing, Institute of, Researches of the, 51

- Briançon Snow, The Reddish-brown Coloration shown in March 1922 by the, Pons and Rémy, 28
- Bristol University: The Fry Colston Research Fellowship awarded to F. B. Wrightson, 25; J. Lineham awarded the Degree of Ph.D., 466; Gift to, by the Bristol Medico-Chirurgical Society, 620
- British: and American Fine Chemicals, 653; and Swiss Universities, Conference of, 399; Association: at Hull, 124, 345, 391; Programmes of the Sections, 263; Presidential Address, Sir C. S. Sherrington, 346; Summaries of Addresses of Presidents of Sections, 352; Addresses of 1922, The, 507; The, a Retrospect, 1831-1921, O. J. R. Howarth, 302; Prof. H. E. Armstrong, 341; Research Committees, 560; The Local Handbook of the, B. Hobson, 605; Committee on Training in Citizenship, Three Reports of the, 828; Broadcasting Company, The, 581; Cast Iron Research Association, Activities of the, 820; Empire, Geology and Tin Resources of the, 5; Labour, Replacement and Conciliation, 1914-21: Part 1, on Replacement, Co-ordinated and Revised by Miss L. Grier and Miss A. Ashley; Part 2, on Conciliation, Edited by A. W. Kirkaldy, 145; Medical Association, The Glasgow Meeting of the, 293; The Gold Medal presented to Sir T. Clifford Allbutt and Lt.-Col. A. Martin-Leake, and the Stewart Prize to Dr. J. C. McVail, 294; Measures, Metric and, 29; Museum (Natural History). British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report. Zoology, Vol. 6, No. 2. Protozoa, Part 2: Foraminifera, E. Heron-Allen and A. Earland, 241; Catalogue of the Books, Manuscripts, Maps and Drawings in the, Vol. 6. Supplement: A-I, 540; Non-ferrous Metals Research Association, Resignation by E. A. Smith of the Secretaryship of the, 321; Work of the, 643; Oil Victory, A. S. Brooks, 401; Research Association for the Woollen and Worsted Industries, Awards of the, 234; Science, Ninety Years of, 302; Science Guild, The Journal of the, 19; Acceptance by the Marquess of Crewe of the Presidency of the, 611; Scientific Glass Industry, The, Prof. W. E. S. Turner, 833; West Africa, The Agricultural and Forest Products of, G. C. Dudgeon. Second edition, 210
- Brittle-stars, New Antarctic, Prof. R. Koehler, 713
- Broadcasting: in America, A. P. M. Fleming, 294; in Great Britain, 469; Licences, The Issue of, 553; Radio-telephony and, A. P. M. Fleming, 858
- Brooklyn Institute, Museums of the, Report of the, 676
- Browne, Sir Thomas, The Skull of, Sir Arthur Keith and Prof. Karl Pearson, 149
- Bryozoa, Two new Species of, W. M. Bale, 563
- Bubble, A Constant, S. Weston, 895
- Building Contracts: The Principles and Practice of their Administration, E. J. Evans, 110
- Bullets in Flight, Photography of, P. P. Quayle, 514
- Butyl: Alcohol, The Chlorination of Normal, H. Gault and R. Guillemet, 436; -ethyl-malonylurea, A New Hypnotic in the Barbituric Series, P. Carnot and M. Tiffeneau, 299
- "Cable Guide," C. A. Stevenson and the invention of the, Dr. C. G. Knott, 88
- Cacao and Coffee, A New Fungal Disease of, R. J. Tabor, 794
- Calcium: Cyanamide as a Manure, The Practical Conditions for Using, P. Mazé, 864; Phosphate and the Phosphates of Iron and Alumina, The Comparative Assimilability of, Ch. Brioux, 864; The Influence of, on the Utilisation of the Reserves during the Germination of Seeds, L. Maquenne and E. Demoussy, 299
- Calculus: Applied, An Introductory Text-book, F. F. P. Bisacre, 411; of Probabilities and of Mathematical Statistics, A Problem of the, B. Meidell, 758
- Calendar: A Proposed 13-Month, C. F. Marion, 747; of Industrial Pioneers, 61, 99, 135, 166, 199, 234, 267, 298, 331, 368, 400, 436, 467, 499, 531, 562, 591; 622, 654, 685, 721, 756, 793, 829, 861
- California, Cainozoic Fishes of, Prof. D. S. Jordan and J. Zaccus, 397
- Calluna "Cuttings," M. C. Rayner, 794
- Cambridge: and the Royal Commission, 689; Sir William Ridgeway, 873; The Writer of the Article, 874; Advanced Mathematical Study and Research at, Prof. H. S. Carslaw, 8; Oxford and Universities of, Bill, 201; University, F. Lavington and J. Line elected Fellows of Emmanuel College; J. A. Carroll elected Fellow of Sidney Sussex College, 25; W. B. R. King elected a Fellow and Lecturer in Natural Sciences at Magdalene College; P. M. S. Blackett elected Charles Kingsley Bye Fellow of Magdalene College; L. E. Bayliss elected Michael Foster Student in Physiology, 25; Conferment of Honorary Degrees, 60; Observatory, Report of the, 127; Prof. H. R. Dean appointed Professor of Pathology in, 368; Appointments in, 530, 590; Bequests to, by C. Jewell and Dr. W. H. R. Rivers; W. J. H. Sprott appointed Demonstrator in Experimental Psychology; J. C. Burkill and A. E. Ingham elected Fellows of Trinity College, 561; Appointments; Women Students and Degrees, 620; Bequest to the Medical School by A. M. Shield, 621; E. C. Francis elected Fellow and Mathematical Lecturer at Peterhouse; C. G. Lamb appointed Reader in Electrical Engineering; Allotment for the School of Biochemistry; A Studentship to be Founded under the Will of Sir John Sandys, 653; Solar Physics Observatory, Annual Report of the, 678; Elections in, 684; Proposed Creation of a Readership in Biochemistry, 720; Proposal to create a Lectureship in Crystallography for A. Hutchinsonson; The Admission of Women to the Titles of Degrees, 792; Dean Inge and Sir Sidney F. Harmer elected Honorary Fellows of King's College; K. P. Chatterji elected to the Anthony Wilkin Studentship; Dr. A. B. Appleton and Dr. H. W. K. Vines awarded the Raymond Horton-Smith Prize, 828; R. G. W. Norrish awarded the Gordon Wigan Prize; Proposed University Lectureship in Embryology, 828; Local Lectures, Report for 1921-22, 860; Dr. A. P. Maudslay elected an Honorary Fellow of Trinity Hall, 893
- Canadian Rocky Mountains, Geological Explorations in the, Dr. C. D. Walcott, 18
- Cancer: and the Public, 766; New Growths and, Prof. S. B. Wolbach, 766; of the Breast and its Treatment, Prof. W. S. Handley. Second edition, 376; Research Fund, The Imperial, 266
- Canned: Foods, Dr. W. G. Savage, 366; Meat and Fish, Bacteriology of, Dr. W. G. Savage, R. F. Hanwicke, and R. B. Calder, 614
- Capillarity: W. Taylor, 377; R. M. Deeley, 543
- Carbon: -black in the United States, E. G. Sievers, 397; Dioxide, Velocity of Absorption of, by Ammoniacal Solutions, P. Riou, 591; Monoxide displaces Oxygen, Determinations of the Velocity with which, from its Combination with the Blood Pigment Hæmoglobin, Dr. H. Hartridge and F. J. W. Roughton, 758; The Velocity with which, displaces Oxygen from its Combination with Hæmoglobin, 2 parts, Dr. H. Hartridge and F. J. W. Roughton, 685; The Quantitative Determination of, and of Hydrogen by the Use of Chromic and Sulphuric Acids, L. J. Simon and A. J. A. Guillaumin, 623
- Carbonisation, Low Temperature, Prof. J. W. Cobb, 718
- Carnegie: Hero Fund, Award from the, to Dr. J. Spence, 524; Institution, The Magnetic Work of the, Dr. L. A. Bauer and others; Dr. C. Chree, 94
- Cass, Sir John, Technical Institute, Courses at the, 621
- Cassava, Bitter (*Manihot utilissima*), Growth and Transport of Organic Substances in, T. G. Mason, 831
- Cast Irons, The Thermal Modifications of Some, J. Durand, 623
- Castor, The System of, W. Rabe, 189
- Catalysis by Platinum Black, G. Vavon and A. Husson, 299
- Catalytic Actions at Solid Surfaces, A Study of, Parts viii and ix., Dr. E. F. Armstrong and T. P. Hilditch, 62
- Cathode and X-rays, Emission of, by Celestial Bodies, Dr. H. Deslandres, 847
- Cell, The, and the Surrounding Medium, Mechanism of the Exchanges between the, L. Lapique, 28

- Cells, Living, New Apparatus and Methods for the Dissection and Injection of, R. Chambers, 722
- Centaureidine, a Product obtained from Centaureine, M. Bridel and G. Charoux, 895
- Centaureine, a New Glucoside, extracted from the Roots of *Centaurea jacea*, M. Bridel and C. Charoux, 759
- Cepheid Variables, The Distance of the, Prof. H. Shapley, 645
- Cepheids, Parallaxes of 22; Dr. S. A. Mitchell, 493
- Ceramic Products, The Baking of, in Electrically Heated Furnaces, A. Granger, 235
- Ceremonial Exchange, Dr. A. C. Haddon, 472
- Ceylon: Birds and Some Invertebrates of, W. E. Wait; Dr. Annandale, 228; The Snakes of, 538
- Chaussées modernes, Les, Prof. P. Le Gavrian, 272
- Chelsea Porcelain, W. King, 871
- Chemical: Analysis, Qualitative, A Systematic: A Theoretical and Practical Study of Analytical Reactions of the more Common Ions of Inorganic Substances, Prof. G. W. Sears, 477; Apparatus, Catalogue of, A. Gallenkamp and Co., Ltd., 712; Combination and Sir Alfred Ewing's Magnetic Atom, Prof. A. P. Laurie, 100; Change and Catalysis, Prof. H. E. Armstrong, 367; Engineering Design, The General Principles of, H. Griffiths, 726; Examination of Water, Sewage, Foods, and other Substances, The, J. E. Purvis and T. R. Hodgson, 571; Foundation, The United States, 334; Industry, English, Germany and, 337; Society of, Glasgow Meeting of the, 130; The Society of, Activities of, 642; Lecture Diagrams, Modern, with Uses and Applications fully described, Dr. G. Martin, assisted by J. M. Dickson and Maj. J. W. Christelow, 571; Notes: General, T. Steel, 759; Plant Construction—Non-Metals, Materials of, H. Griffiths, 726; Society, Nominations of Officers of the, 524; Substances, The Weighing and Measuring of, H. L. Malan and A. I. Robinson, 726; Technology, 726; and Analysis of Oils, Fats, and Waxes, Dr. J. Lewkowitsch. Sixth edition, revised by G. H. Warburton. Vols. i. and ii., 109; Works, New editions of, 305
- Chemicals, Fine, British and American, 653
- Chemie, anorganischen, Lehrbuch der, Prof. K. A. Hofmann. Vierte Auflage, 695
- Chemische Analyse, Die, Herausgegeben von Dr. B. M. Margosches. VIII.-IX. Band: Methoden zur Untersuchung von Milch und Molkereiprodukten, Dr. K. Teichert, 110
- Chemist, a Master, A Monument to, Dr. E. F. Armstrong, 142
- Chemistry: A Concise History of, Dr. T. P. Hilditch. Second edition, 305; A Modern Text-book of, Prof. H. B. Baker, 374; A New Treatise on, 801; and Life, 173; and Medicine, Prof. G. Barger, 69; Applied, A Dictionary of, Sir Edward Thorpe. Vol. 3. Revised and enlarged edition, 305; Reports of the Progress of. Vol. 6, 1921, 147; Arabic, E. J. Holmyard, 573; Colloid, Prof. W. C. McC. Lewis, 892; Inorganic, Prof. T. M. Lowry, 374; and Theoretical, A Comprehensive Treatise on, Dr. J. W. Mellor. Vols. i. and ii., 802; Laboratory Exercises in, Prof. J. F. Norris and Prof. K. L. Mark, 602; International, 196; Micro Methods in the Practical Teaching of, Prof. E. C. Grey, 309; of the Plant Cell, 403; of the Sugars, Principal Irvine, 352; Organic, A Text-book of, Dr. A. Bernthsen. New edition, revised to date, by Prof. J. J. Sudborough, 602; A Text-book of, Prof. J. S. Chamberlain, 805; Physical, An Introduction to the Principles of, from the Standpoint of Modern Atomistics and Thermodynamics, Prof. E. W. Washburn. Second edition, 305; Pure and Applied, International Union of, Sir William Pope elected President of the, 126, 197; International Union of, Annual Meeting of the, 196; Teaching of, Micro-chemical Methods in the Practical, J. W. Blagden and A. Wechsler, 447; The Tutorial. Part 2: Metals and Physical Chemistry, Dr. G. H. Bailey. Edited by Dr. W. Briggs. 12th impression (4th edition), 663
- Chemists at Utrecht, International Reunion of, 431
- Chetoptera, Comparative Spectroscopic Study of the Green Pigment of the, and the Chlorophyll of the Green Alga, *Ulva lactuca*, M. Romieu and F. Obaton, 200
- Chicago University, Bequest to, by S. Coman, 166
- Child Sacrifice at Carthage, Pouissote and Lautier, 322
- Childhood, Seven Ages of, Ella L. Cabot, 872
- Children and Museums, 301
- Chilian Earthquake, The, 683, 709
- Chimie, La, et la Vie, G. Bohn and Dr. Anna Drzewina, 173
- Chinese Tibet: Expedition to, Prof. J. W. Gregory and J. C. Gregory, 719; The Alps of, and their Geographical Relations, Prof. J. W. Gregory and J. C. Gregory, 826
- Chitral and the Pamirs, Devonian Fossils from, F. R. Cowper Reed, 291
- Chlorine, Isotopes of, Separation of, Dr. Ishino, 647
- Chlorophyll, Animal, J. F. Fulton, Jr., 429
- Chromic Oxidation of the Homologues of Acetic Acid, The, L. J. Simon, 268
- Chromium, Green Sulphate of, Some New Properties of the, A. Recoura, 28
- Chrysalids, Metallic Coloration of, A. Mallock, 344
- Cinema, The, and Agricultural Education, 642
- City and Guilds of London Institute, Report for 1921, 330
- Civil: Engineers, Institute of, Awards of the, 675; List Pensions, Grant of, 259
- Clarencetown-Paterson District, Geology and Petrography of the, Part ii., G. D. Osborne, 864
- Cleveland Technical Institute, The Bulletin of the, 321
- Climates and Photography, H. G. Cornthwaite, 429
- Climates of the Continents, The, W. G. Kendrew, 630
- Climatology, Brazilian, 291
- Clinical Laboratory Methods, A Manual of, Prof. C. L. Cummer, 731
- Coal: in South Africa, W. J. Wybergh, 786; -mining, An Elementary Text-book of, R. Peel. Revised and enlarged by Prof. D. Burns. Twentieth edition, 628; Swamps, The Physiography of the, Prof. P. F. Kendall, 811; -tar Colours in the Decorative Industries, A. Clarke, 768
- Cobalt and Nickel in Plants, The Presence of, G. Bertrand and M. Mokragatz, 532
- Cochlea, The Mechanism of the, Dr. G. Wilkinson, 559, 737; Sir W. M. Bayliss, 632; Dr. W. Perrett, 633
- Codeine, The Estimation of, H. E. Annett and R. R. Sanghi, 722
- Coke in Domestic Appliances, The Efficiency of Low Temperature, Dr. Margaret W. Fishenden, 434
- Cold, Generation and Utilisation of, E. A. Griffiths and others, 618
- Coleoptera, New Social, Dr. A. D. Imms, 95
- Collembola of Spitsbergen and Bear Island, The, Prof. G. H. Carpenter and Miss K. C. J. Phillips, 100
- Colloidal Suspensions, Law of the Distribution of Particles in, with special reference to Perrin's Investigations, Prof. A. W. Porter and J. J. Hodges, 135
- Colloids, Corrosion and, Dr. G. D. Bengough and J. M. Stuart, 651
- Collophane, A. F. Rogers, 292
- Colombia, Discovery of the Ruins of an Ancient City in, Dr. J. A. Mason, 459
- Colorado University Catalogue, 1921-22, The, 435
- Colour: and Chemical Constitution, Part xvii., J. Moir, 64; Part xviii., J. Moir, 832; Symbolism, D. A. Mackenzie, 261; Vision and Syntony, Prof. E. H. Barton, 357; Dr. F. W. Edridge-Green, 513; H. S. Ryland, 668; Vision, Investigation of the, of 527 Students by the Rayleigh Test, Dr. R. A. Houstoun, 794
- Colours, The Quantitative Determination of, Prof. W. Ostwald, 751
- Columbia University, Bequest to, by A. F. Eno, 26
- Columbine, A Mutation of the, Prof. T. D. A. Cockerell and Dorothy Young, 701
- Columns: A Treatise on the Strength and Design of Compression Members, Dr. E. H. Salmon, 210
- Coma, A Physical Study of, L. C. Martin, 591
- Combustible Liquids, International Congress on, 818
- Comet: A New, Dr. Baade, 584; Notes, 712
- Comets, 785; Periodical, Miss J. M. Young, 89; M. Kamensky and others, 290; Mlle. V. Hansen; M. Kasakov, 613; Perrine's, and 1922a, 555

- Commons, House of, Representatives of the Universities in the, 720
- Congo, Insectivora from the, 365
- Consciousness, The Evolution of, A. W. Tilby, 147, 279; The Reviewer, 280
- Constantinople, The Walls and other Antiquities of, G. B. Gordon, 89
- Constellations' Names, Abbreviations of, 364
- Continents, The Flotation of, E. Gagnebin, 262
- Co-operation and the Problem of Unemployment, Capt. J. W. Petavel, 298
- Copepods, Parasitic, C. B. Wilson, 54
- Copper: and Bronze Ages of South America, The, Baron E. Nordenskiöld, 141; Films, Structure and Chemical Activity of, and the Colour Changes accompanying their Oxidation, C. N. Hinshelwood, 62
- Coprosma Baueri*, End., J. Shirley and C. A. Lambert, 168
- Coral: -bearing Limestones of the Cainozoic within the Pacific, E. C. Andrews, 168; Black, Prof. S. J. Hickson, 217; Dr. M. Nierenstein, 313; Dr. F. A. Bather, 344; in Medicine, Prof. F. Jeffrey Bell, 481; Reefs of the Louisiade Archipelago, Prof. W. M. Davis, 56
- Corals, Deep-sea, in Western European Seas, The Geographical Distribution of Some, L. Joubin, 831
- CORRESPONDENCE.
- Absorbed Films, Density of, R. M. Deeley, 313
- Acoustic Research, Prof. F. Lyman, 773
- Acoustics of Enclosed Spaces, The, Sir Arthur Schuster, 247, 341
- After-image, the Positive, The movement of, Dr. F. W. Edridge-Green, 772
- American Slipper Limpet (*Crepidula fornicata*) and its Allies, Occurrence of a Crystalline Style in the, Dr. J. H. Orton, 149
- A New Worship? Prof. H. E. Armstrong, 700
- Animal Mechanism, H. S. Rowell, 542
- Annelids of Iceland and the Faroes, Rev. H. Friend, 342
- Anticyclones, The Cause of, W. H. Dines, 845
- Antimony, The Isotopes of, Dr. F. W. Aston, 732
- α -Particles as Detonators, Dr. H. H. Poole, 148
- Archannelids, Saccocirrus, and Protodrilus, on the South and West Coasts of England, On the Occurrence of the, Dr. J. H. Orton, 574
- Area, The Dimensions of, Dr. N. R. Campbell, 9
- Atmospheric: Electric Phenomena, One Possible Cause for—A Query, Sir Oliver Lodge, 512; A Reply, Dr. G. C. Simpson, 604; Turbulence, Telescopic Observation of, Catharine O. Stevens, 280
- Atomic: Model with Stationary Electrons, An, Dr. H. S. Allen, 310; Models of Bohr and of Lewis and Langmuir, A Possible Reconciliation of the, W. Hughes, 37
- Atoms: and Electrons, R. N. Pease, 379; and Elements, Periodic Structure of, H. N. Allen, 415; Bohr and Langmuir, Sir Oliver Lodge, 341
- Aurelia aurita*, The Mode of Feeding of the Jelly-fish, on the Smaller Organisms in the Plankton, Dr. J. H. Orton, 178
- Ball, Lightning, Prof. J. B. Cleland, 40
- Biology, Practical, First Lessons in, E. W. Shann, 736
- Births of Eminent People, Seasonal Incidence of the, Dr. F. J. Allen, 40
- Blood Relationships, Human, and Sterility, Christopher Blayre; The Writer of the Article, 846
- Bloomsbury, Dr. A. Morley Davies, 250; T. Ll. Humberstone, 250
- Botany, School Instruction in, Dr. Lilian J. Clarke, 512
- British Association: The, Prof. H. E. Armstrong, 341; The Local Handbook of the, B. Hobson, 605
- Broadcast "Rainbow," A, Prof. R. C. McLean, 605
- Browne, Sir Thomas, The Skull of, Sir Arthur Keith and Prof. Karl Pearson, 149
- Cambridge: Advanced Mathematical Study and Research at, Prof. H. S. Carslaw, 8; and the Royal Commission, Sir William Ridgeway, 873; The Writer of the Article, 874
- Capillarity, W. Taylor, 377; R. M. Deeley, 543
- Chemistry: Arabic, E. J. Holmyard, 573; Micro Methods in the Practical Teaching of, Prof. E. C. Grey, 309; J. W. Blagden and A. Wechsler, 447
- Chrysalids, Metallic Coloration of, A. Mallock, 344
- Cochlea, The Mechanism of the, Sir W. M. Bayliss, 632; Dr. W. Perrett, 633; Dr. G. Wilkinson, 737
- Colour Vision and Syntony, Dr. F. W. Edridge-Green, 513; H. S. Ryland, 668
- Consciousness, The Evolution of, A. W. Tilby, 279
- Coral: Black, Dr. M. Nierenstein, 313; Dr. F. A. Bather, 344; in Medicine, Prof. F. Jeffrey Bell, 481
- Cosmical Theory and Radioactivity, Prof. J. Joly, 112
- Cutting Tools, Action of, A. Mallock, 277, 603; H. S. Rowell, 413, 771; Prof. E. G. Coker, 700; Prof. A. Pollard; Prof. E. N. da C. Andrade, 875
- Dampier's "Discourse of the Winds" and the Distribution of Wind on the Earth's Surface, A. Mallock, 478
- Earth: Geology and the Primitive State of the, Dr. H. Jeffreys, 148; The Primitive Crust of the, Prof. G. A. J. Cole, 249; J. Parkinson, 413
- Earthquake Foci, The Variable Depth of, Dr. Dorothy Wrinch and Dr. H. Jeffreys, 310
- Echinoderm Larvæ and their bearing on Classification, Prof. Th. Mortensen, 806
- Echinus esculentus*, Habits of, R. Elmhirst, 667
- "Einstein's Paradox," Rev. H. C. Browne, 668; Prof. H. Wildon Carr, 669
- Electric Atoms, Ideal, A Type of, J. L., 873; Discharge in Oxygen, Peculiarities of the, Rev. Dr. P. J. Kirkby, 249
- Electrical: Analogue of the Vocal Organs, An, J. O. Stewart, 311; Condenser, A New Type of, Dr. T. F. Wall, 810
- Electrolytes in the Blood, Condition of, Prof. B. S. Neuhausen, 8
- Electron, Speculation concerning the Positive, Sir Oliver Lodge, 696
- Experimental Towing-Tank, An, used by Benjamin Franklin, P. C. Whitney, 10
- Eyes, Divided Composite, A. Mallock, 770
- Flat Solid falling through Water, The Track of a, E. W. Wetherell, 845
- Gas Pressures and the Second Law of Thermodynamics, R. d'E. Atkinson, 112; A. Fairbourne, 113
- Geology and the Nebular Theory, Prof. J. Joly; W. B. Wright, 76
- German Book Prices, Prof. K. C. Browning, 845
- Gravity Observations in India, R. D. Oldham, 665; Variations, Sir G. P. Lenox-Conyngham, 874; C. S. Wright, 875
- Green Ray at Sunset and Sunrise, The, Prof. A. W. Porter, 513; Capt. C. J. P. Cave, 604; Prof. W. M. Flinders Petrie, 604
- Harpoons under Peat at Holderness, Yorks, O. G. S. Crawford, 481; T. Sheppard, 701, 735
- Hearing, The Resonance Theory of, Dr. H. Hartridge, 9
- Helium: The Spectrum of, in the Extreme Ultra-Violet, Prof. T. Lyman, 278; The Spectrum of Neutral, Prof. C. V. Raman, 700; Neutral, Spectrum Lines of, Prof. W. M. Hicks, 309; Some Spectrum Lines of, derived Theoretically, Dr. L. Silberstein, 247, 248
- Hermit-crab (*Eupagurus bernhardus*), The Relationship between the Common, and the Anemone (*Sagarita parasitica*), Dr. J. H. Orton, 735, 877
- Histological Stains, Prof. A. E. Boycott, 114
- Hudson, W. H., Memorial, R. B. Cunninghame Graham, 846
- Hydrogen Molecules: Bohr's Model of the, and their Magnetic Susceptibility, Prof. K. Honda, 664; The Secondary Spectrum of, A. C. Menzies, 876
- Intervals, The Measurement of, Prof. A. S. Eddington, 697; E. Cunningham, 698
- Irish Yew Trees, Sex of, Dr. C. J. Bond, 810
- Iron, The Mass Spectrum of, Dr. F. W. Aston, 312
- Isotopes, Series Spectra of, The Difference between, Prof. J. W. Nicholson, 37
- Lead and Animal Life, Miss K. Carpenter, 543
- Lepidopterous Larvæ, The effect of a Lead Salt on, Dr. F. C. Garrett and Hilda Garrett, 380
- Light, Rotary Polarisation of, Prof. F. Cheshire, 807; Dr. A. E. H. Tutton, 809
- Liquids, Transparency of, and Colour of the Sea, Prof. C. V. Raman, 280
- Lockyer, Sir Norman, Biography of, Lady Lockyer, 481

- Logarithmic Spiral, The Elliptic, C. E. Wright, 40; H. S. Russell, 214
- Luminous Phenomenon, A Curious, S. R., 481
- Magnetism, the Kinetic and Molecular Theories of, An Experimental Confirmation of, Dr. J. R. Ashworth, 10
- Masaris, Origin of the Name of the Genus, E. W. Adair, 574; F. A. B., 574
- Medical Education, Sir G. Archdall Reid, 769; Prof. W. J. Dakin, 845; J. S. Dunkerly, 846; J. T. Cunningham, 846
- Melbourne University Bill, The, Sir J. H. MacFarland, 39
- Mersenne's Numbers, Prof. G. H. Hardy, 542
- Mesoplodon Layardi, on the Tasmanian Coast, Occurrence of the Rare Whale, Prof. T. T. Flynn, 379
- Metals, the Hardness of, A Curious Feature in, H. O'Neill and Dr. F. C. Thompson, 773
- Metre, The Legal Equivalent of the, Sir R. T. Glazebrook, 446
- Miraculous Draught of Fishes, The, Prof. E. W. Gudger, 572; T. R. R. S., 665; Sir Herbert Maxwell, 666; W. B. Drummond, 666; H. Harries, 666
- Molecular, Elotropy in, Prof. C. V. Raman, 11; Viscosity, F. M. Lidstone, 733
- Molecules in a Magnetic Field, Orientation of, M. Holmes, 635
- Mollusca, Sex Change in, Prof. J. Brontë Gatenby, 544
- Moon, Colour Observations of the, A. F. Warth, 605
- NATURE Volumes, An offer of, M. Gheury de Bray, 737
- Nerve-Energy, On the Reality of, Prof. D. Fraser Harris, 342, 666; Dr. E. D. Adrian, 447
- Noctiluca as an Enemy of the Oyster, R. W. Dodgson, 343
- Nomenclature, A Question of, F. H. Masters, 543
- Oaks, Defoliation of, E. W. Swanton, 250; Sir Herbert Maxwell, 344
- Occult Phenomena and After-images, Prof. E. N. da C. Andrade, 843
- Opalescence Phenomena in Liquid Mixtures, Prof. C. V. Raman, 77
- Optical: Definition and Resolving Power, J. Evershed, 179; Dispersion, A Quantum Theory of, Prof. C. G. Darwin, 841
- Ouramoeba, F. R. Rowley; R. Kirkpatrick, 40; G. Lapege, 114
- Oyster (*O. edulis*): and Crepidula, The Phenomena and Conditions of Sex-change in the, Dr. J. H. Orton, 212; The Conditions of Sex-change in the, Dr. R. Spärck, 480
- Patent, An Empire, E. W. Hulme, 633; E. E. Towler, 772
- Periodicities, Dr. G. T. Walker, 511; Sir W. H. Beveridge, 511
- Persid Meteors in July 1592, H. Beveridge, 667
- Physics, The Dictionary of Applied, Sir R. T. Glazebrook, 699
- Pigeon Tick, The, L. H. Matthews and A. D. Hobson, 313; A. G. Lowndes, 380
- Plants, Mosaic Disease in, K. M. Smith, 668
- Polar and Non-polar Valency in Organic Compounds, W. E. Garner, 543
- Polarisation of Diffused Light under the Sea, E. E. Brooks, 114
- Potassium: Cyanide, The X-ray Structure of, P. A. Cooper, 544; Vapour in the Associated Series, Absorption of, Prof. A. L. Narayana and D. Gunnaiya, 250
- Radiolaria from Oozes, Extraction of, H. L. Thomas, 216; A. Earland, 216
- Rat and its Repression, The, Earl of Denbigh, 278
- Rate of Radioactive Disintegration by use of Penetrating Radiation, An Attempt to Influence the, Dr. G. Hevesy, 216
- Red Lithium Line, The Structure of the, Prof. T. R. Merton, 632
- Relativity: and Physical Reality, Dr. A. A. Robb, 572; and the Æther, Sir Oliver Lodge, 446; Paradox, A, C. C.; Prof. A. S. Eddington, 844
- Research and Razors, Prof. J. R. Partington, 415
- Rickets, The Cause of, Sir W. M. Bayliss, 212
- Rise of Temperature of Living Plant Tissue when infected by Parasitic Fungus, Dr. I. B. Pole Evans and Mary Pole Evans, 480
- Roche's Limits for Satellites, Prof. J. Joly, 179
- Rocks of the Earth's Crust, The Oldest Known, Prof. G. A. J. Cole, 39
- Rudbeckia and Aquilegia, Prof. T. D. A. Cockerell, 278
- Russian Names, Transcription of, Major-Gen. Lord Edward Gleichen, 78, 635; C. A. Hoare, 279; J. G. F. Druce and A. Glazunov, 512; J. H. Reynolds, 635
- Sand-flies, Pairing and Parthenogenesis in, A. D. Peacock, 215
- Science: and the Empire, Major A. G. Church, 876; The Influence of, Sir G. Greenhill, 78; Rev. A. L. Cortie, 180, 378; Sir Oliver Lodge, 277
- Scientific and Industrial Pioneers, Eng.-Capt. E. C. Smith, 846
- Scorpions and their Venom, Major C. E. F. Mouat Biggs, 250
- Scottish People, The Stature of the, Sir Arthur Keith, 8
- Selenium and some other Elements, The Isotopes of, Dr. F. W. Aston, 664
- Smell in Birds, Sense of, C. B. Williams, 149; Prof. A. Meek, 279
- Smoke of Cities, The, Prof. A. E. Boycott, 413; Prof. J. B. Cohen, 414
- Soil-acidity, Experiments on the Theory of, Prof. J. N. Mukherjee, 732
- Solenoids, Skin Effect in, G. Breit, 668
- Sound: The Production of a Standard Source of, Capt. E. T. Paris, 378; of Explosions, Transmission of, Sir Napier Shaw, 415
- Space-time Geodesics, Prof. H. T. H. Piaggio, 699; Dr. A. A. Robb, 809
- Spectra: New, of Water Vapour, Air, and Hydrogen in the extreme Ultra-violet, J. J. Hopfield, 732; Some Significant Relations in the Quantum Theory of, S. Ray, 215; the Principle of Selection in, An exception to, S. Datta, 39
- Spectrum of the Night Sky, Lord Rayleigh, 769
- Sterility, Interspecific, Dr. W. Bateson, 76; Prof. R. R. Gates, 179, 447; Prof. J. P. Lotsy, 843; Dr. J. W. H. Harrison, 312
- Surface Tension and Cell Division, H. G. Cannon, 181
- Tables of the Incomplete Gamma-Function, Prof. Karl Pearson, 669
- Time-Triangle and Time-Triad in Special Relativity, The, R. A. P. Rogers, 698
- Tropical Medicine, Discoveries in, Sir Ronald Ross, 38; Lt.-Col. A. Alcock, 114
- Values, A Coincidence in, L. M. Stewart, 279
- Vegetable Rennet, R. Hedger Wallace, 543
- Volcanic Shower in the N. Atlantic, Prof. G. A. J. Cole, 635
- Wasp, An Ancient, Prof. T. D. A. Cockerell, 313
- Water Snails and Liver Flukes, Dr. Monica Taylor, 701; R. Hedger Wallace, 845
- Waterspouts, Dr. G. D. Hale Carpenter, 414; Dr. D. Brunt, 414; W. J. Fisher, 669
- Wegener's Displacement Theory, P. Lake, 77; E. R. Roe-Thompson, 214
- Weights and Measures for India, New, H. Richards, 734; C. A. Silberrad, 735
- Winkle, The Freshwater, A. E. Hodge, 380
- Winter Thunderstorms, Capt. C. J. P. Cave, 877
- X-ray Reflection from Powdered Crystals, The Intensity of, Prof. W. L. Bragg and R. W. James, 148; Prof. A. H. Compton and N. L. Freeman, 38
- Zinc, the Isotopes of, Separation of, A. C. Egerton, 773
- Corrosion: and Colloids, Dr. G. D. Bengough and J. M. Stuart, 651; Control of, by Deactivation of Water, F. N. Speller, 84; of Ferrous Metals, The, 878; A. Pickworth, 83
- Cosmical Theory and Radioactivity, Prof. J. Joly, 112
- Cotton; Research in Egypt, 748; Spinning, W. Scott Taggart. Vol. ii. Sixth edition, 75
- Coué, Émile, The Man and his Work, H. MacNaughten, 376
- Creek Indians, The, I. R. Swanton, 646
- Cretaceous: and Tertiary Outliers of the West of England, The Petrography of the, Prof. P. G. H. Boswell, 62; Marine Transgression in the African Region, The, Dr. L. F. Spath, 291
- Crime and Remedial Punishment, 692
- Croesus, Coins of, Dr. L. Shear, 54
- Crystal: Analysis, X-ray, Ten Years of, (Dr. A. E. H. Tutton, 47; Structure of Beryllium and Beryllium

- Oxide, L. W. McKeehan, 563; -symmetry, The Statement of, E. T. Wherry, 586
- Crystalline Style, Occurrence of a, in the American Slipper Limpet (*Crepidula fornicata*) and its Allies, Dr. J. H. Orton, 149
- Crystallised Sulphates from the Province of Huelva, Spain, H. F. Collins, 100
- Crystallographic Notation, Prof. H. Hilton, 100
- Crystallography: A Standard Treatise on, 303; and Practical Crystal Measurement, Dr. A. E. H. Tutton. Second edition. In 2 vols., 303; Graphical and Tabular Methods in, as the Foundation of a New System of Practice: with a Multiple Tangent Table and a 5-figure Table of Natural Cotangents, T. V. Barker, 629; Graphical Methods in, 629
- Crystals, Organic, The Structure of, Sir William Bragg, 115
- Cuckoos, Two, reared together in the same nest, Miss E. R. Saunders, 160
- Current Meters for Use in River Gauging, Dr. M. A. Hogan, 292
- Curtis's Botanical Magazine* re-started, 674
- Cutting Tools, The Action of, Prof. E. G. Coker, 118, 700; A. Mallock, 277, 603; H. S. Rowell, 413, 771; Prof. A. Pollard, 875; Prof. E. N. da C. Andrade, 876
- Cyanosis, the Production of, The Quantitative Influences of Certain Factors involved in, C. Lundsgaard and D. D. Van Slyke, 564
- Cyclohexanol, The Preparation of, A. Brochet, 623
- Cyclones, New Theory of, Dr. E. Kuhlbrodt, 91
- Cylindrical Journal Lubrication at High Values of the Eccentricity, The Characteristics of, Dr. T. E. Stanton, 794
- Cystoscopic Irradiator, A, and an Ultra-violet Light Illuminator, J. S. van der Lingen, 236
- Czechoslovak Republic, The, J. Císaf and F. Pokorný, 839
- Dairy Cattle, The Feeding of, Prof. A. C. McCandlish, 695
- Dakota Series, The Flora of the, C. W. Berry, 291
- Daly, Charles P., Medal presented to Sir Francis Young-husband, 158
- Dampier's "Discourse of the Winds" and the Distribution of Wind on the Earth's Surface, A. Mallock, 478
- Dams: The Design and Construction of, including Masonry, Earth, Rock-fill, Timber, and Steel Structures, also the Principal Types of Movable Dams, E. Wegmann. Seventh edition, 661
- Dante and Avernoholm in Italy, Prof. Castiglioni, 296
- Dartmoor Granite, The: Its Accessory Minerals and Petrology, A. Brammall and H. F. Harwood, 99
- Darwinia Homoranthus*, Species of, and *Rylstonea* in N.S.W., Victoria, South Australia, and Queensland, E. Cheel, 236
- Darwinism, The Present Position of, Sir Arthur Keith, 393; Dr. J. C. Willis and others, 751
- Datura Stramonium*, A large Specimen of, H. E. Stone, 525
- DEATHS.
- Balfour (Prof. I. Bayley), 781, 816
- Battermann (Prof. H.), 258
- Bell (Dr. Alexander Graham), 225
- Bergmann (Prof. E.), 425
- Bone (Mrs. W. A.), 225
- Bouty (Prof. E.), 883
- Brown (Prof. A. Crum), 610, 673
- Brown (Prof. F. D.), 490
- Bryant (F. B.), 882
- Bryant (Dr. Sophie), 361, 458
- Codrington (Dr. R. H.), 425
- Degen (E.), 883
- Eleves (H. J.), 780
- Favé (L.), 361
- Fox (Howard), 851
- Godlewski (Prof. T.), 361
- Gowland (Prof. W.), 16
- Grove-Hills (Col. E. H.), 522, 551
- Gurney (J. H.), 781
- Hallwachs (Prof. W.), 158
- Harries (Dr. A. J.), 187
- Hastings (Dr. J.), 610
- Holt (E. W. L.), 17
- Horstmann (Prof. A.), 851
- Hudson (W. H.), 319
- Kapp (Prof. Gisbert), 257
- Kapteyn (Prof. J. C.), 48
- Kellner (Dr. W.), 491, 522
- Knott (Dr. C. G.), 610
- Kuenen (Prof. J. P.), 491, 673
- Langton (Dr. H.), 742
- Lemoine (Prof. G.), 850
- Mayer (Prof. A.), 491
- Mayor (Dr. A. G.), 224
- McClure (Canon E.), 781
- M'Robert (Sir Alexander), 17
- Miller (H. W.), 851
- Möller (Prof. A.), 781
- Monaco (Albert, Prince of), 17, 156
- Moore (Sir Norman), 781, 817
- Nobbe (Prof. F.), 610
- Noelting (Prof. E.), 425
- Onslow (Hon. V. A. H. H.), 85
- Parkin (Sir George R.), 49
- Pollock (Prof. J. A.), 359
- Powell (H. J.), 742
- Ransome (Dr. A.), 225, 256
- Rubens (Prof. H.), 740, 741
- Salomonson (Prof. J. K. A. W.), 552
- Sharp (Dr. D.), 361, 521
- Smith (Prof. Alexander), 457
- Smith (Prof. C. Michie), 491, 610
- Smith (S. P.), 187
- Solvay (Ernest), 84
- Sturley (Dr. A. A.), 674
- Sudeley (Lord), 851
- Takamine (Dr. J.), 361
- Tawney (C. H.), 225
- Trouton (Prof. F. T.), 459, 490
- Tschugaeff (Prof. L.), 781
- Tupman (Lt.-Col. G. L.), 742
- Visger (Mrs. J. A. Owen), 257
- Waller (Mrs. A. D.), 708
- Walter (L. H.), 459
- Ward (John), 49
- Waterhouse (Major-Gen. J.), 491, 552
- Wesley (W. H.), 583, 609
- Willis (Dr. A. R.), 86
- Willson (Dr. R. W.), 851
- Wislicenus (Prof. W.), 50, 223
- Delambre, J. B. J., Centenary of the Death of, 259
- Desensitising of Silver Bromide-gelatin Plates, The, Dr. T. Slater Price, 849
- Deutsche Gesellschaft für Vererbungswissenschaft, Second Annual Meeting of the, 583
- Development Commission, The, 865
- Devonian Fossils from Chitral and the Pamirs, F. R. Cowper Reed, 291
- Dextrose in Water, Solubility of, 227
- Diabetes: β -oxybutyric Acid and Levulose, A. Desgraz, H. Bierry, and F. Rathery, 623; Ininsipidus, Experimental, Bailey and Bremer, 748; The Use of a Pancreatic Extract in, Sir C. S. Sherrington, 774
- Dialectic, Prof. H. Wildon Carr, 208
- Dialkylvinryl-carbinols, The Preparation of the, R. Locquin and S. Wouseng, 63
- Diamond, The Matrix of, A. M. MacGregor; H. S. Harger, 262
- Dianthus, The South African Species of, J. Burt-Davy, 27
- Dicrostichus magnificus*, Rainbow, H. A. Longman, 495
- Diet and Race: Anthropological Essays, F. P. Armitage, 308
- Dietetics, Modern, 336
- Differential Invariants and other Concomitants of Quadratic Differential Forms in Four Variables, Prof. A. R. Forsyth, 27
- Diffusion and Intertraction, C. G. Schoneboom, 62
- Diphenols, The Ultra-violet Absorption Spectra of the, F. W. Klingstedt, 436

- Diptera Danica: Genera and Species of Flies hitherto found in Denmark. W. Lundbeck. Part vi. Pipunculidæ and Phoridae, 602; Researches on, Dr. A. E. Cameron; Major W. S. Patton; F. W. Edwards, 396
- Dirigible Balloons, Experiments on the Guidance of, through Fog by the Method of W. A. Loth, E. Fournier, 863
- Discours et mélanges, Prof. E. Picard, 629
- Dominance Ratio, The, R. A. Fisher, 100
- Donders, F. C., Reden gehalten bei der Enthüllung seines Denkmals in Utrecht, am 22 Juni 1921, Prof. C. A. Pekelharing and others, 147
- "Donneurs de sang," The, in Veterinary Medicine, L. Panisset and J. Verge, 136
- Drahtloser Übersee-Verkehr, Dr. G. Eichhorn, 374
- Drainage of Agricultural Land, Proposed Scheme for the, 426
- Draper Gold Medal of the National Academy of Sciences of the U.S.A. presented to Prof. H. N. Russell, 820
- Drone-Fly, Attack on a, by a Wasp, Major E. E. Austen, 323
- Drought of 1921, The, C. E. P. Brooks and J. Glasspoole, 55
- Drugs in Commerce: Their Source, Preparation for the Market, and Description, J. Humphrey, 7
- Durée et Simultanéité: Apropos de la théorie d'Einstein, H. Bergson, 503
- Durham: University Calendar, 530; Philosophical Society, Election of Officers of the, 784
- Dust-raising Winds, Dr. C. W. B. Normand, 262
- Dutch Zoological Society, The Fiftieth Anniversary of the, Prof. J. F. van Bemmelen, 589
- Dye Industry, The French, 164
- Earth: Currents in France, Dr. A. Nodon, 888; Evolution and its Facial Expression, Prof. W. H. Hobbs, 270; The Primitive Crust of the, Prof. G. A. J. Cole, 249; J. Parkinson, 413
- Earthquake: Foci, The Variable Depth of, Dr. Dorothy Wrinch and Dr. H. Jeffreys, 310; in the Midland Counties, 393; of August 7, 1895, in Northern Italy, R. D. Oldham, 757; Waves, The Propagation of, Dr. J. H. Jeans, 794
- Earthquakes: Focal Depths of, Prof. H. H. Turner, 55; in the Region around Tokyo, Prof. Omori, 162
- Earth's Crust: Chemical Composition of the, Prof. W. Vernadsky, 229; The, and its Composition, T. Crook, 253; The Oldest-known Rocks of the, Prof. G. A. J. Cole, 39
- Earth's Structure, The, and its Evolution, 270
- Earthworks in America, C. C. Willoughby, 585
- East: Africa, Twenty-five Years in, Rev. John Roscoe, 36; Anglian Institute of Agriculture, H. M. McCreath elected Principal of the, 530
- Eastman Kodak Company, Research Laboratory of the, Abridged Scientific Publications from the, Vol. 4, 644
- Eaux souterraines, Nouveau Traité des, E.-A. Martel, 242
- Echinoderm Larvæ and their Bearing on Classification, Prof. H. Mortensen, 806
- Echinus*: *esculentus*, Habits of, R. Elmhirst, 667; *miliaris*, the lantern of Aristotle in, The Development of the Calcareous Parts of, D. W. Devanesen, 26
- Echtfärbung der Zellkerne, Untersuchungen über, mit künstlichen Feizenfarbstoffen und die Theorie des histologischen Färbeprozesses mit gelösten Lacken, Prof. S. Becher, 33
- Ecological Investigation, The Methods of, Dr. E. J. Salisbury, 208
- Edaphon: Das, Untersuchungen zur Ökologie der bodenbewohnenden Mikroorganismen, Dr. R. H. Francé. Zweite Auflage, 206
- Edinburgh: and East of Scotland College of Agriculture, Calendar of the, 621; Royal Society of, Election of Officers and Council of the, 612; University, J. A. S. Watson appointed Professor of Agriculture and Rural Economy; Conferment of Degrees, 133; Conferment of Honorary Degrees; Dr. E. M. Wedderburn appointed Professor of Conveyancing, 198; C. G. Darwin appointed Tait Professor of Natural Philosophy, 720
- Education: How to Measure in, Prof. W. A. McCall, 601; Psycho-analysis and, Dr. C. W. Kimmins and others, 650; Research and Invention, Prof. H. S. Hele-Shaw, 715; The Board of Technical Institutions and, 657
- Educational and School Science, Sir Richard Gregory, 420
- Eel: the Blood of the, The Variation of the Osmotic Pressure of, as a Function of Modifications of the Salinity of the External Medium, P. Portier and M. Duval, 332; The Life History of the, Dr. Johs. Schmidt, 716; the "Wiped," Osmotic Pressure of the Blood of, on a Function of Modifications of the Salinity of the External Medium, P. Portier and M. Duval, 864
- Efficiency of Man, The, and the Factors which influence it, Prof. E. P. Cathcart, 354, 453
- Egg, the Germinal Localisations of the, The Properties of, A. Brachet, 622
- Ego: The Beloved, Foundations of the New Study of the Psyche, Dr. W. Stekel. Translated by R. Gabler, 805
- Egypt, Excavations in, Lord Carnarvon and H. Carter; Sir E. Wallis Budge, 783; Science in, Col. H. G. Lyons, 283
- Einstein: Bergson and, Prof. H. Wildon Carr, 503; Pour comprendre, l'Abbé Th. Moreux, 568
- Einstein'schen Relativitätstheorie: Die Grundlagen der, eine kritische Untersuchung, Prof. H. Strasser, 568
- Einstein's: Paradox, Rev. H. C. Browne, 668; Prof. H. Wildon Carr, 669; Theories, H. Reichenbach and others, 398
- "Electrets," the Analogues of Magnets, M. Sató, 714
- Electric: Atoms, A Type of Ideal, J. L., 873; Conduction in Metals, An Electron Theory of, E. H. Hall, 687; Discharge in Gases at Low Pressures, The Minimum Potential of, E. Dubois, 831; Power Systems, W. T. Taylor, 506; Power, The Control of, 373; Traction, Railway, F. W. Carter, 338
- Electrical: Analogue of the Vocal Organs, An, J. O. Stewart, 311; Condenser, A New Type of, Dr. T. F. Wall, 810; 885; Engineering Principles of, Prof. W. H. Timbie and Prof. V. Bush, 506; Engineers, Institution of, Dr. J. A. Fleming elected an Honorary Member of the, 745; Furnace, An, with Molybdenum Resistance *in vacuo*, P. Fleury, 795; Review, Jubilee of the, 709; Theory, Modern, Supplementary Chapters—Chapter xv.: Series Spectra, Dr. N. R. Campbell, 767
- Électricité atmosphérique, B. Chauveau. Premier Fasc.: Introduction historique, 406
- Électricité générale, Problèmes et exercices d', Prof. P. Janet, 147
- Electricity, S. G. Starling, 176; and Matter, Sir Ernest Rutherford, 182; Applied, 595; Pure and Applied, 474; Technical, 506; Technical, H. T. Davidge and R. W. Hutchinson. Fourth edition, 840
- Electrified Conducting Layers, The Resistance of Thin, H. A. Perkins, 436
- Electrochemical Effects produced by superimposing Alternating Currents upon Direct Currents, W. R. Cooper, 135
- Electrode Potential Drop, Measurements of, with Direct Current and Alternating Current Electrolysis, S. Marsh and A. E. Evans, 722
- Electrodynamics: An Introduction to, from the Standpoint of the Electron Theory, Prof. L. Page, 509
- Electrolytes in the Blood, Condition of, B. S. Neuhausen, 8
- Electrometer: A New, with Rigid Pointer designed for the Measurement of Radiations, B. Szilard, 136; An Absolute Plane-cylinder, L. Bouchet, 831
- Electron, Positive, Speculation concerning the, Sir Oliver Lodge, 696
- Electrons emitted from a Hot Tungsten Filament, The Kinetic Energy of, J. H. Jones, 722
- Electrotherapy and Diagnosis, An Essay on the History of, Dr. H. A. Colwell, 32
- Elektrizität und des Magnetismus. Einführung in die Theorie der, Zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht, Prof. Max Planck, 474
- Elektrotechnik, Lehrbuch der, Dr. E. Blattner. Erster Teil. Vierte Auflage, 176
- Elettrotecnica elementare con numerosi problemi. A. Occhialina. Vol. 1, 474

- Elliot, D. G., Gold Medal of the National Academy of Sciences of the U.S.A. awarded to Prof. O. Abel, 188
- Elliott, John, Memorial Pathological and Bacteriological Laboratory, Opening of the, 460
- Elliptic Logarithmic Spiral, The, C. E. Wright, 40; H. S. Rowell, 214
- Emotions, The, C. G. Lange and W. James, 730
- Empire: Patent, An, E. W. Hulme, 633; E. E. Towler, 772; Science and the, 797; Water-power, Dr. Bryson Cunningham, 767
- Encephalitis Lethargica, Report on, A. C. Parsons, with Contributions by Dr. A. S. MacNalty and J. R. Perdrau, 626
- Encres, Les, les cirages, les colles et leur préparation, M. de Keghel, 731
- Engineering: Drawing, An Introduction to, J. Duncan, 476; Hydro-electric, Vol. 1, Civil and Mechanical, H. D. Cook and Dr. A. H. Gibson, 108; Inspection, Prof. E. A. Allcut and C. J. King, 730; Institutions, Movement for Closer Co-operation amongst, 227; Progress in, Dr. W. H. Maw, 857
- Engineers, Society of, Awards of the, 885
- Englands Handelskrieg und die chemische Industrie, Prof. A. Hesse and Prof. H. Grossmann. Band 1; Band 2, Neue Folge; Band 3, Herausgegeben von A. Hesse, H. Grossmann, and W. A. Roth, 337
- English: Channel, The Geological Study of the Bottom of the, L. Dangeard, 895; Place-names, A Survey of, Prof. A. Mawer, 133; Science Masters and the Teaching of, 127
- Engraving and Etching, Processes of, Prof. A. M. Hind, 583
- Entelodonts from the Oligocene of South Dakota, W. J. Sinclair, 21
- Entomology: Applied, An Introductory Text-book of Insects in their Relations to Man, Prof. H. T. Fernald, 35
- Eocene: Lizard, Redescription of an, C. W. Gilmore, 190; Mollusca and Foraminifera from Nigeria, R. B. Newton; E. Heron-Allen and A. Earland, 322; of Wyoming, Owl from the, A. Wetmore, 190
- Equal Pay: for Equal Work? Should Men and Women Receive, Prof. F. Y. Edgeworth, 533; to Men and Women for Equal Work, Prof. F. Y. Edgeworth, 391
- Equisetum arvense*, Somatic Kinesis in the Aerial Stem of, M. Lenoir, 64
- Erzlagerstätten: Abriss der Lehre von den, In Anlehnung an die dritte Auflage des Lehrbuches und unter Benützung hinterlassener Aufzeichnungen, Prof. R. Beck, bearbeitet durch G. Berg, 205
- Eskimos, Copper, The Life of the, D. Jenness, 245
- Espace, La Motion d', Prof. D. Nys, 471
- Espace, Temps et Gravitation: la théorie de la relativité généralisée dans ses grandes lignes, Prof. A. S. Eddington; Ouvrage traduit de l'anglais, J. Rossignol, 410
- Essex Rivers, Evolution of the, and of the Lower Thames, Prof. J. W. Gregory, 308
- Ether, α - β -dichlorethyl, V. Grignard and A. C. Purdy, 299
- Ethylene, The Absorption of, by Sulphuric Acid, A. Damiens, 623
- Etna, Mount, and Upper Air Currents, Prof. F. Erèdia, 291
- Eucalyptus Oils, The Miscibility Test for, C. E. Fawsitt and C. H. Fischer, 468; Relationship between Oils and Oil Yields in the, M. B. Welch, 592
- Eugenics: and the Improvement of the Human Race, Dr. J. G. Adami, 853; International Commission of, First Annual Meeting of the, 642
- Europe, Political Change in, The Belt of, Prof. J. F. Unstead, 529; Recent Geographical Work in, W. L. G. Joerg, 530; The Peoples of, Prof. H. J. Fleure, 768; The Reopening of, Prof. G. A. J. Cole, 599; Warm Winters in, Spell of, C. E. P. Brooks, 557
- European Fish in New Zealand Waters, Hon. G. M. Thomson and the late T. Anderton, 266
- Eutectics, The Structure of, F. L. Brady, 531
- Eutermes matangensis*, The Rôle of the Soldiers in, J. Bathellier, 591
- Evaporation, Prof. J. W. Hinchley, 130; The Control of, by the Temperature of the Air, J. R. Sutton, 64
- Everest, Mount: District, Geology of the, Dr. A. M. Heron, 22; The Reconnaissance, 1921, Lieut.-Col. C. K. Howard Bury and others, 139; Expedition, 18, 87, 159; a Film Record of the, Capt. J. B. L. Noel, 743, 884
- Evolution, Movement against the Teaching of, in Minnesota, 883
- Evolutionary Naturalism, Prof. R. W. Sellars, 631
- Excavations in Sussex and Surrey, 782
- Exchange, Theory of the Phenomena of, J. Rueff, 863
- Excreta, Methods of Collection and Disposal of, suitable for Small Tropical Villages, Lt.-Col. Clemesha, 232
- Exhibition of 1851, Award of Senior Studentships, 98
- "Existence," The Treatment of, in Recent Philosophical Literature, Prof. R. F. A. Hoernlé, 830
- Explosions: Propagation of the Sound of, 619; Sound of, Transmission of, Sir Napier Shaw, 415
- Eyes: and Spectacles, Dr. M. Rohr, rendered into English by Dr. A. H. Levy, 376; Divided Composite, A. Mallock, 770
- Falkland Islands: Fossil Plants from the, Prof. A. C. Seward and J. Walton, 861; Geological Investigations in the, Dr. H. A. Baker, 861
- Faraday: Medal of the Institution of Electrical Engineers, Presentation of the, to O. Heaviside, 460; Society, Election of Officers and Council of the, 784
- Farm: Book-keeping: the Principles and Practice of Book-keeping applied to Agriculture: for Agricultural Colleges, Extension Classes, Evening Classes, and Practical Farmers, J. Kirkwood, 768; Management: a Text-book for Student, Investigator, and Investor, Prof. R. L. Adams, 404
- Farming: English, Past and Present, Lord Ernle. Third edition, 204; Scientific Management of, 404
- Fat and Oil Chemistry, Progress in, 109
- Fats, The Unavoidable Matter of, D. W. Steuart, 894
- Fauna of the Sea-bottom, The, Dr. C. G. J. Petersen, 527
- Ferrous Metals, The Corrosion of, 878
- Field: Geologists, Handbook for, Dr. C. W. Hayes, Revised and Enlarged by S. Paige. Third edition, 412; Glasses, Telescopes *versus*, Dr. A. Sonnefeld, 292; Museum of Natural History, Chicago, Appointments at the, 158
- Films of Metal on Large Surfaces, Depositing, by Cathodic Projection, P. Lambert and A. Andant, 268
- Filtration: an Elementary Treatise on Industrial Methods and Equipment for the Filtration of Liquids and Gases for those concerned with Water Supply, Ventilation, and Public Health; Chemists, Mechanical Engineers, and others, T. R. Wollaston, 663
- Finger-prints: The Forging of, J. C. Goodwin, 190; The Study of, Identification of Cows, C. L. Enos, 646
- Fireball: A Large, on July 26, 189; on October 31, 678
- Fireballs, Large, W. F. Denning, 821
- Firedamp and Coal Dust, Ignition of, Appointment of a Committee on the, 460
- Fireflies, Phosphorescent Light of, Dr. H. E. Ives, 679
- Fish, European, in New Zealand Waters, Hon. G. M. Thomson and T. Anderton, 266
- Fishery Research, W. B. Hardy, 865
- Fishes: Cartilaginous, Variation of the Osmotic Pressure of the Blood of the, P. Portier and M. Duval, 28; The Cranial Morphology of, E. P. Allis, jr.; Dr. H. L. Kesteven, 748; The Defensive Spines of, H. M. Evans, 26
- Fishing: and Fishing Lore, H. Balfour, 534; from the Earliest Times, W. Radcliffe, 534; Industry, The, Dr. W. E. Gibbs, 840
- Flagellates, E. Penard, 228
- Flamsteed's Letters to Richard Towneley, Dr. J. L. E. Dreyer, 525
- Flat Solid falling through Water, The Track of a, E. W. Wetherell, 845
- Flint Implements, Development of, A. Vayson, 128
- "Floating Islands," Ecology of, H. Nakano, 646
- Flora: Land, The Early History of the, Dr. D. H. Scott, 606; of the Cheyenne Sandstone of Kansas, The, C. W. Berry, 291
- Florentine School of Physics and Optics, A, Dr. L. C. Martin, 496

- Flowers: Ephemeral, Observations and Experiments on, A. D. de Virville and F. Obaton, 655; Insects, and Guinea-pigs, Experiments in crossing, Prof. Meisenheimer, 750
- Fluid Motion, Discontinuous, The Line of Action of the Resultant Pressure in, Dr. S. Brodetsky, 794
- Flying, High-altitude, Rapid, Prof. A. Rateau, 41
- Fonctions elliptiques, Introduction à l'étude des, à l'usage des étudiants des facultés des sciences, Prof. P. Humbert, 308
- Food, The Preservation of, by Freezing, with Special Reference to Fish and Meat, Prof. W. Stiles, 101
- Foraminifera of the Atlantic Ocean, J. A. Cushman, 365
- Forensic Medicine and Toxicology, Dr. J. D. Mann. Sixth edition, revised throughout by Dr. W. A. Brend, 571
- Forest: Management, A Short Manual of, H. Jackson, 407; Mensuration, Prof. H. H. Chapman, 407; Policy and Management, 407
- Forestry: Commissioners, Second Annual Report of the, Year ending Sept. 30, 1921, 369; Practice and Available Timber Supplies throughout the Empire, R. L. Robinson, 159; Schlich's Manual of. Vol. 1: Forest Policy in the British Empire, Sir William Schlich. Fourth edition, 407
- Form- and Acet- aldehydes, The Estimation of, E. W. Blair and T. S. Wheeler, 894
- Formal Lamp, A, E. Berger, 28
- Forstera or Forsteria, The Use of the Name, Dr. B. Daydon Jackson, 756
- Forward Progression, 728
- Fossil: Bryozoa (Polyzoa) in the Department of Geology, British Museum (Natural History), Catalogue of the. The Cretaceous Bryozoa (Polyzoa). Vol. 4: The Cribrimorphs, Part 2, Dr. W. D. Lang, 445; Fish from Southern Italy, Prof. G. D'Erasmio, 190; Remains in the United Kingdom, Gift for the Preservation of, Dr. W. R. Parker, 460
- Foulerton Professorship, Prof. E. H. Starling appointed to the, 787
- Franklin: Benjamin, An Experimental Towing-tank used by, P. C. Whitney, 10; Gold Medal of the Franklin Institute presented to Sir Joseph J. Thomson, 188
- Fraxinus excelsior*, Twin-leaves and other Abnormalities in the Common Ash, T. A. Sprague, 757
- Freezing Machine, A New, with Air as the Working Fluid, M. Leblanc, 136
- Freiburg University, Dr. H. Lecher appointed Professor of Organic Chemistry in, 466
- French Dye Industry, The, 164
- Frequented Ways: a General Survey of the Land Forms, Climates, and Vegetation of Western Europe, considered in their Relation to the Life of Man; including a Detailed Study of some Typical Regions, Dr. Marion I. Newbigin, 599
- Frog, The Rhythm of Discharge of the Spinal Centres in the, Prof. W. A. Jolly, 468
- Frog's Gastrocnemius reflexly excited, The Electrogram of the, Prof. W. A. Jolly, 236
- Fruit: Farming: Practical and Scientific, for Commercial Fruit Growers and others, C. H. Hooper. Second edition, 601; -growing and Research, 497
- Frye Reflecting Telescope, The, 364
- Fuel in Relation to Health, Prof. J. W. Cobb, 232
- Functions, Real, New Properties of all, H. Blumberg, 687
- Fungi, Physiology of, G. M. Armstrong; R. W. Webb, 128
- Furia infernalis*, Sir Arthur Shipley, 27
- Galactic System, The, Dr. Harlow Shapley, 545, 578
- Galen's Work on Anatomical Administration, Dr. D. Campbell, 296
- Gales, Heavy, in July, 87
- Gallinacæ, Sex-linked Heredity in the, A. Pézard and F. Caridroit, 796
- Galton, Francis, 1822-1922: a Centenary Appreciation, Prof. Karl Pearson, 335
- Gamma-Function, Tables of the Incomplete, Prof. Karl Pearson, 669
- Gas: Analysis, Differential, A Method of, Dr. G. A. Shakespear, 615; Calorimeter, A Recording and Integrating, Dr. J. S. G. Thomas, 251; Gasoline, Natural, H. B. Milner, 791; in 1920, E. G. Sievers, 791; Pressures and the Second Law of Thermodynamics, R. d'E. Atkinson, 112; A. Fairbourne, 113; Supply, The Thermal Basis of, Prof. J. W. Cobb, 671; The Explosive Potential of a, G. Holst and F. Oosterhuis, 623
- Gasteropod, A New (fam. Euomphalidæ), from the Lower Marine Series of N.S.W., J. Mitchell, 300
- Gastropods, Giantism among, B. B. Woodward, 128
- Gelatin, Dr. T. Slater Price, 286
- Geobotanische Untersuchungsmethoden, Prof. E. Rübel, 208
- Géographie, La, de l'histoire: Géographie de la paix et de la guerre sur terre et sur mer, J. Brunhes et C. Valbaux, 175
- Geography: Human, Dr. Marion I. Newbigin, 353; First Principles and Some Applications, Dr. Marion I. Newbigin, 416; School, The Scope of, Dr. R. N. R. Brown, O. J. R. Howarth, and J. Macfarlane, 245
- Geological: Congress, The International, of 1922, 715; Mapping of the Globe, L. Koch and others, 91
- Geologists' Association Foulerton Award given to A. S. Kennard, 885
- Geology: A Text-book of, Prof. A. W. Grabau, 2 Parts, 143; American General and Economic, 143; The Nebular Theory, Prof. J. Joly; W. B. Wright, 76; and the Primitive State of the Earth, Dr. H. Jeffreys, 148; and Petrography of the Clarendon-Paterson District, Part 1, G. D. Osborne, 236; Economic, General, A Text-book, Prof. W. H. Emmons, 210; of Antarctic Lands, D. Ferguson and others, 96; of the British Empire, The, Dr. F. R. C. Reed, 5; of the North Sea Basin, Prof. P. F. Kendall and others, 890; Economic Aspects of, C. K. Leith, 143
- Géométrique, Étude, des transformations birationnelles et des courbes planes, H. Malet, 276
- Geophysical and Geochemical Observatories, A Plea for, T. A. Jaggard, 884
- German: Book Prices, Prof. K. C. Browning, 845; Chemicals and France, Profs. Béhal, Haller, and Moureu, 820; Dyes, France and, 226; Men of Science and Physicians, Society of, Centenary Celebrations, Prof. B. Rassow, 750; Science, The Development of, Prof. Max Planck, 750; Universities, Gifts to, by Industrial Concerns, 466; Universities, Number of Students in, 755
- Germany and English Chemical Industry, 337
- Glacial Waters of Argentière and Bossons, The, d'Arsonval, Bordas, and Touplain, 27
- Glaciation of the Counties of Antrim, etc., Dr. A. R. Derryhouse, 167
- Glands in Health and Disease, Dr. B. Harrow, 658
- Glanvill, John, and Psychological Research in the Seventeenth Century, H. S. Redgrove and I. M. L. Redgrove, 36
- Glare from Motor Headlights, 557
- Glasgow: Royal Technical College, Calendar of the, 684; University, A. D. Lindsay appointed Professor of Moral Philosophy, 25; Bequest to, by Sir William Lorimer, 26; Gift from H. Mehan, 859, 893
- Glass: Colourless, Selenium in the Production of, A. Cousen, 830; Industry, The, and Methods of Manufacture in Czecho-Slovakia, Prof. W. E. S. Turner, 830; The British Scientific, Prof. W. E. S. Turner, 833; Optical, Durability of, T. Haigh; Dr. J. Weir French, 97; Painting, Medieval, Processes and Methods of, J. A. Knowles, 687; Research, Prof. W. E. S. Turner and others, 430; Sheet, Influence of Alumina in preventing the Devitrification of, during the Drawing Process, K. Kamita, 63; The Devitrification caused upon the Surface of, by Heat, Y. Amenomiya, 63; Stained and Painted, Modern Developments in the Making of, H. J. Powell, 687; Surfaces, Abraded, Structure of, F. W. Preston, 162; Technology, Society of, The Frank Wood Medal of the, presented to G. G. Middleton and H. W. Howes, 784; The Journal of the Society of, 19
- Glauconite from the Greensand near Lewes; The Constitution of Glauconite, A. F. Hallimond and E. G. Radley, 100

- Glaze Storm in America, A. J. Henry, J. E. Lockwood, and D. A. Sealey, 91
- Glider, British-built, Offer by Selfridge and Co. of a Prize for Flight by a, 643
- Gliding: Contests, Results of, 581; or Soaring Flight, in Germany, 288
- Globular Clusters in the Large Magellanic Cloud, 584
- Gloucester Cathedral, The Painted Glass of, G. M'N. Rushforth, 585
- Glycerine, The Distillation of, T. H. Gray, 130
- Gold: Coast, New Maps of the, 647; -leaf Electrometer, Rev. A. Bennet Inventor of the, 126
- Gorgas Memorial Institute of Tropical and Preventive Medicine, The, 492
- Grain: Pests (War) Committee, Reports of the, Royal Society. Nos. 1 to 10, 145; -size and Diffusion, J. H. Andrew and R. Higgins, 467
- Graphical Analysis: a Text-book on Graphic Statics, W. S. Wolfe, 412
- Graptolites, Evolution of the, Dr. Gertrude Elles, 262
- Grasses, South Indian, A Handbook of Some, Rai Bahadur K. Ranga Acharya, assisted by C. Tadulinga Mudaliyar, 376
- Gravitational Waves, The Propagation of, Prof. A. S. Eddington, 721
- Gravity: Observations in India, R. D. Oldham, 665; Variations, Sir G. P. Lenox-Conyngham, 874, C. S. Wright, 875
- Great: Britain, Agricultural Research in, 93; Lakes Region, A Naturalist in the, E. R. Downing, 444
- Greek Biology and Greek Medicine, Dr. C. Singer, 631
- Green Flash at Sunset, The, Sir Arthur Schuster, 370; at Sunset and Sunrise, Prof. A. W. Porter, 513; C. J. P. Cave; Prof. W. M. Flinders Petrie, 604
- "Green Ray," The: or "Green Flash" (Rayon Vert), at Rising and Setting of the Sun, Prof. M. E. Mulder, 370
- Greenland, The Bacterial Flora of, Dr. C. Barthel, 366
- Greenwich, The Royal Observatory, 356
- Gypsum, Transformation of, into Ammonium Sulphate, C. Matignon and M. Fréjacques, 200
- Gypsy: English, Christian Names, E. O. Winstedt, 90; Folklore, T. W. Thompson, 556
- Gyroscope, Some Applications of the, P. Schilowsky, 829
- Hampshire, T. Varley, 339
- Hanbury Medal of the Pharmaceutical Society, The, presented to Prof. E. Perrot, 554
- Hancock Museum, Newcastle-upon-Tyne, T. R. Goddard appointed Curator of the, 583
- Harmonism and Conscious Evolution, Sir Charles Walston (Waldstein), 443
- Harper-Adams Agricultural College, Prof. C. Crowther appointed Principal of the, 399
- Harpoons under Peat at Holderness, Yorks, O. G. S. Crawford, 481; T. Sheppard, 735
- Harrison Memorial, The, 717
- Harvard College Observatory, Report of the, 127
- Hawaiian: Grasses, A. S. Hitchcock, 614; Natural History, 365; Zonitidæ and Succineidæ, Notes on, C. M. Cooke, jr., 365
- Head-hunting in Assam, L. H. Hutton, 322
- Heads of Departments in Pure and Applied Science, Association of, Annual General Meeting of the, 860
- Health: and Weight Probabilities, Prof. Karl Pearson, 228; Public, Relative Values in, Sir Arthur Newsholme, 820, 853
- Hearing, The Resonance Theory of, Dr. H. Hartridge, 9
- Heat: and Light in Chemical Combination with other Elements, C. A. C. Nicoresti, 524; in Water, The Propagation of, J. R. Sutton, 832
- Heating and Ventilation in Passenger Ships, J. L. Musgrave, 586
- Heavens, The New, Prof. G. E. Hale, 2
- Hedgehog, The, and Virus of Rabies, Mme. M. Phisalix, 796
- Hegel: The Ethical Theory of, A Study of the Philosophy of Right, Prof. H. A. Reyburn, 70
- Hegelian: Dialectic, Studies in the, Dr. J. McT. E. McTaggart. Second edition, 208; Method and Modern Science, The, 70
- Height Record, A New, J. A. McCready, 87
- Helicinidæ, Radula of the, H. B. Baker, 396
- Helium: Neutral, Spectrum Lines of, Prof. W. M. Hicks, 309; The Spectrum of, Prof. C. V. Raman, 700; in the Extreme Ultra-violet, Prof. T. Lyman, 278
- Hemerocallis fulva*, Median Proliferation of Flowers of, Dr. J. C. Costerus, 494
- Heredity, Prof. Johannsen, 750; Acquired, J. Costantin, 167; Handbook of, On Review of his, Dr. M. J. Sirks, 394; in the Human Race, Dr. Lenz, 750
- Hermit-crab (*Eupagurus bernhardus*), The Relationship between the Common, and the Anemone (*Sagartia parasilica*), Dr. J. H. Orton, 735, 877
- Herring: Catch in Winter, The Prediction of the Value of the, E. Le Danois, 864; Fishery, The, and its Fluctuations, B. Storrow, 705
- Herschel, William, Centenary of the Death of, 255
- Hesperopithecus, The Anthropoid Primate of Western Nebraska, Prof. H. F. Osborn, 281
- Hevea Brasiliensis*, The Rôle of Calcium Chloride in the Coagulation of the Latex of, G. Vernet, 686
- Hexosamines and Mucins, Dr. P. A. Levene, 292
- Hiera Picra, C. J. S. Thompson, 296
- Highway Engineering, 272
- Histological Stains, Prof. A. E. Boycott, 114
- History: and Science Different Kinds of Knowledge? Are, R. G. Collingwood, Prof. A. E. Taylor, and Dr. F. C. S. Schiller, 231; of the World, A Short, H. G. Wells, 867; Unified Human, F. S. Marvin, 867
- Hockey in Ancient Greece, 556
- Hog Louse, Structure and Biology of the, Miss L. Florence, 396
- Holophane, Ltd., Visit to the New Showrooms and Laboratories of, by the Circle of Scientific, Technical, and Trade Journalists, 554
- Homework and Hobby Horses, edited by H. C. Cook, 211
- Homo (Os Modernos Estudos sobre a origem do homem), Prof. A. A. M. Corrêa, 510
- Homogeneous Balanced Action, The Mathematics of the, Prof. J. P. Dalton, 468
- Homoranihus virgatus*, and *H. flavescens*, The Essential Oils of, A. R. Penfold, 896
- Honey that drove Men Mad, Prof. W. R. Halliday and Prof. McLean Thompson, 462
- Hong-Kong: Meteorology at, T. F. Claxton, 229; Students of the University of, Sir Frederick Lugard, 894; University, the Aims and Needs of, 828
- Hookworm Infection in Brazil, 1918-20, Studies on, Dr. W. G. Smillie, 169
- Horniman Museum, The, A Handbook to the Collections illustrating a Survey of the Animal Kingdom, H. N. Milligan. Second edition, 412
- Horse: -chestnut, Seedlings of, Dr. A. B. Rendle, 26; Serum, Separation of the Globulins of, M. Vila, 687
- Hovering Flight in the Mediterranean, H. Fabre, 863
- Hudson, W. H., Memorial, R. B. Cunninghame Graham, 846
- Hull: and the East Riding, 539; and the East Riding of Yorkshire, Handbook to, prepared for the Members of the British Association for the Advancement of Science on the Occasion of their Visit to Hull, in September 1922. Edited by T. Sheppard, 539; Gift of Site for Advanced Technical Departments, T. R. Ferens, 530; Municipal Museum, The, T. Sheppard, 291
- Humaine, L'Expérience, et la causalité physique, Prof. L. Brunschvicg, 471
- Human: Blood Relationships, 738; Dentition, The Origin and Evolution of the, Prof. W. K. Gregory, 834; Development, The Trend of, H. Jackson, 554; Skull and Bones in an Ancient Gold Working at Gwanda, Rhodesia, 612; Society, The Theory of, Studies in, Prof. F. H. Giddings, 571; Traits and their Social Significance, Dr. I. Edman, 146
- Humanism, The Philosophy of, and of other Subjects, Viscount Haldane, 471
- Humidity and Vesicular State, The Influence of, on the Diffusion in Air of Drops containing Micro-organisms, A. Trillat, 332
- Humpback Whale from the Miocene of California, R. Kellogg, 322
- Hybrid, Disjunction and Combination of the Characters of the Parents in a, P. Viullemin, 436

- Hydraulics: Elementary, for Technical Students, Prof. F. C. Lea, 839; with Working Tables, E. S. Bellasis. Third edition, 34
- Hydrocarbons in Dying Leaves, The Disappearance of, R. Combes and Mlle. Denise Kohler, 623
- Hydrochloric Acid and Potassium Chloride in Presence of Sucrose, The Electrical Conductivity of, A. J. Kieran, 136
- Hydro-electric Engineering, vol. i., Civil and Mechanical, H. D. Cook and Dr. A. H. Gibson, 108
- Hydrogen: Concentration of Natural Waters, The, and Some Etching Reagents in Relation to Action of Metals, Dr. W. R. G. Atkins, 758; Ion Concentration of Sea Water near the Coast, Diurnal Variations of the, R. Legendre, 724; Lines $H\alpha$ and $H\beta$, Structure of the, A. E. M. Geddes, 862; Molecule, The, Prof. A. C. Crehore, 587; Positive Rays, The Scattering of, and the Existence of a Powerful Field of Force in the Hydrogen Molecule, G. P. Thomson, 654; Selenide, The Viscosity and Molecular Dimensions of, C. J. Smith, 758; The Secondary Spectrum of, A. C. Menzies, 876
- Hyperacoustics, J. L. Dunk. Division ii.: Successive Tonality, 411
- Idromeccanica Piana, Prof. U. Cisotti. Parte prima e parte seconda, 243
- Igneous Rocks: in relation to Petrogenic Theories, The Frequency-distribution of, W. A. Richardson, 756; rich in Alkalies, The Origin of, Dr. S. J. Shand, 323
- Illuminating Engineering: in relation to the Architect, L. M. Tye, 746; Progress in, 746
- Index Animalium, C. Davies Sherborn. Sectio Secunda 1801-1850. Part I., 3
- Indexing Scientific Literature, G. S. Fulcher, 679
- India: Central, Marine Fossils in, 556; Cretaceous Fossil Reptiles in, Dr. C. A. Matley, 90; Gravity Observations in, R. D. Oldham, 665; Industrial Research in, 59; Impending Abolition of the Posts of Electrical Adviser to the Government of, and Chief Engineer of the Hydro-Electric Survey of, 88; Selections from Educational Records. Vol. ii., 894; The Probable Amount of Monsoon Rainfall for 1922, Dr. G. T. Walker, 159; The Weights and Measures of, C. A. Silberrad, 325, 735; H. Richards, 734
- Indian: Barley, Germination of, W. Youngman, 585; *Industries and Labour, Journal of*, August, 553; Institute of Science, Bangalore, 649; Dr. M. O. Forster appointed Director of the, 258; Leeches, Some, T. Kaburaki, 822; Painting and Mohammedan Culture, Sir T. W. Arnold, 228; Science Congress, Forthcoming, 643
- Individual, The, and the Community, R. E. Roper, 340
- Industrial: Pioneers, Calendar of, 61, 99, 135, 166, 199, 234, 267, 298, 331, 368, 400, 436, 467, 499, 531, 562, 591, 622, 654, 685, 721, 756, 793, 829, 861; Research in India, 59
- Influenza: Essays by several authors. Edited by Dr. F. G. Crookshank, 30; The Bacteriology of, Dr. M. Gordon, 293
- Infusorien über Flimmerbewegung, Lokomotion und Reizbeantwortung, Studien an, Dr. F. Alverdes, 509
- Inks, C. Ainsworth Mitchell, 426
- Insect Pests: of Fruit Trees, Collected Leaflets on, 427; of the Horticulturalist: their Nature and Control, K. M. Smith and J. C. M. Gardner. Vol. i., Onion, Carrot, and Celery Flies, 694
- Insects: Coaptations of, The Development of some, L. Cuénot and R. Poisson, 591; The Psychic Life of, Prof. E. L. Bouvier. Translated by Dr. L. O. Howard, 402; The Ways of, 402
- Installations électriques industrielles: choix du matériel, R. Cabaud, 474
- Insulation Testing, 586
- "Insulin" and the Oxidation of Sugar, Dr. Banting, 713
- Intellectual Co-operation Commission of the League of Nations, First Session of the, 362
- Interferometer Telescope, A Fifty-foot, Dr. G. E. Hale, 482
- Interferometers, List of, Adam Hilger, Ltd., 229
- Interferometry, Displacement, applied to Acoustics and to Gravitation, Prof. C. Barus, 7
- Intermetallic Actions, Q. A. Mansuri, 531
- Internal: Combustion Engine, The, Prof. W. E. Dalby, 122; Secretion, Sir W. M. Bayliss, 658; L. T. Hogben and F. R. Winton, 686; and the Ductless Glands, Prof. Swale Vincent. Second edition, 658
- International: Co-operation in Intellectual Work, E. C. Richardson, 883; Geological Congress, The, of 1922, 715; Research Council, The, 230
- Intersexuality, Recent Work on, Dr. R. de la Vaulx, 54
- Intervals, The Measurement of, Prof. A. S. Eddington, 697; E. Cunningham, 698
- Intestinal Flora, a Treatise on the Transformation of the, with Special Reference to the Implantation of Bacillus Acidophilus, Prof. L. F. Rettger and H. A. Cheplin, 694
- Intramolecular Ionisation, Prof. T. M. Lowry, 757
- Inventions, The Protection of: an Empire Patent, 437
- Ionic Permeability, The Elective, of the Cellular Elements, W. Mestrézat, P. Girard, and V. Morax, 168
- Ionizing Potentials, A New Method for studying, H. D. Smyth, 654
- Ions: Electrons, and Ionising Radiations, Dr. J. A. Crowther. Third edition, 340; The Effect of the, on Physiological Surfaces, Prof. Hoerber, Prof. Spiro, 751
- Ireland, The Royal College of Science for, 814
- Iridescent Marls, The Composition of the, M. Thiébaud, 532
- Iris: Structure of the Cell in the, P. A. Dangeard, 167, 200; The Light of, Variability in, Miss Harwood, 584
- Irish Yew Trees, Sex of, Dr. C. J. Bond, 810
- Iron: and Steel: at Temperatures below 280° C., The Changes in, F. C. Thompson and E. Whitehead, 794; Institute. Carnegie Scholarship Memoirs. Vol. ii.: The Corrosion of Iron, Dr. J. Newton Friend. Edited by G. C. Lloyd, 731; The Metallurgy of, based mainly on the Work and Papers of Sir Robert A. Hadfield, 507; -founding, B. Whiteley, 537; Industry, Sussex, Early History of the, R. Jenkins, 893; On the Electro-deposition of, with an Appendix containing a Bibliography of the Subject, W. E. Hughes, 445; The Corrosion of, Dr. J. Newton Friend. Edited by G. C. Lloyd, 731; The Mass-spectrum of, Dr. F. W. Aston, 312
- Isochronal Vibrations, Non-maintained, Three Classes of, and Three Types of Timepieces, J. Andrade, 63
- Isothermal Frontier of Ancient Cities, The, Dr. Vaughan Cornish, 558
- Isotopes: of Lead, separating the, A Chemical Method of, T. Dillon, Rosalind Clarke, and V. M. Hinchey, 167; Series Spectra of, The Difference between, Prof. J. W. Nicholson, 37
- Ithone fusca*, Life-history of, Dr. R. J. Tillyard, 495
- Japan, The Foundations of: Notes made during Journeys of 6000 Miles in the Rural Districts as a Basis for a Sounder Knowledge of the Japanese People, J. W. R. Scott, 538
- Japanese: Botanical Serials, New, 891; Geology, Prof. I. Hayasaka, Prof. H. Yabe and S. Hanzawa, 749; *Journal of Geology and Geography, The*, No. 1, 227; Pliocene Fossils, Prof. M. Yokoyama, 646; Social and Economic Life, 538
- Jena University, Grants to, from the Society of Friends of, 98
- "Judith," Gift to Science from the Performance of, 553
- Jungle, The Edge of the, W. Beebe, 211
- Jura Chain, The Nature and Structure of the Substratum of the, E. Fournier, 592
- Jussieu, B. de, The Work of, Abbé L. Parcot, 320
- Juvenile Delinquency, H. H. Goddard, 477
- Kaolin, The Problem of the Decomposition of, by Organisms, W. J. Vernadsky, 532
- Katanga, The Blue Crystals of Disthene found at, C. Cesàro, 864
- Kelvin Lecture, The, Sir Ernest Rutherford, 182
- Kent Coalfield, Water in the, E. O. Forster Brown, 822

- Kew, The Royal Botanic Gardens, 423; Major T. F. Chipp appointed Assistant Director of the, 189
- Kitchen Ranges, 434
- Knossos, New Discoveries at, Sir Arthur Evans, 125
- Knowledge: The Evolution of, G. Shann, 471; The Humanising of, Dr. J. H. Robinson, 298
- Kodaikanal Observatory, the Establishment of the, W. Pogson and, 711
- Kohlenhydrate und Fermente II. (1908-1919), Untersuchungen über, E. Fischer. Herausgegeben von M. Bergmann, 142
- Kontinente und Ozeane, Die Entstehung der, Dr. A. Wegener. Dritte Auflage, 798
- Korea, Weather in, 714
- Koristka Microscopes and Accessories, Catalogue of the, 52
- Kristalle, Das feinbauliche Wesen der Materie nach dem Vorbilde der, Prof. F. Rinne. 2 und 3 Auflage, 839
- Kukkersite, the Oilshale of Esthonia, E. H. C. Craig, 55
- Kunzea corifolia*, The Essential Oil of, F. R. Morrison, 896
- Kwakiutl Indians, The, Dr. C. F. Newcombe, 190
- Labour: British, Replacement and Conciliation, 1914-21: Part 1, on Replacement, Co-ordinated and Revised by Miss L. Grier and Miss A. Ashley; Part 2, on Conciliation, Edited by A. W. Kirkaldy, 145
- Lac, Turpentine, and Rosin, Reports on, 159
- Lacertidæ, Monograph of the, Dr. G. A. Boulenger. Vol. ii., 410
- Lactic Fermentation, Studies on, C. Richet and Mme. A. G. Le Ber, 863
- Lake: Chad Region, Desiccation in the, F. W. H. Migeod, 786; Dwellings of Switzerland, Recent Investigations of the, Prof. E. Pittard, 12
- Lamps with Three Electrodes, Anode, Cathode, and Intermediate Grid where the Current is carried by Ions, and their Applications, M. Leblanc, 268
- Lancaster Astronomical and Scientific Association, Annual Report of the, 676
- Land: Drainage, W. L. Powers and T. A. H. Teeter, 211; Flora, The Early History of the, Dr. D. H. Scott, 606, 638
- Landowners and the State, Lord Bledisloe, 501
- Langley's, S. P., Pioneer Work in Aviation, Prof. L. Bairstow, 637
- Latex, The Coagulation of, L. Lindet, 758
- Laughter, Problem of, J. A. T. Lloyd, 396
- Lead: and Animal Life, Miss K. Carpenter, 543; and Zinc, The Mining District of North Cardiganshire and West Montgomeryshire, Dr. O. T. Jones, 476; Isotopes of, Separation of, Drs. T. Dillon and R. Clarke, and V. M. Hinchy, 430
- Leaf Pictures, Exhibition of, by W. J. King, 709
- League of Nations: Committee on Intellectual Co-operation of the, 87; Resignation of Dr. G. E. Hale; Appointment of Dr. R. A. Millikan, 460; First Session of the Intellectual Co-operation Commission of the, 362; Report of the European Health Conference of the, 362
- Lecythidaceæ, Flower Structure in the, Prof. McLean Thompson, 614
- Leeds University: Dr. W. T. David appointed Professor of Civil and Mechanical Engineering; Dr. J. W. McLeod appointed Sir Edward Brotherton Professor of Bacteriology, 25; Report of the Department of Coal Gas and Fuel Industries (with Metallurgy) for 1920-21, 26; A Gas Research Fellowship awarded to S. Pexton, 98; Dr. W. MacAdam appointed Medical Tutor and Registrar, and H. W. Symons and P. J. Moir appointed Clinical Assistants in Surgery, 133; Conferment of Honorary Degrees, 399, 435, 561; L. Abercrombie elected Professor of English Language and Literature, 530; Appointments in, 621; Sanction by the Treasury of a Grant in Aid of the new Agricultural Building; Gift by the Turner Tanning Machinery Co. to the Leather Industries Department; A. H. Priestley appointed Lecturer in Bacteriology and G. Priestley Assistant Lecturer in Cloth Analysis, 720; Students in, Assistance to, the Laboratory of the British Silk Research Association; the Department of Agriculture; Gift of the Clothworkers' Company; Tribute to Prof. Smithells; Title of Emeritus Professor conferred on Profs. Kendall and Goodman; Dr. W. H. Pearsall appointed Reader in Botany, 893
- "Lektrik" Lighting Connections, G. C. Lundberg and the late W. P. Maycock. Seventh edition, 176
- Leonardo da Vinci's Work on the Structure of the Heart, Prof. Wright, 296
- Leonid Meteor Shower, The, W. F. Denning, 712
- Lepidopterous Larvæ, The Effect of a Lead Salt on, Dr. F. C. Garrett and Hilda Garrett, 380
- Leptospermum: flavescens*, The Essential Oils of two Varieties of, A. R. Penfold, 759; *Liversidgei*, Some Essential Oils from, A. R. Penfold, 300
- Libocedrus and its Cone in the Irish Tertiary, T. Johnson and J. G. Gilmore, 167
- Library of Congress, MSS. added to the, in 1921, 522
- Liebig's Annalen*, Prof. Wieland appointed to the Editorial Board of, 554
- Life in the Sea, The Progression of, Dr. E. J. Allen, 353, 448
- Light: Deflection of, in a Gravitational Field, H. Dingle, 389; Molecular Diffraction of, Prof. C. V. Raman, 505; Molecular Scattering of, 505; Rotary Polarisation of, Prof. F. Cheshire, 807; Dr. A. E. H. Tutton, 809; scattered by Mercury Vapour near the Resonance Periodicity, Polarisation of the, Lord Rayleigh, 654
- Lighting in Factories and Workshops, Departmental Committee on, Third Report of the, 89
- Lightning, Ball, Prof. J. B. Cleland, 40
- Lignite of Washing Bay, Co. Tyrone, T. Johnson and J. G. Gilmore, 167
- Lilies, the Formation of Anthocyanine in the Scales of the Bulbs of, Influence of Light on, M. Mirande, 592
- Liquids in Pipes, The Flow of, N. Swinden, 726
- Liverpool University, impending Retirement of Prof. F. Carey, 754
- L'Océanographie, Prof. J. Thoulet, 541
- Lockyer, Sir Norman: Biography of, Lady Lockyer, 481; Portrait Medallion of the late, 87; Observatory, Report of the, for 1921-22, Dr. W. J. S. Lockyer, 53; Unveiling a Portrait Medallion of the Founder, Speeches by Sir Richard Gregory, Lt.-Col. F. K. McClean, and Sir Frank Dyson, 192
- Locomotive, Electric, The, Sir Vincent Raven, 41
- Locomotives, Feed-water Heaters for, Prof. E. Sauvage, 41
- London: County Council, Programme of Lectures and Classes for Teachers, 331; General Omnibus Co., Ltd., Visit to the Repair Works of the, 783; Mathematical Society, Election of Officers and Council of the, 711; Proceedings of the. Second series. Vol. 20, 570; The Site and Growth of, C. E. M. Bromehead, 494; University: H. J. Waring elected Vice-Chancellor, 25; J. H. Woodger appointed University Reader in Biology at Middlesex Hospital Medical School; Sir Charles W. C. Oman appointed Creighton Lecturer for 1922-23; The Lindley Studentship for 1922 awarded to Miss M. J. Wilson-Smith; The University Studentship in Physiology for 1922-23 awarded to Miss M. M. A. Murray, 25; Bloomsbury and the, T. Ll. Humberstone, 150; Dr. J. C. Drummond appointed Professor of Biochemistry at University College; Prof. A. Stokes appointed Dunn Professor of Pathology at Guy's Hospital Medical School; Conferment of Doctorates, 165; Acceptance by H. G. Wells of the Labour Candidature for Representation to Parliament, 166; Dr. J. F. Unstead appointed Professor of Geography, 198; History, Present Resources and Future Possibilities, Sir Gregory Foster, 240; T. Ll. Humberstone, 435; H. G. Wells adopted as Labour Parliamentary Candidate, 530; Dr. G. Senter and C. W. Crook elected to the Senate, 562; Scheme for the School of Hygiene: the Question as to the Site for the University; Thanks accorded for Grant and Donation; Conferment of Doctorates, 590; F. J. F. Barrington awarded the William Julius Mickle Fellowship; Conferment of Doctorates, 720; Acceptance of a Bequest of Sir William Meyer; Continuance of the Franks Studentship in Archaeology, 859; Grant to the *Annals of Applied Biology*; Conferment of a Doctorate on Rev. G. H. Dix, 860; College, T. A.

- Stephenson appointed Assistant in the Department of Zoology and Comparative Anatomy, 435
- Long Barrows in the Cotswolds and Welsh Marches, O. G. S. Crawford, 585
- Loranthaceæ of Australia, The, Part ii., W. F. Blakely, 300
- Lord Howe Island, Some Australian Moths from, A. J. Turner, 864
- Lough Neagh Clays, The Lignite of the, Prof. Johnson and Miss J. G. Gilmore, 586
- Loughborough Technical College, Calendar of, 562
- Louisiade Archipelago, Coral Reefs of the, Prof. W. M. Davis, 56
- Low Temperature Carbonisation, Prof. J. W. Cobb, 718
- Lowestoft Fisheries Laboratory, Work of, E. S. Russell, 757
- Luminous Phenomenon, A Curious, S. R., 481
- Madeira, Biological Studies in, Dr. M. Grabham, 45
- Madras : Government Museum, Work at the, Dr. Gravely, 710 ; University, Bequest to, by Sir William S. Meyer, 754
- Magistri Salernitani nondum cogniti, Dr. Capparoni, 296
- Magnetic : Atom, The New, and its Properties, Sir J. A. Ewing and others, 162 ; Measurements in the Paris Basin, L. Eblé, 592 ; Work of the Carnegie Institution, The, Dr. L. A. Bauer and others, Dr. C. Chree, 94
- Magnetisation, The Atomic Process in, Sir J. A. Ewing, 862
- Magnetism : and Electricity, J. Paley Yorke. New edition, 630 ; the Kinetic and Molecular Theories of, An Experimental Confirmation of, Dr. J. R. Ashworth, 10 ; The Origin of, Prof. A. O. Rankine and others, 616
- Man : and the Ice Age, Prof. P. F. Kendall and others, 617 ; The Efficiency of, and the Factors which influence it, Prof. Cathcart, 354, 453 ; The Study of, H. Peake, 354, 516
- Manchester : Birds, 1822-1922, T. A. Coward, 563 ; College of Technology, Courses at the, 621 ; Museums and Art Galleries, Lectures for Elementary School Children in, S. Hey, 582 ; New X-ray Department at, 753 ; University : E. D. Telford appointed Professor of Systematic Surgery, 26 ; Roll of Service, 111 ; Prof. J. S. Dunn appointed Procter Professor of Pathology, 133 ; W. W. C. Topley appointed Professor of Bacteriology, 134 ; Conferment of Doctorates, 198 ; a Fund to commemorate the Work of Prof. H. B. Dixon, 621 ; Opening of the Lewis Departmental Library ; Appointments in, 653
- Manila Typhoon of May 23, 1922, The, Rev. J. Algué, 795
- Mannite in Alkaline Solution, The Action of Boric Acid on, R. Dubrisay, 723
- Manson, Sir Patrick, Institution of a Memorial Medal to, 492
- Maori Mode of Drilling, The, E. Best, 679
- Marine : Biological : Association, Journal of the, 746 ; Laboratory, Plymouth, Prof. W. D. Henderson appointed Ray Lankester Investigator at the, 98 ; Deposits above Sea-level, Formation of, Dr. P. Bartsch, 396
- Marquesas Islanders, The Art of the, H. U. Hall, 128
- Mars : E. C. Slipher, Prof. W. H. Pickering, 428 ; M. Maggini ; Dr. Fountain, 364 ; Observations of, at Sétif, Algeria, R. Jarry-Desloges and G. Fournier, 160
- Masaris, Origin of the Name of the Genus, E. W. Adair ; F. A. B., 574
- Massachusetts Institute of Technology, Dr. S. W. Stratton elected President of the, 641
- Maternity and Child Welfare, Sir George Newman, 232
- Mathematics, Practical, A. Dakin. Part i., 375
- Mathématiques spéciales, Cours complet de, Prof. J. Haag. Tome 2, Géométrie, 375
- Measures, Metric and British, 29
- Mechanical : Engineers, Institution of, The Paris and Liège Meetings of the, 41 ; Testing : a Treatise in two Volumes. R. G. Batson and J. H. Hyde. Vol. i. : Testing of Materials of Construction, 804
- Mechanics, Theoretical : an Introductory Treatise on the Principles of Dynamics, with Applications and Numerous Examples, Prof. A. E. H. Love. Third edition, 243
- Medical Education, 683 ; Sir G. Archdall Reid, 769 ; Prof. W. J. Dakin, 845 ; J. S. Dunkerly ; J. T. Cunningham, 846
- Médicaments organiques, Préparation des, Prof. E. Fourneau, 69
- Medicine : Chemistry and, Prof. G. Barger, 69 ; History of, Third International Congress of the, 296 ; The Psychology of, Dr. T. W. Mitchell, 412
- "Meg" Insulation Tester, The, Evershed and Vignoles, Ltd., 586
- Melaleuca : *acuminata*, Lævo-phellandrene in the Oil of, H. G. Smith, 759 ; *linariifolia* and *Melaleuca trichostachya*, E. Cheel, 236
- Melaleucas, The, and their Essential Oils, Part vi., R. T. Baker and H. G. Smith, 468
- Melanesia, Depopulation of, Essays on the, edited by Dr. W. H. R. Rivers, 594
- Melbourne University Bill, The, Sir J. H. MacFarland, 39
- Mendel, The Centenary of the Birth of, 491
- Mendelian Ratios, Problems of, R. A. Fisher, 786
- Mensch, Der fossile : Grundzüge einer Paläanthropologie, Prof. E. Werth. Erster Teil, 508
- Mentally Deficient Children : their Treatment and Training, Dr. G. E. Shuttleworth and Dr. W. A. Potts. Fifth edition, 663
- Menthone, The Stereoisomeric Forms of, R. S. Hughesdon, H. G. Smith, and J. Read, 895
- Merchant Venturers' Technical College, Calendar of, 562
- Mercury : in Gases, Variation of the Surface Tension of, J. G. Popesco, 268 ; The Production of the Spectrum of, G. Déjardin, 831 ; The Surface Properties of, E. Perucca, 623 ; Vapour : Energy Losses accompanying Ionisation and Resonance in, J. A. Eldridge, 563 ; The Determination of the Specific Inductive Capacity of, M. Bedeau, 268
- Mercury : visible as a Morning Star, 553
- Mersenne's Numbers, Prof. G. H. Hardy, 542
- Mesoplodon *Layardi*, Occurrence of the Rare Whale, on the Tasmanian Coast, Prof. T. T. Flynn, 379
- Mesopotamia, Geology of, Dr. E. H. Pascoe, 21
- Mesothorium-2, The Chemical Properties of, D. Yovanovitch, 332
- Méssel : Medal, The, presented to Prof. H. E. Armstrong, 130 ; Memorial Lecture, The First, Prof. H. E. Armstrong, 367
- Metabolism, Basal, Prof. Cathcart, 294
- Metallic State, The, Prof. C. A. Kraus, 165
- Metallografiska Institutet, Stockholm, Opening of the, Gift for a Scholarship by Sir Robert Hadfield, 18
- Metallography : in the Workshop, 837 ; Prof. C. H. Desch. Third edition, 305
- Metallurgical : Chemist : The, Prof. C. H. Desch, 710 ; The Work and Position of the, Sir Robert Hadfield, 51 ; Research, 462
- Metallurgy : Commercial, 71 ; of Iron and Steel, The, Prof. C. H. Desch, 537 ; of the Common Metals : Gold, Silver, Iron (and Steel), Copper, Lead, and Zinc, L. S. Austin. Fifth edition, 71 ; Modern, 507
- Metals : and Alloys, Cast, New Forms of Apparatus for determining the Linear Shrinkage and for Bottom-pouring of, F. Johnson and W. G. Jones, 531 ; crystallise, The Systems in which, J. L. Haughton and G. Winifred Ford, 136 ; Ferrous, The Corrosion of, A. Pickford, 83 ; F. N. Speller, 84 ; Hardness of, A Curious Feature in the, H. O'Neill and Dr. F. C. Thompson, 773 ; Institute of : Admission of Student Members of the, 784 ; Programme of the, for 1922-1923, 394 ; The Effect of Temperature on some of the Properties of, Prof. F. C. Lea, 41 ; The Fatigue Failure of, C. F. Jenkin, 794 ; White, A. H. Munday, C. C. Bissett, and J. Cartland, 467
- Meteor : Great, of December 6, 886 ; Large, of October 17, W. F. Denning, 645 ; Shower, Possible Recurrence of a, 747 ; Showers, October, 493
- Meteoric : Flowers, Persistent, The Opening and Closing of, A. D. de Virville and F. Obaton, 759 ; Iron, The, of Karee Kloof, etc., Dr. G. T. Prior, 757
- Meteorological : Literature, A Bibliography of, 885 ; Theory in Practice, 762
- Meteors : A Theory of, and the Density and Temperature of the Outer Atmosphere to which it leads, Prof. F. A.

- Lindemann and G. M. B. Dobson, 794; August, 364; Recent, W. F. Denning, 613; September, 395
- Meters, Current, for Use in River Gauging, Dr. M. A. Hogan, 292
- Metre, The Legal Equivalent of the, Sir R. T. Glazebrook, 446
- Metric: and British Measures, 29; System, Sir Richard Gregory, 744; Progress of the, 459; for Engineers, C. B. Clapham, 340
- Mexico, Upper Cretaceous of, New Radiolites and a New Crinoid from the, L. W. Stephenson; F. Springer, 261
- Microbial Physiology and the Accessory Growth Factor, P. Goy, 64
- Microbiology: edited by Prof. C. E. Marshall. Third edition, 694; General, Laboratory Manual in, Second edition, 694
- Microdrilli (Oligochaeta), The Pharyngeal Glands of the, Dr. J. Stephenson, 100
- Microscope: The: a Simple Handbook, C. Beck, 147; The Earliest Drawings made by means of the, Dr. C. Singer, 829; in Paper-making, J. Strachan, 99; The Use of the, in the Brewing Industry, A. Chaston Chapman, 99
- Microscopes and Microtomes, Catalogue of, The Bausch and Lomb Optical Co., Ltd., 363
- Microscopy, Colour Filters in, Kodak, Ltd., 679
- Military Medicine, Aspects of, 729
- Milk: The Peril of, Prof. H. E. Armstrong, 648; Whole, The Marketing of, Dr. H. E. Erdman, 570; -yield, The Variation of, with the Cow's Age and the Length of the Lactation Period, Prof. J. Wilson, 830
- "Millions" Fish, Chromosomes of the, Dr. O. Winge, 748
- Mimicry among Birds, G. T. Harris, 161
- Mind: The Machinery of the, Violet M. Firth, 146; The Misuse of, a Study of Bergson's Attack on Intellectualism, K. Stephen, 541
- Mineral: Land Surveying, Dr. J. Underhill. Third edition, 541; Resources: of Burma, The, N. M. Penzer, 74; of Great Britain, Special Reports on the. Vol. 2: Barytes and Witherite, G. V. Wilson and others. Third edition, 211; of Yugoslavia, 33
- Mineralogy, A Text-book of: with an Extended Treatise on Crystallography and Physical Mineralogy, Prof. E. S. Dana. Third edition, revised and enlarged by Prof. W. E. Ford, 210
- Minerals of the Oudjda Region (Morocco), J. Barthoux, 332
- Mining: Engineers, Institution of, and Institution of Mining and Metallurgy, Dinner of the, 709; and Metallurgy, Institution of, Award of Medals to Sir Alfred Keogh and Sir George Beilby, 553
- Ministry of Munitions and Department of Scientific and Industrial Research. Technical Records of Explosives Supply, 1915-1918. Nos. 5, 6, and 7, 777
- Minnesota University, Bequest to, by A. D. Thomson, 166
- Miracles and the New Psychology: a Study in the Healing Miracles of the New Testament, E. R. Micklem, 630
- Miraculous Draught of Fishes, The: an Explanation, Prof. E. W. Gudger, 572; T. R. R. S., 665; Sir Herbert Maxwell; Dr. W. B. Drummond; H. Harries, 666
- Mites injurious to Domestic Animals (with an Appendix on the Acarine Disease of Hive Bees), D. Hirst, 410
- Molecular: Anisotropy in Liquids, Prof. C. V. Raman, 11; Scattering of Light in Vapours and in Liquids and its Relation to the Opalescence observed in the Critical State, K. R. Ramanathan, 655; Viscosity, F. M. Lidstone, 733
- Molecules in a Magnetic Field, Orientation of, M. Holmes, 635
- Molluscs of the Colorado Desert, Dr. S. S. Berry, 887
- Mondes, Origine et formation des, l'Abbé Th. Moreux, 660
- Monotremata, Interpretation of the Pelvic Region and Thigh of, A. B. Appleton, 862
- Monsoons as Rain Makers, Prof. A. McAdie, 324
- Montreal University, Destructive Fire at, 720
- Moon, Colour Observations of the, A. F. Warth, 605
- Mordellistena, A New Species of, parasitic on Termites, G. F. Hill, 759
- Morphine, The Estimation of, J. R. Nicholls, 722
- Mosaic Disease in Plants, K. M. Smith, 668
- Mosquito: Control: J. Marshall, 261; Lt.-Col. H. J. Walton, 838; Eradication, W. E. Hardenburg, 838; Investigations, 526
- Mosquitos, The Destruction of, by Eels, R. Dubois, 468
- Moth, Attack on a, by a Wasp, Miss M. M. Buchanan, 323
- Motor: Cars, Design of, Col. D. J. Smith, 644; Control: Industrial, Direct Current, A. T. Dover, 805
- Motorless or Wind Flight, Dr. S. Brodetsky, 483
- Mucins, Hexosamines and, Dr. P. A. Levene, 292
- Munster, edited by G. Fletcher, 339
- Muscarine, Dr. H. King, 526
- Museums: A Suggested Royal Commission on, 761; Children and, 301; National and Provincial, 320; Association, Presidential Address to the, E. E. Lowe; T. Sheppard elected President for 1924, 163
- Music, Various Factors involved in the Appreciation of, Dr. C. S. Myers, 232
- Mustard Gas Poisoning, Prof. G. Lovatt Evans, 32; The Medical Aspects of, Prof. A. S. Martin and Dr. C. V. Weller, 32
- Mycology: Applied, Review of, 189; Some Present-day Aspects of, F. T. Brooks, 563
- Myriapoda, H. W. Brolemann; R. V. Chamberlin, 90
- National: Academy of Sciences, U.S.A., The New Building of the, Dr. C. D. Walcott, 120; Physical Laboratory, Annual Visitation of the, 92; Collected Researches of the, Vol. 16, 462; Report of the, 1921, 363; Portrait Gallery, Earl of Ilchester, Sir Martin Conway, and W. B. Hardy appointed to the Board of Trustees of the, 394
- Natural: History Museum Staff Association, 88, 642; Philosophy, A Theory of, R. J. Boscovich. Latin-English edition, 870
- Nature: The Relatedness of, Prof. A. N. Whitehead, 63; Volumes, An Offer of, M. Gheury de Bray, 737
- Naval Architects, Institution of, Scholarships of the, 711
- Nebraska Tooth, The, W. P. Pycraft, 707
- Nebula: Dark, Prof. H. N. Russell, 81; New, D. H. Menzel, 364
- Nematode Parasite of a Lizard, A New, Vera Irwin-Smith, 759
- Nematodes of the Genus Physaloptera. Part iii., Vera Irwin-Smith, 300
- Nendrum, Ancient Monastery of, Discovery of the Remains of the, 459
- Neolithic Script in India, Hem Chandra Das Gupta, 365
- Neon, The Rectilinear Diameter of, E. Mathias, Dr. C. A. Crommelin, and Prof. H. Kamerlingh Onnes, 831
- Nephelectrometer, The, a New Apparatus, I. N. Kugelmass, 400
- Nerve-energy, On the Reality of, Prof. D. Fraser Harris, 342, 666; Dr. E. D. Adrian, 447
- Nerves, Outwitting our: a Primer of Psychotherapy, Dr. Josephine A. Jackson and Helen M. Salisbury, 477
- New: Guinea, Exploration of, from the Air, Capt. F. Hurley, 393; South Wales, Royal Society of, C. A. Sussmilch elected President of the, 126; Typical Wheat Soil of, A Chemical and Bacteriological Study of a, J. K. Taylor, 300; York, Allied Chemical and Dye Corporation of, Offer by the, of an Annual Prize to Chemists, 492; Zealand, Upper Cretaceous Gastropods of, Dr. O. Wilckens, 556; Alps, The Conquest of the, S. Turner, 872
- Newcomen Society, The, for the Study of the History of Engineering and Technology. Transactions. Vol. i., 1920-21, 409
- Newt, An Albino-crested, K. Norris, 188
- Nickel: Active, The Preparation of, for Organic Catalysis, A. Brochet, 759; Alloys retaining their Rigidity over an extended Temperature Range, P. Chevenard, 592; and Cobalt in the Biosphere, W. J. Vernadsky, 436
- Nigeria, Volcanic Activity in, A. A. Reading, 97; H. S. Cameron, 497
- Nigerian Plants of Economic Value, J. H. Holland, 323
- Nitrogen: and Alkaline Solutions, The Reactions between the Gaseous Oxides of, A. Sanfourche, 591; Fixing, A New Bacillus capable of, G. Truffaut and N.

- Bezssonoff, 623; Industrial, The Principles and Methods of Nitrogen Fixation and the Industrial Applications of Nitrogen Products in the Manufacture of Explosives, Fertilizers, Dyes, etc., P. H. S. Kempton, 805; Industry, The, Prof. C. H. Desch, Dr. J. A. Harker, and others, 670
- Nobel Prizes, Award of the, for Physics and Chemistry, for 1921 and 1922, 674
- Noctiluca as an Enemy of the Oyster, R. W. Dodgson, 343
- Nolanaceæ, The Morphological Origin of the Internal Liber of the, M. Mirande, 436
- Nomenclature, A Question of, F. H. Masters, 543
- Non-opaque Minerals, The Microscopic Determination of the, E. S. Larsen, 261
- North: American Gulls and Terns, Life-histories of, Order Longipennes, A. C. Bent, 339; Atlantic, The Hydrology of the, E. Le Danois, 655; Australian Termites, Some, G. F. Hill, 236; -East Coast Institution of Engineers and Shipbuilders, Report of the, for 1921-22, 642; of Scotland College of Agriculture, Calendar of the, 621; Sea, Currents of the, New Charts of the, Dr. G. Böhnecke, 885; Basin, Geology of the, Prof. P. F. Kendall and others, 890
- Northampton Polytechnic, Courses at the, 621
- Norwich Castle Museum Committee, Report of the, for 1921, 524
- Nototherium Mitchellii*, Turbinoid Bones of, H. H. Scott and C. Lord, 228
- Nova: in Lyra, The Reported, Dr. A. C. D. Crommelin, 821; Scorpii 1922, 645
- Nozzle Flow, Supersaturated Condition as shown by, Prof. A. L. Mellanby and W. Kerr, 41
- Numbers, The Theory of, Prof. G. H. Hardy, 352, 381
- Nursing Procedure, Pope's Manual of, Amy E. Pope, 445
- Nutrition, National, The Problem of, 226
- Oaks, Defoliation of, E. W. Swanton, 250; Sir Herbert Maxwell, 344
- Oat Straw as a Cattle Food, S. H. Collins and B. Thomas, 887
- Observer, A Reflective, 836
- Occult Phenomena and After-images, Prof. E. N. da C. Andrade, 843
- Ocean, Measuring the Depth of the, by Sound Waves, Dr. Hayes, 159
- Océanographie physique, Manuel d', Prof. J. Rouch, 840
- Ochetoceras, Phylogeny of, Marjorie O'Connell, 322
- Ohm, International, The Standard Reproduction of the, P. Janet, 235
- Ohms, International, Comparisons of the Standard Reproductions of the, R. Jouast, 235
- Oil: -drilling in Galicia, A. Müller, 749; Encyclopedia, The, M. Mitzakis, 474; Palm in French West Africa, The, 164
- Oils, Lubricating and Allied, E. A. Evans, 75
- Oilshale, Carboniferous Material in, 55
- Oil Shales, Dr. H. B. Cronshaw, 307
- Old Stone Age, Everyday Life in the, M. and C. H. B. Quennell, 443
- Oligochæta: in the Antarctic, Distribution of, Prof. W. B. Benham, 823; Some Scottish, with a Note on Encystment in a Common Freshwater Oligochæte, *Lumbriculus variegatus* (Müll.), Dr. J. Stephenson, 723
- One and the Many, The, G. Cator, 894
- One-Teacher Schools, Modern Equipment for, 755
- Opalescence: Critical, The Variations of, with the Filling of the Tubes and the Nature of the Liquids studied, A. Andant, 63; Phenomena in Liquid Mixtures, Prof. C. V. Raman, 77
- Ophidia Toprobanica, or the Snakes of Ceylon, Col. F. Wall, 538
- Opium, The Estimation of Narcotine and Papaverine in, H. E. Annett and M. N. Bose, 722
- Optical: Cosine Law, The, T. Smith, 895; Definition and Resolving Power, J. Evershed, 179; Dispersion, A Quantum Theory of, Prof. C. G. Darwin, 841; Series and Röntgen Series of Lines, Analogies of Structure between the, L. de Broglie and A. Dauvillier, 723; Society of America, Seventh Annual Meeting and Exhibition of the, 676; Sonometer, An, Adam Hilger, Ltd., 464
- Optics, Physics and, A Florentine School of, Dr. L. C. Martin, 496
- Optique, l'Institut d', Report of, 426
- Orchis latifolia*, Linn. (marsh orchis), from the Island of Öland, Sweden, A. J. Wilmott, 757
- Ordnance Survey, Col. E. M. Jack appointed Director-General of the, 158
- Ore: Deposits, Prof. H. Louis, 205; Concerning the Review of, Dr. G. Berg, 583
- Organic Compounds: Influence of the Structure of, on their Oxidation by Chromic and Sulphuric Acids, L. J. Simon, 863; Polar and Non-polar Valency in, W. E. Garner, 543
- Organisms in Rocks capable of Reviving after Sterilisation by Heat, The Possibility of the Existence of, F. Dienert and P. Etrillard, 591
- Organomagnesium Compounds in Synthetic Chemistry, C. J. West and H. Gilman, 833
- Orthoptera and Dermaptera, Researches on, 822
- Otago University Museum, Annual Report of the, 1921, Prof. W. B. Benham, 362
- Oundle School, Dr. K. Fisher appointed Headmaster of, 330
- Ouramœba, F. R. Rowley; R. Kirkpatrick, 40; G. Lapage, 114
- Oxford: and Cambridge Bill, Universities of, 201; University, Conferment of Honorary Degrees, 60; Gifts by Sir William Dunn's Trustees for a School of Pathology and the Future School of Pharmacology, 720; Offer by L. Evans of a Collection of early Scientific Instruments, 828; Press General Catalogue, Third edition, 886
- Oxidation by Mixtures of Sulphuric Acid and Chromates, L. J. Simon, 168
- Oxygen: Electric Discharge in, Peculiarities of the, Rev. Dr. P. J. Kirkby, 249; Supply, Athletics and, Prof. A. V. Hill, 588
- Oyster (*O. edulis*) and *Crepidula*, The Phenomena and Conditions of Sex-change in the, Dr. J. H. Orton, 212; Dr. R. Spärck, 480
- Ozone, Pure, The Preparation and Properties of, Prof. E. H. Riesenfeld, 615
- Pagrosomus auratus*, The Food Value of the Snapper, W. M. Doherty, 896
- Paguridea, British and Irish, C. M. Selbie and Dr. S. W. Kemp, 191
- Paint and Varnish Technologists, An Institute of, to be founded, 394
- Palæobotany and Earth-history, Prof. A. C. Seward, 585
- Palæozoic Brachiopoda from Eastern Asia, I. Hayasaka, 161
- Palestine, Archæology in, 556
- Palms, Climbing, and the Sago Palms, 372
- Pan-American Geologist*, The, 19, 321
- Panus stypticus*, Luminosity in, Prof. A. H. R. Buller, 563
- Paracelsus: Sir T. E. Thorpe, 202; Theophrastus Bombastus von Hohenheim, called, his Personality and Influence as Physician, Chemist, and Reformer, Prof. J. M. Stillman, 202
- Parasite, A Remarkable, P. Justesen, 128
- Parasitic Diptera, The Loss of the Faculty of Flight in, L. Cuénot and L. Mercier, 532
- Paris: Academy of Sciences, Sir William H. Bragg elected a Corresponding Member of the, 820; Astrographic Catalogue, The, J. Baillaud, 160; Observatory: The, 127; Report of the, for 1921, 712; on the 200th Anniversary of its Construction, G. Bigourdan, 895; Société de Géographie of, A Gold Medal of the, presented to Prof. J. W. Gregory, 820; University, Conferment of Honorary Doctorates upon Prof. Bordet, Prof. M. Lugeon, and Prof. A. Michelson, 754
- Parker and Haswell's Zoology, 765
- Parliament, University Representation in, 625
- Parliamentary Candidates, University, Unopposed Return of, 653
- Parsis, Religious Ceremonial of the, I. M. Casanowicz, 161

- Pasteur Centenary, 611; Preparations for the Celebration of the, 394; Celebration in Paris, 883
- Patent, an Empire, The Protection of Inventions, 437
- Patents for Inventions, J. E. Walker and R. B. Foster, 663
- Peabody Museum of Natural History, Appointments at the, 675
- Peking to India, Journey to, General Sir George Pereira, 852
- Penal Discipline, Mary Gordon, 692
- Penicillium glaucum* and of *Mucor stolonifer*, Mechanism of the Parasitic Action of, P. Nobécourt, 168
- Pepsin and Hydrochloric Acid, The Absorption of, by Foods, J. Efront, 758
- Periodicities, Dr. G. T. Walker; Sir W. H. Beveridge, 511
- Perseid Meteors in July 1592, H. Beveridge, 667
- Petrography, Sedimentary: an Introduction to, with Special Reference to Loose Detrital Deposits and their Correlation by Petrographic Methods, H. B. Milner, 804
- Pétrole, Les Gisements de, J. Chutard, 474
- Petroleum: and Allied Industries, The: Petroleum, Natural Gas, Natural Waxes, Asphalts and Allied Substances, and Shale Oils, J. Kewley, 866; Industry, The, 866; H. B. Milner, 474; in the Philippines, Dr. W. D. Smith, 21: Products, The Supply of, 401; Standardisation of, Dr. A. E. Dunstan, 677; The Economics of, J. E. Pogue, 474
- Petrology of the Metamorphosed Rocks of the Start Area (South Devon), C. E. Tilley, 167
- Pflanzenanatomie, Handbuch der, herausgegeben von Prof. K. Linsbauer. Allg. Teil: Cytologie (Die Organe der Zelle). Bd. 1., Zelle und Cytoplasma, H. Lundegårdh; Bd. 2., Allgemeine Pflanzenkaryologie, Prof. G. Tischler, 176
- Pflanzenzelle, Chemie der, Prof. V. Grafe, 403
- Pharmaceutical Education and Research, 233
- Pharmacognosy and the Pharmaceutical Curriculum, Prof. H. G. Greenish, 233
- Pharmacy: in Great Britain and Ireland, J. B. Gilmour, 296; Italian, Art in the, of the 15th Century, Prof. Castiglioni, 296
- Phasma, A New, belonging to the Genus *Extatosoma*, W. W. Froggatt, 759
- Pheasants: A Monograph of the, W. Beebe. In four Volumes. Vol. iii., 105; Natural History of, 105
- Phellandrenes, The Chemistry of the, E. Hurst, H. G. Smith, and J. Read, 895
- Phellinus cryptarum*, The Destruction of the Woodwork at the Château of Versailles by, L. Mangin and N. Patouillard, 467
- Phenological Observations, 1921, J. E. Clark, H. B. Adames, and I. D. Margary, 27
- Philippine: Cattle Round-worm, B. Schwartz, 823; Foraminifera, J. A. Cushman, 261; Islands, Social Economics in the, R. F. Barton, 90
- Philosopher, A, with Nature, B. Kidd, 836
- Philosophical Congress at Manchester, The, 231
- Philosophy and the New Physics: an Essay on the Relativity Theory and the Theory of Quanta, Prof. L. Rougier. Translated by Prof. M. Masius, 568
- Phonation and Telephonic Audition, M. Marage, 687
- Phosphatic Fertilisers, 306
- Phosphorescent Sulphides, The Refractive Indices of the, M. Curie, 655
- Phosphorite, The Composition of, A. F. Rogers, 292
- Photo-elastic Researches on Engineering Problems, Recent, Prof. E. G. Coker, 41
- Photo-electric Phenomena and the Surface Tension of Mercury, The Relation between, J. G. Popesco, 299
- Photographic: Development, The Course of, A. P. H. Trivelli, F. L. Righter, and S. E. Sheppard, 397; Emulsions, Grain Size in, E. P. Wightman, A. P. H. Trivelli, and S. E. Sheppard, 714; Layer, The Deformability of the, C. Benedicks, 723; Lens from the Historical Point of View, The, Dr. R. S. Clay, 675, 739; Lenses, Cooke and Tassar, Unit Surfaces of, Miss Alice Everrett, 829; Sensitometry and Testing, R. Davis and F. M. Walters, Jr., 430
- Photography: of Bullets in Flight, P. P. Quayle, 514; Optics, and Cinematography, Forthcoming International Exhibition of, in Turin, 583; *Record of*, No. 1, 363
- Photosynthesis: Dr. F. F. Blackman and others, 856; of Nitrogen Compounds, Profs. E. C. C. Baly, I. M. Heilbron, and D. P. Hudson, 129
- Phyllosiphon, A New Host of, G. Nicolas, 200
- Physaloptera, the Genus, Nematodes of, Part IV., Vera Irwin-Smith, 864
- Physical: Measurement, Physiological Aspects of, Sir J. Herbert Parsons, 824; Reality, The New Way of Thinking, Prof. H. Wildon Carr, 471
- Physics: An Ideal Text-book of, 405; and Optics, A Florentine School of, Dr. L. C. Martin, 496; Applied, The Dictionary of, Sir R. T. Glazebrook, 699; Applied, A Dictionary of, edited by Sir Richard Glazebrook: (In 5 Volumes.) Vol. I., 439. Vol. II.: Electricity, 595; Industrial, Major G. W. C. Kaye, 439; Modern, Tendencies of, Prof. C. E. Guye, 558; Practical, W. R. Bower and Prof. J. Satterly. Eighth impression (second edition), 445; Readable School, J. A. Cochrane, 340; The Teaching of, to Engineering Students, Prof. A. W. Duff, 792
- Physikalisch-Technische Reichsanstalt, Dr. Noddack appointed Director of the, 554
- Physiography of the Coal Swamps, Prof. P. F. Kendall, 353
- Physiology: and Biochemistry in Modern Medicine, Prof. J. J. R. MacLeod and others. Fourth edition, 872; of Life in the Andes, The, J. Barcroft, 152
- Physique générale, Cours de, à l'usage des candidats au certificat de Physique générale, au diplôme d'Ingénieur-Électricien et à l'Agrégation des Sciences physiques, Prof. H. Ollivier. Tome II. Deux. édition, 405
- Phytoläontologie und Geologie, Prof. W. Deecke, 375
- Pictures, The Preservation and Cleaning of, Prof. A. P. Laurie, 710
- Pigeon Tick, The: L. H. Matthews and A. D. Hobson, 313; A. G. Lowndes, 380
- Pigeons, Some Digestive Functions in Normal, fed with Polished Rice or kept without Food, Mme. Danysz-Michel and W. Koskowski, 200
- Pigments, Animal, Origin of, 429
- Pilot Cable, The Discovery of the, 820
- Pitdown Skull, The, E. N. Fallaize, 161
- Pipe Shrine House, Dr. J. W. Fewkes, 819
- Piperitone, Isolation and Identification of the Acid Bodies produced by the Oxidation of, by means of Potassium Permanganate, A. R. Penfold, 236
- Pituitary Body, The, 748
- Plague Bacillus, Healthy Carriers of the, M. Leger and A. Baury, 687
- Planets, Study of the Surface of, R. Jarry-Desloges, 200
- Plant: and Animal Diseases, Some Similarities and Dissimilarities in the Micro-biology of, Dr. R. M. Buchanan and Prof. V. H. Blackman, 293; Biology: a Course of Elementary Lectures on the General Morphology and Physiology of Plants, Prof. H. H. Dixon, 274; Cell, Chemistry of the, 403; Juices, The Filtration of, G. André, 300; Materials for Decorative Gardening: The Woody Plants, Prof. W. Trelease. Second edition, 177; Morphology and Physiology, 274; Nutrition, Manganese in, J. S. McHargue, 396
- Plants: Common, Dr. M. Skene, 177; Transport of Organic Substances in, Prof. H. H. Dixon, 355, 547
- Plumbers' Handbook, S. E. Dibble, 602
- Pluralisme, Les Sciences et le, J.-H. Rosny, aîné, 541
- Poetic Mind, The, F. C. Prescott, 443
- Poland, University Education in, Prof. L. Natanson, 828
- Polarisation of Diffused Light under the Sea, E. E. Brooks, 114
- Pôle Sud, Le: Histoire des voyages antarctiques, J. Rouch, 540
- Polishing, Practical, and Staining, A. W. Parkhouse, 147
- Polonium, α -Rays of, The Determination of the Velocity of, Mlle. Irène Curie, 299
- Pons-Winnecke Comet, The Meteors of the, G. Shann, 678
- Potash, S. J. Johnstone. New edition, 307
- Potassium: Carbonate, Caking of, Expansion and Shrinkage during, Prof. T. M. Lowry and E. E. Walker, 135; Cyanide, The X-ray Structure of, P. A. Cooper, 544; The Estimation of, R. L. Morris, 723; Vapour: Absorption of, in the Associated Series, Prof. A. L.

- Narayana and D. Gunnaiya, 250; The Absorption Spectrum of, S. Datta, 655
- Potato: Conference, Address to the, Dr. Salaman, 884; Trials at Ormskirck, 431; Wart Disease, Sir Daniel Hall, 431
- Potatoes: Physiology of the Dry-rot Disease of, in Storage caused by *Fusarium cæruleum*, Miss E. S. Moore, 795; Wart Disease of, Prof. M. C. Potter, 563
- Pottery-making on the Blue Nile, H. A. Macmichael, 713
- Potts: Howard N., Gold Medal presented to Prof. E. G. Coker, 288; Howard N., Medal, The, awarded to Dr. C. R. Downs and J. M. Weiss, 643
- Pound Weight, Suggested Alteration of the Value of the, 52
- Poverty and its Vicious Circles, Dr. J. B. Hurry. Second edition, 177
- Powdering of Minerals by Decrepitation, Prof. T. M. Lowry and L. P. McHatton, 135
- Powders, Two Properties of, A. M. Williams, 135
- Power Transformers, High Voltage, W. T. Taylor, 506
- Practitioner and the Laboratory, The Link between the: a Guide to the Practitioner in his Relations with the Pathological Laboratory, G. Fletcher and H. McLean, 376
- Prairie Vegetation in Illinois, H. C. Sampson, 823
- Precipitation: in the United States, Prof. R. De C. Ward, 366; Effect of a Coast Line on, J. S. Dines, 235
- Pre-Devonian Geology of Great Britain, 261
- Prehistoric Antiquities, Our Homeland, and how to study them, W. G. Clarke, 510
- Prehistory for the Schoolroom, 443
- Primeval Forest, On the Edge of the: Experiences and Observations of a Doctor in Equatorial Africa, Prof. A. Schweitzer. Translated by C. T. Campion, 308
- Primitive Custom and Administration, 593
- Principia Ethica, Dr. G. E. Moore, 74
- Printing Types, The History of, 583
- Prismatic Spectra, The Law of Dispersion of, in the Ultra-violet, P. Salet, 805
- Probabilités, Essai philosophique sur les, Pierre-Simon Laplace, Dr. S. Brodetsky, 6
- Produce Markets, Organised, Prof. J. G. Smith, 404
- Progress and Science: Essays in Criticism, R. Shafer, 662
- Prominences, Kalocsa Observations of, Rev. B. G. Swindells, 678
- Protein Precipitation in Grasses, Margaret H. O'Dwyer, 759
- Protozoa and Worms parasitic in Man, Diagnosis of, Prof. R. W. Hegner and W. W. Cort, 604
- Prussian Academy of Sciences, Berlin, Prof. H. K. Onnes, Prof. P. Zeeman, and Prof. N. Bohr elected Corresponding Members of the, 158
- Psychical Monism, 24
- Psycho-analysis: and Education, Dr. C. W. Kimmins and others, 650; The Technique of, Dr. D. Forsyth, 246
- Psychology: An Introduction to, S. S. Brierley, 872; in Great Britain, The Influence of the late W. H. R. Rivers on the Development of, Dr. C. S. Myers, 392, 485
- Psychophysics as the Key to the Mysteries of Physics and Metaphysics, L. T. Troland, 24
- Public Health: On the State of the, 676; Relative Values in, Sir Arthur Newsholme, 820; Work, Compulsion and Education in, Sir Arthur Newsholme, 232
- Pultenæa, Revision of the Genus, Part iii., H. B. Williamson, 563
- Pumping in the Chemical Works, N. Swindin, 726
- Pyrex Glass, 22
- Pyrogallol, Gallotannin, and Gallic Acid, The Colorimetric Estimation of, C. Ainsworth Mitchell, 722
- Pyrometers, Application of, to High Frequency Measurements, R. Jouaust, 863
- Qualitative Analysis, Notes on, Concise and Explanatory, Dr. H. J. H. Fenton. Supplement, 840
- Quantum: Mechanism in the Atom, Prof. E. T. Whittaker, 23; -orbit Theory, Spectra on the, Prof. W. M. Hicks, 292; Theory and Electromagnetic Phenomena, The, Prof. W. Wilson, 722; Theory of Spectrum, Some Significant Relations in the, Satyendra Ray, 215
- Quartz: at High Temperatures, The Elasticity and Symmetry of, A. Perrier and B. de Mandrot, 655; Crystallisation of, Heat of, R. C. Ray, 62
- Queensland, Mesozoic Insects of, No. 9, Dr. R. J. Tillyard, 864
- Quest: Movements of the, 87; Return of the, 427; The Work of the, 18
- Radiative Equilibrium, E. A. Milne, 62
- Radio: -active Disintegration, An Attempt to Influence the Rate of, by Use of Penetrating Radiation, Dr. G. Hevesy, 216; Substances, An Introduction to the Chemistry of, Dr. A. S. Russell, 477; -activity and Radio-active Substances, Dr. J. Chadwick, 412; of the Springs of Hercules in Roumania, P. Loisel and Michalesco, 863; of the Springs of Echailon, J. Cluzet and A. Chevallier, 895; of the Springs of the Region of Bagnoles-de-l'Orne and its Relation to the Geological Structure, P. Loisel, 795; Broadcasting in Great Britain, 197, 237; Communication, 273; Direction-finding, G. Breit, 188; Effects of Local Conditions on, Smith-Rose and Barfield, 753; in Flying Machines, G. Breit, 59; for Everybody, A. C. Lescarboura. Edited by R. L. Smith-Rose, 695; Receiving for Beginners, R. T. Snodgrass and V. F. Camp, 411; Research Board and its Sub-Committee on Atmospherics, Composition of the, 675; -telephony and Broadcasting, A. P. M. Fleming, 858
- Radiography, The Principles of, Dr. J. A. Crowther, 35
- Radiolaria from Oozes, Extraction of, H. L. Thomas; A. Earland, 216
- Radiology, A State Institute of, established at Prague, 643
- Radium: Direct Estimation of very small Quantities of, by the penetrating Rays, B. Szilard, 168; Institute for the Experimental Treatment of Cancer, A, to be established by the Quebec Government, 290; Salt, a Standard, The Preparation of, M. Yovanovitch and Mlle. Chamie, 299
- Railway: Bridges, The Design of, J. S. Wilson and others, 825; Electric Traction, F. W. Carter, 338
- "Rain of Blood," The Fall of Dust called a, O. Mengel, 299
- "Rainbow": A Broadcast, Prof. R. C. McLean, 605; Peculiarity, A, L. C. W. Bonacina, 160
- Rainfall: in Southern Italy and Tripoli, Prof. F. Eredia, 60; of May and June, 88
- Rain-producing Influences in South Australia, E. T. Quayle, 586
- Rains, Heavy, in England, 259
- Ramsay Memorial: Fellowships, Award of, 199; Fund, Presentation of the Gold Medal of the, to the Prince of Wales, 745; in Westminster Abbey, The, 636
- Ranges and Cooking Appliances, Tests on, A. H. Barker, 434
- Rangoon University, D. H. Peacock appointed Professor of Chemistry and F. J. Meggett Professor of Biological Science in, 720
- Rasmussen Arctic Expedition, Work of the, 18
- Rat: Problem, The Rodier System and the, W. Rodier, 612; The, and its Repression, Earl of Denbigh, 278
- Reale Accademia dei Lincei, Prof. E. T. Whittaker elected a Foreign Member of the, 188
- Rectangular Glass Jars, The Supply of, 19; Gallenkamp and Co., Ltd., 89
- Red: Crag Flints of Foxhall, The, J. Reid Moir, 188; S. H. Warren, 54; Lithium Line, The Structure of the, Prof. T. R. Merton, 632
- Rede Lecture for 1922, The, Dr. W. R. Inge, 104
- Refractometer, A Differential, Bellingham and Stanley, Ltd., 91
- Refrigration, Mechanical, The Principles of, Prof. H. J. MacIntire, 36
- Relatives, Our Nearest Living, Sir Arthur Keith, 834
- Relativité, Le Principe de la, et la théorie d'Einstein, Dr. L. Bloch, 568; Prof. L.-G. du Pasquier, 568
- Relativity: and Physical Reality, Dr. A. A. Robb, 572; and the Æther, Sir Oliver Lodge, 446; Misconceptions about, 747; Paradox, A, C. C.; Prof. A. S. Eddington, 844; Special, The Time-Triangle and Time-Triad in,

- R. A. P. Rogers, 698; The Philosophical Aspects of the Principle of, Prof. A. N. Whitehead, 231; The Philosophical Importance of the Theory of, Prof. Schlick, 750; The Principle of, Profs. A. Einstein and H. Minkowski. Translated by M. N. Saha and S. N. Bose, 275; The Special Theory of, The Meaning of Rotation in, P. Franklin, 563; The Theory of, and its Influence on Scientific Thought, Prof. A. S. Eddington, 568; Prof. von Laue, 750; Summary of, Prof. H. T. H. Piaggio, 432
- Religio Chirurghi, 726
- Rennet, Vegetable, R. Hedger Wallace, 543
- Repeating Patterns as Decorations, Major P. A. MacMahon, 162
- Reptilia, the Pubi-tibialis (sartorius) Muscle of, The Innervation of, A. B. Appleton and F. Goldby, 862
- Research, Prof. A. Mair, 134; and Razors, Prof. J. R. Partington, 415; Association of British Rubber and Tyre Manufacturers, The, 297; Defence Society, Address to the, by Sir Walter Fletcher, 50; Institutes, etc., in India, Possible Reduction of Assistance to, Lord Meston, 581; in Universities, The Development of, Principal Irvine, 131; The Organisation of, Principal J. C. Irvine, 385
- Réseaux d'énergie, Construction des, M. Daval, 731
- Reservoir and other Dams, Dr. B. Cunningham, 661
- Respiration, Dr. J. S. Haldane, 803; Physiology of, J. Barcroft, 803; The Rôle of, in the Diminution of the Carbohydrates in Leaves during the Autumnal Yellowing, R. Combes and D. Kohler, 468
- Retzius, The Anders, Medal, 611

REVIEWS AND OUR BOOKSHELF

Agriculture, Forestry, and Horticulture :

- Acharyar (Rai Bahadar K. Ranga), assisted by C. Tadulinga Mudaliyar, A Handbook of Some South Indian Grasses, 376
- Adams (Prof. R. L.), Farm Management: A Text-book for Student, Investigator, and Investor, 404
- Beccari (Dr. O.), Annals of the Royal Botanic Garden, Calcutta. Vol. 12, Parts 2 and 3, 372
- Burr (Prof. W.), Rural Organisation, 404
- Chapman (Prof. H. H.), Forest Mensuration, 407
- Dudgeon (G. C.), The Agricultural and Forest Products of British West Africa. Second edition, 210
- Erdman (Dr. H. E.), The Marketing of Whole Milk, 570
- Ernie (Lord), English Farming: Past and Present. Third edition, 204
- Francé (Dr. R. H.), Das Edaphon. Untersuchungen zur Ökologie der bodenbewohnenden Mikroorganismen. Zweite Auflage, 206
- Gamble (J. S.), A Manual of Indian Timbers: An Account of the Growth, Distribution, and Uses of the Trees and Shrubs of India and Ceylon, with Descriptions of their Wood-structure. Reprint, 276
- Hawley (Prof. R. C.), The Practice of Silviculture: With Particular Reference to its Application in the United States, 407
- Hooper (C. H.), Fruit Farming: Practical and Scientific for Commercial Fruit-growers and others. Second edition, 601
- Jackson (H.), A Short Manual of Forest Management, 407
- Keatinge (G.), Agricultural Progress in Western India, 442
- Kirkwood (J.), Farm Book-keeping: The Principles and Practice of Book-keeping applied to Agriculture: for Agricultural Colleges, Extension Classes, Evening Classes, and Practical Farmers, 768
- McCandlish (Prof. A. C.), The Feeding of Dairy Cattle, 695
- MacGarr (Ll.), The Rural Community, 412
- Orr (J.), A Short History of British Agriculture, 204
- Powers (W. L.) and T. A. H. Teeter, Land Drainage, 211
- Robertson (Dr. G. Scott), Basic Slags and Rock Phosphates, 306
- Schlich (Sir William), Schlich's Manual of Forestry. Vol. I.: Forest Policy in the British Empire. Fourth edition, 407

- Smith (Prof. J. G.), Organised Produce Markets, 404
- Stone (H.), A Text-book of Wood, 73; A Guide to the Identification of our more useful Timbers: Being a Manual for the Use of Students of Forestry, 276
- Warman (W. H.), Agricultural Co-operation in England and Wales, 404

Anthropology and Archæology :

- Ameghino, Florentino, Obras completas y correspondencia científica de. Vol. 3, 540
- American Ethnology, Thirty-fifth Annual Report of the Bureau of, to the Secretary of the Smithsonian Institution, 1913-1914. In two parts. Part 2, 176
- Armitage (F. P.), Diet and Race: Anthropological Essays, 308
- Brown (A. R.), The Andaman Islanders: A Study in Social Anthropology, 106
- Claridge (G. C.), Wild Bush Tribes of Tropical Africa, 340
- Clarke (W. G.), Our Homeland Prehistoric Antiquities, and How to Study Them, 510
- Corrêa (Prof. A. A. M.), Homo (Os Modernos Estudos sobre a origem do homem), 510
- Evans (I. H.), Among Primitive Peoples in Borneo: A Description of the Lives, Habits and Customs of the Piratical Head-hunters of North Borneo, 146
- Gregory (Prof. W. K.), The Origin and Evolution of the Human Dentition, 834
- Jeness (D.), The Life of the Copper Eskimos, 245
- Johnston (Sir Harry H.), A Comparative Study of the Bantu and Semi-Bantu Languages. Vol. 2, 67
- Malinowski (Dr. B.), Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea, 472
- Melanesia, Depopulation of, Essays on the. Edited by Dr. W. H. R. Rivers, 594
- Nordenskiöld (Baron E.), The Copper and Bronze Ages of South America, 141
- Peake (H.), The English Village: The Origin and Decay of its Community. An Anthropological Interpretation, 371
- Radcliffe (W.), Fishing from the Earliest Times, 534
- Roscoe (Rev. John), Twenty-five Years in East Africa, 36
- Watkins (A.), Early British Trackways, Moats, Mounds, Camps, and Sites, 176
- Werth (Prof. E.), Der fossile Mensch: Grundzüge einer Paläanthropologie. Erster Teil, 508

Biology :

- Alverdes (Dr. F.), Studien an Infusorien über Flimmerbewegung, Lokomotion und Reizbeantwortung, 509
- Artschwager (Dr. E.) and E. M. Smiley, Dictionary of Botanical Equivalents: French-English, German-English, 177
- Baxter (Evelyn V.) and Leonora J. Rintoul, Some Scottish Breeding Duck: Their Arrival and Dispersal, 476
- Beebe (W.), A Monograph of the Pheasants. In four vols. Vol. III., 105; The Edge of the Jungle, 211
- Bent (A. C.), Life-histories of North American Gulls and Terns, Order Longipennes, 339
- Boulenger (Dr. G. A.), Monograph of the Lacertidæ. Vol. II., 410
- Bouvier (Prof. E. L.), translated by Dr. L. O. Howard, The Psychic Life of Insects, 402
- Brachet (Prof. A.), Traité d'embryologie des vertébrés, 275
- Collett (A.), The Changing Year, 410
- Dixon (Prof. H. H.), Practical Plant Biology: A Course of Elementary Lectures on the General Morphology and Physiology of Plants, 274
- Downing (E. R.), A Naturalist in the Great Lakes Region, 444
- Fernald (Prof. H. T.), Applied Entomology: An Introductory Text-book of Insects in their Relations to Man, 35

Flattely (F. W.) and C. L. Walton, The Biology of the Seashore, 540
 Garstang (Prof. W.), Songs of the Birds, 209
 Gibbs (Dr. W. E.), The Fishing Industry, 840
 Hardenburg (W. E.), Mosquito Eradication, 838
 Hedin (Dr. Sven), Southern Tibet: Discoveries in Former Times compared with my own Researches in 1906-1908. II. A List of Flowering Plants from Inner Asia, collected by Dr. Sven Hedin, determined by various authors, and compiled by Prof. C. H. Ostenfeld and Dr. Paulsen, 170
 Hegner (Prof. R. W.) and Prof. W. W. Cort, Diagnosis of Protozoa and Worms Parasitic in Man, 694
 Heron-Allen (E.) and A. Earland, British Museum (Natural History). British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report. Zoology. Vol. 6, No. 2. Protozoa, Part 2: Foraminifera, 241
 Hirst (S.), Mites Injurious to Domestic Animals (with an Appendix on the Acarine Disease of Hive Bees), 410
 Hyman (L. H.), A Laboratory Manual of Comparative Vertebrate Anatomy, 571
 Lundbeck (W.), Diptera Danica: Genera and Species of Flies hitherto found in Denmark. Part VI. Pipunculidæ and Phoridae, 602
 Maquenne (Prof. L.), Précis de physiologie végétale, 177
 Microbiology, Edited by Prof. C. E. Marshall. Third edition, 694; General, Laboratory Manual in. Second edition, 694
 Milligan (H. N.), The Horniman Museum: A Handbook to the Collections illustrating a Survey of the Animal Kingdom. Second edition, 412
 Parker (the late Prof. T. J.) and Prof. W. A. Haswell, A Text-book of Zoology. In two volumes. Third edition, 765
 Pearson (Prof. Karl), Francis Galton, 1822-1922: A Centenary Appreciation, 335
 Pflanzenanatomie, Handbuch der, herausgegeben von Prof. K. Linsbauer. Allgemeiner Teil: Cytologie (Die Organe der Zelle). Band 1, Zelle und Cytoplasma, Dr. H. Lundegårdh. Band 2, Allgemeine Pflanzenkaryologie, Prof. G. Tischler, 176
 Phisalix (Dr. Marie), Animaux venimeux et venins. 2 vols., 691
 Rettger (Prof. L. F.) and H. A. Cheplin, A Treatise on the Transformation of the Intestinal Flora, with special reference to the Implantation of Bacillus Acidophilus, 694
 Richet (Prof. Ch.), Autorisierte Übersetzung von Dr. J. Negrin y López, Die Anaphylaxie, 694
 Royal Society, Reports of the Grain Pests (War Committee). Nos. 1 to 10 (in 1 volume), 145
 Rübel (Prof. E.), Geobotanische Untersuchungsmethoden, 208
 Shann (E. W.), First Lessons in Practical Biology, 601
 Sherborn (C. D.), Index Animalium. Sectio Secunda, 1801-1850. Part 1: Introduction, Bibliography and Index, 3
 Simmons (A. T.) and A. J. V. Gale, A First Book of General Science: An Introduction to the Scientific Study of Animal and Plant Life, 406
 Sirks (Dr. M. J.), Handboek der algemeene Erfelijkheidslcer, 111
 Skene (Dr. M.), Common Plants, 177
 Smith (K. M.) and J. C. M. Gardner, Insect Pests of the Horticulturalist: Their Nature and Control. Vol. I.: Onion, Carrot, and Celery Flies, 694
 Swann (H. Kirke), A Synopsis of the Accipitres (Diurnal Birds of Prey). Parts 1, 2, 3. Second edition, 339
 Thomson (Hon. G. M.), The Naturalisation of Animals and Plants in New Zealand, 868
 Thoulet (Prof. J.), L'Océanographie, 541
 Trelease (Prof. W.), Plant Materials of Decorative Gardening: The Woody Plants. Second edition, 177
 Wall (Col. F.), Ophidia Toprobanica, or the Snakes of Ceylon, 538
 Wetmore (A.), A Study of the Body Temperature of Birds, 566
 Zoologischen Anzeiger, Herausgegeben von Prof. E. Korschelt. Register zum Zoologischen Anzeiger.

Band xxxvi.-xl., und Bibliographia Zoologica, Vol. xviii.-xxii., 245

Chemistry:

Bailey (Dr. G. H.), Edited by Dr. W. Briggs, The Tutorial Chemistry. Part 2: Metals and Physical Chemistry. 12th Impression (4th edition), 663
 Barker (T. V.), Graphical and Tabular Methods in Crystallography as the Foundation of a New System of Practice: with a Multiple Tangent Table and a 5-Figure Table of Natural Cotangents, 629
 Becher (Prof. S.), Untersuchungen über Echtfärbung der Zellkerne mit künstlichen Beizenfarbstoffen und die Theorie des histologischen Färbeprozesses mit gelösten Lacken, 33
 Bernthsen (Dr. A.), new edition, revised by Prof. J. J. Sudborough, A Text-book of Organic Chemistry, 602
 Bohn (G.) and Dr. Anna Drzewina, La Chimie et la vie, 173
 Chamberlain (Prof. J. S.), A Text-book of Organic Chemistry, 805
 Chemistry, Applied, Reports of the Progress of. Vol. 6, 1921, 147
 Clarke (A.), Coal-tar Colours in the Decorative Industries, 768
 Desch (Prof. C. H.), Metallography. Third edition, 305
 Fabre (Prof. L.), La Séparation industrielle des solides en milieu liquide, 872
 Fenton (Dr. H. J. H.), Notes on Qualitative Analysis: Concise and Explanatory. Supplement, 840
 Fischer (E.), Herausgegeben von Dr. M. Bergmann, Untersuchungen über Kohlenhydrate und Fermente II. (1908-1919), 142
 Fischer (Prof. M. H.), and others, Soaps and Proteins: Their Colloid Chemistry in Theory and Practice, 70
 Fournneau (Prof. E.), Préparation des médicaments organiques, 69
 Friend (Dr. J. N.), Edited by G. C. Lloyd, The Corrosion of Iron, 731
 Grafe (Prof. V.), Chemie der Pflanzenzelle, 403
 Griffiths (H.), Materials of Chemical Plant Construction—Non-Metals, 726; The General Principles of Chemical Engineering Design, 726
 Hesse (Prof. A.) and Prof. H. Grossmann, Englands Handelskrieg und die chemische Industrie. Band I. Band II: Neue Folge. Band III: Herausgegeben von A. Hesse, H. Grossmann, und W. A. Roth, 337
 Hilditch (Dr. T. P.), A Concise History of Chemistry. Second edition, 305
 Hofmann (Prof. K. A.), Lehrbuch der anorganischen Chemie. Vierte Auflage, 695
 Humphrey (J.), Drugs in Commerce: Their Source, Preparation for the Market, and Description, 7
 de Kegel (M.), Les Encres, les cirages, les colles et leur préparation, 731
 Kempton (P. H. S.), Industrial Nitrogen: The Principles and Methods of Nitrogen Fixation and the Industrial Applications of Nitrogen Products in the Manufacture of Explosives, Fertilizers, Dyes, etc., 805
 Kewley (J.), The Petroleum and Allied Industries: Petroleum, Natural Gas, Natural Waxes, Asphalts and Allied Substances, and Shale Oils, 866
 Lewkowitsch (Dr. J.), Chemical Technology and Analysis of Oils, Fats and Waxes. Sixth edition, entirely revised by G. H. Warburton. Vols. 1 and 2, 109
 Lowry (Prof. T. M.), Inorganic Chemistry, 374
 Malan (H. L.) and A. I. Robinson, The Weighing and Measuring of Chemical Substances, 726
 Martin (Dr. G.), assisted by J. M. Dickson and Maj. J. W. Christelow, Modern Chemical Lecture Diagrams, with Uses and Applications fully described, 571
 Mellor (Dr. J. W.), A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vols. i. and ii., 801
 Michaelis (Prof. L.), Die Wasserstoffionen-Konzentration: ihre Bedeutung für die Biologie und die Methoden ihrer Messung. Zweite Auflage. Teil I, 305

- Ministry of Munitions and Department of Scientific and Industrial Research. Technical Records of Explosives Supply, 1915-1918. No. 5: Manufacture of Sulphuric Acid by Contact Process. No. 6: Synthetic Phenol and Picric Acid. No. 7: Manufacture of Nitric Acid from Nitre and Sulphuric Acid, 777
- Monier-Williams (G. W.), Power Alcohol: Its Production and Utilisation, 172
- Norris (Prof. J. F.) and Prof. K. L. Mark, Laboratory Exercises in Inorganic Chemistry, 602
- Parkhouse (A. W.), Practical Polishing and Staining, 147
- Plimmer (Violet G.) and Prof. R. H. A. Plimmer, Vitamins and the Choice of Food, 336
- Purvis (J. E.) and T. R. Hodgson, The Chemical Examination of Water, Sewage, Foods, and other Substances. Second edition, 571
- Rinne (Prof. F.), Das feinbauliche Wesen der Materie nach dem Vorbilde der Kristalle. 2 und 3 Auflage, 839
- Rogers (Dr. A.), Practical Tanning, 840
- Russell (Dr. A. S.), An Introduction to the Chemistry of Radio-active Substances, 477
- Schidrowitz (Dr. P.), Recent Progress in Rubber Chemistry and Technology, 726
- Sears (Prof. G. W.), A Systematic Qualitative Chemical Analysis: A Theoretical and Practical Study of Analytical Reactions of the More Common Ions of Inorganic Substances, 477
- Sherman (Prof. H. C.) and S. L. Smith, The Vitamins, 6
- Simon (E. D.) and Marion Fitzgerald, The Smokeless City, 269
- Stillman (Prof. J. M.), Theophrastus Bombastus von Hohenheim, called Paracelsus: His Personality and Influence as Physician, Chemist, and Reformer, 202
- Swindin (N.), Pumping in the Chemical Works, 726; The Flow of Liquids in Pipes, 726
- Teichert (Dr. K.), Methoden zur Untersuchung von Milch und Molkereiprodukten, 110
- Thorpe (Sir Edward), A Dictionary of Applied Chemistry. Vol. 3. Revised and enlarged edition, 305
- Tutton (Dr. A. E. H.), Crystallography and Practical Crystal Measurement. Second edition. In 2 vols., 303
- Washburn (Prof. E. W.), An Introduction to the Principles of Physical Chemistry from the Standpoint of Modern Atomistics and Thermodynamics. Second edition, 305
- Wollaston (T. R.), Filtration: An Elementary Treatise on Industrial Methods and Equipment for the Filtration of Liquids and Gases for those concerned with Water Supply, Ventilation, and Public Health: Chemists, Mechanical Engineers, and Others, 663
- Engineering:**
- Allcut (Prof. E. A.) and C. J. King, Engineering Inspection, 730
- Batson (R. G.) and J. H. Hyde, Mechanical Testing: A Treatise in Two Volumes. Vol. I.: Testing of Materials of Construction, 804
- Bellasis (E. S.), Hydraulics with Working Tables. Third edition, 34
- Blattner (Dr. E.), Lehrbuch der Elektrotechnik. Erster Teil. Vierte Auflage, 176
- Booth (H.), Aeroplane Performance Calculations, 110
- Cabaud (R.), Installations électriques industrielles: choix du matériel, 474
- Carter (F. W.), Railway Electric Traction, 338
- Daval (M.), Construction des réseaux d'énergie, 731
- Dover (A. T.), Industrial Motor Control: Direct Current, 805
- Duncan (J.), An Introduction to Engineering Drawing, 476
- Eichhorn (Dr. G.), Drahtloser Übersee-Verkehr, 374
- Evans (E. A.), Lubricating and Allied Oils, 75
- Evans (E. J.), Building Contracts: The Principles and Practice of their Administration, 110
- Hayes (S. Q.), Switching Equipment for Power Control, 373
- Hydro-Electric Engineering. Vol. I.: Civil and Mechanical. Editor: Dr. A. H. Gibson. Contributors: H. D. Cook and the Editor, 108
- Lea (Prof. F. C.), Elementary Hydraulics for Technical Students, 839
- Le Gavrian (Prof. P.), Les Chaussées modernes, 272
- Lertes (Dr. P.), Die drahtlose Telegraphie und Telephonie, 273
- Lescarboua (A. C.), Edited by R. L. Smith-Rose, Radio for Everybody, 695
- Lundberg (G. C.) and the late W. P. Maycock, "Lektrik" Lighting Connections. Seventh edition, 176
- MacIntire (Prof. H. J.), The Principles of Mechanical Refrigeration, 36
- Marchant (W. H.), Marine Wireless Pocket-book for the Practical Operator and Student, 273
- Metcalf (L.) and H. P. Eddy, Sewerage and Sewage Disposal: A Text-book, 510
- Mittell (B. E. G.), Continuous Wave Wireless Telegraphy: A Non-Mathematical Introduction to the Subject of Wireless Telegraphy from the Engineer's Point of View, 273
- Newcomen Society for the Study of the History of Engineering and Technology, The, Transactions, Vol. I., 1920-21, 409
- Poole (H. E.), Switching and Switchgear, 805
- Salmon (Dr. E. H.), Columns: A Treatise on the Strength and Design of Compression Members, 210
- Smith (Dr. C. F.), The Testing of Transformers and Alternating Current Machines, 805
- Snodgrass (R. T.) and V. F. Camp, Radio Receiving for Beginners, 411
- Starling (S. G.), Electricity, 176
- Taylor (W. T.), Electric Power Systems, 506; High Voltage Power Transformers, 506
- Timbie (Prof. W. H.) and Prof. V. Bush, Principles of Electrical Engineering, 506
- Water-Power in the British Empire. The Reports of the Water-Power Committee of the Conjoint Board of Scientific Societies, 767
- Wegmann (E.), The Design and Construction of Dams: including Masonry, Earth, Rock-fill, Timber, and Steel Structures, also the Principal Types of Movable Dams. Seventh edition, 661
- Geography and Travel:**
- Bedford, A History of the County of. Part I.: Geology and Palæontology, 339
- Brown (Dr. R. N. Rudmose), O. J. R. Howarth, and J. Macfarlane, The Scope of School Geography, 245
- Brunhes (J.) et C. Vallaux, La Géographie de l'histoire: Géographie de la paix et de la guerre sur terre et sur mer, 175
- Buchanan (A.), Exploration of Air: Out of the World North of Nigeria, 35
- Bury (Col. C. K. Howard), and others, Mount Everest: The Reconnaissance, 1921, 139
- Campbell (D.), In the Heart of Bantuland, 246
- Cisaf (J.) and F. Pokorný, The Czechoslovak Republic, 839
- Fleure (Prof. H. J.), The Peoples of Europe, 768
- Francé (Dr. R. H.), Süd-Bayern, 246
- Gordon (Seton), Amid Snowy Wastes: Wild Life on the Spitsbergen Archipelago, 597
- Howarth (O. J. R.), The World About Us: A Study in Geographical Environment, 376
- Munster. Edited by G. Fletcher, 339
- Newbiggin (Dr. Marion I.), Frequent Ways: A General Survey of the Land Forms, Climates, and Vegetation of Western Europe, considered in their Relation to the Life of Man; including a Detailed Study of some Typical Regions, 599
- Rouch (J.), Le Pôle Sud: Histoire des voyages antarctiques, 540
- Schweitzer (Prof. A.), Translated by C. T. Campion, On the Edge of the Primeval Forest: Experiences and Observations of a Doctor in Equatorial Africa, 308
- Scott (J. W. R.), The Foundations of Japan: Notes

made during Journeys of 6000 Miles in the Rural Districts as a Basis for a Sounder Knowledge of the Japanese People, 538
 Smith (Sir Ross), 14,000 Miles through the Air, 631
 Statesman's Year-Book, The, Statistical and Historical Annual of the States of the World for the year 1922. Edited by Sir John Scott Keltie and Dr. M. Epstein, 75
 Sweden, A Book about, 631
 Turner (S.), The Conquest of the New Zealand Alps, 872
 Ulster. Edited by G. Fletcher, 339
 Varley (T.), Hampshire, 339
 Volonakis (Dr. M. D.), The Island of Roses and her Eleven Sisters: or, the Dodecanese from the Earliest Time down to the Present Day, 146

Geology and Mineralogy :

Beck (Prof. R.), bearbeitet durch Dr. G. Berg, Abriss der Lehre von den Erzlagernstätten: In Anlehnung an die dritte Auflage des Lehrbuches und unter Benützung hinterlassener Aufzeichnungen, 205
 Chautard (J.), Bibliothèque de géologie et de minéralogie appliquées: Les Gisements de pétrole, 474
 Cole (Prof. G. A. J.), Rocks and their Origins. Second edition, 768
 Crabtree (J. H.), Rocks and Fossils and How to Identify Them, 74
 Cronshaw (Dr. H. B.), Oil Shales, 307
 Dana (Prof. E. S.), Third edition, revised and enlarged by Prof. W. E. Ford. A Text-book of Mineralogy: With an extended Treatise on Crystallography and Physical Mineralogy, 210
 Deecke (Prof. W.), Phytopaläontologie und Geologie, 375
 Emmons (Prof. W. H.), General Economic Geology: A Text-book, 210
 Grabau (Prof. A. W.), A Text-book of Geology, 2 parts, 143
 Gregory (Prof. J. W.), Evolution of the Essex Rivers and of the Lower Thames, 308
 Hayes (Dr. C. W.), Handbook for Field Geologists. Third edition, 412
 Hobbs (Prof. W. H.), Earth Evolution and its Facial Expression, 270
 Johnstone (S. J.), Potash. New edition, 307
 Jones (Dr. O. T.), Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. 20: Lead and Zinc. The Mining District of North Cardiganshire and West Montgomeryshire, 476
 Lang (Dr. W. D.), Catalogue of the Fossil Bryozoa (Polyzoa) in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa (Polyzoa). Vol. 4: The Cribrimorphs. Part 2, 445
 Leith (C. K.), The Economic Aspects of Geology, 143
 Martel (E.-A.), Nouveau Traité des eaux souterraines, 242
 Milner (H. B.), An Introduction to Sedimentary Petrography: with special reference to loose Detrital Deposits and their Correlation by Petrographic Methods, 804
 Mitzakis (M.), The Oil Encyclopedia, 474
 Moon (F. W.), and H. Sadek, Topography and Geology of Northern Sinai, 175
 Peel (R.), Twentieth edition, revised and enlarged by Prof. D. Burns, An Elementary Text-book of Coal-Mining, 628
 Penzer (N. M.), The Mineral Resources of Burma, 74; The Tin Resources of the British Empire, 5
 Pogue (J. E.), The Economics of Petroleum, 474
 Quennell (M. and C. H. B.), Everyday Life in the Old Stone Age, 443
 Reed (Dr. F. R. C.), The Geology of the British Empire, 5
 Reeves (J.), The World-Story of 3,000,000,000 (?) years, 443
 Rogers (Dr. A. W.), The Geology of the Country around Heidelberg and Geological Map of the Country around Heidelberg, 662
 Underhill (Dr. J.), Mineral Land Surveying. Third edition, 541
 Wegener (Dr. A.), Die Entstehung der Kontinente und Ozeane. Dritte Auflage, 798

Whitaker (W.), The Water Supply of Cambridgeshire, Huntingdonshire, and Rutland from Underground Sources, 7
 Wilson (G. V.), and others, Special Reports on the Mineral Resources of Great Britain. Vol. 2: Barytes and Witherite. Third edition, 211
 Wray (D. A.), The Geology and Mineral Resources of the Serb-Croat-Slovene State: Being the Report of the Geologist attached to the British Economic Mission to Serbia, 33

Mathematical and Physical Science :

Barnard (Prof. R. J. A.), Elementary Statics of Two and Three Dimensions, 243
 Barus (Prof. C.), Displacement Interferometry applied to Acoustics and to Gravitation, 7
 Biologischen Arbeitsmethoden, Handbuch der, herausgegeben von Prof. E. Abderhalden. Lief. 55. Abt. V. Teil 6, Heft 3, 509
 Bisacre (F. F. P.), Applied Calculus: An Introductory Text-book, 411
 Bloch (Dr. L.), Le Principe de la relativité et la théorie d'Einstein, 568
 Bosovich (R. J.), A Theory of Natural Philosophy. Latin-English edition. With a short Life of Bosovich, 870
 Bower (W. R.) and Prof. J. Satterly, Practical Physics. Eighth impression (second edition), 445
 Campbell (Dr. N. R.), Modern Electrical Theory. Supplementary Chapters. Chapter XV.: Series Spectra, 767
 Capstick (Dr. J. W.), Sound: An Elementary Text-book for Schools and Colleges. Second edition, 510
 Chadwick (Dr. J.), Radioactivity and Radioactive Substances, 412
 Chauveau (B.), Électricité atmosphérique. Premier fasc.: Introduction historique, 406
 Cisotti (Prof. U.), Idromeccanica Piana. Parte Prima and Parte Seconda, 243
 Clapham (C. B.), Metric System for Engineers, 340
 Cochran (J. A.), Readable School Physics, 340
 Comstock (Prof. G. C.), Observations of Double Stars, 1907-1919, 7
 Crowther (Dr. J. A.), Ions, Electrons, and Ionising Radiations. Third edition, 340
 Dakin (A.), Practical Mathematics. Part I., 375
 Davidge (H. T.) and R. W. Hutchinson, Technical Electricity. Fourth edition, 840
 Doublet (E.), Histoire de l'astronomie, 600
 Dunk (J. L.), Hyperacoustics. Division II.: Successive Tonality, 411
 Eddington (Prof. A. S.), Ouvrage traduit de l'anglais par J. Rossignol, Espace, Temps et Gravitation: la théorie de la relativité généralisée dans ses grandes lignes, 410; The Romanes Lecture, 1922. The Theory of Relativity and its Influence on Scientific Thought, 568
 Einstein (Prof. A.) and Prof. H. Minkowski. Translated by M. N. Saha and S. N. Bose, The Principle of Relativity, 275
 Fowler (Prof. A.), The Physical Society of London. Report on Series in Line Spectra, 690
 Günther (H.), (W. de Haas), Technische Träume, 663
 Haag (Prof. J.), Cours complet de mathématiques spéciales. Tome 2, Géométrie, 375
 Hale (Prof. G. E.), The New Heavens, 2
 Hicks (Prof. W. M.), A Treatise on the Analysis of Spectra: Based on an Essay to which the Adams Prize was awarded in 1921, 690
 Humbert (Prof. P.), Introduction à l'étude des fonctions elliptiques à l'usage des étudiants des facultés des sciences, 308
 Janet (Prof. P.), Problèmes et exercices d'électricité générale, 147
 Laplace (Pierre-Simon), Essai philosophique sur les probabilités, I., II., 6
 London Mathematical Society, Proceedings of the, Second Series. Vol. 20, 570
 Love (Prof. A. E. H.), Theoretical Mechanics: An

- Introductory Treatise on the Principles of Dynamics, with Applications and Numerous Examples. Third edition, 243
- Malet (H.), Étude géométrique des transformations birationnelles et des courbes planes, 276
- Mallik (Prof. D. N.), The Elements of Astronomy, 731
- McClean (Capt. W. N.), Land and Sea Speed Reckoner, 308
- Mills (J.), Within the Atom: A Popular View of Electrons and Quanta, 246
- Moreux (l'Abbé Th.), Origine et formation des mondes, 660; Pour comprendre Einstein, 568
- Mulder (Prof. M. E.), The "Green Ray" or "Green Flash" (Rayon Vert) at Rising and Setting of the Sun, 370
- Occhialini (A.), Elettrotecnica elementare con numerosi problemi. Vol. I, 474
- Ollivier (Prof. H.), Cours de physique générale à l'usage des candidats au certificat de Physique générale, au diplôme d'Ingénieur-Électricien et à l'Agrégation des Sciences physiques. Tome Second: Thermodynamique et étude de l'énergie rayonnante. Deuxième édition, 405
- Page (Prof. L.), An Introduction to Electrodynamics: From the Standpoint of the Electron Theory, 509
- du Pasquier (Prof. L.-G.), Le Principe de la relativité et les théories d'Einstein, 568
- Physics, Applied, A Dictionary of. Edited by Sir Richard Glazebrook (In 5 Volumes). Vol. I.: Mechanics, Engineering, Heat, 439; Vol. II.: Electricity, 595
- Planck (Prof. Max), Einführung in die Theorie der Elektrizität und des Magnetismus. Zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht, 474; Vorlesungen über Thermodynamik. Sechste Auflage, 207
- Poirée (J.), Précis d'arithmétique, 445
- Raman (Prof. C. V.), Molecular Diffraction of Light, 505
- Rohr (Dr. M. von), Rendered into English by Dr. A. H. Levy, Eyes and Spectacles, 376
- Rouch (Prof. J.), Manuel d'océanographie physique, 840
- Rougier (Prof. L.), Translated by Prof. M. Masius, Philosophy and the New Physics: An Essay on the Relativity Theory and the Theory of Quanta, 568
- Strasser (Prof. H.), Die Grundlagen der einstein'schen Relativitätstheorie: Eine kritische Untersuchung, 568
- Tweedie (C.), James Stirling: A Sketch of his Life and Works, along with his Scientific Correspondence, 111
- Wolfe (W. S.), Graphical Analysis: A Text-book on Graphic Statics, 412
- Medical Science:**
- Blanchard (Dr. Phyllis), The Care of the Adolescent Girl: a Book for Teachers, Parents, and Guardians, 411
- Colwell (Dr. H. A.), An Essay on the History of Electrotherapy and Diagnosis, 32
- Crowther (Dr. J. A.), The Principles of Radiography, 35
- Cummer (Prof. C. L.), A Manual of Clinical Laboratory Methods, 731
- Donders (F. C.), Reden gehalten bei der Enthüllung seines Denkmals in Utrecht, am 22. Juni 1921. Von Prof. C. A. Pekkelharing, Dr. Sikkel, Dr. A. F. Baron van Lijnden, Dr. J. P. Fockema Andreae, aus dem Holländischen übersetzt von Paula Kraiss geb. Engelmann, 147
- Fletcher (C.) and H. McLean, The Link between the Practitioner and the Laboratory: a Guide to the Practitioner in his Relations with the Pathological Laboratory, 376
- Forsyth (Dr. D.), The Technique of Psycho-analysis, 246
- Haldane (Dr. J. S.), Respiration, 803
- Handley (Prof. W. S.), Cancer of the Breast and its Treatment. Second edition, 376
- Harrow (Dr. B.), Glands in Health and Disease, 658
- Influenza: Essays by several authors. Edited by Dr. F. G. Crookshank, 30
- Keynes (Dr. G.), Blood Transfusion, 871
- Little (E. M.), Artificial Limbs and Amputation Stumps: a Practical Handbook, 805
- MacLeod (Prof. J. J. R.), assisted by R. G. Pearce, A. C. Redfield, and N. B. Taylor. Fourth edition: Physiology and Biochemistry in Modern Medicine, 872
- Mann (Dr. J. D.), Sixth edition, revised by Dr. W. A. Brend, Forensic Medicine and Toxicology, 571
- Martin (Prof. A. S.) and Dr. C. V. Weller, The Medical Aspects of Mustard Gas Poisoning, 32
- Mitchell (Dr. T. W.), The Psychology of Medicine, 412
- Parsons (A. C.), Dr. A. S. MacNalty, and J. R. Perdrau, Report on Encephalitis lethargica, 626
- Pope (Amy E.), Pope's Manual of Nursing Procedure, 445
- Singer (Dr. C.), Greek Biology and Greek Medicine, 631; The Discovery of the Circulation of the Blood, 602
- Smith (H. M.), Gaseous Exchange and Physiological Requirements for Level and Grade Walking, 728
- Vincent (Prof. Swale), Internal Secretion and the Ductless Glands. Second edition, 658
- War, History of the Great, based on Official Documents. Medical Services: Diseases of the War. Vol. I. Edited by Maj.-Gen. Sir W. G. MacPherson and others, 729
- Wolbach (Prof. S. B.), New Growths and Cancer, 766
- Metallurgy:**
- Aitchison (Dr. L.), Engineering Steels, 537
- Austin (L. S.), The Metallurgy of the Common Metals: Gold, Silver, Iron (and Steel), Copper, Lead, and Zinc. Fifth edition, 71
- Brearily (H.), The Case-hardening of Steel: an Illustrated Exposition of the Changes in Structure and Properties induced in Steels by Cementation and Allied Processes. Second edition, 537
- Cronshaw (Dr. H. B.), Imperial Institute: Monographs on Mineral Resources with Special Reference to the British Empire: Silver Ores, 477
- Hughes (W. E.), On the Electro-deposition of Iron, 445
- Iron and Steel, The Metallurgy of, based mainly on the Work and Papers of Sir Robert A. Hadfield, 507
- Urquhart (J. W.), Steel Thermal Treatment, 837
- Whiteley (B.), Iron-founding, 537
- Meteorology:**
- Richardson (L. F.), Weather Prediction by Numerical Process: Forms whereon to write the Numerical Calculations described in "Weather Prediction by Numerical Process," 762
- Shaw (Sir Napier), Air Ministry: Meteorological Office. The Weather Map. An Introduction to Modern Meteorology. Fifth issue (Reprint of fourth), 768
- Miscellaneous:**
- Annual Register, The, A Review of Public Events at Home and Abroad for the Year 1921, 75
- Barber (Prof. F. D.) and others, First Course in General Science, 406
- Beck (C.), The Microscope: a Simple Handbook, 147
- Bell (Dr. L.), The Telescope, 627
- British Labour: Replacement and Conciliation, 1914-21: being the Result of Conferences and Investigations by Committees of Section F of the British Association. Part 1, on Replacement, Co-ordinated and Revised by Miss L. Grier and Miss A. Ashley; Part 2, on Conciliation, Edited by A. W. Kirkaldy, 145
- British Museum (Natural History), Catalogue of the Books, Manuscripts, Maps, and Drawings in the. Vol. 6, Supplement: A-I, 540
- Campbell (Dr. Norman), What is Science? 728
- Caulery (Prof. M.), Translated by J. H. Woods and E. Russell, Universities and Scientific Life in the United States, 72
- Contemporary Science, Edited, with an Introduction, by W. B. Harrow, 111

Eikenberry (Prof. W. L.), The Teaching of General Science, 731
 Foster (Sir Gregory), The University of London (History, Present Resources and Future Possibilities), 240
 Frederick (Mrs. C.), Scientific Management in the Home : Household Engineering, 177
 Garnett (Dr. W.), A Little Book on Water Supply, 275
 Gordon (Mary), Penal Discipline, 692
 Homework and Hobby Horses, Edited by H. C. Cook, 211
 Howarth (O. J. R.), The British Association for the Advancement of Science : a Retrospect, 1831-1921, 392
 Hull and the East Riding of Yorkshire, Handbook to, prepared for the Members of the British Association for the Advancement of Science on the Occasion of their Visit to Hull in September 1922, Edited by T. Sheppard, 539
 Hurry (Dr. J. B.), Poverty and its Vicious Circles. Second edition, 177
 Inge (Dr. W. R.), The Victorian Age : The Rede Lecture for 1922, 104
 Lethaby (W. R.), G. L. Pepler, Sir T. G. Chambers, R. Unwin, and R. L. Reiss, Edited, with an Introduction, by C. B. Purdom, Town Theory and Practice, 307
 MacNaughten (H.), Émile Coué : The Man and his Work, 376
 Manchester University Roll of Service, 111
 Modern Science, Problems of, Edited by Prof. A. Dendy, 409
 Picard (É.), Discours et mélanges, 629
 Redgrove (H. S.) and I. M. L. Redgrove, Joseph Glanvill and Psychological Research in the Seventeenth Century, 36
 Rhodes (R. C.), The Stagery of Shakespeare, 36
 Roper (R. E.), The Individual and the Community, 340
 Science, The Advancement of, 1922. Addresses delivered at the 90th Annual Meeting of the British Association for the Advancement of Science, Hull, September 1922, 507
 Shafer (R.), Progress and Science : Essays in Criticism, 662
 Van Buskirk (E. F.) and E. L. Smith, The Science of Everyday Life, 406
 Walker (J. E.) and R. B. Foster, Patents for Inventions, 663
 Wells (H. G.), A Short History of the World, 867
 White (E. G.), The Voice Beautiful in Speech and Song : a Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. Third edition, 871

Philosophy and Psychology :

Aristotle, The Works of, translated into English. De Caelo, by J. L. Stocks ; De Generatione et Corruptione, by Prof. H. H. Joachim, 174
 Bergson (Prof. H.), Durée et simultanéité : A propos de la théorie d'Einstein, 503
 Brierley (S. S.), An Introduction to Psychology, 872
 Brooks (H. Jamyn), Universal Problems, 804
 Brunschvicg (Prof. L.), L'Expérience humaine et la causalité physique, 471
 Cabot (Ella L.), Seven Ages of Childhood, 872
 Edman (Dr. I.), Human Traits and their Social Significance, 146
 Firth (Violet M.), The Machinery of the Mind, 146
 Giddings (Prof. F. H.), Studies in the Theory of Human Society, 571
 Goddard (H. H.), Juvenile Delinquency, 477
 Haldane (Viscount), The Philosophy of Humanism and of other Subjects, 471
 Jackson (Dr. Josephine A.) and Helen M. Salisbury, Outwitting our Nerves : A Primer of Psychotherapy, 477
 Kennedy (B.), Thought-Coin, 147
 Kidd (B.), A Philosopher with Nature, 836
 Lange (C. G.) and W. James, The Emotions, 730
 McCall (Prof. W. A.), How to Measure in Education, 601

McTaggart (Dr. J. McT. E.), Studies in the Hegelian Dialectic, 208
 Micklem (E. R.), Miracles and the New Psychology : A Study in the Healing Miracles of the New Testament, 630
 Moore (Prof. G. E.), Principia Ethica, 74
 Nys (Prof. D.), La Notion d'espace, 471
 Ogden (C. K.), I. A. Richards, and J. Wood, The Foundations of Aesthetics, 375
 Prescott (F. C.), The Poetic Mind, 443
 Reyburn (Prof. H. A.), The Ethical Theory of Hegel : A Study of the Philosophy of Right, 70
 Rosny, aîné (J.-H.), Les Sciences et le pluralisme, 541
 Sellars (Prof. R. W.), Evolutionary Naturalism, 631
 Shann (G.), The Evolution of Knowledge, 471
 Shuttleworth (Dr. G. E.) and Dr. W. A. Potts, Mentally Deficient Children : Their Treatment and Training. Fifth edition, 663
 Stekel (Dr. W.), Translated by Rosalie Gabler, The Beloved Ego : Foundations of the New Study of the Psyche, 805
 Stephen (K.), The Misuse of Mind : A Study of Bergson's Attack on Intellectualism, 541
 Tilby (A. W.), The Evolution of Consciousness, 147
 Walston (Waldstein) (Sir Charles), Harmonism and Conscious Evolution, 443
 Warren (Prof. H. C.), A History of the Association Psychology, 75

Technology :

Barker (Prof. A. F.) and others, Textiles. Revised edition, 272
 Deerr (N.), Cane Sugar : A Text-book on the Agriculture of the Sugar Cane. The Manufacture of Cane Sugar, and the Analysis of Sugar-house Products. Second edition, 4
 Dibble (S. E.), Plumbers' Handbook, 602
 Gaschet (H.), Manuel de tournage du bois, 510
 Jones (Ll.) and F. I. Scard, The Manufacture of Cane Sugar. Second edition, 4
 King (W.), Chelsea Porcelain, 871
 Murke (Dr. F.), Condensed Description of the Manufacture of Beet Sugar, 4
 Taggart (W. Scott), Cotton Spinning. Vol. II. Sixth edition, with Appendix, 75
 Watson (W.), Textile Design and Colour : Elementary Weaves and Figured Fabrics. Second edition, 74

Revista : de Ciencias, 363 ; *Mensal de Meteorologia*, No. 1, 52

Rhinanthine and Aucubine, M. Bridel and Mlle. Marie Braecke, 655
Rhinanthus Crista-Galli, Seeds of, Presence of Aucubine and of Saccharose in the, M. Bridel and Mlle. Marie Braecke, 623
Rhinosporidium seeberi, with Special Reference to its Sporulation and Affinities, Prof. J. H. Ashworth, 723
 Rhodes Trust, Annual Report for 1921-22, 860
 Rice, Fungal Diseases of, 823
 Richardson Gyro-magnetic Effect, The, Prof. A. P. Chattock and L. F. Bates, 721
 Rickets : The Cause of, Dr. L. Findlay ; Dr. Chick, and others, 137 ; Sir W. M. Bayliss ; The Writer of the Article, 212 ; The Etiology of, Dr. L. Findlay and Prof. Mellanby, 294
 Riemann, The Law of, the Perihelion of Mercury, and the Deviation of Light, G. Bertrand, 167
 River Discharge Measurements, Improved, E. B. H. Wade, 495
 Roche's Limit for Satellites, Dr. E. O. Fountain, 89 ; Prof. J. Joly, 179
 Rock : Carvings and Inscribed Symbols of the Neolithic and Bronze Ages, Prof. R. A. S. Macalister, 852 ; -desert, A, 175 ; -formation, Processes of, J. H. Goodchild, 589
 Rockall, The Structure of, Prof. J. B. Charcot, 90
 Rockefeller Foundation, Report of the, for 1921, 52

- Rocks : and Fossils and how to Identify them, J. H. Crabtree, 74 ; and their Origins, Prof. G. A. J. Cole. Second edition, 768
- Rocky Mountain Oil-field, The, W. T. Thorn, jr., 714
- Roman : Antiquities, Some, A. M. Woodward ; C. D. Chambers, 748 ; Balance in South America, The, Baron E. Nordenskiöld, 526 ; Remains in London, W. C. Edwards, 556
- Romanes Lecture, Prof. Eddington's, E. Cunningham, 568
- Root Respiration, 58
- Roots : of Crop Plants, Development and Activities of, Prof. J. E. Weaver, F. C. Jean, and J. W. Crist, 887 ; The Respiration of the, J. Stoklasa, 831
- Roses, The Island of, and her Eleven Sisters : or, The Dodecanese from the Earliest Time down to the Present Day, Dr. M. D. Volonakis, 146
- Rowett Institute of Research in Animal Nutrition, opened by the Queen, 393, 464
- Royal : Aeronautical Society, Prof. L. Baird elected Chairman of the, 50 ; Botanic Garden, Calcutta, Annals of the, Vol. 12, Parts 2 and 3, Dr. O. Beccari, 372 ; Gardens, The, Kew, 423 ; Society, *Quarterly Summary* of the, 746 ; Society's Gardens, The, 185 ; College of Science, Dublin, The Position and Prospects of the, 610, 814 ; Dutch Institute of Engineers, Sir Charles Parsons, Dr. J. H. Tudsbury, and C. le Maistre elected Honorary Members of the, 188 ; Institute of British Architects, Award of Dawnay Scholarships, 233 ; Institution, Sir Arthur Keith elected Secretary of the ; Profs. Urbain, Ehrenfest, Knudsen and Bjerknes, and Dr. I. Langmuir elected Honorary Members of the, 784 ; Observatory, The, Greenwich, 356 ; Photographic Society's Exhibition, The, 498 ; Sanitary Institute, The Congress of the, 232 ; Scholarships and Free Studentships, 1922, Successful Candidates in the Open Competition for, 621 ; Scottish Geographical Society, The Gold Medal of the, awarded to Prof. J. W. Gregory, 675 ; Scottish Museum, Edinburgh, E. L. Gill appointed an Assistant at the, 427 ; Society, Anniversary Dinner, 781 ; Anniversary Meeting, Presentation of Medals, 787 ; Conversazione, The Second, 23 ; Council, Members recommended for Election to the, 641 ; Medals, Award of the, 674 ; Reports of the Grain Pests (War) Committee, Nos. 1 to 10, 145 ; for the Protection of Birds, Bequest to the, by W. H. Hudson, 711 ; of Arts, Albert Medal of the, presented to Sir Dugald Clerk, 50 ; of Edinburgh, James Scott Prize of the, presented to Prof. A. N. Whitehead, 50 ; Prize Awards of the, to Prof. R. A. Sampson and Sir E. Sharpey Schafer, 19
- Rubber : and Tyre Manufacturers, The Research Association of British, 297 ; Chemistry and Technology, Recent Progress in, Dr. P. Schidrowitz, 726
- Rudbeckia and Aquilegia, Prof. T. D. A. Cockerell, 278
- Rugose Corals from the Burindi Series (Lower Carboniferous) of N.S.W., W. N. Benson and D. Smith, 62
- Rural : Community, The, L. MacGarr, 412 ; Organization, Prof. W. Burr, 404 ; Schools, Home Economics in, 755
- Russia : Medical Men in, Appeal for Help for, 883 ; The Needs of Engineers in, 818
- Russian : Men of Science, Relief for Distressed, 492 ; Names, Transcription of, Maj.-Gen. Lord Edward Gleichen, 78, 635 ; C. A. Hoare, 279 ; J. G. F. Druce and A. Glazunov, 512 ; J. H. Reynolds, 635 ; Universities, Life To-day in, H. Gibson, 755
- Saccharose, The Tritoluminescence Spectrum of, H. Longchambon, 136
- Saccocirrus and Protodrilus, On the Occurrence of the Archannelids, on the South and West Coasts of England, Dr. J. H. Orton, 574
- Sachs-Georgi and the Wassermann Reactions, The Serum Constituents responsible for the, T. J. Mackie, 832
- Safeguarding of Industries Act, The, 818
- Sahara, Danish Expedition to the, led by Prof. Olufsen, 643
- Salters' Institute of Industrial Chemistry, Award of Fellowships of the, 368
- Sand : The Apparent Swelling of, on the Addition of Water, L. E. Norton, 63 ; -blasted and Ground Glass Surfaces, Comparison of the Structure of, F. W. Preston, 591
- Sanitation, General and Specific, 169
- Satellites and Minor Planets, The Orbital Distances of, Prof. G. Armellini, 260
- Saw-flies, Pairing and Parthenogenesis in, A. D. Peacock, 215
- Scabious, An unusual, N. L. Silvester, 188
- Scandinavia : Temperature in, The Distribution of, H. E. Hamberg, 557 ; The Ethnology of, Prof. H. F. Osborn, 190
- Science Abstracts*, W. R. Cooper appointed Editor of, 493
- Science : and Education at South Kensington, T. Ll. Humberstone, 79 ; and Progress, 662 ; and Research, A National Focus of, Dr. G. E. Hale, 676 ; and the Empire, 797 ; Major A. G. Church, 876 ; Editor, 877 ; and the Laity, The Need of an Interpreter between, Prof. A. L. Bowley, 320 ; and the Scriptures, Dr. W. W. Keen, 726 ; British, Ninety Years of, 302 ; Contemporary, Edited, with an Introduction, by W. B. Harrow, 111 ; Educational and School, Sir Richard Gregory, 355, 420 ; General, A First Book of, An Introduction to the Scientific Study of Animal and Plant Life, A. T. Simmons and A. J. V. Gale, 406 ; First Course in, Prof. F. D. Barber and others, 406 ; The Teaching of, Prof. W. L. Eikenberry, 731 ; in Egypt, Col. H. G. Lyons, 283 ; in Schools and Colleges, The Teaching of, Sir William Tilden and others, 754 ; Modern, Problems of, Edited by Prof. A. Dendy, 409 ; of Everyday Life, The, E. F. Van Buskirk and E. L. Smith, 406 ; Primers, C. L. Bryant, 406 ; The Advancement of, 1922, 507 ; The Influence of, Sir G. Greenhill, 78 ; Rev. A. L. Cortie, 180, 378 ; Sir Oliver Lodge, 277 ; The Nature of, 728 ; The Philosophy of, or the Principles of Scientific Procedure, Sir Oliver Lodge, 887 ; What is ? Dr. Norman Campbell, 728
- Scientia*, an Inquiry in, into the Einstein Theories, 885
- Scientific : Advance, Thoughts on, 409 ; and Industrial Pioneers, Eng.-Capt. E. C. Smith, 846 ; Research, Some Aspects of, Prof. R. F. Ruttan, 130 ; Instruments, Historical, Exhibition of, at Oxford, 783 ; Management in the Home : Household Engineering, Mrs. C. Frederick, 177 ; Problems and Progress, 352 ; Societies, The Need for Co-operation between, the late Dr. W. H. R. Rivers, 493
- Scorpions and their Venom, Major C. E. F. Mouat-Biggs, 250
- Scottish : Breeding Duck, Some, Their Arrival and Dispersal, Evelyn V. Baxter and Leonora J. Rintoul, 476 ; People, The Stature of the, Sir Arthur Keith, 8
- Sea : -bottom, The Fauna of the, Dr. C. G. J. Petersen, 527 ; Life in the, The Progression of, Dr. E. J. Allen, 353, 448
- Seal Cylinders, The Oldest-dated, L. Legrain, 462
- Seashore, The Biology of the, F. W. Flattely and C. L. Walton, 540
- Secondary Schools : Geography in, 466 ; Home Economics in, Reorganization of, 755
- Secretaries, The Duties of, P. L. Marks, 51
- Seeds, The Catalase of, J. de Vilmorin and Cazaubon, 200
- Selacians, The Sphincter of the Iris in the, L. Carrere, 468
- Selborne Society, Cinematograph Lectures of the, 884
- Selective Coloration of the Nervous System in some Invertebrates, A Method of, M. Romieu, 532
- Selenium, The Isotopes of, and some other Elements, Dr. F. W. Aston, 664
- Semi-Diesel Engine, The, A. Schubert, 191
- Sensitisers for the Extreme Red, Drs. C. E. K. Mees and G. Gutekunst, 366
- Sentiments and Complexes, The Relations between, the late Dr. Rivers and others, 231
- Serb-Croat-Slovene State, The Geology and Mineral Resources of the, D. A. Wray, 33
- "Seuil différentiel," The Idea of the, and Progressive Masculinisation of certain Female Birds, A. Pézard, 299
- Sewerage and Sewage Disposal : A Text-book, L. Metcalf and H. P. Eddy, 510

- Sex : Change in Mollusca, Prof. J. Brontë Gatenby, 544 ; Economics, Mrs. B. Wootton, 533
- Shakespeare, The Staging of, R. C. Rhodes, 36
- Shear, Constants of a, The Graphical Construction of the, Prof. H. Hilton, 100
- Sheep, Poisoning of, by *Solanum cinereum*, S. Dodd, 592
- Sheffield : Scientific School, Yale University, Retirement of Dr. R. H. Chittenden as Director ; succeeded by Dr. C. H. Warren, 60 ; University, Conferment of Honorary Degrees, 60 ; Prof. A. H. Leahy appointed Emeritus Professor of Mathematics, R. Platt appointed Demonstrator in Pathology and Bacteriology, 562 ; R. Stoneley appointed Curator of the Observatory, 684
- Shipping Casualties and Loss of Life at Sea, Statistics of, J. W. Verdier, 51
- Sidereal System, The Arrangement and Motion of the, Prof. Kapteyn, 163
- Sierra Leone, The Geology of, F. Dixey, 757
- Silicates and the Silicic Acids, The Magnetic Analysis of, P. Pascal, 758
- Silicosis of the Lungs, Experimental, A. Mavrogordato, 366
- Silk, Acetate, Colouring Matters for Dyeing, Prof. A. G. Green, 743
- Silver : Bromide-Gelatin Plates, The Desensitising of, Dr. T. Slater Price, 849 ; Ores, Dr. H. B. Cronshaw, 477 ; -plated Work, The Cause of Red Stains on, A. Jefferson, 531
- Silviculture, The Practice of, with Particular Reference to its Application in the United States, Prof. R. C. Hawley, 407
- Sinai, Northern, Topography and Geology of, Part 6, F. W. Moon and H. Sadek, 175
- Singing Flame, The Theory of the, E. G. Richardson, 829
- Sirius, The Orbit of, C. P. Howard, 461
- Sison Ammi*, Linn., The Identification of, T. A. Sprague, 27
- Size, The Inheritance of, 463
- Skjellerup's Comet, Mr. Davidson, 89 ; G. Merton, 160 ; 1922*b*, Dr. W. H. Steavenson, 20 ; Ephemeris of, 53 ; 1922*d*, Observations of the, A. Schaumasse, 295
- Smallpox and Vaccination, 725
- Smell : in Birds, Sense of, C. B. Williams, 149 ; Prof. A. Meek, 279 ; Dr. B. S. Neuhausen, 677 ; Lt.-Col. W. E. M'Kechnie, 784 ; The Organs and Sense of, and of Odorous Substances, Bibliography of, J. H. Kenneth, 427
- Smithsonian Institution, Exploration and Field-work of the, 1921, 677
- Smoke : Abatement Bill, The New, Prof. J. B. Cohen, 269 ; of Cities, The, Prof. A. E. Boycott, 413 ; Prof. J. B. Cohen, 414
- Smokeless : City, The, E. D. Simon and Marion Fitzgerald, 269 ; Methods in Glasgow Housing Schemes, W. B. Smith, 232
- Snowdonia, The Lavas of, H. Williams, 888
- Snowy Wastes, Amid, Wild Life on the Spitsbergen Archipelago, S. Gordon, 597
- Soaps and Proteins, Their Colloid Chemistry in Theory and Practice, Prof. M. H. Fischer and others, 70
- Social : Beetles in British Guiana, A Study of some, and of their Relations to the Ant-Plant Tachigalia, Prof. W. M. Wheeler, 95 ; Sciences, Correlation of the, J. S. Marvin and others, 682
- Sodammonium : The Action of, on Hexamethylene-tetramine, etc., M. Picon, 686 ; with Hydrocarbons, The Reactions furnished by, P. Lebeau and M. Picon, 299
- Soil : -acidity, Experiments on the Theory of, Prof. J. N. Mukherjee, 732 ; Arable, The Presence of Cobalt and Nickel in, G. Bertrand and Mokragatz, 235 ; The Bacterial and Protozoan Population of the, D. W. Cutler, L. M. Crump, and H. Sandon, 26 ; The Living, 206
- Solar : Atmospheric Changes, Dr. W. J. S. Lockyer ; A. M. Newbegin ; C. P. Butler, 20 ; Eclipse, The Total, of September 21, Dr. A. C. D. Crommelin, 389, 457 ; Radiation and its Changes, Dr. C. G. Abbot, F. E. Fowle, and L. B. Aldrich, 608 ; at Helwan Observatory, 790 ; Observations of, 1915-1921, H. Knox-Shaw, 790 ; Rotation, The Law of, Dr. Hahn, 428
- Solenoids, Skin Effect in, G. Breit, 668
- Solides en milieu liquide, La Séparation industrielle des, Prof. L. Fabre, 872
- Solifluxion, The Rôle of the Phenomena of, in the Model of the Region of Saulieu (Morvan), Mlle. F. Brepson, 686
- Solution, The Problem of, 470
- Sonometer, An Optical, Adam Hilger, Ltd., 464
- Sophocles, The Statue of, in the Lateran Museum, T. Reinach, 494
- Sound : Absolute Measurements of, Prof. A. G. Webster, 42 ; Amplifier, A New, L. Gaumont, 863 ; An Elementary Text-book for Schools and Colleges, Dr. J. W. Capstick. Second edition, 510 ; Standard Source of, The Production of a, Capt. E. T. Paris, 378
- South : Africa, Parasitology in, Dr. A. Porter ; Prof. H. B. Fantham, 90 ; Problems of Race and Nationality in, Dr. J. E. Duerden, 21 ; Some Protozoa found in Soils in, Prof. H. B. Fantham, 831 ; The Union of, Department of Mines and Industries : The Geology of the Country around Heidelberg : Geological Map of the Country around Heidelberg, Dr. A. W. Rogers, 662 ; African Geology, A Bibliography of, to the End of 1920, A. L. Hall, 677 ; Larval Trematodes and the Intermediary Hosts, F. G. Cawston, 832 ; America, The Early Metal Ages in, H. Balfour, 141 ; Australia, Ecology of, 365 ; Iron Ore in, R. L. Jack, 129 ; Plant Habits and Habitats in the Arid Portions of, W. A. Cannon, 365 ; -Eastern Agricultural College, Wye, R. M. Wilson appointed Principal of the, 134 ; Kensington, Science and Education at, T. Ll. Humberstone, 79 ; Wales and Monmouthshire, University College of, Dr. A. J. S. Pippard appointed Professor of Engineering at, 562 ; -west of England, University College of the, First Meeting of the Court of Governors of the, 684
- Southern Sudan, Secret Societies in the, 21
- Space : Division of, by Congruent Triangles and Tetrahedra, D. M. Y. Sommerville, 862 ; -time Geodesics, Prof. H. T. H. Piaggio, 699 ; Dr. A. A. Robb, 809
- Spain and Ireland, The Prehistoric Relations between, Dr. W. E. Scott, 228
- Spark Spectra in Water, L. and E. Bloch, 27
- Specialisation in Universities, 65
- Spectra : A Treatise on the Analysis of, based on an Essay to which the Adams Prize was awarded in 1921, Prof. W. M. Hicks, 690 ; on the Quantum-orbit Theory, Prof. W. M. Hicks, 292 ; Line, Report on Series in (The Physical Society of London), Prof. A. Fowler, 690 ; Selection in, An Exception to the Principle of, S. Datta, 39 ; The Study of, 690
- Spectrometer : A Direct-reading, Bellingham and Stanley, Ltd., 129 ; A Chemical, Adam Hilger, Ltd., 191
- Spectro-polarimeter, A New, Bellingham and Stanley, Ltd., 526
- Spectroscopic : Parallaxes for Type A, Adams and Joy ; J. Evershed, 584 ; Parallaxes of B Stars, D. L. Edwards, 886 ; Studies of Stellar Velocities, Dr. W. J. S. Lockyer, 95
- Spectrum : Lines of Neutral Helium derived Theoretically, Some, Dr. L. Silberstein, 247, 248 ; Prof. W. M. Hicks, 309 ; Unsymmetrical, Errors arising in the Measurement of, Prof. T. R. Merton and D. N. Harrison, 62 ; of Carbon Monoxide, The Mass of the Particles which give the, M. Duffieux, 268 ; of the Night Sky, Lord Rayleigh, 769
- Speed Reckoner, Land and Sea, Capt. W. N. McClean, 308
- Sphere : -gap Voltmeter, The, Dr. E. A. Owen, 615 ; Motion of a, in a Rotating Liquid, G. I. Taylor, 62
- Spirula, Live Specimens of, Dr. Johs. Schmidt, 788
- Spitsbergen : and its Wild Life, 597 ; Surveys in, R. A. Frazer, 786
- "Standards, Immured," The, in the House of Commons, 230
- St. Andrews University : Conferment of the Honorary Degree of LL.D. upon the Prince of Wales, 498 ; Dr. H. S. Allen appointed Professor of Natural Philosophy in, 653 ; Rudyard Kipling elected Rector of, 684
- Stannic Acids, Magnetic Analysis of the, P. Pascal, 863
- Star : A Bright New, 785 ; A very Massive, 53 ; Dr. J. S. Plaskett, 364

- Stars: Absolute Magnitudes of, Dr. H. D. Curtis, 395; Double, Observations of, 1907-1919, Prof. G. C. Comstock, 7; of the N type, Observations of, C. Nordmann and Le Morvan, 167; The Atmosphere of the, H. Deslandres and V. Burson, 268; The Radial Velocities of, 594; Dr. J. S. Plaskett and others, 95; of the Spectra of, The Rôle of Anomalous Dispersion in, M. Maggini, 723; Variable, 645; near M. 53, Dr. Baade, 364; Visual Binary, The Masses of, J. A. Miller and J. H. Pitman, 555
- State throw away the Keys? Shall the, 782
- Statesman's Year-Book, The, 1922, Edited by Sir John Scott Keltie and Dr. M. Epstein, 75
- Static Deflection, Logarithmic Decrement and First Semi-period of the Vacuum Gravitation Needle, Prof. C. Barus, 687
- Statics: Dynamics, and Hydrodynamics, Dr. S. Brodetsky, 243; Elementary, of Two and Three Dimensions, Prof. R. J. A. Barnard, 243
- Stearoptene, Preliminary Note on a New (probably a Phenol Ether) occurring in some Essential Oils of the Myrtaceæ, A. R. Penfold and F. R. Morrison, 300
- Steel: Bars, Mild, hardened by Extension, The Possibilities of the Commercial use of, M. Seigle, 623; The Principal Characteristics of Mild, previously broken by Traction, M. Seigle, 591; Oxygen in, The Estimation of, G. Chaudron and L. Blanc, 795; The Case-hardening of, an Illustrated Exposition of the Changes in Structure and Properties induced in Steels by Cementation and Allied Processes, H. Brearley. Second edition, 537; Thermal Treatment, J. W. Urquhart, 837
- Steels: Engineering, Dr. L. Aitchison, 537; the Ar 1 Change in, The Effect of Deformation on, J. H. Whiteley, 682; The Flow of, at a Low Red Heat, J. H. Dickenson, 776; under Stress, Electrical Resistivity of, Sin-iti Fukuta, 430
- Stellar: Distances, The Determination of, Dr. W. J. S. Lockyer, 219; Radiometers and Measurements of the Energy Distribution in the Spectra of 16 Stars, Tests of, Dr. W. W. Coblentz, 367; Radiation in the Infra-red, 367; Temperatures and Planetary Radiation, Dr. W. W. Coblentz, 886; Velocities, Spectroscopic Studies of, Dr. W. J. S. Lockyer, 95
- "Stereo-autograph," A New, M. Poivilliers, 723
- Sterility: Interspecific, Dr. W. Bateson, 76; Prof. R. R. Gates, 179, 447; Dr. J. W. H. Harrison, 312; Prof. J. P. Lotsy, 843; Species-crosses in, J. B. S. Haldane, 748
- Stirling, James, A Sketch of his Life and Works, along with his Scientific Correspondence, C. Tweedie, 111
- Stone on Buildings, The Preservation from Decay of, Prof. A. P. Laurie, 746
- Stonehenge: The Age of, E. H. Stone, 291; The Date of, Rear-Admiral B. T. Somerville, 429
- Storm Tracks, Anomalous, E. H. Bowie, 429
- Strasbourg University, Conferment of an Honorary Doctorate upon Sir James Frazer, 754
- Strathmore Meteorite, Structure and Composition of the, W. E. P. McLintock and F. R. Ennos, 99
- Stratosphere, The Geostrophic Approximation in the, L. F. Richardson, A. Wagner, and R. Dietzius, 27
- Street Lighting, H. T. Harrison and others, 888
- Submarine: A New Method for detecting the Presence of a, P. Sacerdote and P. Lambert, 299; Cable Telegraphy, Pioneer Work in, Sir Charles Bright, 195
- Süd-Bayern, Dr. R. H. Francé, 246
- Sugar: Beet, Condensed Description of the Manufacture of, Dr. F. Murke, 4; Cane, A Text-book on the Agriculture of the Sugar Cane: The Manufacture of Cane Sugar, and the Analysis of Sugar-house Products, N. Deerr. Second edition, 4; The Manufacture of, L. Jones and F. I. Scard. Second edition, 4; from Beet Molasses, Recovery of, C. Deguide and P. Baud, 22; Technology, Prof. A. R. Ling, 4
- Sulphate on Limestone in Urban Centres, The Spontaneous Formation of, A. Kling and D. Florentin, 831
- Sulphur: Dioxide in Cattle Foods after Fumigation, Presence of, H. A. Peacock, 894; Absorption Spectrum of, for the X-rays, A. Lindh, 200
- Sulphuric Acid Test for Fish Liver Oils, N. Evers and H. J. Foster, 894
- Summer Time, End of, 493
- Sun, Observations of the, made at the Lyons Observatory, J. Guillaume, 235
- Sunflower, Embryo of the, Comparative Resistance to Heat of the Growing Points of the, E. Gain, 64
- Sun's Activity, The, 1890-1920, Dr. W. J. S. Lockyer, 465
- Sunspot: in High Latitude, 428; Periodicity, The, Prof. T. J. J. See, 525
- Sunspots, Invisible, Dr. G. E. Hale, 395
- Superheated Steam, Effect of, on Non-ferrous Metals used in Locomotives, Sir Henry Fowler, 467
- Surface Tension and Cell-division, H. G. Cannon, 181
- Surveying Instruments, T. Cooke and Sons', List of, 324
- Sussex Iron Industry, Early History of the, R. Jenkins, 893
- Swanley Horticultural College, Dr. Katie Barratt appointed Principal of, 828
- Swastika: Symbol, Origin of the, H. K. Deb, 228; Gammadion, Fylfot, H. K. Deb, 365
- Sweden, A Book about, 631
- Switching: and Switchgear, H. E. Poole, 805; Equipment for Power Control, S. Q. Hayes, 373
- Switzerland, The Lake Dwellings of, Recent Investigations of, Prof. E. Pittard, 12
- Sydney University Eclipse Expedition, The Photographic Work of the, E. H. Booth, 896
- Sylvinit and its Components, The Comparative Action of, on the First Development of Plants, P. Lesage, 831
- Symbiosis, Studies in, Part ii., J. McLuckie, 500
- Symbolism as a Basis for Metaphysics, Bishop Temple, 231
- Syme, David, Research Prize of Melbourne University, H. G. Smith awarded the, 259
- Syntony, Colour Vision and, Prof. E. H. Barton, 357
- T Coronæ (1866), Nova, K. Lundmark, 493
- Tanning, Practical, Dr. A. Rogers. Partly based on the Third edition of "Practical Tanning," by L. A. Flemming, 840
- Tar Distillation, W. A. Walmsley, 130
- Tartaric Acid, The Neutralisation of, by Potash in presence of the Chlorides of the Alkaline Earths, L. J. Simon and L. Zivy, 655
- Technical: Education, J. Paley Yorke, 24; Lord Burnham, 25; Institutions and the Board of Education, 657
- Technische Träume, H. Günther (W. de Haas), 663
- Telegraphie und Telephonie, Die drahtlose, Dr. P. Lertes, 273
- Telephony: Long Distance, F. Gill, 718; Proposed Conference on, 745
- Telescope, The, Dr. L. Bell; Dr. J. Weir French, 627
- Telescopes *versus* Field Glasses, Dr. A. Sonnefeld, 292
- Tellurium, Amorphous, The Crystallisation of, A. Damiens, 63
- Temperature: in the Upper Air, Circumstances determining the Distribution of, under Conditions of High and Low Barometric Pressure, A. H. R. Goldie, 795; Rise in, of Living Plant Tissue when infected by Parasitic Fungus, Dr. I. B. Pole Evans and Mary Pole Evans, 480
- Temperatures: Recent Remarkable, R. C. Mossman, 126; Surface, in the North Sea and in German Lakes, 229
- Terrestrial Magnetism, A Rapid Method of determining the Elements of, A. Perot, 795
- Tetanic and Diphtheric Toxins administered by the Mouth, The Action of the, J. Dumas, D. Combiesco, and J. Baltiano, 724
- Tetramitus, Preliminary Note on, Martha Bunting, 687
- Textile: Design and Colour: Elementary Weaves and Figured Fabrics, W. Watson. Second edition, with an Appendix in Standard Yarns, Weaves, and Fabrics, 74; Fibres, A New, A. S. Moore, 679; Institute, Journal of the, 819; Technology, 272
- Textiles, Prof. A. F. Barker and others. Revised edition, 272
- Thermal: Basis of Gas Supply, The, Prof. J. W. Cobb, 671; Ionisation of Gaseous Elements at High Temperatures, A. A. Noyes and H. A. Wilson, 687
- Thermodynamics, The Presentation of, 207
- Thermodynamik, Vorlesungen über, Prof. Max Planck. Sechste Auflage, 207

- Thermographs and Hydrographs, Pastorelli and Rapkin's List of, 52
- Thermostats with Multiple Jackets, A. Tian, 27
- Thionic Epos, Rhapsodies culled from the, Prof. H. E. Armstrong, 130
- Thionyl Chloride, The Action of, on the α -acid Alcohols, E. E. Blaise and Mlle. Montagne, 64
- Thomas Slag, The Accessory Elements in, A. Demolon, 168
- Thorium-X, the Oxidising Properties of, Some Microbiological Consequences of, P. Lemay and L. Jaloustre, 863
- Thortveitite from Madagascar, The Composition and Chemical Characters of, C. Boulanger and G. Urbain, 27
- Thought-coin, B. Kennedy, 147
- Three Bodies, The Problem of, 290
- Thunderstorms: Formation of, E. V. Newnham, 129; Local or Heat, Prof. C. F. Brooks, 615
- Tibet: and Nepal, The Border Land of, 139; Chinese Expedition to, Prof. J. W. Gregory and C. J. Gregory, 719; Southern Discoveries in Former Times compared with my own Researches in 1906-1908, Dr. Sven Hedin. II. A List of Flowering Plants from Inner Asia, collected by Dr. Sven Hedin, determined by Various Authors, and compiled by Prof. C. H. Ostenfeld and Dr. O. Paulsen, 170
- Tidal Institute of the University of Liverpool, Third Annual Report of the, 323
- Timber: Home-grown, Exhibition demonstrating some of the Minor Uses of, 744; The Drying of, R. T. Patton, 332
- Timbers: Indian, A Manual of: an Account of the Growth, Distribution, and Uses of the Trees and Shrubs of India and Ceylon, with Descriptions of their Wood-structure, J. S. Gamble. Reprint, 276; Useful, A Guide to the Identification of our more: being a Manual for the Use of Students of Forestry, H. Stone, 276
- Tin: and Tungsten Ores, Treatment of, 647; Resources of the British Empire, The, N. M. Penzer, 5
- Tinctorial Chemistry and Histology, Dr. M. Nierenstein, 33
- Titration of Strong Liquids by Dilution and Use with Aliquot Parts, A Sliding Scale for the Convenient, C. H. D. Clark, 894
- Tobacco Plants, Relation of Transpiration to Dry Weight in, N. B. Mendiola, 679
- Toronto University, Prof. A. T. Delury appointed Dean of the Faculty of Arts of, 684
- Tournage du bois, Manuel de, H. Gaschet, 510
- Town Theory and Practice, W. R. Lethaby and others, 307
- Trackways, Moats, Mounds, Camps, and Sites, Early British, A. Watkins, 176
- Trails leading to Springs of Water, Indian Method of marking, 523
- Transformers and Alternating Current Machines, The Testing of, Dr. C. F. Smith, 805
- Transparency of Liquids and Colour of the Sea, Prof. C. V. Raman, 280
- Transparent Liquids, The Polarisation and Intensity of Light diffused by, J. Cabannes, 795
- Transport by Different Agencies, The Relative Cost of, 744
- Tropical: Africa, Wild Bush Tribes of, G. C. Claridge, 340; Cyclones in Southern Hemisphere, Dr. S. S. Visher, 647; Medicine, Discoveries in, Sir Ronald Ross, 38; Lt.-Col. A. Alcock, 114
- Tungsten, The Decomposition of, Drs. Wendt and Irion, 529
- Turbo-compressor for Aviation Motors, General Theory of the, Prof. A. Rateau, 63
- Turbulence: as exhibited by Anemometer Records, Smoke and Cloud Formation, A. E. M. Geddes and C. A. Clarke, 235; on a Large Scale, A Defant, 495
- "Turtle-Oreodon Layer," The, in S. Dakota, Prof. W. J. Sinclair, 128
- Typhoon, A Violent, at Swatow, 260
- Ulster, edited by G. Fletcher, 339
- Ultraviolet Rays, Absorption of the, by Naphthalene, V. Henri and P. Steiner, 468
- Unconscious, Is the, a Conception of Value in Psychology? G. C. Field, Dr. F. Aveling, and Prof. J. Laird, 231
- Underground Workrooms, 191
- Uniformity and Contingency, Prof. A. N. Whitehead, 756
- United States: Universities and Scientific Life in the, Prof. M. Caullery. Translated by J. H. Woods and E. Russell, 72; State Universities and State Colleges, Statistics for 1920-21 of, 98; Educational Legislation in, in 1919-20, 267; Secondary Education in the, 297; Chemical Foundation, The, 334; Administration of Schools in the Smaller Cities, 562
- Universal Problems, H. Jamyn Brooks, 804
- Universities: an International Congress of all, A Project for, 330; of Great Britain and Ireland, Proceedings of the Annual Conference, 860; Parliamentary Aid to, 1; Research in, The Development of, Principal Irvine, 131; Specialisation in, 65
- University: College: London, Bequest to, by Sir William S. Meyer, 754; of North Wales, Bangor, Dr. E. Greenly appointed Special Lecturer in Geology at the, 198; Education in London, 240; Representation in Parliament, 625; Teachers, Association of, Extension of Work of the, 793
- Upper: Air Research in the United States, W. R. Gregg, 397; Cloud Drift, Observations of, as an Aid to Research and to Weather Forecasting, C. K. M. Douglas, 235
- Uranus, The Brightness and Rotation of, C. Wirtz, 747
- Uranyl Nitrate, The Precipitation of, by Soda, P. Jolibois and R. Bossuet, 136
- Urease and Urea in Fungi, A. Goris and P. Costy, 623
- Ute Indians, The Music of the, Miss Frances Densmore, 646
- Vaccination: before Operation, P. and L. Bazy, 167; Smallpox and, 725
- Vaccine, An Unpublished Method of preparing, R. Zivy, 687
- Values, A Coincidence in, L. M. Stewart, 279
- Vanadium in Fused Salts, Quantitative Researches on the Line Spectrum of, A. de Gramont, 895
- Vapour Pressure of some Copper-zinc Alloys in the Solid State, L. Guillet and M. Ballay, 863
- Végétale, Physiologie, Précis de, Prof. L. Maquenne, 177
- Vegetation: in the North and East of France, The Limits of, A. Guillaume, 686; of High Asia, The, 170
- Venoms, Animal, 691
- Ventilation and Atmosphere in Factories and Workshops, Prof. L. Hill, 644
- Venus and Jupiter, Conjunction of, 260
- Verse, Physical Nature of, Prof. E. W. Scripture, 494
- Vertebrate Anatomy, Comparative, A Laboratory Manual for, L. H. Hyman, 571
- Vertebrates, The Development of, 275
- Vertébrés, Traité d'embryologie des, Prof. A. Brachet, 275
- Vesuvius, Activity of, 87
- Veterinary Anatomy in England in the 16th, 17th, and 18th Centuries, Maj.-General Sir Frederick Smith, 296
- Vibration Galvanometers with Asymmetric Moving Systems, R. Ll. Jones, 829
- Victoria: Contributions from the National Herbarium of, No. 2, S. R. Tovey and P. F. Morris, 332; The Dominion Astrophysical Observatory, 189; the Flora of, An Addition to, H. B. Williamson, 168; The Giant Trees of, J. D. Peirce, 830
- Victorian: Age, The: the Rede Lecture for 1922, Dr. W. R. Inge, 104; Fossils, New or Little-known, in the National Museum, Part xxvi., F. Chapman, 168
- Village: Communities, 371; The English: the Origin and Decay of its Community. An Anthropological Interpretation, H. Peake, 371
- Viper, Common, Capture of a Large Specimen of the, in Epping Forest, W. K. Ford, 461
- Virus Diseases: in Animals and Man, J. A. Arkwright, 622; in Plants, E. J. Butler, 622
- Visibility as a Sign of Coming Rain, W. H. Pick, 713
- Vision, A New Theory of, Dr. F. Schanz, 557
- Visual Images, Recurrent, Self Light, Fatigue, Inhibition, and, Prof. W. Peddie, 100
- Vitamin: A, Sources of, H. L. Jameson and others, 429; Problems, Prof. A. Harden, 14

- Vitamins: Prof. H. C. Sherman and S. L. Smith, 6; Prof. J. C. Drummond and others, 652; and the Choice of Food, Violet G. Plimmer and Prof. R. H. A. Plimmer, 336; Testing for, Drummond and Watson, 557
- Voice Beautiful in Speech and Song, The: a Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production, E. G. White. Third edition, 871
- Volcanic: Activity in Nigeria, A. A. Reading, 97; H. S. Cameron, 497; Shower in the N. Atlantic, Prof. G. A. J. Cole, 635
- Vulcanising Rubber in Solution, F. Boiry, 235
- Wake Forest College School of Medicine, Gift to, by J. A. Bostwick, 166
- Walking, Level and Grade, Gaseous Exchange and Physiological Requirements for, H. M. Smith, 728
- Walnut Trees, The Withering of Young, in 1922, M. Gard, 686
- War: History of the Great, based on Official Documents. Medical Services: Diseases of the War, vol. i., Edited by Maj.-General Sir W. G. MacPherson and others, 729; Museum, Fifth Annual Report of the Imperial, 523; Office Research Department, Dr. R. C. Farmer appointed Deputy Director of Explosives Research at the, 460
- Wasp, An Ancient, Prof. T. D. A. Cockerell, 313
- Wasserstoffionen-Konzentration, Die, ihre Bedeutung für die Biologie und die Methoden ihrer Messung, Prof. L. Michaelis, Zweite Auflage, Teil i., 305
- Watches and Chronometers, A New Balance for Compensating the Temperature Error of, P. Ditisheim, 830
- Water: -power in the British Empire. The Reports of the Water-power Committee of the Conjoint Board of Scientific Societies, 767; Snails and Liver Flukes, Dr. Monica Taylor, 701; R. Hedger Wallace, 845; -supply, A Little Book on, Dr. W. Garnett, 275; in Central Australia, O. H. T. Rishbeth, 822; of Cambridgeshire, Huntingdonshire, and Rutland from the Underground Sources, The, W. Whitaker, 7; Underground, Prof. G. A. J. Cole, 242; Vapour, Air, and Hydrogen in the Extreme Ultra-violet, New Spectra of, J. J. Hopfield, 732
- Waterspouts: Dr. G. D. Hale Carpenter; Dr. D. Brunt, 414; Dr. W. J. Fisher, 669; and Centrifugal Force, E. R. Welsh, 644
- Weather: at Blue Hill, 91; Charts of the Northern Hemisphere, Daily, 853; Cold, in October, 612; Cycles in Relation to Agriculture and Industrial Fluctuations, Sir William Beveridge and others, 889; Map, The, an Introduction to Modern Meteorology, Sir Napier Shaw. Fifth issue (reprint of fourth), 768; of the Past Summer, The, 362; Prediction by Numerical Process; Forms whereon to write the Numerical Calculations described in "Weather Prediction by Numerical Process," L. F. Richardson, 762; The Proportion of Successes in, J. Mascart, 655
- Wegener's: Displacement Theory, P. Lake, 77; E. R. Roe-Thompson, 214; Disruption Hypothesis, Maps illustrating the Zoological Aspects of, K. H. Barnard, 332; Drifting Continents, Prof. G. A. J. Cole, 798
- Weights and Measures for India, New, C. A. Silberrad, 325, 735; H. Richards, 734
- West: Africa, French, The Oil Palm in, 164; Indian Agricultural College, 134, 684; Prof. J. B. Farmer, 775; Hurricanes, E. H. Bowie, 614; Indies, Fungus-hunting in the, Miss E. M. Wakefield, 563; Weather in the, 823
- Western Australia, Economic Minerals of, 746
- Whaling Industry, The Present Position of the, Sir Sidney F. Harmer, 827
- White Settlement, Distribution of Future, Dr. Griffith Taylor, 526
- Whitethroat's Fanfare, The Lesser, Prof. W. Garstang, 319
- Whitgift Hospital, Croydon, Threatened Destruction of, 782
- Whitworth Scholarships, The, 620
- Wild Birds Protection Acts, Dr. J. Ritchie appointed an Additional Member of the Committee on the, 461
- Wind: Flight, Motorless or, Dr. S. Brodetsky, 483; -speed from Sea and Land, N. K. Johnson and S. N. Sen, 462; Velocity and Diurnal Range of Temperature, 749
- Winkle, The Freshwater, A. E. Hodge, 380
- Winter Thunderstorms, Capt. C. J. P. Cave, 877
- Winters, Severe, The Periodic Return of, E. Roger, 863
- Wireless: Equipment, Safety Devices in, 22; Pocket Book, Marine, for the Practical Operator and Student, W. H. Marchant, 273; Receiving Set, Metropolitan Vickers Co., Ltd., 324; Telegraph, Short-wave Directional, C. S. Franklin, 220; Telegraphy: Continuous Wave, A Non-Mathematical Introduction to the Subject of Wireless Telegraphy from the Engineer's Point of View, B. E. G. Mittell, 273; The Transmission of Handwriting and Drawings by, E. Belin, 136; Telephony, A. P. M. Fleming, 852; Receiving Sets, C. F. Edwell, Ltd., 127; *Weather Manual, The*, 461
- Wisconsin University, Prof. A. Sommerfeld to lecture at, 368
- Witwatersrand University, Dr. R. A. Dart appointed Professor of Anatomy in, 720
- Wolf's Comet, Perturbations of, Prof. Kamensky, 525
- Wood, A Text-book of, H. Stone, 73
- World: About us, The, A Study in Geographical Environment, O. J. R. Howarth, 376; First Circumnavigation of the, The Fourth Centenary of the, 426; -story of 3,000,000,000 (?) Years, The, J. Reeves, 443
- Worlds, The Origin of, Dr. A. C. D. Crommelin, 660
- Worship? A New, Prof. H. E. Armstrong, 700
- Wren, Sir Christopher, Preparations for the Celebration of the Bi-Centenary of the Death of, 226
- X-radiation, Variation of the Intensity of Reflected, with the Temperature of the Crystal, I. Backhurst, 654
- X-ray: Crystal Analysis, Ten Years of, Dr. A. E. H. Tutton, 47; Department at Manchester, New, 753; Electrons, le Duc de Broglie, Prof. R. Whiddington, Prof. A. O. Rankine, 681; Reflection from Powdered Crystals, The Intensity of, Prof. A. H. Compton and N. L. Freeman, 38; Prof. W. L. Bragg and R. W. James, 148
- X-rays, The Spectral System of the, L. de Broglie and A. Dauvillier, 686; Ultra X-rays, and Corpuscular Rays, The Emission of, by the Celestial Bodies, Dr. H. Deslandres, 622
- Year, The Changing, A. Collett, 410
- Yorkshire Philosophical Society, Centenary of the, 393, 459
- Zinc, Isotopes of, Separation of the, A. C. Egerton, 773
- Zoological: Nomenclature, International Commission on, Proposals for the, Dr. D. S. Jordan, 523; Society, The, E. G. Boulenger, 314; Gardens, Scheme for an Aquarium at the, 17; Station at Rovigno, Istria, taken over by the Italian Royal Committee for Scientific Marine Investigations, 19
- Zoologischen Anzeiger, Register zum*, begründet von J. V. Carus. Herausgegeben von Prof. E. Korschelt. Band xxxvi.-xl., und *Bibliographia Zoologica*, vol. xviii.-xxii., 245
- Zoology, A Text-book of, the late Prof. T. J. Parker and Prof. W. A. Haswell. In two volumes. Third edition, 765



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

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CONTENTS.

	PAGE
Parliamentary Aid to Universities	1
The New Astronomy. By R. A. G.	2
Index Animalium	3
Sugar Technology. By Prof. Arthur R. Ling	4
Geology and Tin Resources of the British Empire. By C. G. C.	5
Our Bookshelf	6
Letters to the Editor :—	
The Stature of the Scottish People.—Sir Arthur Keith, F.R.S.	8
Advanced Mathematical Study and Research at Cambridge.—Prof. H. S. Carslaw	8
Condition of Electrolytes in the Blood.—Benjamin S. Neuhausen	9
The Dimensions of Area.—Dr. Norman R. Campbell	9
The Resonance Theory of Hearing.—Dr. H. Hartridge	9
An Experimental Towing-tank used by Benjamin Franklin.—Paul C. Whitney	10
An Experimental Confirmation of the Kinetic and Molecular Theories of Magnetism.—Dr. J. R. Ashworth	10
Molécular <i>Ælötropy</i> in Liquids.—Prof. C. V. Raman	11
Recent Investigations of the Lake Dwellings of Switzerland. (<i>Illustrated</i>). By Prof. Eugène Pittard	12
Vitamin Problems. By Prof. A. Harden, F.R.S.	14
Obituary :—	
Prof. W. Gowland, F.R.S. By H. C. H. C.	16
E. W. L. Holt. By E. J. A.	17
Current Topics and Events	17
Our Astronomical Column	20
Research Items	21
Quantum Mechanism in the Atom	23
The Second Royal Society <i>Conversazione</i>	23
Psychical Monism	24
Technical Education	24
University and Educational Intelligence	26
Societies and Academies	25
Official Publications Received	28
Diary of Societies	28

Parliamentary Aid to Universities.

THERE is need for a clear definition of the present position in regard to Government grants for university education in Great Britain. Statements of a seemingly contradictory nature have been made, and it is not surprising that misunderstandings have arisen. On one hand we have the fact that the parliamentary votes for university education are reduced from 1,500,000*l.* to 1,169,000*l.*, while on the other we are told that the grants to the universities this year will be no less than last and that the annual grants are to be maintained at their present scale. The real facts of the situation have become obscured by certain complexities, arising mainly from the difference between the Government financial year and the academic year, and from the exclusion this year of the Irish grants.

The first announcement of the Treasury's decision to reduce Government aid to university education was a simple one, to the effect that Parliament would be asked to vote for this purpose only 1,200,000*l.* instead of the million and a half voted last year. But the larger amount of last year included provision for Irish universities, amounting altogether to 111,000*l.* (not counting an emergency grant to Trinity College, Dublin), while this year the sum reserved in the estimates—namely, 1,169,000*l.*—makes no allowance for the Irish universities. The amount available for university education in Great Britain therefore falls, if the estimates are approved by parliament, from 1,389,000*l.* to 1,169,000*l.*—that is, by 220,000*l.*—the sum mentioned by the president of the Board of Education in his recent speech at Bristol.

The net reduction in the grant is happily less than was at first anticipated. But, even so, it is difficult at first sight to reconcile a loss of over 220,000*l.* with Mr. Fisher's remark to the effect that there would be

no real reduction of the amount of parliamentary money placed at the disposal of the universities this year. The explanation is to be found in the fact that the grants to the universities are made in respect of the academic year ending on July 31, while the parliamentary votes are for the year ending on March 31. Thus the grants for this present academic year are based on the parliamentary vote for the financial year which came to an end on March 31 last, and that was the year in which the vote was at its maximum. The grants for this academic year naturally show no reduction. On the contrary, they have increased because they are based on the increased vote.

The fall in the grants to universities will, of course, occur in the academic year ending in July 1923, and will be the direct and inevitable result of the reduction of the parliamentary vote for the financial year ending in March next. The reduction in the grants assigned to the various institutions in the financial year 1922-23 is seen to be no less than 113,905*l.*; but the loss in the academic year 1922-23 will be much greater than this, the difference being due to the fact that the amounts of grant shown in the estimates for 1921-22 are a good deal less than the sums actually received by the universities in the academic year 1921-22, being made up of three parts, namely:

(a) "Annual grant" for the second half of the academic year 1920-21 (before the vote had been increased by 500,000*l.*).

(b) "Annual grant" for the first half of the academic year 1921-22 (after the increase in the vote).

(c) What has been called a "non-recurrent grant," but might more correctly be termed a recurrent grant of variable amount.

It is obvious that, as the first of these three factors is based on the earlier low rate of grant, the total of the three will be considerably less than the aggregate of the grants received by the universities in the academic year 1921-22. Although exact figures are not available, there is reason to suppose that the actual fall in the academic year 1922-23, as compared with the present academic year, will be not far short of 250,000*l.*

If the smaller vote proposed for the current financial year is approved by Parliament, a large reduction in the university grants next academic year is a result which cannot be avoided. But even so, it may be urged, the universities will still receive considerably more than in 1920-21. This view, however, ignores two important considerations. First, the increase in the vote in 1921-22 was justified by the pressing need of the universities for additional aid, and the only reasonable ground for criticising it was that it was on too small a scale. Second, the increased vote encouraged the University Grants Committee to add

to the grant list certain institutions—notably Oxford and Cambridge Universities and the clinical units of the London Medical Schools—which had not previously figured on the list. These new commitments, totalling approximately 120,000*l.*, undertaken on the strength of the enlarged vote, remain a permanent charge on the reduced vote.

The statement which has been made, and has given rise to some misconception, that the annual grants to the universities will be maintained at their present level, depends for its truth on what is little more, in fact, than a technicality.

In allocating to the universities the money voted by Parliament, the University Grants Committee has adopted the practice of giving only part of the money in the form of "annual grants" and the remainder (except what is kept in reserve) in the form of grants (called "non-recurrent"), the amount of which is decided in the case of each university each year. Whatever may be thought of this method of allocating the money voted by Parliament, and whatever these grants may be called, the fact remains that they have been made this year and in previous years, and that they will not be made next year. A reduction of a quarter of a million in the income of the universities is no less a reduction of a quarter of a million because the money lost has not been technically called an "annual grant." It must also be understood that it is not because the universities have not needed the whole of the money voted by Parliament that some of it has been treated by the "non-recurrent" method and some kept in reserve. The whole of the money, and much more than the whole of it, is sorely needed by the universities, and no amount of discrimination between grants of one denomination and grants of another denomination can alter the fact that the amount coming to the universities next year will be about a quarter of a million less than the amount received this year. Such a reduction must deal a very serious blow at the efficiency of university education in Great Britain.

The New Astronomy.

The New Heavens. By Prof. G. E. Hale. Pp. xv + 88. (New York and London: C. Scribner's Sons, 1922.) 7*s.* 6*d.* net.

IT is impossible not to be impressed by the wonderful story of astronomical achievement told by Prof. Hale in felicitous language in this little volume. Before the invention of the telescope not more than about six thousand stars had ever been seen by human eyes, and less than half this number at any one time. The small telescope, with an object-glass an inch or

so in diameter, used by Galileo in 1610, brought within the range of vision stars down to magnitude 10.5, numbering about five hundred thousand. The 60-inch reflector of the Mount Wilson Observatory, Pasadena, of which Prof. Hale is director, reveals stars of the 18th magnitude, and the 100-inch carries the sounding-line still further, while with both instruments many stars can be photographed which the eye cannot see directly, the photographic limit with four or five hours' exposure being about the 20th magnitude.

The expansion of the stellar universe as regards the number of stars in it which can be seen or photographed represents, however, only a small part of modern astronomical discovery. The test of a telescope is its resolving power, and this is expressed with sufficient accuracy by the relation $5''/d$, where the numerator is the normal angular limit of separation of a double star and d is the diameter of the object-glass in inches. The separating power of the 36-inch refractor of the Lick Observatory is thus $0''\cdot14$, and that of the 100-inch of the Mount Wilson Observatory $0''\cdot05$. By the use of the interferometer, the latter limit is reduced to $0''\cdot02$, and this increase in resolving power was established by observations of Capella. More than twenty years ago, this star was found by Campbell and Newall to be a spectroscopic binary (that is, to consist of two stars in motion about a common centre of gravity and so close together that the system is known to be duplex only by detecting differences, due to orbital movement, exhibited by the composite spectrum), and determination of the orbit showed that the separation of the components could not exceed $0''\cdot06$. It was, therefore, within the theoretical limit of separation into its components by the use of Michelson's interferometer on the 100-inch telescope of the Mount Wilson Observatory. Observations made at the end of the year 1919 and the beginning of 1920 confirmed the accuracy of this conclusion, and the distance between the two stars of the pair was found on several occasions to be about $0''\cdot045$.

The capacity of the interference method was thus established by these observations with a test-object among the stars. Thirty years previously the method had been used to determine the diameters of Jupiter's chief satellites, but it was only when the 100-inch telescope had been completed that Prof. Hale suggested the application of the principle to the measurement of diameters of stars—a more difficult problem than that of separating close doubles. Prof. Eddington, in his presidential address to Section A of the British Association in 1920, gave the probable angular diameters of some stars and remarked that "the star with the greatest apparent diameter is almost certainly Betelgeuse, diameter $0''\cdot051$." Measurements with

the 20-foot interferometer on December 13, 1920, gave an apparent diameter of $0''\cdot047$, which is as striking a confirmation of theoretical deduction by observed result as that represented by the discovery of the planet Neptune. The parallax of Betelgeuse is uncertain, but there are reasons for believing it to be about $0''\cdot02$, which would make the diameter of the star about 215,000,000 miles, or 250 times greater than the diameter of the sun. Antares has similarly been found to have a diameter of 400,000,000 miles and Arcturus of 21,000,000. These stars are in an early stage of stellar evolution—attenuated masses of matter low down on the ascending side of the temperature curve of Lockyer's meteoritic hypothesis—and from "giants" they will be transformed to "dwarfs" as they contract and increase in temperature.

Prof. Hale devotes particular attention to the various stages of growth and decay as indicated by modern studies of stellar types, and shows that they afford no direct evidence in favour of Laplace's theory of the formation of planets in our solar system. Recent investigations have truly revealed "The New Heavens," which he describes so clearly and illustrates so attractively with some of the most remarkable astronomical photographs ever obtained. In his last chapter, entitled "Cosmic Crucibles," he deals particularly with the sun as a star and some of the discoveries in the field opened by him by means of the spectroheliograph, which enabled him to prove that every large sun-spot is an electric vortex producing a magnetic field. As helium was discovered by Lockyer in the sun long before it was isolated on the earth, so in the laboratories of the heavens conditions are now continually being studied which not only enlarge our conceptions of the universe but also provide physicists and chemists with results of outstanding interest and value. No one is more competent than Prof. Hale to survey this great territory of which he is the leading pioneer explorer, and his account of the methods used to examine it and the rich store of new knowledge gathered from it, makes as fascinating a scientific story as ever was told.

R. A. G.

Index Animalium.

Index Animalium. A Carolo Davies Sherborn. Sectio Secunda 1801-1850. Part 1: Introduction, Bibliography and Index A-Aff. Pp. cxxxi+128. (London: British Museum (Natural History), 1922.) 20s.

WE congratulate Mr. C. D. Sherborn on the appearance of the first instalment of the second part of his great work. Since the first part was published in 1902, zoologists have eagerly awaited its continuation,

and we hope that the remainder will now follow with all speed, for the real value of the work can be fully appreciated only in its complete form.

The second part follows closely the form and arrangement of the first. After an explanatory introduction there follows the bibliography, from which the stupendous nature of the task which has occupied the best thirty-one years of Mr. Sherborn's life can be judged. One hundred and thirty-one pages of closely printed matter in small type are required to give the titles of the publications which the author has indexed. Against this, less than two pages of similar type, giving the publications to which the author has not had access (some of these have been seen since the list was set up in print) represent an almost negligible part of zoological literature that has not passed through his hands.

When it is remembered that, but for some 5000 entries made for the author by friends, the whole of the literature has been examined and every entry in the index recorded from the original, arranged, sorted, checked and passed for press by Mr. Sherborn himself, we begin to realise something of the debt which zoology, now and for all time, owes to the author. The personal equation has been reduced to a minimum, and Mr. Sherborn's accuracy, which has stood the severe test of the first part of this index, is a guarantee of the absolute reliance which can be placed on the second part. The author has given valuable bibliographical notes to the literature he has examined, and has smoothed the path of systematic zoologists considerably by indicating where that literature is to be found in England and whether it contains new names or any information likely to be of use.

The "Index Animalium" should henceforth be regarded as the bible of systematic zoology. It seems to us that all the vexed questions of nomenclature and priority could be settled by a reference to its pages, and the time and labours of systematists freed for the more complete examinations of the animals themselves. Acknowledgments are due to the Committee of the British Association and to the Trustees of the British Museum for the financial assistance they have given to this work, and to the latter body for assuming the responsibilities of publication. It is only fitting and proper that the most important centre of systematic zoology in the world should undertake the issue of this invaluable and indispensable work, and we are grateful to the Trustees of the British Museum for having done so.

A word of praise is due, too, to the printers and publishers for the admirable way in which this instalment has been printed and for its freedom from errors. We have detected no typographical mistakes in a fairly

close scrutiny. Sir Sidney Harmer in his preface refers to the index as a "labour of love," and we can but inadequately express our thanks to Mr. Sherborn for his magnificent and untiring work. We may, perhaps, be allowed to express our pleasure in the fact that publication is assured and that the results of Mr. Sherborn's work will be preserved in permanent form as a splendid monument to his labours in the cause of science.

Sugar Technology.

- (1) *Cane Sugar: A Textbook on the Agriculture of the Sugar Cane. The Manufacture of Cane Sugar, and the Analysis of Sugar-house Products.* By Noël Deerr. Second (revised and enlarged) edition. Pp. viii+644+xxix plates. (London: Norman Rodger, 1921.) 42s. net.
- (2) *The Manufacture of Cane Sugar.* By Llewellyn Jones and Fredric I. Scard. Second revised edition. Pp. xix+481+270 plates. (London: Duckworth and Co., 1921.) 25s. net.
- (3) *Condensed Description of the Manufacture of Beet Sugar.* By Dr. F. Murke. Pp. v+175. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 15s. net.
- (4) **B**EARING in mind the importance of the sugar industry to the British Empire, more especially in its relation to sugar cane, it is not surprising, and distinctly comforting, to know that we are so well supplied at the present time with up-to-date literature on the subject. Mr. Deerr's treatise ranks among the most important, occupying as it has done for the last ten years—and if we include his first smaller work we may say seventeen years, not to mention his "Sugar House Control" published in 1900—a unique position, the subject being treated from both the theoretical and practical standpoints. The long experience of the author as a technologist and an experimentalist had qualified him eminently for the task he undertook, while for the past ten years he has added still further to his previous extensive experience by being associated with the sugar industry in Cuba and with a sugar refinery in New York. The first edition of Mr. Deerr's treatise was published in 1911. The present edition covers 52 additional pages, each containing some 11 per cent. more words, in addition to which it has been completely rewritten. The reputation of the author is so well known and generally admitted that it is a guarantee at once that his task has been carried out with thoroughness. It is worthy of note, however, that his MS. has been submitted to the following authorities, to whom he acknowledges his thanks for help and criticism: Mr.

J. Hamill, Dr. C. A. Browne, Dr. C. A. Barber, Dr. E. J. Butler, and Mr. J. P. Ogilvie.

It is impossible to deal in detail with such a voluminous work as the one before us; it must suffice therefore to point out that it deals with all phases of the subject—botanical, agricultural, chemical, and technological.

We cordially recommend the volume to all engaged in the sugar industry, as well as to students who intend entering that industry.

(2) The first edition of Messrs. Jones and Scard's treatise was published in 1909, and the fact that a second edition has now appeared is a fitting testimonial, if one were needed by two such eminent and well-known technologists, of its utility as well as of its appreciation by technologists. Mr. Aspinall in the introductory chapter tells us that the first impression of the work was soon sold, and that the authors preferred to prepare a new and revised edition instead of issuing at once a reprint of the first edition.

The work as now presented is in its original form, but it has been thoroughly revised with some 27 additional pages of text and 26 further illustrations. The volume is a welcome addition to the literature, more especially from the technological point of view. A special feature is the large number of well-executed drawings and plans, numbering in all 270, for which the authors are indebted to the leading engineering firms.

The work will be found indispensable to all engaged in the industry, and we welcome its appearance at a time when it behoves sugar-cane technologists, more especially in the British Dominions, Dependencies, and Protectorates, to cultivate the highest efficiency in their subject, and so make the Empire self-supporting as regards sugar. This is a matter which in the writer's personal knowledge one of the authors at least, Mr. F. I. Scard, has long had at heart.

(3) Dr. Murke's little book was written in 1903-5, but was not published. Recently the author found that it could be brought up to date with very few alterations and additions. While it contains much valuable information, the text is of a sketchy character, the sequence is not well chosen, and some important processes find no mention. This being so, it is scarcely to be recommended as an elementary textbook on the subject. However, the author states that it has been written for "superintendents, engineers, and foremen of the beet sugar factory," and such readers would doubtless be able to follow the text without the aid of illustrations, of which there are none.

If we may be allowed to make a few comments, we would point out that while a concise account is given of Stephan's process of recovering sugar as

calcium trisaccharate from molasses, no mention is made that the trisaccharate may be used instead of fresh lime for defecating beet juice. We should have expected to find some reference to the strontium process, but the chapter on the osmose process was scarcely needed; indeed the author himself states that it is almost exclusively an historical one. Most English technologists will prefer the French word "massecuite" instead of "fillmass," the translation of the German "Füllmasse."

Now that we have at least two beet sugar factories at work in the United Kingdom, the demand for works on the subject has naturally increased.

ARTHUR R. LING.

Geology and Tin Resources of the British Empire.

- (1) *The Geology of the British Empire.* By Dr. F. R. C. Reed. Pp. viii+480. (London: Edward Arnold, 1921.) 40s. net.
- (2) *The Tin Resources of the British Empire.* By N. M. Penzer. (*The Raw Materials of Industry.*) Pp. x+358. (London: William Rider and Son, Ltd., 1921.) 15s. net.

THE geology of our overseas dominions has been described in a host of publications, many of which are difficult of access and full of local and technical detail. A compact volume, such as the one under notice, in which the outstanding facts concerning the several regions are presented in brief but readable form, cannot fail to meet with a warm welcome. It will appeal not only to students faced with the difficult task of acquiring a general knowledge of world stratigraphy, but also to all who wish to know the larger geological facts of our Empire abroad.

The subject-matter is based upon a course of lectures which the author has given annually for more than a decade. It has not been hastily compiled, therefore, but is the result of many years of wide reading and judicious condensation. Only those who have tried to assemble within a small compass the salient information concerning the geology of countries like Canada, India, or South Africa will be able to gauge the extent of the author's labours or to thank him adequately for placing the results of them at the disposal of the public.

No description is given of the geology of the British Isles, numerous works on this subject being available. The first region dealt with is the Mediterranean, including Gibraltar, Malta, and Cyprus. Egypt follows, reminding us of the rapidity of Empire changes in these days of awakened national aspirations. In the next chapter, dealing with East Africa, an account is given of the geology of Somaliland, Kenya Colony,

and Tanganyika Territory. Then follow two chapters containing a most useful summary of the geology of the Union of South Africa. Central and South-West Africa and British West Africa are dealt with in the two succeeding chapters, the latter including some pages devoted to the British Cameroons and Togoland. Canada and Newfoundland are dealt with in two chapters occupying sixty pages, and the Indian Empire in two of sixty-six pages. These are admirable summaries, which are especially welcome in view of the importance and interest of the work which has been done in these lands and of the great volume of literature that has been epitomised. The Malay States, British Borneo, the Indian Ocean islands, and Hong Kong are treated in a chapter on the East Indies. Then come two chapters on the geology of Australia, one on New Zealand, and one on Oceania, some account being included in the last of territory acquired since the war. The last chapter, under the title of the Mandatory Regions, deals with Mesopotamia and Palestine.

In most cases the descriptions of the several regions are accompanied by sections and folding geological maps in black and white. These are printed on good paper, and students would derive considerable benefit in tinting them with washes of colour. In connection with each area a useful bibliography is also given, which, by referring readers to further sources of information, adds greatly to the value of the book.

Both author and publisher are to be congratulated upon having produced an important and most useful addition to British geological text-books.

(2) Mr. Penzer's book is of a more specialised kind. It is the second of a series devoted to the raw materials of industry, the first of which dealt with cotton and wool throughout the world. This second volume restricts itself to tin within the Empire, which, constituting two-thirds of the world's supply, provides ample material for a single volume. It is proposed to issue later another volume describing the extra-British sources of the metal.

The introduction deals with the history of tin production and with the tin-bearing minerals. Then there are four chapters describing the various fields, arranged according to continents; this part of the book contains much detailed information, and is illustrated by a number of specially drawn distribution maps. There is also a chapter on the industrial applications of tin, and one giving statistics as to output, prices, and conditions of sale. The volume closes with an elaborate classified bibliography.

A perusal of this book has left the impression that its writer has been assembling information upon a subject which is outside the limits of his own practical

experience. This impression detracts a little from the authority of the work, but it must not be allowed to obscure the fact of the author's remarkable industry or of the extraordinary amount of information which he has gathered together into the 350 pages of his book. By indefatigable labour he has made a valuable compilation which many interested in the mineral industries will be glad to possess and keep by them for purposes of reference.

C. G. C.

Our Bookshelf.

The Vitamins. By Prof. H. C. Sherman and S. L. Smith. (American Chemical Society: Monograph Series.) Pp. iii+273. (New York: Chemical Catalog Co., Inc., 1922.) 4 dollars.

A VERY welcome addition to the literature of vitamins has been provided by Prof. Sherman and Mr. S. L. Smith in the volume under notice. The plan of the book is very simple; an historical introduction is followed by three chapters devoted to the three generally recognised vitamins and a final chapter is added on the relation of these important principles to the problem of food supply. A bibliography is also given, which comprises about a thousand entries and includes the literature so far as the end of 1921.

The treatment of the subject is throughout clear and critical, and the authors err if at all on the side of caution. Thus they do not regard the identity of the water-soluble and antineuritic vitamins as proved, but consider that "the preponderance of evidence thus far available favours the view that the water-soluble, growth-promoting vitamin is probably among the substances which may exert antineuritic action." They display a similarly open mind as to the vexed questions of the nature of vitamin B and its relation to the growth of yeast, which are both being actively investigated, with tantalisingly varied results, in many laboratories. The concluding chapter will probably be found the most interesting by the non-specialised reader, as in it the authors discuss the commonly used foodstuffs from a general point of view, devoting attention to their special merits or demerits, not only as carriers of vitamins but as sources of "good" or "bad" proteins and of energy. Their final conclusion brings comfort to those who are anxious as to the suitability of their everyday diet: ". . . we believe it safe to say that with a dietary selected to make the best use of our ordinary staple foods there will rarely if ever be occasion to purchase vitamins in any other form, or to give any greater anxiety to the vitamins than to some other factors which enter into our present conception of nutritive requirements and food values."

Essai philosophique sur les probabilités. Par Pierre-Simon Laplace. (Les Maîtres de la Pensée Scientifique: Collection de mémoires et ouvrages. Publiée par les soins de Maurice Solovine.) I. Pp. xii+103. II. Pp. iv+108. (Paris: Gauthier-Villars et Cie, 1921.) Each vol. 3 francs net.

OUR students spend little or no time in the study of the classical documents of scientific discovery. This neglect is very much to be regretted, for there can be

no doubt that nothing is so inspiring and fascinating as the perusal of the account of a great discovery by the discoverer himself. The personal element, so conspicuously absent in current textbooks, is in this way given its opportunity, especially if the discoverer's account is read in the original language in which it was written. The series now being issued under the editorship of M. Solovine is therefore to be welcomed.

The present essay was first printed as an introduction to Laplace's "Théorie analytique des probabilités." It gives in non-mathematical language the principles underlying Laplace's methods for dealing with the theory of probability, and shows how it is applied to problems of natural science—especially the astronomical problems to which Laplace applied his genius—to sociology and other aspects of communal life. Special attention is devoted to errors in the estimation of probabilities, due to psychological causes, and there is also a brief history of the methods of probability.

Considerable modification has since been introduced into the fundamental notion of probability, but Laplace's essay should be read by all students of mathematics. In it occurs the sentence: "Une intelligence qui pour un instant donné connaîtrait toutes les forces dont la nature est animée et la situation respective des êtres qui la composent, si d'ailleurs elle était assez vaste pour soumettre ces données à l'analyse, embrasserait dans la même formule les mouvements des plus grands corps de l'univers et ceux du plus léger atome: rien ne serait incertain pour elle, et l'avenir comme le passé serait présent à ses yeux." S. BRODETSKY.

Displacement Interferometry applied to Acoustics and to Gravitation. By Prof. Carl Barus. Pp. viii+149. Publication 310. (Washington: Smithsonian Institution of Washington, 1921.)

PROF. BARUS' work is divided into twelve chapters, and occupies an intermediate position between the usual textbook dealing with routine work and the ordinary type of original research which attacks and solves some specific and definite problem. It is throughout of an exploring nature and may be said to investigate the suitability of interferometry as a method for research in various branches of acoustics and gravitation. In the first chapter the open mercury manometer, when read by interference, is discussed. In the second, the interferometer U-tube is used as an absolute electrometer. The third deals with acoustic pressures, the fifth treats of the compression of a sound wave in a pipe, and the sixth with the vibration of a telephone plate. In the eighth and following chapters various gravitational problems are approached. The book is a storehouse of unusual experimental methods and may be consulted with advantage by any one about to commence investigations along the lines indicated.

Publications of the Washburn Observatory of the University of Wisconsin. Vol. X. Part 4: *Observations of Double Stars, 1907-1919.* By George C. Comstock. Pp. 167. (Madison, Wis.: Washburn Observatory, n.d.)

THE volume under notice forms a catalogue of all the observations of double stars made with the 16-inch refractor at Washburn Observatory by Prof. Comstock

between 1907 and 1919; summaries of his earlier observations with the same instrument from 1889 to 1907 are also given, so that it is possible to detect changes. There are some 200 stars in the catalogue, including most of the well-known binaries.

The probable errors are given as $2^{\circ} \cdot 6$, $0^{\circ} \cdot 03$ for separations less than $0^{\circ} \cdot 5$, and $0^{\circ} \cdot 9$, $0^{\circ} \cdot 07$ for those between $2''$ and $4''$. Wires illuminated by red light were employed. This involves the possibility of small errors through unequal refraction of the images of wire and star in the eyepiece, unless the latter is achromatic. A list is given of the eyepieces, which are either Ramsden or Kellner, with powers varying from 196 to 1540; about 800 was commonly used. A. C. D. C.

Drugs in Commerce: Their Source, Preparation for the Market, and Description. By J. Humphrey. (Pitman's Common Commodities and Industries.) Pp. xi+116. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 3s. net.

MR. HUMPHREY has contrived to include within the moderate compass of 113 pages of text a good account of the drugs of natural origin found in commerce. The information given includes descriptions of the drugs, notes on their constituents and sources of supply, and in most cases some particulars as to their modes of preparation for the market. Great pains have evidently been taken to secure accuracy, but it should have been pointed out that the "henbane" imported from Egypt is not derived from *Hyoscyamus niger*.

The book contains six plates illustrating the more important drugs, e.g. cinchona, ergot, opium, and jaborandi, and six more showing scenes in drug warehouses at the London Docks and methods of packing and selecting the spices, such as nutmeg and cinnamon, used in medicine. The book can be cordially recommended to any one desirous of obtaining general information regarding this interesting and little-known group of commercial products.

Memoirs of the Geological Survey: England and Wales. The Water Supply of Cambridgeshire, Huntingdonshire, and Rutland from Underground Sources. By W. Whitaker. Pp. iv+157. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1922.) 7s. net.

THE latest addition to the series on the underground water supplies of England deals with three counties which form a convenient unit. The counties being agricultural rather than industrial or manufacturing, very large water supplies are required in few cases. Supplies are obtained chiefly by means of wells, but some water is obtained from springs, notably the supply of the town of Wisbech, which, however, obtains its water from the county of Norfolk. At least one town of more than 5000 inhabitants seems to have no public supply. Chalk and, to a less extent, lower greensand are the sources of water in these counties. The Oolites and Lias are also of some importance. The value of chalk in this respect in the south-east of England corresponds with that of New Red sandstone in the Midlands. In addition to full details of the wells and springs in the three counties Mr. Whitaker gives some useful indications as regards enlarging and improving existing supplies.

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.]

The Stature of the Scottish People.

ON the data published in the "Final Report of the Anthropometric Committee" of the British Association (1883), the Scottish people have been regarded as being considerably taller than any other British nationality. The following letter from Dr. Aleš Hrdlička, of the United States National Museum, Washington, D.C., shows that, through an error in computation, the Scots have had nearly two-thirds of an inch added to their real stature.

"In preparing my report on the 'Stature of the Old Americans' I had occasion to look up, among other things, the principal records of that nature on the Scotch people. I found quite a number of these and they all showed fairly harmonious results, with one exception. This was the record on the Scotchmen in the 'Final Report of the Anthropometric Committee' of the B.A.A.S., 1883, p. 256. This record gave results that were so much higher than any others that I was finally led to a re-computation of the series. Taking the number of persons measured and the record in inches, in which the measurements were originally recorded, I found to my surprise a different and a very perceptibly lower average. The averages given in the Report were 68.71 in. or 174.6 cm., while I obtained 68.1 in. or 172.97 cm.

"I should be thankful to you if you would bring this matter to the attention of the members of the Anthropological Institute, and have it looked into; and if it should be found that an error has been made, then I think it would be advisable for some one to publish a little note on the subject, for the figures of the Anthropometric Committee have been widely utilised (see Deniker, Martin, etc.)."

I have not checked Dr. Hrdlička's estimates, but I have no doubt that they are right. The average stature of the four British nationalities thus amended reads: Scottish, 172.9 cm.; Irish, 172.6 cm.; English, 171.2 cm.; Welsh, 169.4 cm.

ARTHUR KEITH.

Advanced Mathematical Study and Research at Cambridge.

It has been suggested to me that attention might well be directed through the columns of NATURE to a point in the regulations of the University of Cambridge which prevents many graduates of other universities taking advantage of the opportunities Cambridge offers for advanced mathematical study.

In most universities other than Cambridge our best students of mathematics now usually read for a degree in science. They have passed an entrance examination of a standard far higher, I need scarcely say, than that of the Previous Examination. But neither in their entrance examination nor in their course need they have taken Latin or Greek. They are thus cut off from the privileges of affiliation, which include exemption from the Previous Examination and permission to take their degree on Part II. of the Tripos after a residence of two years.

It is true that graduates of other universities may

proceed to the degrees of M.Sc. and Ph.D. at Cambridge by research, without any questions being asked as to the nature of their entrance examination. But in my opinion, at least, few of the graduates of the Scotch universities, the newer English universities, and the universities of the Dominions are ready to devote themselves to research in mathematics immediately after graduation. What they want at that stage is just such advanced instruction as Cambridge now offers in the subjects of Schedule B of Part II. of the Tripos. They should be able to take the Part II. examination easily after six terms. Before the end of that time they may have begun some research. But the man who wishes to become a professional mathematician should continue research work for at least two years after taking Part II. Some of the time would be spent at Cambridge; and one or other of the great schools of mathematics at Paris, Rome, Berlin, or Göttingen should certainly be visited.

Oxford admits to the status of Senior Student any person who has obtained a degree at an approved university after a three-year course, the degree also having been approved by the Hebdomadal Council. If Cambridge would modify its regulations for admission to the privileges of affiliation so that our best graduates in mathematics could take the Cambridge B.A. on Part II. after six terms, I believe its school of mathematics would receive a larger number of brilliant scholars, and there would be more of our mathematicians at home and abroad engaged in research.

H. S. CARSLAW.

The University, Sydney, May 1.

Condition of Electrolytes in the Blood.

ARE the salts present in the blood ionised to an equal extent as similar concentrations of these salts in aqueous solution? Are the ions absorbed by the protein? These are questions that have been attracting the attention of physiologists and biological chemists. Investigators have attempted to answer these questions principally by two methods—compensatory dialysis of the serum (Rona, Michealis, and their co-workers) or filtration with pressure (Starling, Cushny, Richter-Quittner).

It seemed worth while to determine the concentrations of other ions by electromotive force measurements, as is done in the case of the hydrogen ion. Accordingly, a 0.2 per cent. sodium amalgam that is but slowly decomposed was used as a sodium electrode. After measuring the E.M.F. of this electrode against known concentrations of sodium chloride of known degree of ionisation, the normal potential of this amalgam electrode was obtained. The E.M.F. of samples of serum and plasma were then measured. When from these readings the total concentrations of Na present were recalculated on the basis that the degree of ionisation of the sodium salts was the same as in an aqueous solution, the calculated Na concentration and that found by analysis were in very good agreement. For example in two samples the calculated values of sodium were 3.51 and 3.67 grams; the values found were 3.46 and 3.65 grams per litre. Thus the conclusions of the aforementioned workers that Na is not bound in the serum, because it can be dialysed and filtered *in toto*, has been confirmed.

To determine the concentration of Cl-ions, an Ag/AgCl electrode was used. By calculations similar to those outlined in the case of sodium, it was found that the quantities of Cl present calculated from E.M.F. measurements of serum and plasma, on the assumption that we were dealing with an aqueous

solution of sodium chloride, were in good agreement with those found by analysis. Thus in two samples, for example, the totals for chlorine calculated as NaCl were 6.443 and 6.541; the totals found were 6.535 and 6.61 grams. Chlorine likewise is apparently as free as in an aqueous solution.

The writer is at present developing a calcium electrode to determine the state of calcium in the blood.

BENJAMIN S. NEUHAUSEN.

Johns Hopkins University, Baltimore, Maryland.

The Dimensions of Area.

IN my "Physics," pp. 423-426, it is maintained that it is incorrect to attribute to area (or volume) the dimensions L^2 (or L^3); but no example of an error arising from such attribution could be given. It has since occurred to me that an excellent and important example is provided by Child's high vacuum current law, according to which σ , the current density, is proportional to $\left(\frac{e}{m}\right)^{\frac{1}{2}} \frac{V^{\frac{3}{2}}}{l^2}$.

The laws assumed in the deduction of this relation are (1) $\frac{V}{l} \cdot A = a \cdot e$ (Poisson's equation), (2) $\sigma \cdot l \cdot A = \beta \cdot e \cdot v$, (3) $m \cdot v^2 = \gamma \cdot e \cdot V$, where A and v are area and velocity, and a, β, γ formal constants or no-dimensional magnitudes. If in place of A we write l^2 , we find that $\sigma^2 l^3 m \left(\frac{l}{e}\right)^n V^{n-4}$ is no-dimensional for all values of n . The solution is ambiguous and the Child relation is not deducible by dimensional argument, as it clearly ought to be. If, on the other hand, we retain A , $\sigma^2 l^4 \left(\frac{m}{e}\right) V^{-3}$ is the only no-dimensional magnitude independent of A and v ; we obtain a unique and correct result.

The removal of the ambiguity must be due to the introduction of some additional law. This additional law is that the ratio of the area in (1) to the area in (2) is independent of l , or that l is perpendicular to A in both cases, or that the electrons follow the lines of force. If we omit the important magnitude shape in stating the dimensions of A , this law cannot be introduced into the dimensional argument, because there remains no magnitude to measure direction.

The additional law is not quite strictly true because of the inertia of the electrons. It follows, therefore, that if the electrodes are arranged so that the curvature of the lines of force is very great, small departures from the Child relation are to be anticipated. But so long as the curvature is small, the relation will hold if the systems compared are geometrically similar, differing only in their size l . So far as I know, the relation has hitherto been proved only for parallel plane and concentric cylindrical electrodes; experimentally it is known to be true over a much wider range.

NORMAN R. CAMPBELL.

19 Holland Park, W.11, June 4.

The Resonance Theory of Hearing.

MR. ACKERMANN (NATURE, May 20, p. 649) is probably correct when he states that the first incoming sound wave sets all the resonators of the ear temporarily in vibration, and also, that as the sound waves continue the vibrating resonators decrease in number until only those are left in motion that are executing either sympathetic or forced vibration in time with the incoming sound waves. But surely he has left out of account the probable

amplitude of the motion performed by the resonators, and the probable physiological properties of the mechanism, when he judges the intensity of the sound stimuli sent along the auditory nerve to the brain to be directly proportional to the number of resonators that are swinging at any moment?

At the present time we have practically no information concerning the type of response given by the auditory nerve. It may, like certain motor nerve fibres, obey the all-or-nothing law, or it may conduct with a decrement, or it may be graded in its response. But in all these cases the amplitude will be an important factor in deciding the response given by any one hair cell and nerve fibre. But there are, I think, other physiological factors which Mr. Ackermann has overlooked. For although we cannot directly stimulate the hair cells of the cochlea electrically and ascertain the approximate relationship between strength of stimulus and strength of response, so that we can demonstrate clearly that the auditory mechanisms have such physiological properties as threshold, latent period, simultaneous and successive contrast (as we can, for example, in the case of the skin end organs), yet we have sufficient evidence that these properties are exhibited also by the auditory mechanism as by the other organs of special sense. Reconsidering now the case that Mr. Ackermann has taken, and assuming as a basis for calculation—

- (a) that the sound wave energy entering the ear in unit time is constant;
- (b) that the pitch is constant;
- (c) that the mean amplitude of all the resonators in vibration at any one time is inversely proportional to the number in vibration; and
- (d) that the energy available for distribution is proportional to the length of time during which the sound waves have been arriving, *i.e.* that none of the energy entering the cochlea has been lost in eddies, friction, etc.;

the following table shows the number of oscillators in vibration and their mean amplitude:

No. of Sound Waves from Common Cement.	No. of Resonators in Vibration.	Mean Amplitude.
1	6000	·003
2	1000	·03
3	600	·08
4	450	·13
5	350	·21
6	290	·31
7	240	·44
8	200	·60
9	170	·80
10	150	1·00

It will be seen that after one sound wave 6000 resonators are in vibration with an amplitude of 0.003, whereas after 10 sound waves 150 resonators only are swinging with an amplitude of 1. The table shows that there is a rapid increase in the mean amplitude of the vibrating resonators at the commencement of a tone.

There is no pretence of any exactness in the above values. They merely illustrate the kind of results to be expected. It should be noted further that at any instant those resonators approximately "in tune" with the incoming sound waves will have amplitudes considerably greater than the mean value, others nearest to those which are coming to rest will have amplitudes less than the mean value.

Therefore, even after one complete sound wave there will be already a clearly marked selection of the "in-tune" group of resonators.

Taking now the physiological effects into consideration, the threshold factor will definitely rule out all amplitudes below a certain value, so that after a certain number of sound waves have entered the ear the amplitude of the "in-tune" resonators will be the first to rise above the threshold and will cause impulses to pass up the auditory nerve. A little later a larger number of resonators will have reached amplitudes above the threshold, so that there should be a gradual increase in the number of resonators in active response, until the full steady value is reached. Calculation shows that the "in-tune" resonator should attain 90 per cent. of its final amplitude in eight vibrations. On the resonance theory one would therefore expect a gradual rise in the sound intensity occurring in a time interval of the order of 10-20 vibrations of the incoming sound waves (*i.e.* 1/25-1/12 sec. for middle C), and not a fall as Mr. Ackermann has suggested in his letter. It would seem that this effect is responsible for the absence of roughness at the commencement of a tone due to the imperception of the transient vibrations of "out-of-tune" resonators.

Now if the rise of sound intensity is a gradual one, what, it may be asked, is the mode of perception of a tone which starts with large amplitude and gradually diminishes as it goes on—*e.g.* a piano note? In such a case it would seem that after a very few vibrations, the swings of the resonators must reach such an amplitude that their motion is perceived. In this case, then, the vibration of "out-of-tune" resonators makes itself perceived because the auditory nerve fibres are taking up responses before there have been sufficient incoming sound waves to damp out the "out-of-tune" resonators. It would seem to be this effect which gives the transient harshness to the commencement of a piano note, causing it to sound to the ear as if it started with a consonant.

H. HARTRIDGE.

King's College, Cambridge.

An Experimental Towing-tank used by Benjamin Franklin.

IN the "Calendar of Industrial Pioneers" in NATURE, May 6, p. 598, relative to the anniversary of William Froude, your correspondent says: "His (Froude) work led to the construction by the Admiralty of the experimental tank at Torquay, the first of its kind ever built."

It will be doubtless interesting to readers of NATURE to have it brought to their attention that Benjamin Franklin in his many and varied investigations in philosophical subjects investigated, to some extent, the difference of navigation in shoal and deep water. In a letter written to Dr. John Pringle, May 10, 1768, he gives the results of experiments made along these lines. The letter tells of how, during a trip with Dr. Pringle in Holland, it was brought to their attention that the *treckschuyt* in one of its trips went slower than usual, due, as the boatmen explained, to the water in the canal being low. After his return to England, not being entirely satisfied with the boatman's explanation, Franklin questioned the Thames river watermen and found them all agreeing as to fact, but differing widely in expressing the quantity of the difference. He, therefore, designed the following experiment, which in its nature is a forerunner of the modern towing-tank. I quote from his letter:

"I provided a trough of planed boards fourteen feet long, six inches wide, and six inches deep in the clear, filled with water within half an inch of the edge, to represent a canal. I had a loose board, of nearly the same length and breadth, that, being put into the water, might be sunk to any depth, and fixed by little wedges where I would choose to have it stay, in order to make different depths of water, leaving the surface at the same height with regard to the sides of the trough. I had a little boat in form of a lighter or boat of burden, six inches long, two inches and a quarter wide, and one inch and a quarter deep. When swimming, it drew one inch water. To give motion to the boat, I fixed one end of a long silk thread to its bow, just even with the water's edge; the other end passed over a well-made brass pulley of about an inch diameter, turning freely on a small axis; and a shilling was the weight. Then, placing the boat at one end of the trough, the weight would draw it through the water to the other.

"Not having a watch that shows seconds, in order to measure the time taken up by the boat in passing from end to end, I counted as fast as I could count to ten repeatedly, keeping an account of the number of tens on my fingers. And as much as possible to correct any little inequalities in my counting, I repeated the experiment a number of times at each depth of water, that I might take the medium. And the following are the results:

	Water. 1½ inches deep.	2 inches.	4½ inches.
1st exp.	100	94	79
2nd "	104	93	78
3rd "	104	91	77
4th "	106	87	79
5th "	100	88	79
6th "	99	86	80
7th "	100	90	79
8th "	100	88	81
	—	—	—
	813	717	632
	Medium 101	Medium 89	Medium 79

PAUL C. WHITNEY.

U.S. Coast and Geodetic Survey,
Washington, D.C., May 22.

An Experimental Confirmation of the Kinetic and Molecular Theories of Magnetism.

CURIE'S law states that ferromagnetics above the critical temperature behave in such a way that the susceptibility (k) is inversely proportional to the absolute temperature (T), in short, that the product $k \cdot T$ is a constant. The physical meaning of this law is that when the molecular magnets have complete freedom of rotational movements, the energy of magnetisation is then only opposed by the energy of thermal agitation and, consequently, any given state is a state of equilibrium.

Below the critical temperature complications introduced by the mutual magnetic actions of the molecules, one on the other, and by the approach to a saturation limit have obscured any such simple law. It is, however, possible to eliminate, or allow for, the effects of these disturbing factors and to make experiments, under hysteresis-free conditions, upon the variation of susceptibility with temperature. Experiments of this kind have been carried out on

iron and nickel, and the reduction of the observations has now been completed, with the result that the Curie law, with certain limitations, is found to apply to the ferromagnetic state, and the relation $k.T = a$ constant is approximately satisfied, but the constant now is of a very different magnitude from the former one. There is, however, this simple and important relation between the constants in the two states—their ratio is the *kinetic energy per unit of temperature per gram of two degrees of freedom*, and is thus immediately connected with the gas constant R. This result is of importance because it shows that the change from the ferromagnetic to the paramagnetic state is quantitatively explicable as due to the acquisition of the kinetic energy per unit temperature required for the two degrees of rotational freedom which are effective in controlling magnetic susceptibility.

Thus there is proof from magnetic data alone, independently of thermal data, that the change at the critical temperature from ferro- to paramagnetism is due to the gain of energy associated with two degrees of freedom.

This acquisition of energy-content makes itself evident in the increase of specific heat which ferromagnetics show at and above the critical temperature, and is quantitatively in agreement with the magnetic result.

It is no longer necessary now to assume, as has been done, that an immense intrinsic *magnetic* field is the cause of ferromagnetism, although it may be convenient to introduce a fictitious magnetic field such that it will give rise to energy effects equivalent to the energy of two degrees of freedom.

The results which have been discussed above are also a confirmation of the simple view advanced by Ewing in his earlier papers on the molecular theory of magnetism, in which he suggests that the loss of ferromagnetic qualities may be caused by the oscillations of the molecular magnets which become wider and wider up to the critical temperature, at which point they pass from vibration to rotation.

J. R. ASHWORTH.

May 30.

Molecular Ælotropy in Liquids.

A VERY remarkable feature shown by many liquids in experiments on the molecular scattering of light is that the scattered beam in a direction transverse to the primary rays shows a large admixture of *unpolarised* light, the proportion of this to polarised light in the scattered beam being several times greater than in the case of the same substance in the condition of vapour at atmospheric pressure. This fact seemed at first very puzzling; an explanation is, however, now forthcoming. A theory of the phenomenon has been worked out by the writer which not only explains the facts in a simple and quantitative manner, but has also pointed out the way to further fruitful research. It may be briefly indicated as follows:

The polarised and unpolarised parts of molecularly scattered light may be conceived as arising in two distinct ways; the former is a *mass-effect* arising from the thermal fluctuations of density in the fluid, and its magnitude is given by the Einstein-Smoluchowski formula

$$\frac{\pi^2}{18} \cdot \frac{RT\beta}{N\lambda^4} \cdot (\mu^2 - 1)^2 (\mu^2 + 2)^2,$$

and as we pass from the condition of vapour to that of liquid in which the molecules are more closely

packed together, it increases much less than in proportion to the increased density. The *unpolarised* part of the scattered light is, on the other hand, a *molecular* effect, and its magnitude increases simply in proportion to the number of molecules per unit volume. The ratio of unpolarised to polarised part of the scattered light should therefore be considerably enhanced. This is exactly what is observed. If I_1 and $2I_2$ are respectively the polarised and unpolarised parts of the transversely scattered light, the ratio $I_2/(I_1 + I_2)$ may be determined experimentally by analysis with the aid of a double-image prism and a Nicol. The Table below shows in the second column the value of this ratio as determined by Lord Rayleigh for certain substances in the state of vapour, in the third column the value of the ratio for the liquid state at ordinary temperature as calculated from the writer's theory, and in the fourth column the value as determined by Mr. K. Seshagiri Rao in the present writer's laboratory. The agreement is significant.

RATIO OF COMPONENTS OF POLARISATION

Substance.	Observed, Vapour.	Calculated, Liquid.	Observed, Liquid.
	Per cent.	Per cent.	Per cent.
Ethyl Ether . . .	1·7	10·9	8·2
Benzene . . .	6·0	39·8	39·8
Chloroform . . .	3·0	18·2	15·5

We may also view the matter in another way. When a substance is in the state of vapour under small pressures, both the positions and orientations of its molecules are absolutely at random, and assuming the molecules to be *ælotropic*, the degree of imperfection of polarisation of the light scattered by it may easily be calculated, as has been done by the late Lord Rayleigh. On the other hand, in the liquid state, the packing of the molecules is so close that their ordering in space is no longer at random; but we may still, at least in the case of ordinary liquids, consider the orientations to be arbitrary without serious error. If we take this into account in determining the resultant effect of the waves scattered by the individual molecules, we should be led to the same result as has been indicated above.

The theory put forward has other notable successes to its credit. The Einstein-Smoluchowski formula indicates that though the density of a liquid diminishes with rise of temperature, its scattering power should increase and become very large as the critical temperature is approached. Similarly, as the temperature is increased, the scattering power of the saturated vapour should increase much more rapidly than in proportion to its density. Accordingly, in both cases, we should expect the polarisation of the scattered light to improve steadily with rise of temperature and become practically complete as the critical temperature of the liquid is approached. Experiments with benzene liquid and vapour made by Mr. K. R. Ramanathan have quantitatively confirmed this prediction. A similar improvement in polarisation has also been observed by Mr. V. S. Tamma in experiments on the scattering of light in *binary liquid mixtures* as the critical temperature for separation into two phases is approached.

C. V. RAMAN.

210 Bowbazar Street, Calcutta,

May 11, 1922.

Recent Investigations of the Lake Dwellings of Switzerland.

By Prof. EUGÈNE PITTARD, University of Geneva.

AS a result of the persistent drought at the beginning of 1921, the level of the Swiss lakes fell considerably, and hitherto-unsuspected depths were brought to light. This phenomenon was particularly marked in the three lakes of Neuchâtel, Bienné, and Morat, in which important areas had already been laid bare by the regulation of the waters of the Jura. Long stretches of beach which, until that time, had not been accessible to the inhabitants of the shore, completely modified the aspect of these lakes.

During the early months of 1921, in those districts in which the men of the polished stone age had built their dwellings, a large number of piles gradually

culture of these ancient populations. We have obtained, to some extent, an insight into their mode of life; we can frame hypotheses as to their race; but there are still many problems which require elucidation. I will indicate here a few of these problems which relate to the neolithic period.

1. We do not yet know with certainty to which ethnological group to assign the builders of the lake dwellings and their successors up to the end of the bronze age. It has been held, on the evidence of bones recovered from among the piles, that this type of habitation was invented or introduced by brachycephals—until that time unknown in Western Europe.



FIG. 1.—Part of the site at Greng, Lake of Morat.

emerged which the present generation had seen only under several feet of water. It was a revocation of vanished ages which appealed to the emotions. It enabled the imagination to reconstruct more readily a picture of those who, thousands of years ago, were the authors of the greatest of social changes when they introduced the cultivation of cereals, the domestication of animals, and the like. From day to day more and more of the substructure of these cities of the lake was uncovered, and from all parts travellers came to look upon this impressive spectacle, which perhaps we shall never see again.

It will be readily understood that such exceptional conditions encouraged Swiss men of science to undertake fresh investigations on several of the lacustrine sites.

The numerous finds which have been made since 1854 in all the lakes which were at one time inhabited by men of the stone age and the bronze age have enabled us to reconstruct, in great part, the material

Further, that this race held its own on the Swiss lakes until the end of the neolithic age, when dolichocephals begin to appear in the lake-dwelling sites, coming, perhaps, from the north. (Their ethnical affinities also are still to be determined. Will our hypotheses stand?)

2. The dispositions of lake-dwelling sites, their town planning, if one may use the phrase, is, in essentials, unknown. Even the extent of the ground they covered in many cases has not been determined exactly.

What exactly was the topographical plan of each site? Were the sites, that is, those of the same epoch and situated on the same lake, arranged on a specific plan, identical throughout, or was a free rein given to the fancy of the builders in each case? In other words, was there a type of lake village, and, if so, what was it? Was the lacustrine city an organic whole, with the houses grouped on one frontage, or was it composed of a series of small islands, and, in that case, what were the dimensions and dispositions

of these islands? Did they communicate with one another by bridges or by navigable canals? If so, what were the measurements and arrangement of these bridges or canals?

What was the form of the dwellings? Those authors who have attempted to reconstruct groups of lake dwellings have differed remarkably in their attempts. These diversities show how little solid basis there is for our knowledge in this matter, notwithstanding the evidence from sites such as Schüsslenried, Robenhausen, Niederwil, etc. Was the settlement protected against the waves caused by prevailing winds by some projecting construction—it may be assumed, a stockade of piles?

3. Do the most important of the articles in daily use by the inhabitants of the lake dwellings in the

tions on sites which are always submerged. The diving bell alone can be used. It is for this reason that the persistent drought at the beginning of the year 1921 has proved so favourable to research.

Let us now consider the results which were obtained in the course of recent investigation.

Very few human skeletal remains of neolithic age were found; but an important discovery was made at St. Aubin. In the lowest stratum of this site, which is the oldest of the Swiss neolithic lake-dwellings, M. Vouga found a human cranium, which was sent to me. It is unquestionably dolichocephalic. This is the first piece of definite evidence of this character. Does it affect previous hypotheses as to the race of the builders of the lake-dwellings? I do not think on such slender evidence we can maintain that it does.

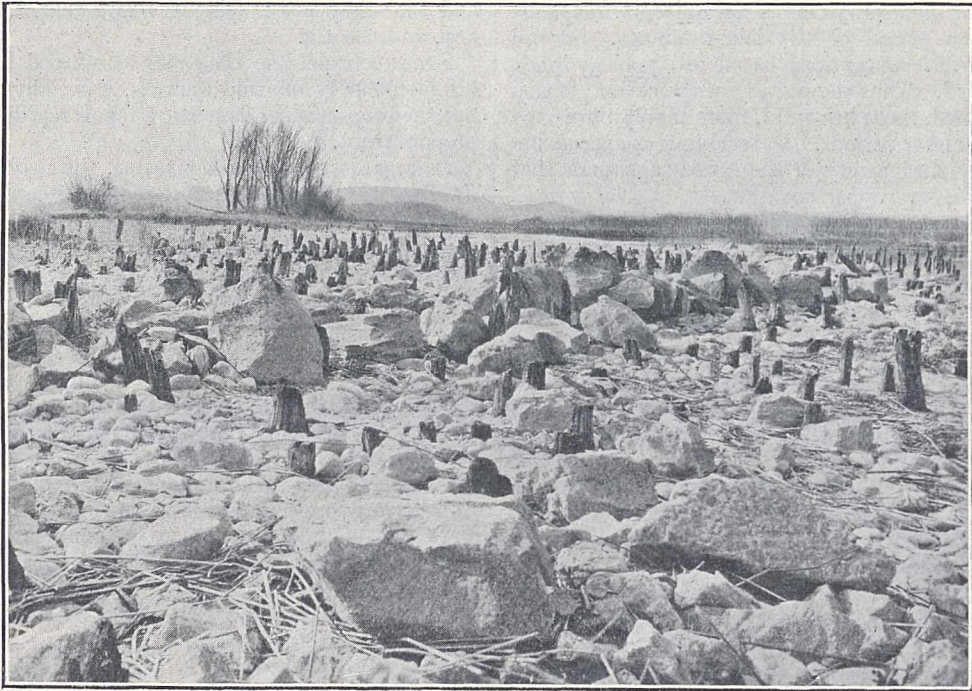


FIG. 2.—Part of the Neolithic site at Greng, Lake of Morat.

neolithic period date from the beginning of lake settlements? Were the various types of objects which are exhibited in the cases of our museums invented at different ages in accordance with the growth of needs, or were they in use in the earliest period? This question can be settled finally only by stratigraphical study.

4. Were the five domesticated animals of the neolithic period (the ox, the dog, the pig, the goat, and the sheep) present in the earliest period of the lake dwellings, or may we accept the suggestions put forward by various authors that these domestic animals were introduced gradually during the age of polished stone?

These are a few of the questions which still await an answer, notwithstanding the numerous investigations which have been undertaken since the memorable winter of 1853-54. The solution of these problems is naturally very difficult owing to the nature of the ground upon which investigations have to be carried out. It is not easy to make stratigraphical observa-

The skull in question is feminine, from which fact we may conclude that it belonged to an inhabitant of the site at St. Aubin and not to a foreigner, whose head might perhaps have been brought home as a trophy of war. The discovery, however, is of importance, because it was made in the course of investigations on stratigraphical lines. It is not a skull unearthed at hazard from the mud or sand. It was *in situ*.

In the course of the spring and the summer of 1921, two detailed topographical surveys were made—one, at my suggestion, at Greng in the Lake of Morat (Figs. 1 and 2) by MM. Le Royer and Winkler, the other on the foreshore of Geneva. This is the first time that any work of this character has been undertaken in Switzerland. The station at Greng was not completely surveyed. A record was made of the position of those piles only which were left uncovered by the fall of the lake and of those which were in shallow water. At Geneva, work of considerable extent was undertaken

by MM. Le Royer and Blondel. It has recently been completed (April 1922). Among the conclusions which emerge, it is now clear that the inhabitants of the lake-dwellings in the polished stone age had constructed stockades facing the open water, for protection against the waves raised by the prevailing northerly wind. These breakwaters must have afforded the dwellings relatively smooth water. From these investigations it may also be concluded that the lake-dwelling sites of Geneva were of considerable size. Unfortunately of these there remain to-day only some thousands of piles implanted in the bed of the lake.

Geneva is thus one of the most ancient cities of the world, since man has lived on this site continuously ever since the neolithic period.

The stratigraphical investigations undertaken by M. Vouga enable us to establish with certainty the succession of the types of industrial objects throughout the neolithic period of the lake-dwellings. Several of our *a priori* conceptions based on typology must be abandoned. Thus the pottery of the earliest period is more refined, more beautiful, more highly burnished than that of later periods. In technique it approaches more nearly the pottery of the bronze age than that of the middle and upper neolithic.

Thanks to a careful study of the stratification of objects found at Auvernier, M. Vouga has been able to plot out the progressive modification of several objects in daily use, such as the axe-hafting sockets of stag horn, flint arrow-heads, and the like.¹

In many cases, however, stratigraphical study has only slightly modified classifications, such as those of Ischer, based upon the typology of lake-dwelling sites which have been investigated with minute care.

Other observations of importance for the history of culture have also been made by M. Vouga:—

The lowest stratum (IV.) has not yet yielded any of the spindle whorls which are necessary for weaving. The art of drilling stone would appear to begin in Stratum III., but only in the triangular axe hammer-head. The true perforated axe hammer-head appears much later—in Stratum I.

In Stratum I.—the latest—appear flint flakes of Grand-Pressigny type. Relations between Switzerland and western France are thus clearly established.

For the first time *all* bones found in the excavation of a lake-dwelling site have been preserved. My

¹ I would refer the reader to the reports published by M. Vouga in "Indications d'Antiquités suisses" in the *Arch. suisses d'Anthrop. Gén.*, Geneva, 1921 and 1922.

assistant, Dr. Reverdin, and myself have examined more than 4000 mammalian bones from the station of St. Aubin. Our conclusions, which are valid only in respect of the material obtained and for this site, may be summarised as follows:—In the neolithic period corresponding with the earliest lacustrine sites, the horse was not domesticated. It was not even hunted, or, if it was an object of the chase, its flesh was not brought back to the lake-dwelling. If this were the case, would it not be permissible to suggest a taboo as the reason? The five domesticated animals of the neolithic period were represented in the lake-dwellings from the earliest times. Accordingly, the suggestion that domestic animals appear at different stages cannot be accepted. It is true that these five animals are not represented in equal abundance. At the beginning of the period of domestication, the goat and the sheep are much more rare than the ox, the dog, and the pig.

For a considerable time man continued to rely for his food-supply on wild animals, especially the stag; but the proportion of domestic animals rapidly becomes preponderant.

As regards their culinary tastes, the neolithic lake-dwellers seem to show a preference for certain of the domestic animals. The species of which they ate most abundantly were the ox and the pig; next come the dog (though it is not certain that the dog was eaten), the sheep, and the goat. What is the reason for this order of preference? Does it depend upon a special taste for any particular meat? Would they not in that case rear in large numbers only those species which they appreciated most?

The lake-dwellers in the stone age ate the domestic animals when they were full grown, except in the case of the pig. This animal was frequently eaten while it was young, and even when it was still a sucking pig. The ox and the goat were never eaten when quite young. The distinction was dictated, without doubt, by the desire to use the milk-giving qualities of the cow and the goat, and also, perhaps, the sheep, as long as possible, but this explanation does not affect the males of these species.

It thus appears that the exceptionally low water in the Swiss lakes in 1921 has not been without interest to science. Thanks to this phenomenon, some new and important facts have been recorded in the history of the culture of the neolithic lake-dwellers and, at the same time, of all the neolithic peoples.

Vitamin Problems.¹

By Prof. A. HARDEN, F.R.S.

THE existence of three vitamins, termed A, B, and C, has now been firmly established and a general idea has been obtained of their distribution among animal and vegetable organisms. Hitherto, comparatively little quantitative work has been done in this direction, and further progress must depend on a more general adoption of quantitative methods. These are at present tedious and not very accurate. In the case of each of the vitamins the requirements of the special animal employed serve as the unit of

comparison and these vary considerably from individual to individual, so that many observations are necessary if any, even moderate, degree of accuracy is to be attained. Thus in the estimation of the antiscorbutic potency of food materials, by the method worked out by Miss Chick and her colleagues at the Lister Institute, it has seldom been possible to achieve a greater accuracy than about 25-50 per cent. This obviously imposes a very serious limitation on any attempts to study variations in potency unless these are of a very gross order. Another great difficulty inherent in this kind of observation is that when the

¹ Abridged from a Discourse delivered at the Royal Institution on Friday, April 28.

potency is low, the necessary dose of the material to be tested is correspondingly high, and soon transcends what is permissible without interference with other necessary conditions of the diet, such as protein content, etc. Very much the same conditions hold with regard to Vitamin B, especially when this is estimated by the effect of the material on the growth of rats; and, as a matter of fact, the great bulk of the work carried out in America by this method is not strictly quantitative, but simply leads to the result that a certain ration does, or does not, suffice for the growth of a young rat.

As regards Vitamin A the method of Zilva and Miura promises to yield moderately accurate and consistent results. This is attained by keeping the experimental animals (young rats) on a diet totally deficient in Vitamin A until they have ceased to grow, and then ascertaining the minimum dose of the material to be tested which will induce definite and steady growth for four weeks. Animals which do not cease to grow in three weeks are rejected, greater uniformity in the results being thus attained. The test material is, whenever possible, administered quantitatively to the animal and not, as was formerly the practice, mixed with the ration in a known proportion. One of the immediate results of the application of this method has been the discovery that cod-liver oil, formerly classed with butter as a good source of Vitamin A, is in reality 200-250 times as potent as butter and is, along with similar fish-liver oils, by far the richest in this material of all the substances which have so far been examined.

A further piece of information, which is essential for the detailed study of these substances, is their behaviour towards heat, oxidation, etc. In this respect some progress has been made, and it may be stated with some confidence that both Vitamins A and C are moderately stable towards rise of temperature, provided that air be excluded, whereas in the presence of air they are rapidly inactivated. Whether the effect of air is reversible or not has not yet been ascertained. Vitamin B, on the other hand, appears not to be affected by air and is also moderately stable towards rise of temperature. None of the three vitamins is easily inactivated by hydrolysis under anaerobic conditions, and this fact has led to the interesting observation that Vitamin A, although usually associated, in the animal organism, with fat, is not itself a fat but remains in the unsaponifiable residue with almost unabated potency. This indicates how small a weight of the vitamin itself is necessary for the daily ration of a young rat. In some cases as little as 1.2 milligram of the oil is sufficient to permit of definite growth, and of this only 1-2 per cent. is unsaponifiable, while, as is well known, the chief constituent of the unsaponifiable matter is cholesterol, which has itself no vitaminic potency. The actual requirement of the vitamin itself must therefore be of the order of 1/500 milligram per diem. The other two vitamins have not been obtained in so concentrated a form, but it appears highly probable that they too are present in foodstuffs only in infinitesimal amounts.

The origin of all three vitamins is to be sought in the vegetable kingdom. The production of Vitamin

A has been followed (Coward and Drummond) from the seed, and it has been found that it does not appear until the photosynthetic processes begin. Thus sunflower seeds are almost devoid of it, and so are the etiolated seedlings formed when these seeds germinate in the dark. In the light, on the other hand, the green seedlings, grown in a medium free from the vitamin, produce it freely. This vitamin is often closely associated with the carotene and xanthophyll of plants; so intimately, indeed, that it was at one time thought that it might be closely related to, if not identical with, one of them. The association, however, although very frequent, is not essential, and no definite relation can be shown to exist between the two. Vitamin C is either absent from seeds or only present in them in very minute amount, but appears when the seed germinates and before any green parts are formed. Nothing is, however, known of the inactive pro-vitamin or of the process by which it is rendered active.

Concerning the origin of Vitamin B a considerable amount of discussion has taken place. Its presence in a large proportion in yeast points to the probability that it can be produced without the intervention of light, and both in America and in this country it has been found that yeast can actually produce the vitamin when grown in a "synthetic medium" comprising only substances of known composition and free from the vitamin in question. Recently, however, Eijkman, in Holland, has obtained a contrary result, so that this question remains at the moment open.

The animal organism appears to be unable, in normal circumstances, to produce any of these principles for itself, and hence the amounts found in animal products depend ultimately on the diet of the animal. This opens up, among many other problems, the important question of the vitaminic properties of milk, and there seems to be no doubt, from experimental work, both here and in America, that these properties are profoundly affected by the diet of the cow. Milk obtained in winter when the animals are stall-fed has been shown to be markedly deficient in Vitamin A, and there is also great danger of a deficiency of Vitamin C. One of the pressing requirements of the moment is the careful quantitative examination of foodstuffs available for the feeding of cattle, so that a rational system of winter feeding can be adopted which will produce milk as good as that given in summer. Such an examination would seem naturally to fall within the purview of the Board of Agriculture.

The evil results of a deficiency of Vitamins B and C, especially in the diet of children, are well known—beri-beri and scurvy, latent or patent—but the effect of a lack of Vitamin A is not so well recognised or so universally acknowledged. One school considers that a deficiency of this vitamin is at least a prominent factor in the causation, if not, as they formerly held, the sole cause of rickets. Others consider rickets to be a disease brought on by non-hygienic surroundings, lack of fresh air and exercise, etc. The latest experimental results show that rickets (in rats) can infallibly be produced by dietetic changes, but that the lack of Vitamin A does not of itself lead to the disease unless at the same time the diet is faulty as regards the supply of calcium or phosphorus. This faulty mineral supply

does not usually lead to true rickets if sufficient Vitamin A be present, although the bone formation under these circumstances is not quite normal. This explains the well-known curative effect of cod-liver oil in rickets. So marked is the effect of this remedy, that McCollum, not appreciating the relatively enormous concentration of Vitamin A present in it compared with that in butter, as proved by Zilva, has suggested that cod-liver oil contains some other specific substance absent from butter, to which its great superiority is due. The difference, however, seems to be merely quantitative, and the further complication suggested by McCollum appears to be unnecessary.

These experiments on rickets have led to what promises to be a discovery of far-reaching importance. Rats on a diet, which in the laboratory will infallibly

produce rickets, do not acquire the disease if they are exposed to sunlight in the open air or to ultra-violet radiation, and rats which have acquired the disease can be cured by either of these treatments, just as they can be cured by the administration of cod-liver oil. Sunlight and ultra-violet radiation have also been found to be effective cures or preventives of rickets in children. The cures by light and by cod-liver oil seem to proceed in precisely the same way, and the idea naturally suggests itself, especially to the mind of a chemist, that the light actually brings about the synthesis of the Vitamin in the animal body just as it does in the plant. This idea still awaits experimental verification or disproof; but there is no doubt that the discovery of this function of light will lead to profoundly important developments in our knowledge.

Obituary.

PROF. W. GOWLAND, F.R.S.

PROF. WILLIAM GOWLAND died on June 10 in his eightieth year. He had originally intended to enter the medical profession and actually worked with a medical man in Sheffield for two or three years. Afterwards he became a student at the Royal College of Chemistry, from which he passed in 1868 to the Royal School of Mines. Two years later he obtained the associateship both in mining and metallurgy. He was awarded the Murchison medal in geology and the De la Beche medal in mining.

His first post was that of chemist and metallurgist to the Broughton Copper Company, Manchester. Two years later he went out to the Imperial Mint at Osaka, Japan, and held the post of chemist and metallurgist there for six years. During the next eleven years he acted as assayer, metallurgist, and chief of the foreign staff at Osaka, and was for some time adviser to the Imperial Arsenal. His work was of a decidedly varied nature, and he did much to introduce Western metallurgical and chemical methods into the departments with which he was associated. It was during this period that he acquired the knowledge of Japanese methods of extracting, refining, and working metals for which he afterwards became so famous. He carried out exploration work in Korea on behalf of the Japanese Government, in the course of which his expedition had some lively skirmishes with the natives.

As a young man Prof. Gowland was a keen oarsman, and was the first to introduce rowing into Japan. He had two modern "eights" built to encourage boat-racing among the staff of the mint, but they found these craft too unstable for their liking. Eventually they decided to choose their own boats and presented two for his inspection: He found they had selected a pair of "cutters" and had fitted each with port and star-board lights. He was also the first to initiate the Japanese into the use of the wheelbarrow. He had occasion to do this in connexion with some excavation work in the copper mint, and provided the labourers with barrows. The next morning he was astonished to find that the wheels had been removed and the sturdy Japanese were carrying the loaded wheelbarrows. On leaving Japan in 1889, the order of "Chevalier of the Imperial Order of the Rising Sun" was conferred

on him personally by H.I.M. the Emperor of Japan. During his residence there he gradually built up a very fine Japanese art collection, which included some valuable kakemonas.

Returning to England, Prof. Gowland acted as chief metallurgist to the Broughton Copper Company for some years, and in 1902 was appointed professor of metallurgy at the Royal School of Mines, in succession to the late Sir William Roberts-Austen. This post he held for seven years and retired in 1909.

So far as metallurgy is concerned, his chief interest lay in the non-ferrous metals, principally copper, silver, gold, lead, and their alloys. His knowledge, in particular, of the metallurgy of copper was unique, based as it was upon experience of the best methods in vogue, both in the East and West. In 1914 he published a textbook on the metallurgy of the non-ferrous metals which quickly became recognised as an authoritative work on the subject, and is now in its third edition. He also contributed various papers to the Institution of Mining and Metallurgy, the Chemical Society, and the Society of Chemical Industry. He was an original member of the Institute of Metals, its third president, and its first May lecturer. In 1907 he was elected president of the Institution of Mining and Metallurgy, and in 1909 was awarded the institution's gold medal.

There was, however, another side to his intellectual interests, as shown by his membership of the Society of Antiquaries, the Royal Anthropological Institute, and the Numismatic Society. His publications under these heads were numerous and varied, dealing with, *e.g.*, the early metallurgy of silver and lead, the remains of a Roman silver refinery at Silchester, the burial mounds and dolmens of the early Emperors of Japan, and silver in pre-historic and proto-historic times. From 1905 to 1907 he acted as president of the Royal Anthropological Institute.

Prof. Gowland was a man of great personal charm and distinction. He was extremely thorough in all he undertook, and never spared himself in the execution of his duty. His lectures were very carefully prepared and well delivered. The geniality of his disposition made him a general favourite with his colleagues and students, and he will always be affectionately remembered at the Royal School of Mines. H. C. H. C.

E. W. L. HOLT.

It is with deep regret that we record the death in London on June 10, at the age of fifty-seven, of Mr. Ernest William Lyons Holt, Chief Inspector of Irish Fisheries. Educated at Eton, where he won the Biological Prize, he entered the Army through Sandhurst and joined the Duke of Cornwall's Light Infantry, with whom he served in the Nile Campaign of 1884-5 and afterwards in the Burmah War 1886-7, during which his health broke down and he was invalided home.

Retiring from the Army, Holt took up the study of natural history, in which he had always been interested. His first zoological research was carried out at the St. Andrews Marine Laboratory, and resulted in a paper on the morphology of the brain of fishes, especially of the herring, which was communicated in 1890 to the Royal Society of London. In the same year he was appointed assistant-naturalist for the survey of fishing grounds on the west coast of Ireland, which was being carried out by the Royal Dublin Society. As the result of cruises carried out in 1890 and 1891 a valuable series of papers was published, the most important of which dealt with the eggs and larvæ of fishes, while in others the economic aspects of scientific fishery investigation were ably dealt with.

In 1892 Mr. Holt was appointed by the Marine Biological Association to take charge of a laboratory which was opened near Grimsby for the purpose of studying the fishery problems of the North Sea. Here for three years he successfully carried out investigations dealing with all aspects of fish life in their relation to commercial fisheries, paying special attention to the destruction of immature fish by trawling, a question which was thought at that time to be of the greatest practical importance. On leaving Grimsby, he spent some time in the south of France, where he resumed his studies on eggs and larval stages, publishing a finely illustrated memoir on this aspect of the natural history of Mediterranean fishes. Following this, three years were spent at the Plymouth Marine Laboratory, where he not only continued and extended his work on fishes, but took up the study of several groups of invertebrates which are largely used as food by fishes.

In 1900 Mr. Holt returned to Ireland, where he became scientific adviser to the fisheries branch of the

Department of Agriculture and Technical Instruction, succeeding the Rev. W. Spotswood Green as chief inspector of fisheries in 1914. Under his direction an important survey of the fishing grounds, especially to the west and south-west of Ireland, was organised and carried on for a number of years, the deep water of the Atlantic slope receiving a large share of attention. Mr. Holt gathered around him a brilliant staff of young naturalists, and an excellent series of reports was published. He continued to devote himself personally to the study of fishes, and included fresh-water fishes, especially the salmon, in his studies. His personal knowledge of fish life in all its aspects was probably greater than that of any other British naturalist, and at the same time he was a keen student of the literature of the subject. In his earlier years he had great facility as a draughtsman, and his papers were beautifully illustrated with his own drawings. He possessed an acute and critical intellect, a sound sense of proportion, and a quick eye for the things that really mattered in connexion with any question he took up. His work was greatly helped by a gift of rapid literary expression, accompanied by a quiet humour, which always made his writings interesting. His mind was essentially honest, he suffered from no illusions, and did his best to destroy what he thought were illusions in others.

E. J. A.

WE much regret to announce the death, on June 26, at the age of seventy-three years, of Albert, Prince of Monaco, well known for his oceanographical research work.

WE regret to see the announcement of the death, on June 22, of Sir Alexander M'Robert, at the age of sixty-eight years. After acting for a time as a lecturer in experimental physics and in chemistry, in Aberdeen, Sir Alexander went to India, where he passed the greater part of his life, closely associated with technical education. He was made a fellow of the University of Allahabad in the Faculty of Science, served on the committee of management of the Government Engineering College, Roorkee, and also as governor of the Agricultural College, Cawnpore. Sir Alexander had travelled extensively in many parts of the world, and received knighthood for his services in 1910, being created K.B.E. in 1919.

Current Topics and Events.

THE Council of the Zoological Society of London has approved a scheme for the establishment of an aquarium at the Zoological Gardens in Regent's Park. The aquarium is to be built under the Mappin Terraces, but so installed as to be invisible from the front, and will not interfere with the panorama of the Terraces. It will consist of a crescentic gallery, 400 ft. long, lined with tanks on both sides. Those on the outer curve will have both daylight and electric illumination, while those on the inner curve will be lighted by electricity only, a method used at the Berlin Aquarium with complete success. The gallery will be divided into three parts—fresh water, marine, and tropical

aquaria—with special ponds for seals, diving birds, and trout. The tanks are to be constructed with the bottoms, sides, and backs of slate, and the fronts of polished plate glass set in a framework of white marble. They will be provided with rock-work arranged to suit the needs of their inhabitants. The water will be kept constantly circulating, flowing into the tanks from high-level reservoirs and thence through a series of underground filter-beds, on the plan of those in use at the New York Aquarium, to low-level reservoirs, from which it will be pumped by electric pumps to the high-level reservoirs again. Special arrangements are to be installed for heating

the tanks and for regulating the temperature of the water in the different aquaria. The plans for the gallery have been prepared by Messrs. Belcher and Joass, and the circulation, electric plant, and the heating, lighting, and ventilating systems have been designed by Sir Alexander Gibb. The scheme will cost about 50,000*l.*, and should provide London with the best-equipped and most carefully arranged aquarium in Europe.

A THIRD attempt to reach the summit of Mount Everest began on June 3. The monsoon being due to arrive early in June, it was clear that this must be the last attempt this season. The *Times* gives an account by Capt. Finch of his ascent with Capt. Bruce to 27,300 ft. in the previous attempt. The oxygen apparatus did not prove satisfactory and only one in ten was fit for use, but by reassembling the sound parts four serviceable sets were obtained. By the help of oxygen the climbers reached the North Col perfectly fresh and camped at 25,500 ft. A heavy gale with snow set in and lasted for two days, making progress impossible. When a start was made the Gurkha with the party collapsed and had to be sent back. Eventually, after five hours' diagonal climbing, Messrs. Finch and Bruce reached an altitude of 27,300 ft. The wind and cold were then so severe that they were compelled to turn, and reached No. 3 Camp thoroughly exhausted. A telegram from Jangkok, Sikkim, dated June 22, states that Dr. Longstaff, Major Morshead, Colonel Strutt, and Captain Finch have arrived there on their return from Tibet.

THE growing interest in metallography is well illustrated by the establishment of the Metallografiska Institutet of Stockholm, the formal opening of which has recently taken place. The new Institute is under the direction of Dr. Carl Benedicks, whose work on the physical chemistry of metals is well known. An inaugural address was delivered by Prof. Arrhenius, who referred to the international character of scientific research, as shown by the presence of foreign representatives at the ceremony, and by the review of the history of metallography contained in the address of Dr. Benedicks. Beginning with the work of Sorby in Sheffield, and continued by many workers, among whom the French worker, Osmond, was prominent, metallographic research has always preserved an international character. It was announced that Sir Robert Hadfield, who has himself made many important contributions to this branch of study, had presented to the Institute an annual sum of 150*l.* for two years, to form a scholarship for a research worker, Englishmen having a preference. In his statement regarding this foundation, Sir Robert Hadfield directs attention to the remarkable contributions made by Sweden to chemistry, and especially to the chemistry of metals. The metals used in the manufacture of alloy steels, such as nickel, cobalt, tungsten, molybdenum, and vanadium, were discovered by Swedish chemists, while direct contributions to metallurgy have been made by many of their compatriots, from Swedenborg

and Bergman to Akerman and Brinell. The recent important work of Dr. Westgren on the space lattice of the allotropic modifications of iron, as determined by means of X-rays (*NATURE*, June 24, p. 817), is an addition to the record of which Sweden may be proud. It must not be forgotten, also, that the Sheffield steel industry owes its existence to the use of the pure Swedish irons obtained from native ores.

THE *Quest* arrived at Cape Town on June 18 from South Georgia via Tristan da Cunha and Gough Island. The *Times* announces that, in view of the low power and small size of the ship, it has been decided to abandon the proposed cruise in search of lost islands in the Southern Ocean and to return home. Landings were made at Tristan da Cunha, Inaccessible, Nightingale, and Gough Islands. At the last of these islands several days seem to have been spent ashore, during which some biological collections were made. The visit of the *Scotia* in 1904 showed that Gough Island has a most interesting fauna and flora, particularly worthy of study because the nearest land, with the exception of the Tristan da Cunha group, is South Africa, which is some 1500 miles distant. Details of the *Quest's* deep-sea soundings are not given, but they should be of great interest, since between South Georgia and Tristan da Cunha she traversed an area of the ocean in which practically no soundings have previously been taken.

NEWS from Mr. Knud Rasmussen, published in the *Times*, gives some account of his work in Melville Peninsula and Fox Basin until the middle of last January. The autumn was spent around Lyon Inlet, which offered scope not only for biological work, but also for researches into Eskimo archæology. During the winter, Mr. P. Freuchen was engaged in charting the western coast of Baffin Land against Fox Basin, which was imperfectly known. Mr. Rasmussen himself went south to Chesterfield Inlet near the mouth of Baffin Bay. To the west of this inlet two tribes of inland Eskimo are reported to live. This is of interest because all other tribes of Eskimo are coast dwellers. This autumn Messrs. Rasmussen and Freuchen hope to start on their long journey to the west across the Barren Lands through the area inhabited by the Kinipetu tribe, in an attempt to investigate the original routes of migration of the Eskimo, and to throw light on their origin.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, has left Washington to continue his geological explorations in the Canadian Rocky Mountains. Dr. Walcott's work in previous seasons has done much towards clearing up the geological formations of this interesting region, and many thousands of fossil specimens have been brought back to add to the completeness of the exhibition and study series of the U.S. National Museum. One of the important results several years ago was the discovery of fossil bacteria in the pre-Cambrian rocks, probably the earliest form of life on the earth. The section to be studied this year will take in several localities north and south of the Bow Valley between

Banff and Lake Louise on the Canadian Pacific railroad. The particular problems to be attacked are connected with the growth of certain formations and the sequence of marine life in the rocks composing them. It is expected that many photographs of glaciers, mountains, and forests will be obtained.

At the meeting of the Royal Society of Edinburgh on June 19, the Keith Prize (1919-1921) was presented to Prof. R. A. Sampson for his astronomical researches, including the papers "Studies in Clocks and Time Keeping: No. 1, Theory of the Maintenance of Motion; No. 2, Tables of the Circular Equation," published in the Proceedings of the Society within the period of the award; and the Neill Prize (1919-1921) was presented to Sir Edward Sharpey Schafer, for his recent contributions to our knowledge of physiology, and in recognition of his published work, extending over a period of fifty years.

WE have received an intimation that the Italian Royal Committee for Scientific Marine Investigations has assumed charge of the Zoological Station at Rovigno, Istria, which was formerly under German administration, and that the station is now in active work, with Prof. Raffaele Issel as Director.

THE second lecture of the series on physics in industry, arranged by the Institute of Physics, will be given on Tuesday, July 4, at 5.30 p.m., in the hall of the Institution of Electrical Engineers, Victoria Embankment, W.C.2, by Sir J. Alfred Ewing, whose subject will be "The Physicist in Engineering Practice, with Special Reference to Applications of Thermodynamics." The chair will be taken by Sir Charles A. Parsons, vice-president of the Institute.

THE fifth international Neo-Malthusian and Birth Control conference will be held in London on July 11-14, under the presidency of Dr. C. V. Drysdale. Many delegates from abroad are expected and the discussions have been arranged to take place in several sections. A visit to Dorking is arranged for July 15. This was the birthplace of the Rev. T. R. Malthus, author of the famous essay on the Principle of Population.

The American Geologist, which in 1905 was merged with *Economic Geology*, now resumes independence as *The Pan-American Geologist*. This monthly journal, devoted to speculative geology, constructive geological criticism, and geological record, is edited by Dr. Charles Keyes, Des Moines, Iowa. The associated editors are Edward W. Berry, Baltimore, Md.; Eliot Blackwelder, Cambridge, Mass.; Henry S. Washington, Washington, D.C.; and Gilbert D. Harris, Ithaca, N.Y. The first issue, volume xxxvii. No. 1, appeared in February last.

RECTANGULAR glass jars suitable for the exhibition of museum specimens were, before the war, generally obtained from Germany. Recently some attempt has been made to draw again on that source, but the difficulties remain considerable. For many years the Museums Association has sought to rouse British manufacturers to the desirability of meeting the ever

increasing need, but it is only now that any satisfactory result has been attained. We understand that there are at least two firms willing and able to meet the demand. The June number of the *Museums Journal* publishes a list of the sizes that can readily be made and asks curators to state their needs without delay. We regret to learn that Dr. Tattersall, the secretary of the Association, to whom this development is due, is at present ill, but letters may be addressed to the Secretary of the Museums Association, care of E. E. Lowe, The Museum, Leicester.

THE Journal of the Society of Glass Technology of May contains papers on the melting of glass, the action of analytical reagents on glass, methods used in determining the durability of glass, Zulkowski's theory of the relation between the composition and durability of glasses, and other subjects. It is clear from the contents of various issues of this journal which have been received that research on glass and matters relating thereto is proceeding in a very satisfactory manner, and the great improvements which must result from this scientific investigation may be expected to have a most beneficial effect on the British glass industry. It is satisfactory to note that the Journal is acquiring an international status, since one paper in the present issue comes from the Geophysical Laboratory of the Carnegie Institution of Washington, although many of the best papers owe their inception to the work of Prof. Turner, of the Department of Glass Technology of the University of Sheffield.

ON Wednesday June 7, a lecture was given by Prof. A. F. Holleman, of Amsterdam, at the Imperial College of Science and Technology, under the auspices of the University of London, entitled "Recent Researches on Substitution in the Benzene Nucleus." After a brief statement of the position of the subject at the time (1910) of the publication of his book, "Die direkt Einführung von Substituenten in den Benzolkern," Prof. Holleman dealt with the qualitative and quantitative investigations which have since been carried out in the laboratories at Amsterdam. Considering the matter in the light of his own and Boësen's theory as to the mechanism of substitution (involving primary addition to one or other of the Kekulé double bonds), it was shown that in many complex instances the extent to which substituents enter the different positions can be predicted with fair accuracy from the general rules which have emerged from the experimental study of the simpler cases. Full emphasis was laid on the exceptions and unforeseen results. Indeed the whole discourse was highly critical and gave an illuminating insight into the methods by which, under Prof. Holleman's direction, the workers at Amsterdam are gradually reducing to ordered measure the whole chemistry of benzene substitution.

IN the editorial remarks in the opening pages of the Journal of the British Science Guild for May, attention is directed to a departure, namely, the inclusion of matter going beyond the actual records of the work of the Guild. No doubt the wider scope

thus afforded in emphasising the benefits of applied science will be appreciated by readers. Interesting light is shed on two incidents during the war—the Coronel sea-battle and the German advance in 1914—both illustrating the importance of accurate information regarding warfare on land and sea. Among other matters that are the subject of editorial comment may be mentioned “The Science of Sailing,” “The Bases of Politics,” and “The Need for a Scientific Missionary Journal.” Much of the issue is naturally devoted to the annual report of the Guild and the annual meeting. Special interest attaches to the address of Sir Richard Gregory explaining the origin of the appeal to be conducted by Commdr. L. C. Bernacchi for funds to consolidate and extend the Guild’s activities. Among other important steps may be mentioned the establishment of local branches of the Guild and the completion of the catalogue of scientific books, comprising over 6000 entries—in itself a remarkable piece of work that justifies the Guild’s existence. A summary is given of Sir Leslie Mackenzie’s address at the Edinburgh meeting of the British Association on “Science and Citizenship,” and a tribute is paid to the memory of Sir Ernest Shackleton, whose passing away on the *Quest* at the commencement of this year will be fresh in the minds of readers, and whose achievements in the field of polar exploration will not soon be forgotten.

A NEW catalogue (No. 94) of second-hand works on Zoology, Botany, and Agriculture has been

issued by Messrs. Dulau & Co., Ltd., 34 Margaret Street, W.1. Among the 1400 volumes listed are two of especial interest, namely, a nearly complete set of *Cyrtis’s Botanical Magazine*, formerly the property of Sir Joseph Hooker, with MS. corrections in nomenclature by Sir W. J. and Sir J. D. Hooker, and an unusual French Herbal, entitled “Recueil des plantes les plus usuelles peintes d’après Nature,” in 12 vols. containing nearly 5000 illustrations drawn and coloured by hand, with manuscript descriptions.

MESSRS. W. HEFFER & SONS, Ltd., Cambridge, have just issued a list (No. 213) of some 600 works in new condition which they offer at greatly reduced prices. Many of the books listed deal with scientific subjects. The catalogue is obtainable from the publishers upon request.

A REPORT of the address given by Mr. F. W. Sander-son to the National Union of Scientific Workers, just before his death, is to be published shortly. Copies may be obtained from Maj. A. G. Church, General Secretary, 25 Victoria Street, S.W.1.

THE firm of Mr. T. Fisher Unwin, Ltd., 1 Adelphi Terrace, London, W.C.2, is arranging for the publication of the memoirs of Sir William Crookes, edited by Dr. Fournier d’Albe. Any letters and information likely to be useful to the editor will be gratefully received and carefully preserved and returned.

Our Astronomical Column.

SKJELLERUP’S COMET, 1922 *b*.—This proves to be a short-period comet of the Jupiter comet-family. The following elliptical orbit has been derived from observations on May 20, 31, June 12, the third being by Dr. W. H. Steavenson at Norwood.

$$\begin{aligned} T &= 1922, \text{ May } 15, 0.0325 \text{ G.M.T.} \\ \omega &= 354^\circ 47' 20'' \\ \Omega &= 215^\circ 43' 31'' \\ i &= 17^\circ 23' 36'' \\ \phi &= 43^\circ 9' 00'' \end{aligned} \quad \left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} 1922.0.$$

$$\begin{aligned} \log a &= 0.44930. \\ \log q &= 9.94904. \\ \text{Period} &= 4.7201 \text{ years.} \end{aligned}$$

These elements indicate a much closer approach to the earth than the parabolic elements did. Prof. Leuschner has pointed out that the comet is probably identical with 1902 II., discovered by Mr. John Grigg in New Zealand, and followed by him for 11 days. No one else saw it, and the observations were too rough to give a good orbit. If the period of less than 5 years is confirmed it will be the second shortest cometary period known, that of Encke, 3.3 years, being the shortest.

SOLAR ATMOSPHERIC CHANGES.—In the current number of the Monthly Notices of the Royal Astronomical Society (April) there are three communications relative to solar activity. The first is by Dr. William J. S. Lockyer, and deals with the relationship between solar prominences and the corona. In 1903 Dr. Lockyer published a paper on the same subject, concluding that the various forms of the corona, as photographed during eclipses, were dependent on the positions and intensities of the zones of

prominence activity. In the present paper, using quite independent prominence and corona data, the former extending over the period 1890–1920 and thus including three sunspot maxima and minima, he points out that the previous conclusion is well endorsed by these new observations. Mr. A. M. Newbegin publishes the results of his solar prominence observations for the year 1921 and gives curves showing mean areas and mean numbers. He shows that the main zones of prominences were situated in latitudes 40° N. and 55° S., and a much lesser zone of activity in latitudes 20° N. and 25° S. These zones are in conformity with the curves of latitudes of prominences illustrated in Dr. Lockyer’s paper referred to above, the higher latitude zones being the commencement of a new zone of activity which will gradually move polewards.

Mr. C. P. Butler communicates a first paper on the systematic distribution of solar calcium flocculi, this contribution dealing with inclination of elongated groups. Several observers have previously shown that the mean inclinations of the axes of sunspot groups were found to vary from 0° to 11° , and that the amount of inclination increases with the solar latitude of the group. Mr. Butler has investigated the case of the areas of calcium flocculi as determined from measures taken from photographs secured with the spectroheliograph. He concludes that the inclinations range in general from 0° to 40° , with a few cases of specially high inclination. The range is therefore much greater than that found for spot-groups. In the above range there are maximum frequencies at certain latitudes, namely, 15° , 21° , and 28° – 32° . Other more detailed results are given.

Research Items.

PROBLEMS OF RACE AND NATIONALITY IN SOUTH AFRICA.—The problems of race and nationality are discussed in the presidential address delivered before the South African Association for the Advancement of Science by the president, Dr. J. E. Duerden. He gives an instructive survey of the social condition of the Bantu races and of the European immigrants. The hereditary attributes of all the people of colour are markedly inferior to the white in all that pertains to the requirements of modern civilisation, and there is every reason to expect that they will remain so in the future, "for in considerations of this nature the teachings of zoology are overwhelmingly in favour of the unchangeableness of the germ plasm." He goes on to say that the Nordic race, represented by the English and Dutch, stands at the head of the human genus, and "it is in the daily competition with those that the Bantu, Indian, and Malay are to lead their lives. In the commingling of these races in South Africa there can be no question as to which will be dominant. In his hereditary endowments the white is far more gifted than the coloured, and must lead. Dominance, however, is not arrogance, nor does superiority necessarily carry with it harshness or unfairness."

SECRET SOCIETIES IN THE SOUTHERN SUDAN.—The spread of secret societies among the Sudanese is a question of some political importance, and the reports of several correspondents on the subject are summarised in *Sudan Notes and Records* (vol. iv. No. 4). The baneful influence of such associations has attracted the attention of the Government, which has recently revised "The Unlawful Societies' Ordinance" in order to bring them under control. The authorities emphasise their evil influence through terrorism, debauch, and robbery, and it is suggested that they are mainly the work of unscrupulous persons who exploit the fears of primitive man for their own nefarious ends. But, as is the case with similar organisations among tribes of the lower culture elsewhere, it is believed that the use of "fetish" or other magical objects in their rites implies a religious side to the practices of these societies which deserves to be more closely studied. It would be interesting to learn whether these cults are regarded as supplementary or antagonistic to the traditional beliefs and rites of the uninitiated members of the community, and whether their influence depends on the transitory prestige of some particular leader, or is deeply rooted in the official religion of the tribe.

GEOLOGY OF MESOPOTAMIA.—An interesting memoir just issued by the Geological Survey of India (Memoirs, vol. xlviii., 1922) embodies the results of Dr. E. H. Pascoe's reconnaissance of the part of Mesopotamia lying mainly to the east of the Tigris from about the latitude of Baghdad to that of the Great Zab river just below Mosul. Excluding the recent alluvium and the pleistocene conglomerates, the rock groups described are all of Tertiary age and fall naturally into two divisions:—(a) a lower, marine, gypsiferous series corresponding to a part of Dr. Pilgrim's Fars series of the Persian Gulf region; and (b) a younger fluvial series, which is provisionally named the Kurd series and corresponds generally with the beds distinguished by Dr. Pilgrim as the Bakhtiyari series in Persia. The older, marine, gypsiferous beds were laid down in a relatively shallow gulf, which became silted up and finally gave place to fluvial conditions after an intermediate stage of salt lagoons. Local erosion naturally occurred during this transition stage, but there is

no general or widespread unconformity dividing the marine from the later freshwater formations by which the former were covered. Folding of the sediments commenced in Fars times and became accentuated during the subsequent Kurd period, persisting into recent times; this is indicated by the marked steepening of the dips noticeable in passing from the upper to the lower series, while there is in general a marked contrast between the compressed condition of the anticlines and the open disposition of the alternating synclinal folds, which Dr. Pascoe ascribes to the circumstance that the rising anticlinal saddles became eroded and consequently weakened, thus yielding more readily to compressional earth-movements. Petroleum is of outstanding importance among the minerals of economic value, and the conditions for its occurrence are so favourable that Dr. Pascoe regards Mesopotamia as a possible rival of Persia, outclassing Burma altogether in oil resources. Associated with the oil are small quantities of pitch and bitumen, while sulphuretted hydrogen is evolved in such large quantities that its recovery as a source of sulphur (or alternatively as sulphuric acid) is recommended as commercially feasible.

AMERICAN CRETACEOUS DINOSAURS.—The first of a series of preliminary notices on the Cretaceous dinosaurs, obtained in Alberta from 1910 to 1915 by parties sent out by the American Museum of Natural History under Mr. Barnum Brown, has been issued. The article in question, by W. D. Matthew and B. Brown (Bull. Amer. Mus. Nat. Hist., vol. xlvi.) treats of "The family Deinodontidae." This family name was introduced by Cope in 1866, under what is now considered the more correct rendering for the Greek, as Dinodontidae, but the authors of the present brochure have altered it, presumably because the type genus, when founded by Leidy in 1856, was rendered, as then customary, as Deinodon. But if Leidy's original is to be scrupulously adhered to, why not Cope's? The authors discuss the group and give a most valuable "Chronological list of American Cretaceous Deinodonts and Ornithomids." Appended is a description of *Dromaosaurus albertensis*, n. gen. et sp., from the Cretaceous of Alberta, and the conclusion is reached that it should be placed in a distinct subfamily, *Dromaosaurinae*.

ENTELODONTS FROM THE OLIGOCENE OF SOUTH DAKOTA.—W. J. Sinclair describes the "Entelodonts from the Big Badlands of South Dakota in the Geological Museum of Princeton University" (Proc. Amer. Phil. Soc., vol. lx.), some of which had been previously inadequately determined, and had even figured in literature under other names. The new forms include two new species of Archæotherium and *Scaptohyus alidensis*, n. gen. et sp. The origin of the group as a whole is uncertain. Apart from the digging proclivities of *Scaptohyus*, one of the most clearly indicated "habits" of the entelodonts, according to the author, judging from lesions in the preserved remains, appears to have been their pugnacity; but surely the argument is equally allowable that the injuries were due to attacks by powerful enemies.

PETROLEUM IN THE PHILIPPINES.—In the *Philippine Journal of Science* of January last, Dr. Warren D. Smith gives a detailed account of his geological reconnaissance of the Pidatan Oilfield, Cotabato Province, Mindanao, the second largest island of the Philippine group. The occurrence of petroleum in the Philippine Islands has been known for some years, surface indications existing in Luzon, Mindoro,

Panay, Cebu, and Leyte; those of the Cotabato district in Mindanao, in particular the Pidatan seepage, are of more recent discovery, Pidatan not receiving detailed geological attention until the expedition of 1921, of which this paper is a report. The Pidatan field is about 60 kilometres north of Fort Pikit, Cotabato Province, the basin of the Rio Grande de Cotabato, practically in the centre of the island. The topography is mountainous and the country is exceedingly difficult. Geologically, the formations present consist principally of Tertiary limestones, sandstones, and shales pierced by basaltic and andesitic intrusions. The sediments are of recent, Pleistocene, Pliocene, and Miocene ages, many horizons yielding fossil evidence. The structures, however, appear to be very complex, owing to the regional earth movements and the igneous activity manifested. In fact, the faulting and folding has so disturbed the oilfield region that Dr. Smith does not hesitate to condemn the area from the economic point of view. On the other hand, the presence of the seepage and the nature of the oil involved at Pidatan suggest that petroleum certainly occurs in central Mindanao, possibly over an extensive region, and the advisability of intensive geological exploration over a wider area is clearly indicated. Analysis of the oil from the occurrence at Pidatan shows that it has a specific gravity of 0.9297 and is of paraffin base; no light fraction was obtained (under 150° C.), kerosene and heavy oil representing 45 per cent. and 49.5 per cent. of the sample respectively (by volume). Results of other tests indicate that the oil is much inspissated, as would be expected considering the geological circumstances, and is most suitable for use as a Diesel engine fuel. The author concludes his paper with a commendable caution to those controlling oil companies against belittling the value of sound geological work as a necessary preliminary to oil exploration; while not detracting from the value of the "practical" man's work, he makes it quite clear that success is achieved only where both driller and geologist work in harmony, a conclusion deserving of serious consideration by many of the would-be "wild-cat" oil explorers in our own colonies.

THE GEOLOGY OF THE MOUNT EVEREST DISTRICT.—The Mount Everest expedition of last year included among its staff Dr. A. M. Heron, who contributes to the *Geographical Journal* of June an account of his geological investigations, accompanied by a geological map. The mapping is, virtually a westward continuation of Sir H. Hayden's investigations during the Tibet Expedition of 1903-4. Dr. Heron's task was one of unusual difficulty. Over much of the area examined his work had to proceed in advance of surveys, while the movements of the expedition were generally unfavourable to detailed work. Close and prolonged examination, moreover, was considered inadvisable, since it aroused the suspicions of the Tibetans. Dr. Heron claims that his work must be looked on only as a reconnaissance. The area examined covers more than 8000 square miles, and consists in the main of the Tibetan portion of the drainage area of the Arun river above Kharta. Two geological divisions can be recognised: a Tibetan area of sedimentary rocks which consists chiefly of east and west folds of Jurassic slates, and the crystalline Himalayan region to the south. The contrasts in topography clearly illustrate the differences in the underlying structure. On one hand are the somewhat tame rounded ranges, with broad valleys, of Tibet, and on the other the high, steep, and rugged Himalayas.

RECOVERY OF SUGAR FROM BEET MOLASSES.—Beet molasses is a substance of almost constant composi-

tion, containing 50 per cent. of sugar, 10 per cent. of ash, 15 per cent. of other organic substances, and 25 per cent. of water. The sugar cannot be separated from it by direct means, and among the methods employed for recovering the sugar is precipitation by one of the alkali earths. Until the present lime and strontia have chiefly been used. In the year 1838, however, Peligot found that baryta forms a very sparingly soluble saccharate. The use of baryta for the purpose of separating sugar was never carried out to any great extent for two reasons; (a) its cost, and (b) the poisonous nature of barium compounds. The cost of baryta should now be considerably reduced by the discovery of two French chemists, MM. Camille Deguide and Paul Baud (*Comptes rendus*, May 1), who find that when barium carbonate is heated with silica at a temperature of 150°-200° C., and the mixture subsequently lixiviated with water, the carbonate is to the extent of more than 90 per cent. converted into hydroxide. This process should therefore render baryta available for the desaccharification of molasses. It is, however, very doubtful whether any Government will permit its use on account of the toxic character of traces of barium compounds.

PYREX GLASS.—The *Chemiker Zeitung* of May 25 contains an analysis of the "Pyrex glass" manufactured in America and used for cooking vessels. This glass is an astonishingly resistant to changes of temperature, and may be used over an open fire. The chemical composition was found to be, in percentages: silica, 80.71; boric anhydride (B_2O_3), 10.47; alumina, 3.55; lime, 0.70; magnesia, 0.57; soda (Na_2O), 4.14. The low alkali content is noteworthy. Experiments showed that ordinary heating is not sufficient to melt the materials for such a glass, and special furnaces, possibly with surface-combustion heating, are assumed.

SAFETY DEVICES IN WIRELESS EQUIPMENT.—The American Bureau of Standards has given its approval to the recommendations of a committee of the National Fire Protection Association proposing the addition of some new safety rules to the National Electric Code relating to wireless telegraph installations. The proposed regulations provide for the protection of receiving and transmitting equipment against lightning effects, avoidance of risk of contact with neighbouring electric light and power circuits, and protection from effects of high potential surges in the lines supplying power to the equipment, as well as the ordinary requirements of sound construction. It is needless to detail all the proposals, but it may be remarked that, in the case of receiving equipments, a lightning arrester is required where the leading-in wire enters a building and, on account of the larger size of the ordinary transmitting aerial, which is more likely to be subject to damage from lightning, and the high voltages produced in the apparatus, the provision is recommended in transmitting stations of a double-throw switch for connecting the aerial either to the transmitting apparatus or to earth. The use of this switch makes it possible to disconnect the aerial entirely from the transmitting apparatus. On account also of the difficulty which has been experienced by the induction of voltages in the supply lines of a transmitting station, it is advisable to use a protective device across the power line near its point of entrance. It is noticeable that copper-clad steel wire is recommended throughout as an alternative to copper wire, owing to the fact that these two kinds of wire are practically equivalent in their conductivity for high-frequency current, while the former is stronger mechanically.

Quantum Mechanism in the Atom.

AT a meeting of the Royal Society of Edinburgh on May 8 Prof. E. T. Whittaker read a paper on the quantum mechanism in the atom (since published in Proc. Roy. Soc. Edin., vol. xlii. pp. 129-142).

Prof. Whittaker shows that it is possible to explain quantum phenomena satisfactorily in terms of the classical electrodynamics without postulating any structure in the atom beyond that by which it is customary to explain induced magnetisation. The author considers the effect of an approaching electron in producing a "magnetic current" in the atom; up to a certain velocity of approach the electron does not get beyond the atom but suffers an "elastic impact" which repels it without loss of energy. When, however, the velocity of approach exceeds this critical value the electron passes through the magnetic atom and gives to it energy of exactly that amount or quantum which corresponds with the critical velocity. The transformation of this energy into radiant energy can be explained by generalising the conception; thus the magnetic current becomes equivalent to a charged condenser, partaking of the nature of a Hertzian oscillator. By a simple mathematical process, combined with the assumption that the oscillators in the atoms are similar to each other in structure and differ only in scale, the equation $h\nu = U$ can be established, giving Planck's relation connecting the frequency, ν , of the emitted radiation with the amount of kinetic energy, U , absorbed from the bombarding electron. A more definite form to the quantum mechanism is given by linking a conducting circuit with the magnetic structure. Photo-electric phenomena can be interpreted on the basis of this theory, and Bohr's theory of series-spectra likewise finds an explanation.

Sir Alfred Ewing suggested that instead of following Prof. Whittaker in leaving the magnetic atomic model at a certain point there is perhaps an advantage in not dropping the model, especially as it seems to give an immediate explanation of the manner in which oscillations are set up as the electron parts with its quantum of energy. In the Ewing magnetic model the central magnetic system or wheel is controlled by an outer system or ring. When an electron passes through and escapes it gives an impulse producing relative angular displacement of

inner wheel and outer ring, and the mutual magnetic forces tend to restore the original configuration. Oscillations are set up which expend their energy in emitted radiation. Conversely, in an atom in which oscillations are going on, an electron may be ejected (photo-electric effect). In being ejected it exerts an angular impulse which stops the oscillation and deprives the atom of the quantum of energy originally absorbed through resonance.

Dr. H. S. Allen directed attention to the fact that in Prof. Whittaker's "calamoids," or four-dimensional tubes of electromagnetic force, as well as in the Ewing magnetic model, magnetic forces rank on an equality with electrostatic forces. The number of magnetic tubes associated with Prof. Whittaker's magneton must be an integral number of times the unit quantum tube of magnetic induction. More satisfactory is a modified form of the quantum mechanism, in which two ring electrons are placed near together on the same axis, the electromagnetic force between them being repulsive. Such models cannot, in Dr. Allen's opinion, "reconcile" quantum dynamics with classical dynamics.

Dr. R. A. Houstoun suggested the advisability of testing Prof. Whittaker's theory by an appeal to numerical calculation, introducing, for example, definite values of the frequency and calculating the corresponding size of the molecule. The results appear to be satisfactory considering the simple nature of the assumptions made. It seems that the reciprocity which exists between electric and magnetic quantities in the electromagnetic wave must be extended to atomic structure.

Prof. Peddie remarked that the value of Prof. Whittaker's idea does not lie in its being an "only possible" one, for other possibilities exist. Its importance rests on the fact that the idea is a new one, giving for the first time an action on an electron which is not reversed in direction when the electron passes through an atom. A "perfectly elastic" collision seems to be attainable only by implicitly denying collisional radiation, which leaves part of the essential mechanism undescribed. The interactions of the atomic charges, ether and the "magnetic currents," may perhaps introduce difficulty regarding atomic subjection to the Newtonian first law of motion.

The Second Royal Society Conversazione.

THE second conversazione of the Royal Society this year was held in the rooms of the Society at Burlington House on the evening of June 20, when the president, Sir Charles Sherrington, with Lady Sherrington, and the officers of the Society, received a large number of fellows and guests. Many interesting scientific instruments and specimens were shown, several of which were exhibited at the first conversazione held on May 17, and some were briefly described in NATURE of May 27, p. 693. Below are brief descriptions of other noteworthy exhibits.

Some selections from the contents of large pre-historic cooking-places at Buckenham, Tofts Park, Norfolk, were shown by Miss Nina F. Layard. The specimens were found by Miss Layard and Miss M. F. Outram in 1921-1922, and they include hearth-stones, heating-stones, bones and teeth of animals, fragments of pottery, flint flakes and implements. Mrs. Clayton exhibited a Roman bronze measure of capacity, made under Domitian, which was found during draining

works in the vicinity of the Roman Wall, three miles east of Gilsland, Northumberland.

A simple form of respiration meter was exhibited by Mr. H. F. Pierce. Two bellows are mounted on a vertical shaft, one of which measures the volume of inspired air, the other the volume of expired air. The latter is measured at a temperature of 37.2°C . to avoid error due to condensation of contained moisture. Respiration is recorded quantitatively upon a smoked drum. The moving parts are made very light and valves are operated electrically.

Mr. G. C. Robson had an exhibit showing that a highly differentiated character which appears discontinuously in the parthenogenetic gastropod, *Paludestrina jenkinsi*, does not reappear in two generations bred from parents showing this character. There is evidence that this character cannot be compared with an ordinary "fluctuating" variation. The Royal Botanic Gardens, Kew, showed a double coconut, or Coco de Mer, from the Seychelles, which

was germinating. The massive cotyledonary tube emerges from the nut, carrying the plumule and radicle out of the seed, and later the plumule pushes through the tube and grows up into the air. Specimens of the tubers of Ecanda rubber (*Raphionacme utilis*, Brown and Stapf) from Angola, which sometimes weigh as much as 15 lbs., and contain valuable rubber, were also shown.

Mr. W. Barlow exhibited some models of organic substances which are based on the law of valency-volumes and are in harmony with the Bragg structure found in the diamond. The valency-volume unit-cell appropriate for the carbon compounds is a rhombic-dodecahedron. The fundamental valency of carbon is expressed by a close tetrahedral group formed of four of the cells—that of nitrogen by three cells triangularly arranged, that of oxygen by two cells in face-contact, and that of hydrogen by a single cell. By fitting together appropriate numbers of these cells representing the composition and constitution of various compounds, structures can be made representing molecules which present internal symmetry closely corresponding with that of the crystal forms of these organic substances.

The Research Department, Woolwich, had an exhibit showing the time reaction in the colour change of Congo red in organic solvents. The change from red to blue which occurs during titration is associated with its flocculation from the colloidal condition and forms a time reaction related to the concentration of H ions and other properties of the solvent. There were also exhibits from the Air Ministry (Instru-

ment Section), among which was a radiator temperature outfit designed to determine the temperature distribution at different points on an aero-engine radiator and its connecting pipes. A six-junction thermocouple is used, and each set of junctions measures the temperature relative to that of the atmosphere. Another exhibit was a Filon aneroid dial for indicating to the pilot the height of an aeroplane above the ground. The scale is coiled into a spiral groove so that it can be adjusted to meet daily changes in temperature and barometric pressure. A metallic oxygen container was also shown in which a small quantity of silica-gel has been used successfully for cleaning up residual gases.

Mr. A. A. Campbell Swinton demonstrated the recording of wireless telegraphic messages. A short aerial on the roof of the building was connected through a tuner to a thermionic three valve amplifier, which in turn was connected to a 1 to 3 valve note magnifier. A moving coil siphon recorder was used, connected to the note-magnifier, either through a Brown relay, or through a very low frequency thermionic amplifier tuned to respond to the frequency of Morse signals. For the reception of continuous wave signals a separate thermionic heterodyne oscillator is employed which renders the high frequency signals audible by means of musical "beats." Dr. H. E. Hurst and Mr. D. A. Watt exhibited an interesting model, on a scale of 1:50, of the sluice of Aswan dam which is used for calibration purposes. The relation between Q , the discharge of the actual sluice, and q the discharge of the model is given very closely by $Q/q = n \cdot 5/2$, where n is the scale ratio.

Psychical Monism.

THE Journal of the Washington Academy of Sciences of March 19 contains a communication from Mr. L. T. Troland of Harvard University entitled "Psychophysics as the Key to the Mysteries of Physics and Metaphysics." The article is interesting as a revival of the once famous theory of mind-stuff put forward by W. K. Clifford in his lecture on "The Nature of Things in Themselves." Mr. Troland connects it with several recent philosophical theories of psychical monism and brings it forward with particular reference to the consequences of adopting the principle of relativity and the quantum theory in physics, both of which, he contends, demand the recognition of the ultimate psychical nature of physical reality.

The essence of the mind-stuff theory is that it supposes mind to be constituted and articulated, not merely on the analogy of physical reality but on one and the same principle, so that a parallelism runs throughout the universe between mind and matter. Every electron or proton has not only a psychical aspect but in its ultimate nature is a constituent of mind, a bit of mind-stuff. Just as the unit of physics, the electric charge, enters into combination in atoms, molecules, and their more or less stable compounds, acquiring thereby the various

physical and chemical properties of things, so the mind-stuff combines to acquire the various sensational, emotional, and intellectual properties of personalities.

Mr. Troland's argument is interesting but scarcely convincing. He thinks by the theory to get over Berkeley's difficulty that no qualities of things, primary or secondary, are independent of the observing individual. The new realists, though they have recently attached Berkeley, have not, he thinks, succeeded as yet in developing an explanation of the universe which is either simple or plausible.

The difficulty of Mr. Troland's theory, however, if offered as a support of Einstein, would seem to be that it misses the essential difference between the activity of the observer co-ordinating events in space-time systems and the intersecting world-lines which present the events co-ordinated. The theory of knowledge we are waiting for in science as well as in philosophy is one which will give full meaning to the subjective and objective factors without sacrificing either to the other. Psychical monism seems to be no more successful than physical monism as a key to the mysteries of physics and metaphysics, but we commend Mr. Troland's argument, which includes in its scope recent physiological research as well as the new physical theories.

Technical Education.

THE annual conference of the Association of Teachers in Technical Institutions was held on June 5-7 in London, and in the course of his presidential address, Mr. J. Paley Yorke claimed very strongly that technical education is definitely education and is as essential as any other branch of educational activity. He said that technical education is essentially scientific education, and urged

that the advance of scientific knowledge and the development of the applications of science to industry and manufacture have been so tremendous that the time has arrived when a special committee of inquiry should be appointed to investigate the whole field of technical education in relation to industry and to education generally. It is now forty years since there has been any national inquiry on technical

education, and during that time it has developed beyond the recognition of many of those who imagined themselves to be its guardians.

Mr. Paley Yorke protested against the charge of soullessness that is sometimes levelled at scientific education, and argued that it gives an extended vision and develops both imagination and that too rare gift of being able to marvel at the wonders of nature and to appreciate the beauties of life. It cannot be admitted that a good general education can be obtained only by the study of certain subjects in certain ways or that education and culture must be associated necessarily with bygone civilisations.

Reference was made to the fact that opportunity for contact with industry and for research is scant, and it was urged that directors of industry might submit some of their research problems to local Education Authorities and through them to the scientific and technical staffs of the various technical institutions in the area. It is realised, of course, that all problems would not arrive that way because of the publicity involved, but some useful work may be done.

Attention was also directed to the proposed reduction of grants for scientific research and to the reduction in the number of national scholarships for higher education. It was pointed out that not only do these reductions gravely imperil scientific and industrial development, but also that the percentage reduction in the estimates for these items is much greater than that for corresponding items in other branches of educational work.

Lord Burnham said that technical education is slowly gaining its right place in the assessment of national values. This country, with its superiority in industrial matters during the greater part of the nineteenth century, looked with supreme self-confidence upon the efforts of other nations to compete with us in industrial production. When the advance of scientific discovery showed that mere manual dexterity was not sufficient the necessity for technical education was admitted. Lord Burnham doubted whether there is any other class of teacher upon which the future prosperity of the nation depended so much. Technical teachers are striving to shape education for the public good and for the welfare of the generations which are coming to manhood.

Resolutions asking for the appointment of a committee of inquiry to investigate the whole field of technical education in relation to education generally and to industry, and expressing alarm at the reduction in the number and value of scholarships available for higher education, were carried unanimously.

University and Educational Intelligence.

BRISTOL.—The J. S. Fry and Sons, Ltd., Colston Research Fellowship, which provides for payment of fees and a maintenance allowance of 150*l.* a year, has been awarded to Mr. F. B. Wrightson, a student in the Faculty of Engineering.

CAMBRIDGE.—Mr. W. B. R. King, fellow of Jesus College, has been elected to be fellow and lecturer in natural sciences at Magdalene College; Mr. P. M. S. Blackett to be Charles Kingsley Bye fellow of Magdalene College; Mr. L. E. Bayliss, Trinity College, to be Michael Foster student in physiology; Mr. F. Lavington and Mr. J. Line, to be fellows of Emmanuel College; and Mr. J. A. Carroll to be fellow of Sidney Sussex College.

GLASGOW.—Mr. A. D. Lindsay has been appointed to the chair of moral philosophy in succession to the

late Sir Henry Jones. Mr. Lindsay was formerly Shaw Fellow of the University of Edinburgh, and lecturer in philosophy at the old Victoria University. In 1906 he was elected Fellow of Balliol College, Oxford, and was appointed classical tutor and Jowett lecturer in philosophy.

LEEDS.—The Council has appointed Dr. W. T. David to be professor of civil and mechanical engineering in succession to Prof. J. Goodman, who retires in October next. Dr. David, who is at present professor of engineering at the University College of South Wales, was educated at Cardiff and Cambridge. He served as demonstrator in engineering under Prof. Bertram Hopkinson at Cambridge for two years, and later was appointed H.M. Inspector of Technical Colleges under the Board of Education. His research work has been concerned mostly with internal combustion engines.

The handsome gift received some little time ago from Col. Sir Edward Brotherton of 20,000*l.* has enabled the University to make an important development in the work of the department of pathology and bacteriology. Sir Edward's intention was that his gift should be devoted to the furtherance of the study of bacteriology with special reference to public health, and as a step in this direction the Council has instituted a new professorship to be called "The Sir Edward Brotherton Chair of Bacteriology." Dr. J. W. McLeod has been elected as the first holder of this chair. Dr. McLeod graduated with commendation at Glasgow University in the summer of 1908, and after acting as house physician at the Glasgow Royal Infirmary and house surgeon at the Glasgow Western Infirmary, gained the Coats research scholarship and worked for a year under Prof. R. Muir. Later he was appointed assistant lecturer and demonstrator in pathology at the Medical School of the Charing Cross Hospital, and afterwards lecturer in bacteriology at the University of Leeds. Dr. McLeod has carried out important research work in the field of bacteriology, and has published numerous papers dealing more especially with the bacteriology of influenza, dysentery, pneumonia, and the streptococcal infections.

LONDON.—At a meeting of the Senate on June 21, Mr. H. J. Waring, Dean of the Faculty of Medicine and vice-president of St. Bartholomew's Hospital Medical College, was elected Vice-Chancellor for 1922-23, in succession to Sir Sydney Russell-Wells. A cordial vote of thanks was passed to Sir Sydney Russell-Wells for the services which he had rendered to the University as Vice-Chancellor since December 1919.

Mr. J. H. Woodger was appointed to the University readership in biology tenable at Middlesex Hospital Medical School. Mr. Woodger was educated at University College, whence he graduated in zoology, and was awarded the Derby Research Scholarship. In 1917 he was appointed protozoologist to the Central Clinical Laboratory in Amarah, and in 1919 assistant in zoology at University College.

Sir Charles W. C. Oman, Chichele professor of modern history in the University of Oxford, was appointed Creighton lecturer for the year 1922-23. The subject of his lecture will be "Historical Perspective."

The Lindley studentship for 1922, of the value of 120*l.* and tenable in the Physiological Laboratory, has been awarded to Miss M. J. Wilson-Smith of Royal Holloway College; and the University studentship in physiology for 1922-23, of the value of 50*l.* and tenable in the Physiological Laboratory of the University or of one of its Schools, to Miss M. M. A. Murray of Bedford College.

MANCHESTER.—Mr. E. D. Telford, lecturer in practical surgery in the University, and a member of the Honorary Staff of the Manchester Royal Infirmary, has been appointed professor of systematic surgery.

By the will of the late Sir William Lorimer, who died on April 9 last, the Court of the University of Glasgow will receive the sum of 10,000*l.*

It is announced in *Science* that, by the will of the late Amos F. Eno, Columbia University, New York, will receive a bequest of about four million dollars.

THE Beaney Scholarship in *Materia Medica* at Guy's Hospital Medical School is vacant. It is of the yearly value of about 50*l.* and tenable for three years. It is open to candidates who have received at least part of their medical education at Guy's Hospital. The latest date for receiving applications is July 7. They should be sent to the Dean of the School, S.E.1.

THE Gull studentship in pathology and allied subjects, of the annual value of about 250*l.* and tenable for three years, is being offered by Guy's Hospital Medical School. The studentship is open to candidates under 35 years of age who have studied in the school. Applications must reach the Secretary to the Board of Electors, Guy's Hospital Medical School, S.E.1, by, at latest, July 7.

THE summer meeting of the Association of Technical Institutions will be held at Oxford on Friday and Saturday, July 7 and 8. The sessions on Friday and Saturday mornings will commence at 10.30 o'clock, when the president, The Right Hon. Walter Runciman, will occupy the chair. The Rev. L. R. Phelps, Provost of Oriel College and Pro-Vice-Chancellor, will welcome, on behalf of the University, the members of the association at the opening of the conference. Papers will be read by Rev. W. Hardy Harwood (Chairman of the Council) and Principal J. F. Hudson (Huddersfield) on "The Relation of Technical Education to the Question of General Education." Principal J. Quick, on "Central Schools and their part in the Preparation of Scholars for Higher Technical and Junior Technical Schools," and by Mr. E. C. Kyte, Secretary of the Library Association, on "Technical Libraries—How to Start and Develop them."

THE annual report of the Livesey Professor, Prof. John W. Cobb, at the University of Leeds, gives an account of the work done in the department of coal gas and fuel industries (with metallurgy) for the session 1920-21. The number of students (41) reached the highest figure in the history of the department; one third (14) taking the fuel and metallurgy course, the remainder (27) the course in fuel and gas engineering. The special evening classes included courses on the distribution of gas (Mr. Walter Hole), coke oven practice (Mr. W. Greaves), steaming in vertical retorts (Dr. A. Parker), and metallurgy (Mr. P. F. Summers). These courses were attended by 49 external students in addition to the full-time registered students. Researches were carried out on the liberation of nitrogen from coal and coke as ammonia, the structures of cokes prepared at different temperatures, the losses of ammonia in coke oven practice, a laboratory apparatus for coal distillation, the expansion of refractory materials, the trustworthiness of recording gas calorimeters, and the efficiency of production of blue water gas. The endowment funds of the department have benefited by substantial donations from the South Metropolitan Gas Company, the South Suburban Gas Company, and from Mr. A. G. Glasgow.

Societies and Academies.

LONDON.

Royal Society, June 15.—Sir Charles Sherrington, president, in the chair.—H. M. Evans: The defensive spines of fishes, living and fossil, and the glandular construction in connexion therewith, and observations on the nature of fish venoms. The gland in the groove of the spine of the sting-ray (*Trygon pastinaca*) consists of two portions—the deepest part of the groove contains an alveolar-connective tissue structure, which is separated from the true glandular epithelium by a pigmented capillary layer. The dorsal fin-spines of the spiny dog-fish *Acanthias* are grooved, and the groove is occupied by a gland with definite follicles. Cestracion also has a well-developed gland at the base of the dorsal fin spines. The spines of *Chimæra* and of the *Pleuracanthida* show structures which suggest a specialised function. The nature and properties of Weever venom are described; the filtration of venom profoundly affects its hæmolytic properties. Experiments are described on the native use of abrin as an antidote to fish venoms.—D. W. Cutler, L. M. Crump, and H. Sandon: A quantitative investigation of the bacterial and protozoan population of the soil: with an account of the protozoan fauna. The results of 365 consecutive daily counts of the numbers of bacteria and of six species of protozoa in a natural field soil are given. Large fluctuations occur which cannot be correlated with meteorological conditions. Fourteen-day averages of the daily numbers show marked seasonal changes superimposed on the daily variations in numbers. In general, both bacteria and protozoa are most abundant at the end of November, and fewest during February. The changes are not directly influenced by temperature or rainfall. An inverse relationship is found between the numbers of bacteria and certain amœbæ, and a two-day periodicity obtains for the numbers of the flagellate *Oicomonas termo* which are active.—D. W. Devanesen: The development of the calcareous parts of the lantern of Aristotle in *Echinus miliaris*. All the calcareous elements of the lantern of Aristotle, with the exception of the teeth, are deposited as triradial spicules. A "compass" arises from two rudimentary spicules. It is the only element of the lantern absent in the "echinus-rudiment." A tooth is a paired structure in consequence of its composition of a double row of lamellæ. A pair of lamellæ is its ultimate unit. A remarkable stage in the consolidation of these lamellæ is the cone-in-cone arrangement. The carina is formed by the beaks of the serially fitting cones. The ossicles of the lantern are compared with those of the mouth-frame of star-fish.—A. Lipschütz, C. Wagner, R. Tamm, and F. Bormann: Further experimental investigations on the hypertrophy of the sexual glands.

Zoological Society, June 13.—Prof. E. W. MacBride, vice-president, in the chair.—Miss J. B. Procter: A study of the remarkable tortoise *Testudo loveridgii* Blgr., and the morphogeny of the Chelonian carapace.—J. T. Carter: A microscopical examination of the teeth of the primates.—H. G. Jackson: A revision of the isopod genus *Ligia*, Fabricius.—W. R. B. Oliver: A review of the Cetacea of the New Zealand seas.—F. Wood Jones: On the dental characters of certain Australian rats.

Linnean Society, June 15.—Dr. A. Smith Woodward, president, in the chair.—A. B. Rendle: Seedlings of horse-chestnut from which the terminal bud had been removed by cutting through the epicotyledonary stem. Minute buds appeared on the cut surface corresponding in position with the cambium-

layer in the stem. A new shoot was also produced in the axil of each of the cotyledons.—Sir Arthur Shipley: *Furia infernalis*. Linnæus was probably stung by a virulent insect which may have conveyed to his system some pathogenic germs unknown at that time.—T. A. Sprague: The identification of *Sison Ammi*, Linn. *Sison Ammi* is an umbelliferous plant published by Linnaeus in the first edition of the "Species Plantarum" in 1753. The type-specimens in the Linnean Herbarium and the British Museum show that it is *Carum copticum*, a medicinal plant which yields the Ajowan seeds and Ajowan oil, from which thymol is obtained. The history of the drug Ammi goes back to Dioscorides, who lived in the first century of the Christian era; he described it as having a minute seed with the flavour of marjoram. Various plants have been described as the Ammi, but in the plates of Umbelliferæ published by Rivinius at the end of the seventeenth century, the official Ammi is *Carum copticum*. The geographical source of the drug supports this conclusion. The best quality of Ammi was imported from Alexandria, but was actually grown in Arabia, where *Carum copticum* is still cultivated. It has never been found in a wild state.—E. A. Newell Arber: Critical studies of coal-measure plant impressions. The British Upper Carboniferous species of the genus *Lepidostrobus*, Brongn., preserved as incrustations, and other impressions were discussed.—J. Burt-Davy: A revision of the South African species of *Dianthus*. Thunberg's specimen of *D. incurvus*, Thunb., does not match any South African material at Kew or the British Museum. Thunberg himself identifies it on the sheet with *D. albens*, Ait., but the specimen does not agree with the type of *D. albens* in the British Museum. In the "Flora Capensis," Sonder recognised nine species of *Dianthus*. Of these, seven only are valid, and to them must be added four species not recognised by Sonder. Six additional species and three varieties are now described, bringing the total number up to seventeen species and three varieties.

Royal Meteorological Society, June 21.—Dr. C. Chree, president, in the chair.—J. E. Clark, H. B. Adames, and I. D. Margary: Report on the phenological observations for the year 1921. After mid-December the mildness until late March was extreme, which gave premature fruit blossom and its usual concomitant of poor fruit crops, except apples. The four early spring flowers were more than 18 days earlier than the 30 years' mean; April and May, 14 days, June, 10, and July, 6 days. Grain-cutting was very early. The warm uprush along the Bristol Channel, and up the Severn and Dee valleys to include the Wirral Peninsula, was almost identical with the isophenal trend and values for 1920. In the north-east of Norfolk there was a recurrence of the cold area so well marked in the years 1919 and 1920, spreading southward from the North Sea, and curving south-eastward by Norwich to include Bungay, and also of the long tongue stretching from the Scottish border southward to include Leicestershire and Rutland. The northerly bulge of warmth just north of the Isle of Wight was again very definite. High ground is, as before, indicated on the maps by relatively late isophenal areas. Among exceptional effects were the brief blooming period of the summer flowers and the earliness of the autumn flowers, especially the Michaelmas daisies; the dormant or destroyed seed-sowing experiences; the frequency of second blossom after the August rains, typically the horse-chestnut; the early departure of the swallows; the dearth of tortoiseshell and allied butterflies, apparently from lack of nettles. October had a week of unparalleled heat, while November opened with severe frosts.

After a partial fall in late July, trees had retained their foliage to an unusually late date, and those frosts had the effect of making many of the leaves brown and shrivelled as if from excess of heat. Planes and elms kept their green leaves almost or quite until December.—L. F. Richardson, A. Wagner, and R. Dietzius: An observational test of the geostrophic approximation in the stratosphere. Wind velocity, at points not too near the earth's surface or the equator, may be found with an accuracy of about 5 per cent. from the horizontal pressure gradient and the rotation of the earth. A test of the error involved in neglecting other considerations is obtained by inserting the "geostrophic" velocities in the equation for the accumulation of mass. Thus a theoretical equality, valid in the stratosphere, between certain derivatives of wind and temperature is obtained. From observations collected by Wagner and Dietzius, the quantities which this theory makes equal have a positive correlation of about four-tenths.

EDINBURGH.

Royal Society, May 8.—Prof. W. Peddie, vice-president, in the chair.—Prof. E. T. Whittaker: The quantum mechanism in the atom (see p. 23).—A. R. Forsyth: Differential invariants and other concomitants of quadratic differential forms in four variables. The method is that of Lie's continuous groups, and is thus entirely different from the Christoffel method usually expounded. It provides new results which the Christoffel method did not even suggest. It can be applied to obtain Einstein's critical form in the relativity theory of gravitation; on one hand, some of his conditions were covered by others, and on the other hand his form satisfied one equation more than the set he initially postulated.—T. R. MacRobert: The asymptotic expansion of the confluent hypergeometric function, and the Fourier-Bessel expansion.

PARIS.

Academy of Sciences, June 6.—M. Emile Bertin in the chair.—Ch. Boulanger and G. Urbain: The composition and chemical characters of thortveitite from Madagascar. Five complete analyses of this mineral are given. The proportion of yttrium earths does not exceed 0.5 per cent., while the Norwegian mineral contains 4.18 per cent. Of this group only yttrium, neoytterbium, and lutecium could be detected.—MM. d'Arsonval, Bordas, and Touplain: Study of the glacier waters of Argentière and Bossons. There are marked differences in the electrical conductivity and chemical composition of the waters from these two sources.—Carl Stormer: Determination of the external magnetic field of the sun by the structure of the solar corona and the constants of the aurora borealis.—Louis Roy: Electromagnetic actions in an isotropic system.—G. Rebol: A new radiation and its application to the study of the ultraviolet of Millikan and Lyman.—A. Tian: Thermostats with multiple jackets. The copper vessel containing the liquid to be maintained at a constant temperature, is surrounded with felt and placed in one or more boxes, also of copper, which are isolated in the same manner. The external jacket is heated, and a uniform, steady temperature can be thus maintained without stirring. The advantages claimed for this system are that the thermal oscillations due to the regulator are almost entirely eliminated. The temperature of the inside bath is practically independent of variations in the room temperature, and stirring is not required.—Léon and Eugène Bloch: Spark spectra in water.

The photography of spectra of sparks under water, by the automatic separation into arc lines and spark lines and by the differences in the appearance of the lines, appears to be valuable in detecting spectral regularities.—M. de Bellescize: Damping the oscillations of resonators in wireless telegraphy.—A. Recoura: Some new properties of the green sulphate of chromium. Green sulphate of chromium forms complex compounds with potassium sulphate, and the resulting solutions give reactions with benzidine compounds or with barium chloride, indicating that SO_4 ions are absent or present in small proportions only. Results are given of a study of the effects of temperature, dilution, and time on these complexes.—Paul Riou: The velocity of absorption of carbon dioxide by alkaline solutions.—Mlle. Wurmser: The preparation of ammonium nitrate. An extension of earlier work by M. Rengade on the formation of ammonium nitrate by the interaction of sodium nitrate and ammonium chloride.—Mlle. N. Wolff: Furfural- α -methylcyclohexanone and some of its derivatives. Mono- and difurfuralcyclohexanones.—E. Berger: A formal lamp. A detailed account, with diagrams, of the construction of a new lamp for burning methyl alcohol to formaldehyde. With copper oxide as a catalyst the yield is 25-30 per cent. with silvered asbestos, 35-45 per cent. of the alcohol used is obtained as formaldehyde. Results of the application of the lamp to practical disinfection of rooms are given.—H. Joly: The tectonic direction of the Cretaceous and Tertiary deposits in the neighbourhood of Haro (Logroño, Spain).—P. Lory: The glacial stages and a valley recording these stages (Bédinat, Chaîne de Belledonne).—P. L. Mercanton: The glacial system of the Beerenberg of Jan Mayen. This extinct volcano was climbed by the author, with J. M. Wordie and T. Lethbridge, in August 1921. From the highest point (about 2500 metres) the structure of the crater was made out, and a detailed account of this and the glacier system is given.—MM. Pons and Rémy: The reddish-brown coloration shown in March 1922 by the Briançon snow. Specimens of the coloured snow, collected on March 19 at an altitude of 2350 metres, were examined, after melting, chemically and microscopically. There was practically no organic matter, and the microscope showed no remains of microscopic organisms (Algæ, Foraminifera, diatoms), nor were there any vitreous inclusions characteristic of volcanic dust. Chemical analysis showed silica, iron, and alumina. The possible origin of the dust is discussed, but no definite conclusion could be arrived at.—P. Bugnon: The fibrovascular organisation in Mercurialis. Possible descent from a primitive form.—Gustave Chauveaud: The principal variations in the vascular development of the first phyllorhiza of Phanerogams are not determined by intercalary increase.—Louis Lapicque: Mechanism of the exchanges between the cell and the surrounding medium. The osmotic pressure in the cells of marine Algæ is higher than that of sea water. This is incompatible with the currently accepted view that all exchanges of the cells are determined by the laws of osmosis. The author holds that, on the contrary, the exchanges of the cells are the result of physiological work and that diffusion and osmotic pressure intervene often as resistances only.—Paul Portier and Marcel Duval: The variation of the osmotic pressure of the blood of the cartilaginous fishes under the influence of modification of the salinity of the surrounding sea water. The dog-fish was used in these experiments, and it was found that the osmotic pressure of the blood was not equal to that of the sea water in which the fish is immersed. There was a tendency for the osmotic pressure of the blood to follow that of the sea water, but the

adjustment was very imperfect. The fish supported dilution of sea water better than enrichment with salt.—E. Fauré-Fremiet and Mlle. H. Garrault: Constitution of the ovarian egg of the carp (*Cyprinus Carpio*).—H. Vallée and H. Carré: The plurality of the aphthous virus.

BRUSSELS.

Royal Academy of Sciences, June 3.—M. A. Lameere in the chair.—F. Swarts: On trifluoromethylcyclohexane.—F. Swarts: On trifluoroacetic acid.—Th. De Donder: The electromagnetic field and the gravific field.—A. Mélant: The conditions determining the encystment of the infusorian, *Euplotes harpa*.—M. Philippson: A new form of electrical resistance of electrolytes.—M. Nuyens: A change in the variables of M. De Donder.—P. Bruylants and J. Dondeyne: The determination of the atomic weight of selenium.

Official Publications Received.

The Mellon Institute of Industrial Research of the University of Pittsburgh. Ninth Annual Report on the Industrial Fellowships of the Mellon Institute for the Institute's Fiscal Year, March 1, 1921, to March 1, 1922. Pp. vi+23. (Pittsburgh, Pa.)

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1921. Compiled by Lionel C. E. Gee. No. 35. Pp. 72. (Adelaide.)

South Australia. Department of Mines: Geological Survey of South Australia. Bulletin No. 9: The Iron-Ore Resources of South Australia. By R. Lockhart Jack. Pp. 71. (Adelaide.)

Bureau of Education, India. Occasional Reports No. 10: Adult Education (University Extra-Mural Teaching in England and Wales). By J. P. Bulkeley. Pp. ix+98. (Calcutta: Government Printing Office.) 8 annas.

Bureau of Education, India. Indian Education in 1920-21. Pp. ii+87. (Calcutta: Government Printing Office.) 1.8 rupees.

Technical College, Bradford. Diploma and Special Day Courses. Prospectus, Session 1922-23. Pp. 168+plates. (Bradford.)

Report of the Fifteenth Meeting of the Australasian Association for the Advancement of Science. Hobart Meeting, held in Melbourne, January 1921. Edited by Dr. Georgina Sweet and Dr. A. C. D. Rivett. Pp. lxxxix+390. (Sydney, N.S.W.: The Association, Elizabeth Street.)

Diary of Societies.

FRIDAY, JUNE 30.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at the Royal Horticultural Society's Gardens, Wisley), leaving London 11.15-11.30 A.M.—Annual Field Meeting.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.

MONDAY, JULY 3.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—

Right Rev. Bishop Welldon: Modernism. (Annual Address.)

FELLOWSHIP OF MEDICINE (at Royal Society of Medicine), at 5.—Dr.

J. S. Goodall: So-called Functional Diseases of the Heart.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Dr. T. Ashby:

Recent Excavations at Rome.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—W. O. Brigstocke: Probability.

TUESDAY, JULY 4.

EUGENICUS EDUCATION SOCIETY (Annual General Meeting) (at Royal Society), at 5.30.—Dr. Tredgold, Dr. C. H. Bond, Dr. B. Hollander,

R. A. Fisher, and others: Conference on the Inheritance of Mental

Qualities, Good and Bad.

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers), at

5.30.—Sir Alfred Ewing: The Physicist in Engineering Practice, with

Special Reference to Applications of Thermodynamics. (Lectures

on "Physics in Industry" (2).)

SOCIOLOGICAL SOCIETY (at Leplay House, 65 Belgrave Road), at 8.15.—

S. C. Ramsey: Regional and Vocational Influences on Architecture.

WEDNESDAY, JULY 5.

ROYAL METEOROLOGICAL SOCIETY (a Summer Meeting) (at the Croydon

Aerodrome), at 3.—G. R. Hay: Address on the Arrangements for

supplying Meteorological Information to Pilots.—Inspection of

Aerodrome, etc.

THURSDAY, JULY 6.

ROYAL SOCIETY OF MEDICINE, at 5.—Annual General Meeting.

CIVIC EDUCATION LEAGUE (at Leplay House, 65 Belgrave Road), at

8.15.—A. Farquharson: Art as a Mirror of Society.