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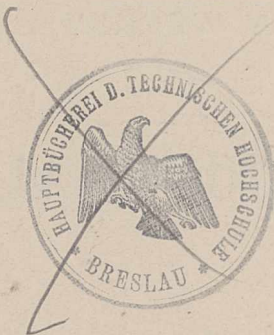
*"To the solid ground  
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.



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# INDEX.

## NAME INDEX.

- Abbot (Dr. C. G.), Distribution of Temperature in Stellar Spectra, 95
- Acres (F. A. S.), Four-wheel Brakes for Motor Cars, 508
- Adams (Prof. E. P.), The Quantum Theory, 369
- Addenbrooke (G. L.), The Properties of Dielectrics, 490
- Adler (A.), The Practice and Theory of Individual Psychology. Translated by Dr. P. Radin, 919
- Adrian (E. D.), and Sybil Cooper, The Electric Response in Reflex Contractions of Spinal and Decerebrate Preparations, 409
- Agafonoff (V.), Some Properties of Loess, 147; and W. Vernadsky, The Product of the Dehydration of Kaolin, 592
- Agersborg (Dr. H. P. K.), A Pelagic Nudibranch, 834
- Ahmad (N.), Absorption of Hard  $\gamma$ -rays by Elements, 513; and E. C. Stoner, The Absorption and Scattering of  $\gamma$ -rays, 878
- Aitchison and Co., Ltd., Sights of London, 798
- Albada (Col. L. E. W. van), Stereo-photographs taken by means of Wide-angle Lenses, 899
- Alexander (H. B.), Nature and Human Nature: Essays Metaphysical and Historical, 564
- Algar (J.), F. Fogarty, and H. Ryan, Dichromone and Dibenzylidichromone, 410
- Allkins (W. E.), Relation between the Tensile Strength and the Electrical Resistivity of Commercially Pure Copper, 478; Shells of Fossil Brachiopods, 657
- Allan (Dr. G. E.), Reminiscences of Prof. G. H. Quincke, 426
- Allen (Prof. F.), Reflex Visual Sensations, 370
- Allen (Prof. H. S.), A Static Model for Helium, 914; The Band-spectrum of Hydrogen, 878
- Allen (M.), Thermal Emission and Evaporation from Water, 663
- Amerio (A.), Variability in the Absorption of the Sun's Atmosphere, 735
- Ami (Dr. H. M.), Some Prehistoric Sites of France, 129
- d'Ancona (M.), Differentiation of Sex in the Eel, 843
- Anderson (J. C.), Maori String Games, 937
- Anderson (Dr. W.), Continuous Radiation from the Sun, 143; The Velocity of Solar Prominences, 799
- Andoyer (Prof. H.), Tables logarithmiques à treize décimales, 637
- André (E.), The Identity of Phocenic and Valerianic Acids, 627
- André (G.), Composition of Plant Juices extracted by Pressure, 147
- Andrews (Sir Frederick W.), and others, Medical Research Council. Diphtheria: its Bacteriology, Pathology, and Immunology, 527
- Andrews (Dr. C. W.), Dinosaurs, 436; [death], 794; [obituary article], 827
- Andrews (E. C.), Geology of the Broken Hill District, 697
- Angeli (A.), Reactions of Certain Aromatic and Aliphatic Derivations, 771
- Angot (C. A.), [death], 685; [obituary article], 793
- Angström (Dr. A.), Solar Radiation, 873
- Annandale (Dr. N.), A Working Model of the Origin of the Ganges in a Temple in Ganjam, 700; Evolution of the Shell-sculpture in Freshwater Snails of the Family Viviparidæ, 482; Evolution of Shell-sculpture in the Viviparidæ, 581; Mollusca damaging Brickwork, 250; The Fauna of the Fresh and Brackish Waters of India, etc., 437; [death], 576; [obituary article], 615
- Annett (Dr. H. E.), Influence of Weather Conditions on Sap and Latex Flows, 821
- Anning-Bell (R.), elected a member of the Athenæum Club, 400
- Anson (M. L.), and others, Relation between the Affinity for Certain Gases and the Position of the Spectral Bands in the Hæmoglobin of Vertebrates, 554
- Anstey (Lavinia Mary), Index to Vols. 1-50 (1872-1921) "Indian Antiquary," 3 parts, 672
- Anthony (Prof. R.), The Brain of Neanderthal Man, 207
- Antrobus (Lieut. P. R.), awarded the Rex Moir prize of Cambridge University, 945
- Appleton (Dr. E. V.), R. A. Watson Watt, and J. F. Herd, Rapid Variations of the Earth's Potential Gradient, 237
- Arden-Wood (W. H.), Changes in the Indo-Gangetic Alluvial Plain, 143
- Armstrong (Prof. H. E.), Chemistry and Physics, 576; Problems of Hydron and Water: The Origin of Electricity in Thunderstorms, 124; Luminous Ice, 163
- Armstrong (W. E.), Rossel Island Money, 325
- Arnell (Dr. H. W.), Phenology in Sweden, 728
- d'Arsonval (M.), Attempts at 1,000,000 Volts at the Ampère Laboratory, 103; The Ampère Testing Laboratory for High Voltages, 246
- Ashcroft (F. N.), Mineral Localities in the Tavetschthal, Switzerland, 374
- Ashford (C. E.), Prof. C. Godfrey, 685
- Ashworth (Dr. J. R.), A Formula for the Specific Heat of Ferromagnetic Substances and its Discontinuity at the Critical Temperature, 13
- Asklöf (S.), Orbit of Mellish's Comet, 1917 I., 619
- Aston (Dr. F. W.), Atomic Species and their Abundance on the Earth, 393; Recent Results obtained with the Mass-spectrograph, 856; The Mass-spectrum of Indium, 192
- Athanasiu (G.), The Calorific Action of Radiation on Metals dipped in Solutions of their Salts, 327; The Electromotive Forces produced by Light on Metals immersed in Solutions of their Salts, 259
- Atholstan (Lord), gift for research on Tuberculosis, 316
- Atkins (Dr. W. R. G.), and Dr. Marie V. Lebour, The Habitats of *Limnaea truncatula* and *L. perversa* in relation to Hydrogen Ion Concentration, 258, 656; The Influence of Soil Acidity on Snails, 320
- Atkinson (R. H.), Fractional Crystallisation of Common Lead, 495
- Aubin (P. A.), Problems of River Pollution, 461
- Audibert (M.), The Mechanism of the Explosive Reaction, 662
- Auger (V.), and Mlle. L. Odinet, The Reduction of Arsenic Acid by Sulphurous Acid in the Presence of Vanadic Acid, 183; and Mlle. I. Robin, A Basic Zinc Acetate analogous to the Acetate of Beryllium, 807
- Automatic and Electric Furnaces, Ltd., Electric Furnaces for Hardening Steel, 658
- Aveling (Rev. Dr. F.), The Thomistic Outlook in Philosophy, 770
- Averseny, Delas, Jaloustre, and Maurin, The Action of Thorium-X on the Maturation of Eggs, the Germination of Seeds, and the Growth of Plants, 771



- Backhurst (I.), and Dr. G. W. C. Kaye, A Metal Vacuum Pump, 763
- Baekeland (Dr. L. H.), elected president of the American Chemical Society, 136
- Bagnall-Wild (Brig.-Gen. R. K.), Notes on Iron and Steel, 867
- Bahl (Prof. K. M.), Nephridia of Worms, 937
- Bailey (Dr. G. H.), [obituary article], 865
- Bailey (H. J. E.), A Course of Experimental Mechanics, 780
- Baillaud (J.), The Distribution of Energy in some Star Spectra, 842; The Selective Absorption of the Atmosphere at the Observatory of the Pic du Midi, 915
- Baker (C.), Catalogue of Second-hand Scientific Instruments, 284; New Model R.M.S. Microscope, 658
- Baker (G. F.), gift to Harvard University, 840
- Baker (P. J.), appointed to the Sir Ernest Cassel chair of International Relations at the London School of Economics, 804
- Baldet (F.), Comparison of the Various Radiations emitted by the Nuclei of Comets, and of still Unknown Origin, with the Spectrum of the Mecker Burner, 35
- Baldit (A.), Études élémentaires de météorologie pratique. Deuxième édition, 43
- Balfour (Earl of), The Sir William Dunn Institute of Biochemistry, Cambridge, 731
- Balgrave (W. N. C.), Coagulation of Hevea Latex, 440
- Ball (Rev. C. J.), [obituary article], 397
- Ball (N. G.), Phototropic Movements of Leaves, 70
- Balls (Dr. W. L.), The Structure of the Cotton Hair, 910
- Bamber (A. E.), The Avonian of the Western Mendips, 182
- Bamber (Ruth C.), (Mrs. Bisbee), An Apparent Connexion between Braxy and Thyroid Activity, 161
- Bamfylde (J. W.), Some Failures in Steel as revealed by the Microscope and Recorded by Photography, 257
- Bandulska (Helena), The Cuticles of some Recent and Fossil Fagaceæ, 446
- Banerji (Dr. S. K.), Tropical Cyclones, 939
- Bangham (D. H.), and F. P. Burt, The Behaviour of Gases in Contact with Glass Surfaces, 293
- Banting (Prof. F. G.), presented with the John Scott medal, 797; and C. H. Best, A Banting Research Foundation established to commemorate the work of, 618
- Bär (R.), M. von Laue and E. Mayer, Low Voltage Arc in Helium, 251
- Barbour (G. B.), Cretaceous Beds in North China, 194
- Barker (J.), elected to the Frank Smart University studentship in Botany in Cambridge University, 552
- Barlow (C. W. C.), and Dr. G. H. Bryan, Elementary Mathematical Astronomy. Eighth Impression (third edition), 7
- Barnard (T. T.), elected to the Anthony Wilkin studentship of Cambridge University, 212
- Barr (Prof. A.), elected president of the Optical Society, 363
- Barratt (S.), The Absorption Spectra of Mixed Metallic Vapours, 213
- Bartholomew (Dr. J. G.), A Literary and Historical Atlas of Europe, 303
- Bartholomew (Mr.), Electric Interference with Telegraphy and Telephony, 617
- Barua (B. M.), Five Bharaut Epithets, 699
- Barus (Prof. C.), Density and Diffusion of Gases measured by Displacement Interferometry, 844; Vibration in Spark-blown Closed Quill Tubes; Electric Oscillation, 447
- Bataillon (Prof. E.), elected associate of the Royal Academy of Belgium, 900
- Bateman (H.), Collisions between Light-quanta, 924
- Bates (L. J.) and J. S. Rogers, Particles of Long-range from Polonium, 446
- Bateson (Dr. W.), Progress in Biology, 644, 681
- Bather (Dr. F. A.), elected a correspondent of the Paleontological Society of America, 248; Fossils and Strata, 37; Government Publications and their Distribution, 83; Klähn's Paläontologische Methoden, 8; The Teaching of Palæontology, 922; The Work of, 361
- Batho (Dr. C.), appointed professor of Civil Engineering in Birmingham University, 876
- Baudouin (C.), translated by Eden and Cedar Paul, The Power Within Us, 121
- Baudouin (M.), A New Method of Prehistoric Trepanning with Circular or Oval Openings, cut with Flint, 35
- Bauer (Dr. L. A.), Report of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, 1923, 869
- Baumhauer (A. C. von), elected a foreign member of the Royal Astronomical Society, 687
- Baxandall (D.), Two Galileo Telescopes, 145; The Troughton Dividing Engine, 374
- Baxendell (J.), Southport Weather Observations, 287
- Bayle (E.), and R. Fabre, The Fluorescence of some Organic Compounds, 374; and H. George, Application of Optical Methods to the Examination of Works of Art, 146
- Bayliss (Sir William M.), elected a corresponding member of the Royal Academy of Medicine, Brussels, 471
- Beal (Prof. W. J.), [death], 933
- Bearden (J. A.), A Test for Possible X-ray Phosphorescence, 857
- Bearn (J. G.), The Chemistry of Paints, Pigments, and Varnishes, 383
- Beccari (Dr. O.), Asiatic Palms—Lepidocaryæ, The Species of Calamus, 120
- Beck, Ltd. (R. and J.), A New Illuminator for examining Metals, 658
- Becker (E. R.), Specificity of Herpetomonas in Flies, 937
- Becker and Co. (F. E.), Catalogue of Balances and Weights, 759; Chemical Catalogue, third edition, 725; Catalogue of Physical Apparatus, 901
- Becker (M. L.), Medieval Metallurgy, 258
- Becket (Dr. F. M.), awarded the Perkin medal of the American Section of the Society of Chemical Industry, 23
- Becquerel (Prof. J.), Gravitation Einsteinienne: Champ de gravitation d'une sphère matérielle et signification physique de la formule de Schwarzschild, 152
- Becquerel (P.), Is there a Bioradioactivity? 447
- Beit (Sir Otto John), created a baronet, 247
- Bell (Prof. F. Jeffrey), [obituary article], 541
- Bell (H. S.), American Petroleum Refining, 78
- Bell (R.), and others, Railway Geography, 99
- Bellemin (Mlle. Eugénie), An Attempt at an Optical Test of the Atmosphere carried out at the Lyons Observatory, 71
- Belling (J.), and A. F. Blakeslee, The Configuration and Size of the Chromosomes in the Trivalents of 25-Chromosome Daturas, 663
- Bennett (G. M.), appointed lecturer in Organic Chemistry in Sheffield University, 912
- Benoit (J.), The Signification of the Right Rudimentary Genital Gland in the Hen, 215; The Rudimentary Right Sexual Gland in the Hen, 439
- Benrath (Dr. A.), Translated by J. Bithell, The Fundamental Ideas of Chemistry, 420
- Berlingozzi (S.), and P. Badolato, Action of Chloropicrin on Phenol, 916
- Berry (A. J.), The Thallous Thallic Halides, 294
- Berry (W. J.), appointed director of Naval Construction at the Admiralty, 436
- Berthoud (Prof. A.), Les nouvelles conceptions de la matière de l'atome, 191
- Bertrand (Capt. A.), [death], 245
- Bertrand (G.), and Mlle. Y. Djouritch, A New Crystallised Chromogen, Esculetol, extracted from the Horse Chestnut, 662
- Besredka (Prof.), Local Immunity in Infectious Diseases, 242
- Betrand (G.), The Fumigation of Silkworm Cocoons by Chloropicrin, 879
- Betts (Annie D.), Practical Bee Anatomy: with Notes on the Embryology, Metamorphoses, and Physiology of the Honey Bee, 78; The Practical Use of the Microscope in the Bee-keeping Industry, 734
- Bews (Prof.), and R. D. Aitken, The Vegetation of Natal, 440
- Bezzi (M.), Fissicorn Tachinidæ, with Description of New Forms from Australia and South America, 148
- Bhattacharya (Prof. D. R.), and Prof. J. B. Gatenby, Spermatogenesis of an Indian Scorpion, 858
- Bhattacharyya (K. P.), Utilisation of Atmospheric Electricity, 287



- Biancani (E. and H.), Action of some Chemical and Physical Agents on the Mobility of the Ciliated Infusoria, 447
- Bicknell (P. F.), The Human Side of Fabre, 709
- Bigelow (Prof. F. H.), [death], 685; [obituary article], 721
- Bigot (A.), Apparatus for the Treatment of Town Refuse, 627; Kaolins, Clays, etc., 146; The Treatment of Town Refuse, 556; Kaolins and Fused Bauxites, 327
- Bigourdan (G.), The Organisation of an Experiment on the Propagation of Sound up to great Distances, 146
- Billington (W.), appointed joint professor of Surgery in Birmingham University, 552
- Bingel (J.), Photo-electric Action in Coloured Rock Salt Crystals, 508
- Birch (Dr. W. de Gray), [obituary article], 468
- Bird (A. L.), Oil Engines, 268
- Birdseye (Col. C. H.), awarded the Charles P. Daly gold medal of the American Geographical Society, 689
- Black (Dr. H.), appointed lecturer in Radiology in Birmingham University, 552
- Blackadder (Dr. W.), appointed professor of Engineering in Aberdeen University, 181
- Blackburn (Kathleen B.), and J. W. H. Harrison, Cytology of the Salicaceae, 938
- Blackman (Dr. A. M.), Luxor and its Temples, 600
- Blackman (V. D.), Atmospheric Electric Currents, Normal and Abnormal, and their Relation to the Growth of Plants, 554
- Blair (Sir Robert), proposed establishment of fellowships in honour of, 372
- Blaise (E. E.), and A. Corrilot, A New Synthesis of *n*-Butylpyrrolidine, 842
- Blakeslee (A. F.), Distinction between Primary and Secondary Chromosomal Mutants in *Datura*, 663
- Bland-Sutton (Sir John), elected a member of the Athenæum Club, 247
- Bledisloe (Lord) and others, speeches at the Annual Inspection of the Rothamsted Experimental Station, 944
- Bliss (H. J. W.), The Nature of the Wool Fibre, 475
- Blizard (J.), Powdered Coal in Furnaces, 508
- Bloch (L.), E. Bloch, and G. Déjardin, The Higher Order Spectra of Argon, Krypton, and Xenon, 447; (and E.) Extension of the Spark Spectra of Lead, etc., in the Extreme Ultra-violet, 295; The Higher Order Spectra of Argon, Krypton, and Xenon, 508
- Bloch (O.), Densities of Photographic Plates, 643
- Bochet (L.), The Results of Watson's Experiments relating to the Expansion of Water under High Constant Pressure, 327
- Bogart (Prof. E. L.), Economic History of American Agriculture, 531
- Bogitch (B.), The Removal of Sulphur from Metals in the Solid State, 514
- Bohr (Prof. N.), elected a foreign member of the Göttingen Academy of Sciences, 23; grant to, by the International Education Board, 171; On the Application of the Quantum Theory to Atomic Structure. Part i., 382
- Bolton (D. J.), Electrical Measuring Instruments and Supply Meters, 79
- Bonacina (L. C. W.), Sunshine and Health in Different Lands, 494, 674, 891; The Geographical Distribution of Snowfall, 210
- Bonaparte (Prince Roland), [death], 616; [obituary article], 755
- Bond (J. R.), Farm Implements and Machinery, 264
- Bond (W. N.), Forced Vibrations produced by Tuning Forks, 355
- von Bonde (C.), The Heterosomata of Portuguese East Africa, 948
- Bone (Prof. W. A.), D. M. Newitt, and D. T. A. Townend, Gaseous Combustion at High Pressures. Pt. iv., 373; A. R. Pearson, and R. Quarndon, Researches on the Chemistry of Coal. Part iii., 513
- Bonney (Rev. Prof. T. G.), 201
- Boquet (A.), and L. Négra, Action of the various Constituents of the Koch Bacillus on the Evolution of Experimental Tuberculosis in the Rabbit and the Guinea-pig, 515
- Borelius (Prof. G.), and F. Gunneson, Temperature Periods in the Emission of Occluded Gases from Iron, 82
- Born (Prof. Max), Atomtheorie des festen Zustandes (Dynamik der Kristallgitter). Zweite Auflage, 232
- Borradaile (Dr. L. A.), A Manual of Elementary Zoology. Fourth edition; Elementary Zoology for Medical Students, 78
- Bose (Sir Jagadis C.), lecture at the India Office, 247
- Bosler (J.), L'Évolution des étoiles, 303
- Botley (Cicely M.), Sunshine and Health in Different Lands, 674
- Bottlinger (K. F.), and P. Guthnick, An Interesting Algal Variable, 173
- Boule (Prof. M.), Translated, with an Introduction, by Jessie E. Ritchie and Dr. J. Ritchie, Fossil Men: Elements of Human Palaeontology, 382
- Boulnois (Helen Mary), Into Little Thibet, 450
- Boulton (W. S.), A Recently Discovered Breccia-bed underlying Nechells (Birmingham), and its Relations to the Red Rocks of the District, 257
- Boutaric (A.), E. Chauvenet, and Mlle. Y. Nabot, Determination of the Molecular Mass of some Sodium Salts by Cyoscopy in Hydrated and Fused Sodium Thio-sulphate, 327; and M. Vuillaume, Influence of the Properties of Sols of Arsenic Sulphide of some Physical Factors intervening during their Preparation, 515
- Bouzat (A.), and L. Azinières, The Experimental Determination of the Composition of the Hydrate of Chlorine, 103; and G. Leluan, The Determination of the Boiling-point of Bromine, 374
- Bowell (E. W.), The Mounting and Photomicrography of Radulæ, 913
- Bowen (W.), Reflections on Pyrometer Design, 556
- Bower (Prof. F. O.), The Present Outlook on Descent, 356
- Boycott (Prof. A. E.), Problems of River Pollution, 817
- Boyd (O. F.), appointed Sugar Technologist in the Imperial College of Tropical Agriculture, 477
- Bracher (R.), *Rhytisma acerinum* and *R. Pseudoplatani*, 33
- Bragg (Sir William), Research Work and its Applications, 255, 311; X-ray Examination of Metal Films, 639
- Bragg (Prof. W. L.), Crystal Structure, 294; The Refractive Indices of Calcite and Aragonite, 446
- Brain (K. R.), Piezo-electric Effects with Dielectrics, 34
- Braithwaite (R. B.), elected to a fellowship at King's College, Cambridge, 477
- Brambell (F. W. R.), The Golgi Apparatus in the Avian Oocyte, 493; and Prof. J. B. Gatenby, Golgi Apparatus in the Nerve Cells of Helix, 762
- Brammall (A.), and H. F. Harwood, Gold and Silver as Accessory Minerals in the Dartmoor Granite, 214
- Brand (Dr. W.), Der Kugelblitz, 677
- Brandt (Dr. B.), Südamerika, 420
- Brauner (Prof. B.), Einstein and Mach, 927
- Brenans (P.), and C. Prost, A New Iodosalicylic Acid, 556; A New *p*-Iodoxy-benzoic Acid, 807
- Brenchley (Dr. Winifred E.), Manuring of Grass Land for Hay, 482
- Brett (M.), A Species of Sterigmatocystis normally producing large numbers of Sclerotia and few Conidia, 553
- Breuil (L'Abbé), The Palæolithic Period in Hungary, 61
- Bridel (M.), The True Nature of the Glucoside with Methyl Salicylate existing in the Bark of *Betula lenta*, 663
- Bridgman (Prof. P. W.), Gases at High Pressure, 404; The Volume Changes of Five Gases under High Pressures, 215
- Briggs (G. H.), Distribution of the Active Deposit of Radium in Helium and Argon in the Electric Field, 104
- Briggs (Prof. H.), Liquid Oxygen and its Uses, 166
- Brigham (Prof. C. C.), A Study of American Intelligence, 158
- Brodetsky (Dr. S.), Norris and Legge's Mechanics via the Calculus, 600; Practical Mathematics, 453
- de Broglie (Duc), The Problem of Light Quanta, 474
- de Broglie (M.), Change of Wave-length by Diffusion in the case of the K Lines of Tungsten, 515; and L., The Experimental Verification of the Projections of Electrons, predicted from the Diffusion of X-rays, by the considerations of Compton and Debye, 259



- Brooks (C. E. P.), Abnormal Weather of Winter and Early Spring, 873; Distribution of Rainfall over Uganda, with a Note on Kenya Colony, 842; The Difference-periodogram, 293
- Brooks (Prof. H. T.), Diagnostic Methods: a Guide for History taking, Making of routine Physical Examinations and the usual Laboratory Tests necessary for Students in Clinical Pathology, Hospital Internes, and Practising Physicians. Fourth edition, 488
- Brotherton (M.), The Emission of Electrons under the Influence of Chemical Action, 145
- Brough (P.), Preliminary Note on the Embryo Sac of *Styphelia longifolia* (R.Br.), 148
- Brown (E. W.), and others, The Development of the Sciences, 419
- Brown (F. B. H.), Secondary Xylem of Hawaiian Trees, 290
- Brown (G. A.), Cinematography in Natural Colours, 368
- Brown (J. S.), The Salton Sea Region, 938
- Brown (W. H.), The New Science Department of Mill Hill School, 323
- Brown (Dr. W. H.), and J. P. McHutchison, A New Technique in Radium Therapy, 274
- Browning (C. H.), Prof. J. B. Cohen, S. Ellingworth, and R. Gulbransen, The Antiseptic Action of Compounds of the Apocyanine, Carbocyanine, and Isocyanine Series, 805
- Brownlie (D.), Mechanical Stoking, 923; Pulverised Fuel and Efficient Steam Generation, 62
- Bruhat (G.), and M. Pauthenier, The Destruction of Carbon Bisulphide by the Ultra-violet Rays, 807
- Brunner, Mond and Co., Ltd., gift to the Department of Physics of Manchester University, 324; gift to the Royal Society for the Publication of Results of Scientific Research, 545
- Brunt (D.), Climatic Continentality and Oceanity, 692
- Bryan (Prof. G. H.), Mathematical Tables, 637
- Bryce (Prof. T. H.), The Early Development of the Human Embryo, 914
- Brylinski (E.), The Precision of Michelson's Experiment, 35
- Bubb (Prof. F. W.), The Vector Quantum, 237
- Buchanan (Sir Walter James), [death], 541
- Buckland (A. S.), L. N. Staniland, and E. B. Watson, British Hymenoptera, 531
- Buckle (P.), [obituary], 169
- Buckley, jun. (A. B.), Silt and Current Velocity, 371
- Buckley (W.), Clean Milk, 127
- Buckman (S. S.), Type Ammonites. Vol. 4, 232
- Buckmaster (Prof. G. A.), Prof. R. Tigerstedt, 359
- Budge (Sir Ernest A. Wallis), the work of, 542
- Bulmer (Sir William), gift to Bankfield Museum, Halifax, 618
- Bulow (C.), The Molecular Constitution of Chemical Compounds, 447
- Bunting (D.), The Brittle Ranges in Brass as shown by the Izod Impact Test, 478
- Bureau (R.), The Meteorological Origin of Certain Disturbances of the Receivers in Wireless Telegraphy, 327; The Origin of Atmospherics, 441
- Burgess (G. K.), and G. W. Quick, Titanium and Silicon in Steel, 474
- Burgess (P. J.), New Uses for Rubber, 583
- Burkill (J. C.), appointed professor of Pure Mathematics in Liverpool University, 877
- Burkill and Holtum, A Botanical Reconnaissance, 290
- Burlingame (Prof. L. L.), Prof. H. Heath, E. G. Martin, and G. J. Peirce, General Biology, 301
- Burns (C. D.), A Short History of Birkbeck College (University of London), 670
- Burroughs Wellcome and Co., Foresight in Photography, 936
- Burton (C. G.), appointed secretary of Birmingham University, 552
- Burton (W.), Early Chinese Pottery and Porcelain, 524
- Bury (H.), Palæolithic Flakes, 310
- Butcher (C. H.), The Bronze Age in Essex, 403
- Butler (C. P.), Eclipses of the Sun, 703
- Butler (E. A.), A Biology of the British Hemiptera-Heteroptera, 156
- Buxton (Rt. Hon. Noel), Agricultural Education at Leeds University, 551; Foot-and-mouth Disease, 315
- Buxton (P. A.), Heat, Moisture, and Animal Life in Deserts, 182
- Caborne (Capt. W. F.), [obituary article], 933
- y Cajal (Prof. Ramón), an honorary doctorate to be conferred upon, by Paris University, 512
- Callendar (Prof. H. L.), presented with the Duddell Memorial medal, 246
- Calthrop (J. E.), The Effect of Torsion on the Thermal and Electrical Conductivities of Metals, 326
- Cambage (R. H.), Acacia Seedlings. Pt. ix., 295
- Campbell (A. J. and A. G.), Interpretation of Rules of Zoological Nomenclature, 798
- Campbell (Prof. L. L.), Galvanomagnetic and Thermomagnetic Effects: The Hall and Allied Phenomena, 743
- Campbell (Dr. N. R.), Physics and Relativity, 784
- Canney (Prof. M. A.), Givers of Life and their Significance in Mythology, 601
- Cannon (H. G.), The Development of an Estherid Crustacean, 182
- Canu (F.), presented with the Daniel Giraud Elliot medal, 798; and R. S. Bassler, North American Later Tertiary and Quaternary Bryozoa, 139
- Cappel (Sir A. J. Leppoc), [death], 685
- di Capua (Clara) and Maria Arnone, Hardness of Lead-cadmium and Lead-tin Alloys, 916
- Cardot (H.), Influence of the Cooking of Food on the Development of *Agriolimax agrestis*, 35; H. Laugier and R. Legendre, A Block giving a Series of Constant Temperatures, 146
- Carleton (H. M.), and G. C. Robson, Histology and Function of certain Sex-limited Characters in *Doratosepion confusa*, 589
- Carmichael (Prof. H.), [death], 502
- Carobbi (G.), Supposed Isomorphism of Uranyl Compounds with those of Isomorphogenic Metals of the Magnesium Metals, 843
- Carpenter (Prof. H. C. H.), Bessemer Steel, 51; The Tarnishing and Fogging of Metals, 178
- Carpenter (K.), Problems of River Pollution, 385
- Carr (Prof. H. Wildon), Human Intercourse by means of Speech, 257; Malebranche, 116; Science and Philosophy, 612, 646; The Foundations of Science, 522
- Carrelli (A.), Polarised Fluorescent Light, 735; and P. Pringsheim, Photoluminescence of Dyestuffs in Viscous Media, 98
- Carrière (E.), and M. Auméras, Experimental Study of the Equilibrium of the System Calcium Oxalate-dilute Hydrochloric Acid, 71
- Carroll (J. A.), A Device for using Mercury Seals on Ground Joints in Horizontal or Inverted Positions, 858
- Carruthers (R. G.), and Sir Aubrey Strahan, Lead and Zinc Ores of Durham, Yorkshire, and Derbyshire, with Notes on the Isle of Man, 75
- Carslaw (Prof. H. S.), An Introduction to the Mathematical Theory of the Conduction of Heat in Solids. Second edition, 742; Oxford and Cambridge and other Universities, 517
- Carter (H. J.), Australian Coleoptera. Notes and New Species, No. 3, 843
- Carus-Wilson (C. A.), A New Method of approaching the General Elementary Science, 180; Sands and Rock Specimens from Reg-i-Ruwan, 274; The Twinkling of Distant Light-points, 426
- Casson (S.), Decorative Design of the Hallstadt Period, 138
- Castaldi (L.), First Results of Experiments on the Effects of the Cortex of Suprarenal Glands on the Somatic Growth of Young Guinea-pigs, 771
- Castle (F.), Four-figure Mathematical Tables, 637
- Castle (W. E.), Does the Inheritance of Differences in General Size depend upon General or Special Size Factors? 448; Linkage of Dutch, English, and Angora in Rabbits, 663
- Castner-Kellner Alkali Co., Brochures on Bleaching, 836
- Catalán (M. A.), Relation between Pressure Shift, Temperature Class, and Spectral Terms of the Iron Lines, 889
- Cattell (Dr. J. McKeen), elected president of the American Association, 289
- Cauquil (Mlle. G.), The Esterification of Cyclohexanol and of some of its Homologues, 215
- Cave (Capt. C. J. P.), elected president of the Royal Meteorological Society, 284; The International Survey of the Sky, 279



- Cazaud (R.), The Influence of Annealing on the Magnetic Properties of Silicon Iron Plates employed in Electric Construction, 842
- Cellier (T.), The French Physical Society's Exhibition, 353
- Cerighelli (R.), The Respiratory Quotient of the Root and its Variations in the Course of the Development of the Plant, 374
- Chalmers (C. H.), appointed demonstrator in agricultural botany in Leeds University, 181
- Chalmers (Lord), elected a trustee of the British Museum, 94
- Chambers (E. K.), elected a member of the Athenæum Club, 545
- Chapman (A. Chaston), elected president of the Royal Microscopical Society, 205
- Chapman (D. L.), and L. J. Davies, The Phosphorescence of Fused Transparent Silica, 309
- Chapman (F.), Tubular Cavities in Sarsen Stones, 239; and F. A. Cudmore, New or Little-known Fossils in the National Museum, Pt. xxvii., 147
- Chapman (Prof. S.), The Lunar Atmospheric Tide at Mauritius and Tiflis; The Semi-diurnal Oscillation of the Atmosphere, 326
- Charaux (C.), The Biochemical Hydrolysis of Rutine, 663
- de Chardonnet (Count Hilaire), [obituary article], 501
- de Chardonnet (M.), The Storage of Volatile Liquids in Industry, 183
- Charlesworth (J. K.), The Glacial Geology of the Northwest of Ireland, 214
- Charlier (Prof. C. V. L.), presented with the Watson medal, 798
- Charpy (G.), and G. Decors, The Determination of the Oxidisability of Coals, 842
- Charriou (A.), The Electrolytic Purification of Precipitates, 515
- Chassy (A.), The Physical Laws of the Formation of Ozone by the Silent Discharge, 771
- Cheel (E.), New or Noteworthy Plants from the National Herbarium, Sydney, 147
- Chéneveau (C.), and R. Boussu, Estimation of Calcium by the Nephelometric Method, 71
- Cherry (T. M.), awarded a Smith's prize by Cambridge University, 408
- Cheshire (Prof. F. J.), The Design of the Petrological Microscope, 214
- Childe (V. G.), Neolithic Painted Pottery from the Bukovina, 656; Stone Battle-axes from Troy, 761
- Chipp (Major T. F.), The Forest Officers' Handbook of the Gold Coast, Ashanti, and the Northern Territories, 153
- Chirol (M.), Appareils de mesures électriques, 349
- Chofardet (P.), Reid Comet (1923c), 71
- Chopra (B.), Indo-Pacific Bopyridæ, 367
- Chree (Dr. C.), Atmospheric Electricity and Atmospheric Pollution, 855; Reflections on Various Subjects, including Meteorology and Sun-spots, 214; and R. E. Watson, Atmospheric Pollution and Potential Gradient at Kew Observatory, 1921 and 1922, 293; and others, Solar Activity and its Effects, 799
- Christiansen (I. A.), G. Hevesy, and S. Lomholt, Researches, by a Radiochemical Method, on the Circulation of Bismuth in the Organism, 663
- Christopherson (Dr. J. B.), Longevity of Parasitic Worms, 903
- Christy (Dr. C.), The Imperial Institute, 617
- Church (Major A. G.), appointed a member of the Medical Research Council, 400; appointed Parliamentary private secretary to Mr. Sidney Webb, 247
- Clark (Dr. G. L.), Reflection of X-rays by Crystals, 621; Stability of Ammines, 209; and W. Duane, Secondary and Tertiary X-rays from Germanium, etc., 663; Tertiary X-radiation, Reflection by a Crystal of its Characteristic X-radiation, 448; The Wave-length of Secondary X-rays, 375; and W. W. Stifler, The Secondary and Tertiary Rays from Chemical Substances of Small Atomic Number due to Primary X-rays from a Molybdenum Target, 844
- Clark (J.), Australian Formicidæ, 103
- Clark (J. E.), I. D. Margary, and A. Marshall, Phenological Observations in the British Isles, Dec. 1922 to Nov. 1923, 841
- Clark (W.), Sensitiveness of Silver Bromide Emulsions, 321
- Clark (Dr. W. M.), Life without Oxygen, 656; The Determination of Hydrogen Ions: an Elementary Treatise on the Hydrogen Electrode, Indicator, and Supplementary Methods, with an Indexed Bibliography on Applications. Second edition, 157; Continuous High Temperature Measurements in Glass Works, 555
- Clarke (Prof. C. K.), [death], 202
- Clarke (F. C.), Technical Education, 944
- Clarke (J. J.), Some Mycological Chromidia, 33
- Cloughton (H.), appointed financial officer and secretary to the Senate of London University, 32
- Clausen (R. E.), and Margaret C. Mann, Inheritance in *Nicotiana Tabacum* (V.), 843
- Clapham (C. B.), Arithmetic for Engineers: including Simple Algebra, Mensuration, Logarithms, Graphs, Trigonometry, and the Slide Rule; with an Appendix on Verniers and Micrometers, 453
- Clement (E.), Seedlings of *Odontoglossum*, *Dendrobium*, *Cattleya*, and *Cymbidium* germinated without Fungal Aid, 806; The Germination of Orchid Seeds without Fungal Aid, 554
- Cleveland (L. R.), Intestinal Flagellates of Termites, 175; Symbiosis between Termites and their Intestinal Protozoa, 375
- Close (Sir C. F.), The Meridian of France, 56; The Supposed Westerly Drift of Greenland, 319
- Clowes (Dr. F.), [obituary article], 57; and J. B. Coleman, Quantitative Chemical Analysis: adapted for Use in the Laboratories of Colleges, of Technical Institutes, and of Analysts. Twelfth edition, 488
- Coad (B. R.), E. Johnson, and Lieut. C. L. McNeil, Cotton Dusting from Aeroplanes, 506
- Coad-Pryor (E. A.), Use of Pyrometers in Glass Works, 555
- Coblentz (Dr. W. W.), presented with the John Scott medal, 797
- Cochrane (Hon. T. G.), Natural Oil-reservoirs as "Stock-tanks," 657
- Cock (A. A.), Prayer, Psychologically and Metaphysically considered, 770
- Cockerell (Prof. T. D. A.), Earthworms and the Cluster Fly, 193; The Coccidæ (Scale-insects and Mealybugs) of the Madeira Islands, 164; The Three-colour Process and Modern Painting, 606
- Cockerlyne (E. W.), gift to Leeds University, 181
- Cohen (Prof. J. B.), Organic Chemistry for Advanced Students. Fourth edition. 3 Pts., 380
- Cole (Prof. G. A. J.), Feldspar or Felspar, 274; [death], 616; [obituary article], 649
- Coleman (L. V.), Museums in Relationship to Schools, 869
- Coleman (Dr. G. S.), Calculations in Heating and Ventilation, 816
- Coleman (Dr. J. B.), Dr. F. Clowes, 57
- Coles (Principal), Non-resident Students, 406
- Collingwood (R. G.), Sensation and Thought, 34
- Collins (E. J.), Sex-conditions in *Silene nutans* Linn., 293
- Collins (J.), the tercentenary of the birth of, 316
- Collins (Marjorie I.), The Vegetation of Arid and Semiarid New South Wales. Part ii., 843
- Collis (A. G.), Practical Control of Electrical Energy, 9
- Colman (Sir Jeremiah), gift to Cambridge University, 911; the Sir William Dunn Institute of Biochemistry, Cambridge, 731
- Comandon and Lomon, The Radiographic Kinematography of the Human Heart, 556
- Comber (Dr. N.), elected professor of agricultural chemistry in Leeds University, 840
- Compton (Prof. A. H.), Scattering of X-ray Quanta and the J Phenomena, 160
- Comrie (L. J.), Occultation of a Star by Jupiter, 173
- Conn (Dr. H. W.), and Dr. H. J. Conn, Bacteriology: a Study of Micro-organisms and their Relation to Human Welfare, 853
- Connaught (Duke of), laying of foundation stone of new Veterinary Research Institute, 830
- Connolly (T. F.), and E. H. Coumbe, A Small Measuring Microscope, 535
- Conrad (Prof. V.), The Twinkling of the Stars in Relation to the Constitution of the Upper Strata of the Atmosphere, 352
- Conradi (C. G.), Mechanical Road Transport, 485



- Conrady (H. G.), Significance of the Foucault Knife-edge Test when applied to Refracting Systems, 553
- Conway (Prof. A. W.), Emission of Volcanic Gases, 891
- Cook (M.), The Cadmium-lead-zinc System, 478
- Cooke, Troughton and Simms, Ltd., Catalogue of Surveying and other Field Instruments, 249
- Coolidge, Milk Testing by Hydrogen-ion Determinations, 209
- Coolidge (President), treated by chlorine gas for a cold, 796; and others, speeches at the dedication of the new building of the U.S. Academy of Sciences and National Research Council, 941
- Cooper (C. Forster), Remains of Extinct Proboscidea in the Museums of Geology and Zoology in the University of Cambridge, 555
- Corbino (O. M.), Limits and Conditions for Good Reception in Radio-telephony, 915
- Corrie (F. E.), Manuring for Profitable Production, 470
- Cortie (Rev. A. L.), Astronomy for All, 884
- Costantin (Prof. J.), The Relations between Trees and Subterranean Fungi, 182; and Prof. F. Faideau, *Histoire naturelle illustrée: Les Plantes*, 119
- Coste (J. H.), Problems of River Pollution, 354
- Cotter (Dr. G. de P.), Alkaline Lakes, 547
- Cotton (A. D.), The Ministry of Agriculture Plant-disease Survey, 554
- Cottrell (K. W.), Asphalt and Related Bitumens, 26
- Coupin (F.), The Brain of the Bear at Birth, 515
- Cousen (A.), and Prof. W. E. S. Turner, The Production of Colourless Glass in Tank Furnaces with Special Reference to the Use of Selenium, 294
- Couvreux (J.), The Photomotor Reflex, 259
- Coward (T. A.), Birds and their Young, 228; Life of the Wayside and Woodland: When, Where, and What to Observe and Collect, 191
- Cowdray (Lord), annual contribution to the Imperial Institute, 543
- Cox (R. R. S.), appointed curator of the University Observatory of Sheffield University, 733
- Cragg (Major F. W.), [death], 685; [obituary article], 720
- Cramer (Dr. W.), Heliotherapy and Phototherapy, 80
- Cramp (Prof. W.), and A. Priestley, Pneumatic Grain Elevators, 176
- Crawley (H.), Evolution in the Ciliate Family Ophryoscolecidae, 691
- Crompton (Prof. A. H.), The Quantum Integral and Diffraction by a Crystal, 215
- Crompton (Col. R. E.), birthday celebration of, 869
- Crompton and Co., Ltd., A New Bridge and Potentiometer, 287
- Crook (T.), The Mineral Resources of the British Empire, 752
- Crowther (Dr. J. A.), An Electrostatic Oscillograph: An Oscillographic Study of a Coolidge X-ray Tube, 70; The Action of X-rays on Tissue Cells, 325; X-ray Measurement, 583
- Crump (N.), Distribution and Inter-relation of Prices, and their Incidence on the Problem of Price Stabilisation, 145
- Cuénot (L.), R. Lienhart, and P. Vernier, The Transmissibility of an Acquired Somatic Character, 627
- Culpin (Dr. M.), Psychology, 919
- Cumming (W. M.), I. V. Hopper, and T. S. Wheeler, Systematic Organic Chemistry: Modern Methods of Preparation and Estimation, 380, 712
- Cummings (Edith J.), The Photo-electric Photometer at the Lick Observatory, 285
- Cunningham (Dr. B.), Water Power Resources of Canada, 803
- Cunningham (J. T.), Experiments on *Ciona intestinalis*, 84; The Natural History of the Common Eel, 199
- Curie (Mlles. Irène), and C. Chemié, The Radioactive Constant of Radon, 915
- Curnow (Irene J.), Western China, 326
- Curtis (Prof. H. D.), Status of the Spiral Nebulae, 60
- Curtis (Dr. W. E.), The Phosphorescence of Fused Transparent Silica, 495
- Curzon (Dr. H. E. J.), A Course in Elementary Mathematics for Schools. Books 3 and 4, 638
- Cushman (J. A.), Foraminifera of the Atlantic Ocean, 139
- Cutler (W. E.), and L. S. B. Leakey, To explore the Deposits of Bones of Dinosaurs in Tanganyika Territory, 361
- Cvijic (Prof. J.), awarded the Cullum gold medal of the American Geographical Society, 689
- Dalby (Prof. W. E.), Strength and Structure of Steel and other Metals, 779
- Dale (T. N.), Lime-rocks in the United States, 97
- Dall (Dr. W. H.), "Nuclear" Characters in classifying Marine Gastropods, 903
- Dallimore (W.), and A. B. Jackson, A Handbook of Coniferae: including Ginkgoaceae, 707
- Dalziel (Sir Kennedy), [death], 245
- Damiens (A.), A New Reagent for Carbon Monoxide, 514
- Dangeard (L.), and M. Solignac, The Geological Nature of the Esquerquis Bank, 71
- Dangeard (P. A.), Sexual Reproduction in *Marchantia polymorpha* in its Relations with Cellular Structure, 215; and P. Dangeard, Vacuome of the Lower Algæ, 591
- Daniel (L.), Graft-inheritance, 174; Heredity of an Acquired Character by Grafting in the Jerusalem Artichoke, 103
- Danjon (A.), Rotation Periods of Mercury and Venus, 580; The Lunar Eclipse of February 24, 619; The Photometric Study of the Eclipse of the Moon of February 20, 1924, 591
- Darling (C. R.), and R. H. Rinaldi, The Thermo-electric Properties of Bismuth Alloys, with Special Reference to the Effect of Fusion, 734
- Darrow (F. L.), The Boys' Own Book of Science, 488
- Dart (Prof. R. A.), Nickel in Ancient Bronzes, 888
- Das-Gupta (H. C.), A Type of Sedentary Game prevalent in many parts of India, 699
- Davey (N.), Studies in Tidal Power, 115
- Davey (Dr. W. H.), The Static Atom, 905
- Davidson (F.) and Co., "Davon" Metallurgical Microscope, 939
- Davidson (Dr. W. B.), Gas Manufacture, 157
- Davies (F. M.), Preliminary Investigation of the Dogger Bank, 442
- Davis (B.), and R. von Nardroff, Refraction of X-rays in Pyrites, 627
- Davison (Dr. C.), Prof. F. Omori, 133; The Experimental Explosions in France, 660
- Dawson (C.), Progress and Decay in Civilisations, 250
- Dawson (Dr. W. B.), Canadian Tidal Stations, 97
- Dean (Dr. Bashford), extended and edited by Prof. E. W. Gudger with the cooperation of A. W. Henn. A Bibliography of Fishes. Vol. 3, 344; presented with the Daniel Giraud Elliot Medal, 798
- Deane (H.), [death], 616; [obituary article], 865
- Debenham (F.), The Physiography of the Ross Archipelago, 777
- Deegener (Prof. P.), Handbuch für das mikroskopisch-zoologische Praktikum der wirbellosen Tiere. Erste Lief., 564
- Déjardin (G.), Excitation of the Spectra of Argon, Krypton, and Xenon, 729
- Delacre (Prof. M.), Essai de philosophie chimique, 456
- Dellinger, Radio Signal Fading, 140
- Delsman (Dr. H. C.), The Ancestry of Vertebrates as a Means of understanding the principal Features of their Structure and Development, 708
- Deming (Prof. H. G.), General Chemistry: an Elementary Survey, emphasising Industrial Applications of Fundamental Principles, 456
- Demoussy (E.), The Displacement of Acids by Diffusion, 183
- Denning (W. F.), Meteor Showers probably associated with Comets, 870; Prevalence of Fireballs in January, 285; The January Meteoric Shower, 60; The Planet Saturn, 402; June Meteors, 902
- Densmore (F.), Mandan Music, 800
- Desch (Prof. C. H.), The Application of Physics to Metallurgy, 282; and others, Fluxes and Slags in Non-Ferrous Metal Melting and Working, 696
- Desgrez (A.), H. Bierry, and F. Rathery, The Fatty Bodies in the Diabetic Ration, 915



- Deslandres (H.), Observations of the Transit of Mercury across the Sun on May 8 at the Observatory of Meudon, 842; Record of La Courtine Explosive Wave, 947; Registration of the Explosive Wave of La Courtine at the Observatory of Meudon, 879
- Detwiler (R. S.), Effects of replacing the Cephalic End of the Embryonic Spinal Cord by an Extraneous Medulla in Amblystoma, 628
- Di Capua (C.), Hardness of Tin-cadmium and Tin-bismuth Alloys, 772
- Dickson (J. G.), Sophia H. Eckerson, and K. P. Link, The Nature of Resistance to Seedling Blight of Cereals, 375
- Dickson (Prof. L.), History of the Theory of Numbers. Vol. 3: Quadratic and Higher Forms, with a chapter on the Class Number by G. H. Cresse, 76
- Dickson (Dr. L. E.), awarded the prize given by a member of the American Association, 204, 289
- Diénert (F.), and F. Wandenbulcke, Study of Colloidal Silica, 327
- Dines (W. H.), Sunshine and Health in Different Lands, 784
- Dingman (C. F.), Plan Reading and Quantity Surveying, 815
- Ditshheim (P.), awarded a record number of marks for a watch by the National Physical Laboratory, 172
- Dixon (Prof. H. B.), a bust of, unveiled in Manchester University, 255; elected president of the Manchester Literary and Philosophical Society, 758; and G. Greenwood, The Velocity of Sound in Gases and Vapours, and the Ratio of Specific Heats, 213
- Dixon (Prof. R. B.), awarded the prize of the American Association, 936
- Dobbie (Sir James J.), [death], 933
- Dobrowolski (A. B.), Historja Naturalna Lodu (Histoire naturelle de la glace), 923
- Dobson (G. M. B.), Apparatus for measuring Photographic Densities, 494; and others, Progress of Meteorology, 99
- Dobson (H. J. E.), appointed lecturer in chemistry in the Durham Colleges, 732
- Dodwell (G. F.), Another Einstein Eclipse Result, 173
- Dohrn (Dr. R.), resumption of post of director of the Zoological Station at Naples, 449
- Domin (Prof. K.), Flora of Western Australia, 439
- Donnan (Prof. F. G.), presented with the Longstaff medal of the Chemical Society, 503
- Doodson (Dr. A. T.), Tide Prediction, 25
- Dootson (F. W.), reappointed a University lecturer in chemistry in Cambridge University, 877
- Dorlodot (Canon), translated by the Rev. E. Messenger, Darwinism and Catholic Thought. Vol. 1: The Origin of Species, 8
- Dott (N. M.), Functions of Pituitary Gland, 207
- Douglas (Capt. C. K. M.), Formation of Mammato-cloud, 462
- Douglas (R.), and Col. W. P. Anderson, Canadian Place Names, 728
- Douvillé (H.), The Earliest Nummulites in the Eocene of Béarn, 146
- Dover (C.), Dr. N. Annandale, 615; Mendelism and Evolution, 712
- Dow (J. S.), The Applications of Artificial Light, 170
- Dowson (W. J.), A Mould causing a Disease of Sweet-pea, 33
- Dreyer (Dr. J. L. E.), Early Astronomy in Oxford, 38; elected president of the Royal Astronomical Society, 317
- Driberg (J. H.), The Lango: a Nilotic Tribe of Uganda, 42
- Driesch (Prof. H.), Leib und Seele: eine Untersuchung über das psychophysische Grundproblem. Dritte Auflage, 233; Wissen und Denken: ein Prolegomenon zu aller Philosophie. Zweite Auflage, 233
- Drummond (Prof. J. C.), and Miss K. H. Coward, The Chemical Nature of Vitamin A, 759
- Drysdale (Dr. C. V.), and others, The Mechanical Properties of Fluids: a Collective Work, 520
- Dubois (R.), A Fine Auriferous Pearl, 72
- Dubrisay (R.), and P. Picard, The Surface Tension exerted at the Surface of Separation of Water and an Organic Liquid in the Presence of the Fatty Acids and of Alkalis, 183
- Dudley (H. W.), and W. W. Starling, Improvements in the Preparation of Insulin, 546
- Dufay (J.), Photograph of the Zodiacal Light, 545
- Duffield (Prof. W. G.), The Formation of Cumulus Cloud above Bush-fires, 126
- Duffieux (M.), The Mass of the Particles which emit several Band Spectra attributed to Nitrogen, 295
- Dufour (A.), The Acoustic Disturbance, recorded at Paris, produced by the Explosion of May 15 at La Courtine, 880
- Duggar (B. M.), and Joanne K. Armstrong, The Views of the Mosaic Diseases, 835
- Dümpelmann (R.), and W. Hein, The Influence of Gases on the Photoelectric Effect, 801
- Dunbar (C. O.), The Predecessors of Limulus, 96
- Duncan (L. L.), [obituary article], 91
- Dunn (Dr. J. T.), Pulverised and Colloidal Fuel, 810
- Dunstan (Dr. A. E.), Persian Crude Oil, 176
- Dunstan (Dr. J. T.), Retarded and Defective Children: Native Mentality: Mental Testing, 65
- Dupont (G.), An Hypothesis on the Related Origins of the Terpenes and the Crystallised Acids constituting the Resins of Conifers, 807
- Durand (J. F.), The Action of Permanganic Acid on the Different Forms of Carbon, 915; The Volumetric Estimation of Carbon, 627
- Durham (M. Edith), Witches and Vampires, 25
- Durst (C. S.), The Relationship between Current and Wind, 326, 905
- Duval (M.), The Remarkable Constancy of the Internal Medium of the Marine Teleosteans, 147
- Dyer (E. A.), a chemical film, 362
- Ebrahim (Sir Currimbhoy), gift to the University of Bombay, 661
- Eddington (Prof. A. S.), A Comparison of Whitehead's and Einstein's Formulæ, 192; awarded the gold medal of the Royal Astronomical Society, 171, 797; Density of Dwarf Stars, 760; presented with the Henry Draper medal, 798; Radial Velocities and the Curvature of Space-time, 746; The Masses and Luminosities of the Stars, 438; The Relation between the Masses and Luminosities of the Stars, 786
- Edridge-Green (Dr. F. W.), Colour Vision and Colour Vision Theories, 196
- Eiffel (G.), [obituary article], 21
- Eijkman (Dr. C.), The Pallor of White Men living in the Tropics, 757
- Einstein (Prof. A.), elected a foreign member of the Göttingen Academy of Sciences, 23
- Elder (J.), the centenary of the birth of, 316
- Elderton (W. Palin), Deferred Annuities (Two Rates of Interest), 50
- Elles (Dr. Gertrude L.), Evolutional Palæontology in Relation to the Lower Palæozoic Rocks, 37; The Scientific Interpretation of Scenery, 180
- Ellis (Dr. C. D.), The  $\beta$ -rays of Uranium-X, 404; and H. W. B. Skinner, The Absolute Energies of the Groups in Magnetic  $\beta$ -ray Spectra; the  $\beta$ -ray Spectrum of Radium-B and Radium-C, 145; The Interpretation of  $\beta$ -ray Spectra, 145
- Ellis (D.), The Life-history of *Beggiatoa alba*, 294
- Ellis (Sir William), presidential address to the Iron and Steel Institute, 722
- Elmhirst (R.), The Moulting of the Lobster, 367
- Eltringham (Dr. H.), Butterfly Lore, 531
- Emmott (Lord), Educational Policy, 406; elected president of the Association of Technical Institutions, 406
- Emrys-Roberts (Prof. E.), [death], 169
- Eneström (G.), [death], 169
- Engledow (F. L.), Inheritance in Barley, 904
- Epstein (P. S.), and P. Ehrenfest, The Quantum Theory of the Fraunhofer Diffraction, 843
- Erdtman (G.), The Micropalæontology of Post-glacial Deposits in Northern Scotland, 947
- Eredia (Prof. F.), Corn Crops and Rainfall in Sicily, 763
- Erikson (P. E.), and R. A. Mack, Maintenance of Telephone Systems, 474
- Errera (Léo), Recueil d'œuvres de, Pédagogie: Biographies, 41
- Erwood (E.), "The Pilgrims' Way" 876



- Esben-Petersen (P.), Australian Neuroptera, Pts. iv. and v., 36
- Esclançon (E.), Observations of the Eclipse of the Moon of February 20, 1924, made at the Observatory of Strasbourg, 515; The Einstein Deviation of Light Rays by the Sun, 183; The Propagation of Sound, 447
- Evans (Sir Arthur), gift of property at Knossos to the British School at Athens, 205; new discovery at Knossos, 898
- Evans (E. V.), Destructive Distillation of Coal, 573; and H. Stanier, Sulphur Studies in Coal Gas, I., 513
- Evans (Dr. J. W.), Continental Drift and the Stressing of Africa, 195; elected president of the Geological Society of London, 436; elected president of the Research Council of the National Union of Scientific Workers, 211; The Thirty-two Classes of Crystal Symmetry, 80; and G. M. Davies, Elementary Crystallography, 562
- Evans (L.), Early Scientific Instruments now housed in the Old Ashmolean Museum, 400
- Evans (U. R.), The Mechanism of the Rusting of Iron, 294
- Evermann (Dr. B. W.), The Steinhart Aquarium of the Californian Academy of Science, 434
- Evershed (Dr. J.), The Stationary Calcium Clouds in Interstellar Space, 318
- Evershed and Vignoles, Ltd., Constant Pressure "Meg" Insulation Tester, 63
- Evrard (E.), translated by B. Miall, The Mystery of the Hive, 452
- Ewald (Prof. A.), [death], 541
- Ewald (Prof. P. P.), Kristalle und Röntgenstrahlen, 302
- Ewart (Prof. J. Cossar), presented with a special gold medal by the Company of Woolmen, 935
- Eyre (Dr. J. V.), and C. R. Nodder, When to stop retting Flax, 939
- F.R.S., Auto-obituaries, 389
- Faber (H.), Agricultural Production in Denmark, 1909-13 and 1922, 34
- Fabre (J. H.), translated by A. Teixeira de Mattos and B. Miall, The Life of the Scorpion, 303
- Fabry (Prof. C.), La Lumière monochromatique, sa production et son emploi en optique pratique; les applications des interférences lumineuses, 120
- Faillebin (M.), Effects of Impurities in Catalysts, 98
- Fantham (Prof. H. B.), The Bloemfontein Meeting of the South African Association, 64
- Farmer (E.), Efficiency in the Glass Trade, 103
- Farran (G. P.), Seventh Report on the Fishes of the Irish Atlantic Slope, 258
- Fassig (O. L.), Weather in West Indies, 97
- Fauvel (Prof. P.), Faune de France, 5: Polychètes errantes, 528
- Fawdry (R. C.), Elementary Experiments in Practical Mathematics, 709; and C. V. Durell, Calculus for Schools, 672
- Feldman (Dr. W. M.), Biomathematics: being the Principles of Mathematics for Students of Biological Science, 484
- Fermi (E.), Reflection and Diffusion of Resonance, 771
- Fernbach (E.), and G. Rullier, Application of the Sörensen Reaction to the Study of the Toxic Power of Tuberculin, 183
- de Ferranti (Dr. S. Z.), awarded the Faraday medal of the Institution of Electrical Engineers, 204
- Ferrié (G.), R. Jouast, and R. Mesny, Amplification of the Current of Photo-electric Cells by means of Lamps with several Electrodes, 626
- Ferrières (M.), The Ultra-violet Absorption Spectrum of Gaseous Ammonia, 183
- Fessenden (Prof. R. A.), Suggested Excavation in the Caucasus, 317
- Feulgen (Prof. R.), Chemie und Physiologie der Nucleinstoffe nebst Einführung in die Chemie der Purinkörper, 524
- Fewkes (Dr. J. W.), Prehistoric Pottery from the Mimbres Valley, New Mexico, 367; The Archaeology of Florida, U.S.A., 138
- Feytaud (J.), The Termite of Saintonge, 183
- Fichter (M.), Variation of the Coefficient of Sliding Friction with the State of the Surfaces in Contact, 947
- Field (J. H.), the work of, 829
- Field (S.), and Capt. M. Field, gifts to the Field Museum of Natural History, 363
- Filchner (Dr. W.), Zum sechsten Erdteil. Die zweite deutsche Sudpolar Expedition, 382
- Fincham (E. F.), A New Form of Corneal Microscope with Combined Slit-lamp Illuminating Device, 374
- Findlay (Prof. A.), Practical Physical Chemistry. Fourth edition, 9
- Fisher (C. S.), Excavations at Bethshean, 937
- Fisher (E. A.), The Discontinuity of the Drying Process, 590
- Fisher (R. A.), and S. Odén, The Mechanical Analysis of Sediments by Means of the Automatic Balance, 294
- Fisher (Prof. W. J.), The Brightness of Lunar Eclipses, 782
- Fitzsimons (F. W.), "Only Way to tackle Locusts," 686; The Natural History of South Africa. Birds. In 2 vols., 228
- Fleish (A.), Oxidation Processes in Tissues, 727; and Dorothy Mary Moyle, 728
- Fleming (A.), Comparison of the Activities of Antiseptics on Bacteria and on Leucocytes, 409
- Fleming (Prof. J. A.), The Jubilee Celebrations of the Physical Society, 504
- Florey (H. W.), elected to the John Lucas Walker Studentship in Cambridge University, 839
- Flux (A. W.), The Census of Production, 479
- Folkard (C. W.), The "Bleeding" of Cut Trees in Spring, 492
- Forbes (Dr. H. O.), An Early Migrant, 239
- de Forcrand (M.), Heat of Vaporisation of Carbon, 947
- Forsdike (Dr. S.), Jacksonian Essay: The Effects of Radium upon Living Tissues, with Special Reference to its Use in the Treatment of Malignant Disease, 601
- Foster (C. E.), Practical Applications of Pyrometers to Glass Works, 555
- Foster Instrument Co., Optical Pyrometer, 801
- Foucher (M.), Movements in Afghanistan, 58
- Fourneau (E.), and others, A New Series of Trypanocidal Drugs, 375
- Fournier (E.), Cyclonic Vortices of Cirrus which do not extend to the Level of the Ground, 735
- Fournier (F. E.), Cause and Origin of Cyclones and Typhoons, 514
- Fournier d'Albe (Dr. E. E.), An Acoustic Spectroscope, 939; The Life of Sir William Crookes, O.M., F.R.S., 227, 607
- Fowler (Prof. A.), The Series Spectrum of Ionised Carbon (C II), 446; The Spectra of Silicon at Successive Stages of Ionisation, 802
- Fowler (H. W.), Fish of the Tai-Hu, Kiangsu Province, China, 663
- Fowler (Canon J. T.), [obituary], 616
- Fox (Dr. C. F.), elected to a Bye fellowship at Magdalene College, Cambridge, 372
- Fox (C. S.), Laterite and Bauxite, 658
- Fox (H. M.), elected Balfour student in Cambridge University, 804; The Migration of a Red Sea Crab through the Suez Canal, 714
- Fox (W. L.), and J. B. Phillips, Weather at Falmouth in 1923, 938
- Frankland (G. C.), Elizabeth Barrett Browning and Scientific Achievement, 462
- Frazer (Sir James George), Folk-lore in the Old Testament: Studies in Comparative Religion, Legend, and Law. Abridged edition, 633
- Fréchet (Prof. M.), On Approximate Integration, 714
- Frederikse (Dr. A. M.), Rudimentary Parthenogenesis, 872
- Freeth (F. A.), confierment upon, of the doctorate of Science by Leyden University, 317
- French (E. A. H.), The Preparation of Coppered Glass Mirrors, 806
- Freundlich (E.), translated by H. L. Brose, The Theory of Relativity: Three Lectures for Chemists, 638
- Frey (Dr. E.), Vegetationsverhältnisse der Grimselgegend, 585
- Friedel (G.), and G. Ribaud, A Transformation of the Diamond, 627, 693
- Friedrich (W.), and M. Bender, The Scattering of X-rays by Light Atoms, 692



- Friend (Rev. H.), British Earthworms and How to Identify Them, 158; Well-worms and their Allies, 272
- Friend (Dr. J. Newton), The Iron Age, 25; and J. S. Tidmus, The Relative Corrosion of Zinc and Lead in Solutions of Inorganic Salts, 478
- Frosch (Prof.), and Prof. Dahmen, Discovery of the Virus of Foot-and-mouth Disease, 685
- Frost (G. A.), Fish Otoliths from the Stomach of a Porpoise, 310
- Froude (Dr. R. E.), [death], 468; [obituary article], 501
- Fryer (P. J.), Successful Spraying and How to Achieve It, 780
- Fulton (J. F.), Lapicque's Investigations on the Chronaxie of Excitable Tissues, 427
- Furon (R.), The Climate of the East of Afghanistan, 147
- Gabriel (J.), The Periodicity of Storms, 556
- Gabriel (Prof. S.), [death], 865
- Gage (Lt.-Col. A. T.), appointed librarian and assistant-secretary of the Linnean Society, 936
- Gallenkamp (A.), and Co., Ltd., Catalogue of Fuel Apparatus, 437; Catalogue of Industrial Testing Apparatus, 140
- Gardiner (Prof. J. Stanley), Bottom Fauna of the North Sea, 442
- Gardner (W.), Chemical Synonyms and Trade Names: a Dictionary and Commercial Handbook, 530
- Gardner (Prof. W. M.), British Dyestuffs, 352
- Garrod (Sir Archibald E.), Inborn Errors of Metabolism. Second edition, 595
- Gascard (A.), and G. Damoy, The Acids of Beeswax, 35; The Alcohols and Hydrocarbons of Beeswax, 103
- Gasted (L.), The Value of Illuminating Engineering to the Electrical Industry, 504
- Gatenby (Prof. J. B.), Chemotaxis of Spermatozoa and its questioned Occurrence in the Animal Kingdom, 275
- Gates (Prof. R. R.), Polyploidy, 286
- Gaubert (P.), The Orientation of Crystals of Ammonium Iodide by the Cleavage Plates of Mica, 514
- Geddes (A. E. M.), The Balmer Series of Hydrogen, 146
- Geiger (H.), and A. Werner, Emission of  $\alpha$ -particles by Radium, 474
- Geitel (H.), [obituary article], 432
- General Electric Company, Ltd., The Research Staff of the, Photoelectric and Selenium Cells, 606
- George (W. H.), Measurement of Photographic Records, 387
- Gepp (H. W.), and G. Rigg, awarded conjointly the gold medal of the Institution of Mining and Metallurgy, 317
- Gerasimovič (Prof. B.), Cosmic Clouds of Calcium and Sodium, 458
- Gerlach (W.), and F. Gromann, Affinity of Neutral Iodine Atoms for Electrons, 140
- Germain (Dr. L.), Planorbidaë in the Indian Museum, Calcutta, 507
- Germann (F. E. E.), and M. C. Hylan, The Sensitiveness of Silver Iodide to Light, 369
- Gessard (C.), The Smell of Pyocyanic Cultures, 915
- Gherzi (Rev. E.), Microseisms, 835
- Gibbs (R. W. M.), Engineering Mathematics. Part I, 121; Technical Arithmetic, 79
- Gibbs (Dr. W. E.), Clouds and Smokes: the Properties of Disperse Systems in Gases and their Practical Applications, 672; and W. Clayton, The Production of Large, Clear, Cubical Crystals of Sodium Chloride, 492
- Giblett (M. A.), The Loss of the *Dixmude*, 435
- Gibson (Prof. A. H.), and H. W. Baker, Exhaust-valve and Cylinder-head Temperatures in High-speed Petrol Engines, 63
- Gibson (Prof. G. A.), Prof. W. Jack, 540
- Gibson (R. E.), The Electrolysis of a Mixture of Acetates and Trichloracetates, 914
- Gibson (Dr. W. H.), The Cost of the Publication of Scientific Proceedings, 92
- Gifford (J. W.), The Choice of Wave-lengths for Achromatism in Telescopes, 373
- Giglio-Tos (E.), Supposed Migration of the Chromosomes towards the Poles during the Ana-phase of Karyokinesis, 916
- Gilchrist (Prof. J. D. F.), The South African Seas, 64
- Giles (Dr.), and others, The Ph.D. Degree as an Encouragement to Higher Study and Research, 730
- Giltay (J. W.), issued into English by the author in co-operation with E. van der Straeton, Bow Instruments, their Form and Construction, 852
- Ginsberg (M.), conferment upon, of the degree of D.Lit. of London University, 32
- Gladstone (H. S.), Notes on the Birds of Dumfriesshire: a continuation of the "Birds of Dumfriesshire," 228
- Glagolewa-Arkadiewa (A.), Short Electromagnetic Waves of Wave-length up to 82 Microns, 640
- Glanely (Lord), gift to the University College of South Wales and Monmouthshire, 291
- Glauert (L.), Fossil Plants from Mingenev and Irwin River, 103
- Glockler (G.), Behaviour of Low Velocity Electrons in Methane Gas, 844
- Goard (A. K.), and Dr. E. K. Rideal, Catalytic and Induced Reactions. Pts. 1 and 2, 213
- Gobert (Dr. E.), Tunisian Tattooing, 834
- Godchot (M.), Some Syntheses of Dibasic Acids of Ether-oxide Function, 35
- Goddard (P. E.), The Pitch Indians, 581
- Godfrey (Prof. C.), [death], 541; [obituary article], 685
- Goetz (A.), Electron Emission from Incandescent Substances, 63
- Gold (Col. E.), Formation of Mammato-cloud, 235
- Golinski (S.), The Variation of Chemical Composition in Tomatoes grafted on Potatoes and on *Lycium barbarum*, 183
- Gompel (M.), A. Mayer, and R. Wurmser, The Oxidisability of Organic Bodies at the Ordinary Temperature, 556
- Good (R. D'O.), The Germination of *Hippuris vulgaris*, Linn., 33
- Goodey (Dr. T.), Nematode Parasites of Plants, 250; Recent Work on Nematode Life-history, 734
- Goodrich (Prof. E. S.), The Origin of Vertebrates, 708
- Goodrich (W. F.), The Utilisation of Low Grade and Waste Fuels, 810
- Gorczyński (L.), The Fraction of the Intensity of the Solar Radiation transmitted, for various Wave-lengths, by Red Jena Glass, 259
- Gordon (D.), Wild Life in Devon, 228
- Gordon (J. W.), Railway Surveying by Photography, 62
- Gornold (W.), forthcoming conjunction of Mars and Jupiter, 757
- Goudsmit (S.), The Spectrum of Iron, 604; The Spectrum of Manganese, 238
- Gould (Lieut.-Commdr. R. T.), John Harrison, 857; The Marine Chronometer: its History and Development, 415; The "Ross Deep" of the Southern Ocean, 507
- Grabham (Dr. M.), *Pseudococcus sacchari* and its Associates in Madeira, 213
- Grablovitz (G.), Harmonic Law of Telesismic Propagation, 736
- Grace (S. F.), A Spherical Source in a Rotating Liquid, 590
- Graff (K.), Rotation Periods of Saturn's Satellites, 690
- Graham (Stephen), In Quest of El Dorado, 887
- de Gramont (A.), [obituary article], 244
- Gran (H. H.), Melting of the Snow as the Chief of the Main Causes of the Increasing Production of Organic Substance in the Sea, etc., 215
- Grandidier (G.), Prince Roland Bonaparte, 755
- Granier (J.), The Conductivity of Electrolytes at very high Frequencies, 807
- Grassi (Prof. B.), The Transmission of Human Malaria, 304, 458; and M. Topi, Inconsistency of the two Species of Vine Phylloxera distinguished by Börner, 771
- Gravely (Dr. F. H.), re-opening of the Invertebrate and Fish Galleries of the Madras Government Museum, 901
- Gravie (A.), The Reaction of Alkaline Bisulphates and Mercuric Chloride, 915
- Gray (J.), appointed demonstrator of comparative anatomy in Cambridge University, 804; Penetration of Hydroxyl Ions into Gelatin; Removal of the Products of Activity by Oxygen, 555; Some Problems in Experimental Cytology, 806
- Gray (Mrs. Robert), [obituary], 397
- Gray (R. C.), The Control Field in Magnetic Hysteresis, 146



- Graystone (S. W.), bequest to Downing College, Cambridge, 552
- Greaves (W. M. H.), appointed chief assistant at the Royal Observatory, Greenwich, 282
- Greenwood (Dr. J. N.), appointed professor of metallurgy in Melbourne University, 32
- Greenwood (M.), *The Mortality Statistics of Sweden and of England and Wales: an Essay in International Comparison*, 806
- Greenwood (Dr. T.), *Euclidean Theory of Parallels*, 547
- Gregory (Prof. J. W.), awarded the Keith prize of the Royal Society of Edinburgh, 471; *Is the Gulf of Suez a Rift Valley?* 49; *The Ancient River System of the Kalahari and the Possibility of its Renewal*, 539; *The Scientific Renaissance in China*, 17; *The Structure of the Great Rift Valley*, 388; and C. J. Gregory, *The Zoology and Physical Geography of Chinese Tibet and its Relations to the Mountain System of South-Eastern Asia*, 805; *To the Alps of Chinese Tibet: an Account of a Journey of Exploration up to and among the Snow-clad Mountains of the Tibetan Frontier*, 6
- Gregory (Sir Richard), *British Climate in Historic Times*, 99, 938; *Science in Civilisation*, 876; and others, *Addresses at the Conference on Science and Labour*, 837
- Gregory (R. P.), Miss D. de Winton, and Dr. W. Bateson, and others, *Genetics*, 252
- Gregory (Dr. W. K.), *Description of Jaws of Dryopithecus, 757; The Gorilla's Foot*, 421; and M. Hellman, *Ancient Man in North America*, 25
- Greig (J. Y. T.), *A Polemic against Mechanism*, 154
- Greig-Smith (R.), *The High Temperature Organism of Fermenting Tan-bark*. Pt. iv., 148
- Grey (E. C.), *The Latent Fermenting Powers of Bacteria*. Pts. I., II., III., 257
- Grèzes (G.), *The Resistance of Fluids*, 879
- Griffiths (Dr. B. M.), appointed reader in Botany in Durham University, 877
- Griffiths (Dr. E.), *Heat Transmission and Wall Insulation*, 240
- Grindell-Matthews (H.), *Invisible Rays of Destruction*, 617
- Groth (Dr. P. von), impending retirement of, 23
- Grubb (Sir Howard) and Sons, Ltd., *Reflecting Telescope for Simeis Observatory, Crimea*, 550\*
- Grubenmann (Dr. U.), [death], 502
- von Gruber (Dr. M.), appointed president of the Bavarian Academy of Science, 362
- Gudden (Dr. B.), and Prof. R. Pohl, *Photoelectric Conductivity*, 254, 476
- Gueugnon, L'Enrégistrateur, 587
- Guillaume (Dr. Ch. Éd.), *The French Physical Society's Exhibition*, 127
- Guillaume (J.), *Observations of the Sun made at the Lyons Observatory*, 327
- Gunther (R. T.), *Early Science in Oxford*. Vol. 2: *Astronomy*, 38; *Early Science in Oxford*. Parts 3 and 4: *Physics and Surveying*, 346
- Gutton (C.), *Electric Discharge at very high Frequency*, 295
- Guye (C. E.), *The Spontaneous Rotation of the Electric Discharge*, 71
- Haas (Prof. A.), *Objective and Subjective Physics*, 829
- Haas (E.), *Experiments on the Sensation of Yellow Light obtained by Mixture of Spectra*, 259
- Hackett (F. E.), and T. A. Crowley, *A Physical Method of separating the Constituents of Butter-fat*, 735
- Haddon (Dr. A. C.), *The Cultural History of the Pacific*, 286; *The Pan-Pacific Science Congress, Australia*, 1923, 28
- Hadfield (Dr. J. A.), *Psychology and Morals: an Analysis of Character*. Second edition, 919
- Hadfield (Sir Robert), *The Use of the Microscope in Metallurgy*, 170
- Haeckel (Prof. E.), *Kunstformen der Natur*. Zweite Auflage. *Niedere Tiere*, 847
- Hague (B.), *Alternating Current Bridge Methods for the Measurement of Inductance, Capacitance, and Effective Resistance at Low and Telephonic Frequencies: a Theoretical and Practical Handbook for the use of Advanced Students*, 530
- Haldane (J. B. S.), *Daedalus, or Science and the Future*, 740; *The Possible Existence of a Growth-regulating Substance in Termites*, 676
- Hale (Prof. G. E.), *Barnard's Dark Nebula*, 249; *Sun-spots as Magnets and the Periodic Reversal of their Polarity*, 105; *Correction for Figure in Article on the Magnetic Polarity of Sun-spots*, 136; *The Mount Wilson Work on Solar Magnetism*, 726
- Hall (Dr. G. Stanley), [death], 685; [obituary article], 794
- Hall (Dr. H. R.), the work of, 361
- Hall (W. E.), *A Simple Apparatus for the Extraction of Micro-organisms from Samples of Water*, 374
- Haller (A.), and L. Palfrey, *A New Mode of Preparation of Phenyl Oxyhomocampholic Acid and its Constitution*, 879
- Hallimond (A. F.), *The Chemical Classification of the Mica Group*, 214
- Hallissy (T.), *Barytes in Ireland*, 440
- Halse (Col. S. C.), elected president of the Society of Glass Technology, 654
- Hambleton (Viscount) and others, *The Lister Memorial*, London, 431
- Hamburger (Prof. H. J.), [death], 57; [obituary article], 244
- Hamilton (E. H.), *Elementary Thermodynamics of Automobile Engines*, 79
- Hammond (D. B.), *Stories of Scientific Discovery*, 118
- Haney (Prof. M.), *History of Petroleum*, 62
- Hanitsch (Dr. R.), *Malayan Blattidæ*, 506
- Hanley (Dr. J. A.), appointed agricultural information officer in Bristol University, 32
- Hardy (Prof. G. H.), elected president of the National Union of Scientific Workers, 211; and Major A. G. Church, *Junior Teaching Appointments at Universities*, 746
- Hardy (W. B.), *Food Preservation*, 96; *The Life and Work of Thomas Graham*, 171
- Hargreaves (F. J.), and Rev. T. E. R. Phillips, *Colour Photography of the Moon*, 833
- Harkins (Prof.), and S. K. Allison, *Are Metals disintegrated by an Electric Discharge?* 729
- Harkness (Prof. J.), [obituary article], 91
- Harmer (Sir Sidney F.), *The Food of Dolphins*, 532
- Harnack (Prof. A. von), *Immanuel Kant*, 723
- Harris (Prof. D. Fraser), *A Defence of Philosophic Neovitalism*, 759
- Harris (R. G.), *Control of the Appearance of Pupa-larvæ in Pædogenetic Diptera*, 375
- Harris (W. J.), *Victorian Graptolites (New Series)*, Pt. I., 147
- Harrison (Dr. H.), *Inheritance of Melanism*, 96
- Harrison (R. G.), *Some Unexpected Results of the Heteroplastic Transplantation of Limbs*, 628
- Harrison (W. J.), reappointed University lecturer in Mathematics in Cambridge University, 804
- Harrod (Miss Caroline), bequest to Birmingham University, 552
- Hart (I. B.), *Makers of Science: Mathematics, Physics, Astronomy*, 118
- Hart (M. D.), *The Degradation of Acoustical Energy*, 145
- Hartog (Prof. M.), [death], 169; [obituary article], 243
- Hartridge (Dr. H.), *Physiology of Vision*, 370; *The Theory of Hearing*, 713
- Harvey (L. C.), *Pulverised Coal Systems in America*, 763
- Hassanein Bey's *Journey in the Libyan Desert*, 59
- Hatch (Dr. F. H.), and Dr. R. H. Rastall, *The Petrology of the Sedimentary Rocks: a Description of the Sediments and their Metamorphic Derivatives*. Revised edition, 886
- Hatschek (E.), and R. H. Humphry, *Certain Differences between Sols and Gels of Agar*, 410
- Havelock (Prof. T. H.), *Optical Dispersion and Selective Reflection*, 589
- Hawkes (L.), *An Olivine-rhyolite from Eastern Iceland*, 699; *The Hypothetical North Polar Land*, 275
- Hawksley (C. W.), *Microscope for Observation of Interference Fringes*, 326
- Hayes (Dr. H. C.), *Sounding by Acoustical Methods*, 621
- Hayward (Dr. W. T.), awarded the medal of the Federal Committee of the British Medical Association, 172
- Head (Dr. H.), *Speech and Cerebral Localisation*, 498



- Headicar (B. M.), *Philosophical Magazine*, 1914-1923, 607  
 Heard (A.), and R. Davies, The Old Red Sandstone of the Cardiff District, 513  
 Heath (Dr. E. R.), elected an honorary corresponding member of the American Geographical Society, 654  
 Heawood (E.), Watermarks of Old Maps, 761  
 Hée (A.), Does the Respiratory Intensity of Plants obey the Law of Surfaces? 327  
 Heffter (Prof. L.), *Lehrbuch der analytischen Geometrie*. Heft 2: Geometrie im Bündel und im Raum, 598  
 Hegner (Prof. R. W.), Euglena in Tadpoles, 403  
 Heis (Dr. L.), Impact Ionisation in Gases, 547  
 Hele (Dr. T. S.), Synthesis of Ethereal Sulphate in the Body, 581  
 Hemsley (Dr. W. B.), 80th birthday of, 23  
 Henderson (Prof. G. G.), elected president of the Institute of Chemistry, 401  
 Henley (F. L.), The Inspection and Testing of Materials, Apparatus, and Lines, 638  
 Hennig (Prof. E.), *Geologie von Württemberg nebst Hohenzollern*, 815  
 Henri (V.), The Absorption of Ultra-violet Light by Acrolein, 514; and H. de László, Analysis of the Absorption Spectrum of Naphthalene Vapour: Structure and Activation of the Molecule of Naphthalene, 878; The Ultra-violet Absorption Spectrum of Naphthalene Vapour, 556  
 Henry (Prof. A.), Larch Manna, 904  
 Henry (D. C.), and V. A. Morris, Influence of Anions in the Coagulation of a Negative Colloidal Sol, 410  
 Henry (M.), A Self-recording Thermo-electric Actinometer, 71  
 Henson (Prof. V.), [death], 865  
 Heppenstall (T. A.), and W. J. Shutt, Conditions of the Appearance of Anode Effect in the Electrolysis of Fused Chlorides, 770  
 Herdman (Sir William), Antarctic Ascidians, 139  
 Hérissey (H.), and J. Cheymol, The Synthetic Action of *α-d*-mannosidase, in the Presence of Ordinary Glycol and of Glycerol, 699  
 Hernandez (J.), Temperature of Mexico, 582  
 Heron-Allen (E.), Art-forms in Nature, 847  
 Hertz (Dr. G.), Spectral Lines produced by Electron Collisions, 693  
 Heslop (G. G.), Further Studies in Contagious Bovine Pleuro-pneumonia, 147  
 Hevesy (Prof. G.), The Hafnium Content of some Historical Zirconium Preparations, 384; and Jantzen, Separation of Zirconium and Hafnium, 63  
 Hewitt (J.), The Distribution of Animals in South Africa, 64  
 Hewlett (Prof. R. T.), Sir Malcolm Morris, 397  
 Hickinbottom (Dr. W. J.), appointed assistant lecturer in chemistry in Birmingham University, 254  
 Hicks (Prof. W. M.), The "Missing Element" between Cadmium and Mercury, 642  
 Hickson (Prof. S. J.), the work of, 434  
 Hilger, Ltd. (Adam), Work of the Research Laboratory of, 253  
 Hill (Prof. A. V.), Thermodynamics in Physiology (Joule Memorial Lecture), 859  
 Hill (Dr. A. W.), The Work of the Royal Botanic Gardens, Kew, 442  
 Hill (R.), A Lens for Whole Sky Photographs, 591  
 Hill (R. A.), The Photochemical Decomposition of Gaseous Sulphur Dioxide, 770  
 Hinks (A. R.), John Harrison, 570; The Figure of the Earth, 800  
 Hinshelwood (C. N.), awarded the Meldola medal, 363  
 Hirst (S.), Arachnida from the Rhynie Chert, 33  
 Hitchcock (Prof. R.), [obituary article], 615  
 Hobson (R. L.), and A. L. Hetherington, The Art of the Chinese Potter from the Han Dynasty to the End of the Ming, 524  
 Hocart (A. M.), The Use of the Plural in Polite Address, 96  
 Hofman (Prof. H. O.), [death], 828  
 Hogben (Dr. L.), appointed Ray Lankester investigator at the Laboratory of the Marine Biological Association, 504  
 Hogg (H. R.), bequest to the British Museum (Natural History), 398  
 Hogner (E.), Theory of Ship Waves, 287  
 Holden (H. S.), Cavity Parenchyma and Tyloses in Ferns, 626; and Miss A. Evelyn Chesters, The Seedling Anatomy of some Species of Lupinus, 626  
 Holloway (Dr. J. E.), appointed lecturer on botany in Otago University, 291  
 Holmes (Dr. A.), appointed reader in geology in Durham University, 877; Petrographic Methods and Calculations, 3 parts, 923  
 Holmes (Prof. S. J.), Studies in Evolution and Eugenics, 667  
 Holmyard (E. J.), Induced Asymmetry of Unsaturated Radicals in Optically Active Compounds, 785  
 Holweck (M.), Improvements in High Power Three Electrode Valves with Removable Parts, 915  
 Hookham (A. H.), Weather at Eastbourne in 1923, 905  
 Hope (Dr. E. W.), in collaboration with Dr. W. Hanna and Dr. C. O. Stallybrass, Industrial Hygiene and Medicine, 188  
 Hope-Jones (F.), The Free Pendulum, 873  
 Hora (Dr. S. L.), Certain Local Names of the Fishes of the Genus Garra; Fish of the Talé Sap, Peninsula of Siam (Part II.), 663; and others, Mollusca from the Salt Range, Punjab, 208  
 Horne (A. S.), and G. N. Jones, A New Species of Eidamia, 33  
 Hornell (J.), The Boats of the Ganges, 663  
 Horton (Prof. A. F.), and Dr. A. C. Davies, The Continuous Spectrum of Hydrogen, 273  
 Hovgaard (W.), The Principle of Minimum Energy and the Motion of Fluids, 215  
 Howard (Mrs. G. L. C.), and Abdur Rahman Khan, Linseed Selection Experiments in India, 872  
 Howard (Dr. L. O.), Retarded Establishment of Introduced Parasites of Injurious Insects, 447  
 Howard (S. H.), W. A. Robertson, and J. L. Simonsen, Camphor Cultivation in India, 320  
 Howarth (F.), The Sexuality of Ustilago, 258  
 Howarth (W. O.), Occurrence and Distribution of *Festuca ovina* L., sensu ampliss. Hack. in Britain, 626  
 Hudson (T. C.), Sense of Direction in Mathematics, 747  
 Huebotter (H. A.), Mechanics of the Gasoline Engine, 485  
 Hughes (Dr. P. T.), reappointed lecturer in mental diseases in Birmingham University, 408  
 Hughes (W.), Classification of the Chemical Elements with Explanatory Notes, 137  
 Hughes (W. E.), Modern Electro-plating, 851  
 Hull (A. F. Basset), The Relation of the Loricates to the Country Rock, 843  
 Hume (E. D.), Béchamp or Pasteur? a Lost Chapter in the History of Biology. Founded upon MS. by Dr. M. R. Levenson, 121  
 Hume (Dr. W. F.), Is the Gulf of Suez a Rift Valley? 49  
 Humphreys (J.), appointed honorary reader in medieval archaeology in Birmingham University, 552  
 Humphreys (Dr. W. J.), Weather Proverbs and Paradoxes, 486  
 Hunter (Prof. M. H.), and Prof. G. S. Watkins, The Background of Economics, 348  
 Hurley (R. T.), elected a foreign member of the Royal Aeronautical Society, 687  
 Hutton (J. H.), Stone Celts from the Naga Hills, 319; The Use of Stone in the Naga Hills, 591  
 Huxley (J. S.), Early Embryonic Differentiation, 276; Mendelism in Evolution, 518, 569, 822; and J. F. Fulton, The Influence of Temperature on the Action of Insulin, 234; and N. E. Odell, Polygonal Surface Markings, 507  
 Imbelloni (Dr.), The Reputed Fossilised Human Skull of Tertiary Age in Patagonia, 58  
 Ingersoll (E.), Birds in Legend, Fable and Folklore, 564  
 Ingold (Dr. C. K.), appointed professor of Organic Chemistry in Leeds University, 324  
 Innes (Dr.), Faint Stars with Large Proper Motion, 318; Proper Motions with the Blink Microscope, 726  
 Iokibe (K.), Copper-zinc Alloys which expand on Solidification, 478  
 Irvine (A. C.), [death], 934



- Irvine (Dr. J. C.), elected a member of the Athenæum Club, 247
- Ishihara (M.), The Equilibrium Diagram of the Copper-tin System, 479
- Jabobson (Dr. M.), The Photographic Action of Canal Rays, 583
- Jack (Prof.), [death], 468; [obituary article], 540
- Jackson (Dorothy J.), Insect Parasite of the Pea-Weevil, 353
- Jackson (H. C.), Totemism in the Upper Nile Province, 620
- Jackson (J.), The Proper Motions of the Spiral Nebulae, 870
- Jackson (Dr. W. Hatchett), [death], 360, 372; [obituary article], 433
- Jacques (Dr. F.), and Dr. Eveline Jacques, gift of Lepidoptera to the British Museum, 619
- James (R. W.), Antarctic Sea-ice, 475
- Jamieson (I.), [death], 721
- Jansky (Prof. C. M.), and Prof. H. P. Wood, Elements of Storage Batteries, 853
- Janson (O. E.), J. R. le B. Tomlin, and Dr. F. A. Bather Gray's *Spicilegia Zoologica*. Conclusion, 348
- Jauncey (Prof. G. E. M.), Photoelectrons and a Corpuscular Quantum Theory of the Scattering of X-rays, 196; The Scattering of X-rays and Bragg's Law, 627
- Jeancon (J. A.), Pre-Columbian Ruins in New Mexico, 403
- Jeans (Dr. J. H.), Report on Radiation and the Quantum Theory. Second edition, 702; The Origin of the Solar System, 314, 329; Origin of Solar Systems, 425
- Jeffery (Prof. G. B.), appointed to the Astor chair of mathematics at University College, 32
- Jeffreys (Dr. H.), The Cause of Cyclones, 35
- Jenkin (Prof. C. F.), and D. N. Shorthose, The Thermal Properties of Ethyl Chloride, 284
- Jenkins (C. H. M.), and D. Hanson, Constitution of the Alloys of Copper and Cadmium, 479
- Jérémme (Mme. E.), The Supposed Syenite from Coutances, 147
- Jette (E. R.), G. Phragmén, and A. F. Westgren, X-ray Studies on the Copper-aluminium Alloys, 479
- Jevons (W.), The Band-spectra of Silicon Oxide and Chloride, and Chlorides of Carbon, Boron, and Aluminium, 878; The Band-spectra of the Oxide and Nitride of Boron, 785; The Band Spectrum of Boron Nitride, 744
- Job (A.), and R. Reich, The Fixing of Unsaturated Molecules by Metals derived from their Organic Derivations, 103
- Joffé (Prof. A.), M. Kirpichewa, and M. Levitzky, The Elastic Limit and Strength of Crystals, 424
- Johannsen (Prof. W.), Inheritance of Characters acquired by Grafting, 536
- Johnson (B. K.), A Reflecting Spherometer, 553; Optical Revolution Counter, 33
- Johnson (J. W. H.), Problems of River Pollution, 817
- Johnson (M.), to collect in Africa for the American Museum of Natural History, 436
- Johnson (R. C.), Ultra-violet Emission Bands associated with Oxygen, 878
- Johnson (Dr. W. E.), Logic. Part 3: The Logical Foundations of Science, 522
- Johnson (W. H.), Cotton-growing in Australia, 652
- Johnstone (Prof. J.) and others, Dinoflagellates and Echinoderms, 286
- Jolliffe (Prof. A. E.), appointed professor of mathematics at King's College, London, 511
- Joly (Prof. J.), The Influence of Radioactivity on the Surface History of the Earth (Halley Lecture), 829
- Jones (A. H.), [death], 360; [obituary article], 502; bequest to the Hope Department of Oxford University, 661
- Jones (Dr. E.), Essays in Applied Psycho-Analysis, 919
- Jones (Dr. E. Lloyd), reappointed demonstrator of medicine in Cambridge University, 660
- Jones (Prof. F. Wood), Fauna of Nuyts Archipelago, 800; The Mammals of South Australia. Part I, 189
- Jones (Prof. H. C.), Trattato di chimica fisica, Seconda edizione italiana a cura di Prof. M. Giua, 455
- Jones (H. Spencer), Magnetic Variation in North Polar Regions, 139
- Jones (J. H.), The Quantum Theory and the Dielectric Constant, 589
- Jones (O. T.), The Upper Towy Drainage System, 326
- Jones (Dr. Tudor), Brain and Speech, 498
- Joseph (H. W. B.), appointed Herbert Spencer lecturer for 1924, 912
- Joubin (Prof. L.), and A. Robin, *Histoire Naturelle Illustrée: Les Animaux. Les Invertébrés; Les Vertébrés*, 119
- Joy (Dr. A. H.), The Companion of Mira Ceti, 173
- Jude (Dr. R. H.), [death], 933
- Juel (Prof. H. O.), elected a foreign member of the Linnean Society of London, 724
- Jumelle (H.), The Cytinus of Madagascar, 103
- Junk (Dr. W.), Catalogue of Publications, 1899-1924, 901
- Kahn (L.), Comparison between Living Beings and Mechanical Engines from the Point of View of the Power necessary for Propulsion in Fluids, 327
- Kant (Immanuel), dedication of a monument to, 723; the bicentenary of the birth of, 651
- Kapitza (P. L.), A Method of producing Strong Magnetic Fields, 878
- Kara-Michailova (Dr. Elisabeth), and Dr. Hans Pettersson, The Brightness of Scintillations from H-particles and from  $\alpha$ -particles, 715
- Kaul (H.), Planetary Rotations, 472
- Kaye (Madge), and Dorothy Jordon Lloyd, A Histological and Chemical Investigation of the Swelling of a Fibrous Tissue, 805
- Kearton (R.), Wild Bird Adventures: a Nature Story Book for Boys and Girls, 228
- Kearton (W. J.), and G. Wood, Alignment Charts for Engineers and Students: a Textbook explaining the Theory and Construction of Alignment Charts, 887
- Keen (Dr. B. A.), Mechanical Aids for the Farmer, 264
- Keith (Sir Arthur), Neanderthal Man in Malta, 405; The Gorilla's Foot, 83
- Kellett (J. G.), conferment upon, of a doctorate by the Bohemian (Charles') University, 912
- Kelvin (Lord), centenary of the birth of, 795
- Kemp (Dr. S. W.), appointed director of research on the *Discovery*, 504; and Dr. B. Chopra, Fauna of the Siju Cave, 762
- Kendall (Rev. H. G. O.), Chipped Flints, 362
- Kendall (Prof. P. F.), elected an honorary member of the Yorkshire Philosophical Society, 171
- Kennaway (Dr. E. L.), Cancer and Tar, 620
- Kennedy (Sir Alexander), Petra, 174
- Kennedy (Prof. R.), [death], 865
- Kenner (Dr. J.), appointed Professor of Organic Chemistry in Sydney University, 512
- Kenneth (J. H.), Osmics, the Science of Smell. No. 2, 743
- Kent (Prof. F. C.), Mathematical Principles of Finance, 853
- Kerr (Prof. J. Graham), A Bibliography of Fishes, 344
- Kerr (R.), Clay Heads from the Gold Coast, 473
- Kewley (J.), Crude Oil of Sarawak, 208
- Keyser (C. E.), elected an honorary member of the Yorkshire Philosophical Society, 171
- Keyser (Prof. C. J.), Mathematical Philosophy, a Study of Fate and Freedom: Lectures for Educated Laymen, 741
- Kidson (Capt. E.), Cloud-heights at Melbourne Observatory, 507
- Kidston (Dr. R.), and Prof. W. H. Lang, Fossil Plants from the Old Red Sandstone of Scotland. No. 2, 513
- Kilian (W.), and G. Sayn, An Important Tectonic Fault at the Southern Edge of the Plateau of Vercors, 295
- Killip (E. P.), Tropical American Species of Passiflora, 547
- Kimpffin (G.), The Permeability of Synthetic Resin to the Infra-red Radiations, 879
- Kingslake (R.), and Dr. L. C. Martin, Measurement of Chromatic Aberration on the Hilger Lens-testing Interferometer, 553
- Kirkpatrick (Prof. P.), Total Reflection of X-rays, 98
- Kirsch (Dr. G.), and Dr. H. Pettersson, The Artificial Disintegration of Atoms, 603
- Kitasato (Prof. S.), the work of, 795
- Kitto (F. H.), Survival of the American Bison, 761
- Klähn (Dr. H.), Paläontologische Methoden und ihre Anwendung auf die paläobiologischen Verhältnisse des Steinheimer Beckens, 8



- Klebahn (H.), Artificial Infection of Plants with Parasitic Fungi, 440  
Kling (A.), and A. Lassieur, Detection of Methyl Alcohol in the Presence of Ethyl Alcohol, 556  
Klotz (Dr. O.), [death], 21; [obituary article], 90  
Knight (Dr. Margery), awarded a grant from the Darwin fund, 102; Alternation of Generations in the Ectocarpaceæ, 143  
Knight (R. C.), The Rooting of Hardwood Cuttings, 626  
Knight (W. A.), Observation of a Sun-pillar, 436  
Kolthoff (Dr. I. M.), Der Gebrauch von Farbenindikatoren: ihre Anwendung in der Neutralisation-analyse und bei der colorimetrischen Bestimmung der Wasserstoffionenkonzentration. Zweite Auflage, 157  
Kostrzewski (Dr. J.), Copper Implements in Poland, 903  
Kramers (Dr. H. A.), The Law of Dispersion and Bohr's Theory of Spectra, 673; and Dr. H. Holst, translated by R. B. Lindsay and Rachel T. Lindsay, The Atom and the Bohr Theory of its Structure: an Elementary Presentation, 378  
Kreiken (E. A.), Distances of Stars, 402  
Kries (Prof. von), elected a foreign member of the Göttingen Academy of Sciences, 23  
Krige (L. J.), and H. Pirow, Temperatures in a Deep Borehole in South Africa, 623  
Kroeber (A. L.), Native Culture in California, 207  
Kruis (K.), and J. Šatava, The Life Histories of Yeasts, 947  
Kuhn (W.), Influence of Temperature on the Decomposition of Ammonia by Ultra-violet Light, 411  
Kutzner (W.),  $\alpha$ -Particles from Polonium, 508
- de Laborie (B.), awarded the gold medal of the Société de Géographie of Paris, 317  
Lacassagne (A.), and Mme. J. S. Lattès, The Detection of Injected Polonium in Organs, 295  
Lacroix (A.), New Observations on the Nephelene Syenites of the Los Islands (Guinea), 626; The Analcitic Lavas of North Africa, and, generally, the Classification of Lavas containing Anacalcite, 327  
Laing (Dr. Mary Evelyn), awarded the Ellen Richards Research prize, 935  
Lamb (Prof. H.), Dynamics. Second edition, 9; to be nominated as president of the Southampton meeting of the British Association, 471  
Lambert (W. D.), Earth Tides and Ocean Tides, 889  
Lambertini (G.), Histogenesis of Formations and Secondary Organs in the Human Embryo, 735  
Lanchester (Dr. F. W.), awarded the medal of the Institution of Automobile Engineers, 23  
Lander (Dr. C. H.), and R. F. McKay, Low Temperature Carbonisation, 920  
Lang (Prof. W. H.), Some Deviations from the Normal Morphology of the Shoot in *Osmunda regalis*, 770  
Langdon (Prof.), Astronomical Contribution to Ancient Chronology, 285; Excavations at Kish, 174  
Langevin (Prof. P.), La Physique depuis vingt ans, 487  
Langmuir (Dr. I.), The Pressure Effect in Discharge Tubes, 320  
Lankester (Sir E. Ray), The Gorilla's Foot, 10, 457  
Lansdell (K. A.), Weeds of South Africa, 761  
Laporte (M.), Thermionic Currents in Hydrogen, 369  
Larmor (Sir Joseph), On editing Newton, 744  
La Rosa (M.), The Constitution of Variables such as Mira Ceti, 735  
Lasareff (P.), The Anomalies of Terrestrial Magnetism and of Gravity in the Province of Koursk, Russia, 35; The Laws of the Magnetic Anomalies caused by Electric Currents, or by Magnetic Deposits, 374; The Velocity of Photochemical Reactions under the Action of a Light of Periodic Intensity, 103  
Laspière, forthcoming High Tension Conference in Paris, 544  
Latter (O. H.), Elementary Zoology, 269  
Lattès (Mme. J. S.), and A. Lacassagne, Chemico-physical Technique and the Detection of Polonium injected into Organs, 374; Estimation in the Different Organs of Polonium injected into the Organism, 447  
Laurence (Sir Percival Maitland), gift to Cambridge University, 911  
Laurie (Principal A. P.), Suggestion for a Magnetic Theory of Valency, 409  
Law (S. C.), The Breeding of some Common Birds in the Vicinity of Calcutta, 700  
Lawson (A. A.), Life-history of Pherosphaera, 36  
Lawyer (G. A.), U.S. Department of Agriculture. Farmer's Bulletin No. 1375. Game Laws for the Season 1923-1924, 341  
Leake (Dr. H. M.), appointed principal of the Imperial College of Tropical Agriculture, 946; The Foundations of Indian Agriculture. Second edition, 743  
Lebeau (P.), The Quantity and the Nature of the Gases disengaged by Solid Combustibles under the Action of Heat and a Vacuum: Coals, 259; and M. Picon, An Arrangement permitting Electrical Heating to a High Temperature in a Vacuum, 627  
Lebour (Dr. M. V.), Food of Plankton Organisms, 138  
Le Coite (P.), elected an honorary corresponding member of the American Geographical Society, 654  
Lecomte du Noüy (P.), Dimensions of the Molecules and the Molecular Weights of the Proteins of Serum, 948  
Leduc (Prof. A.), The Specific Heats of Gases and the Velocity of Sound, 627; Volumes moléculaires: Applications, 383  
Lee (A. W.), Relation of the Circulation in the Upper Air to a Circumpolar Vortex, 35  
Lee (H. W.), The Taylor-Hobson F/2 Anastigmat, 806  
Legendre (R.), The Food of Dolphins, 819  
Legrain (Prof.), The Cult of Dagan, 319  
Leiper (Prof. R. T.), and others, Filariasis in British Guiana, 871  
Leland (O. M.), Practical Least Squares, 158  
Lemoigne (M.), Mechanism of the Production of  $\beta$ -oxybutyric Acid by the Biochemical Method, 592  
Lemon (Prof. H. B.), The Continuous Spectrum of Hydrogen, 127, 570; The Spectrum of "Nebulium," 764  
Le Noir and A. M. de Fossey, The Study of the Urinary Ionic Acidity in Normal Man, 842  
Leonard (F. C.), and P. Doig, Distances of certain Stars, 545  
Lepape (A.), The Search for Thorium Emanation (Thoron) in Thermal Springs by the Method of Induced Activity, 515; Thorium Emanation in Thermal Springs, 729  
Levaditi (C.), S. Nicolau, and Mlle. R. Schoen, Microsporidiosis of the Rabbit: its Relations with Hydrophobia, 183  
Leverhulme (Viscount), awarded the Messel medal of the Society of Chemical Industry, 204; The Object of Education, 945  
Lewis (A. B.), Block Prints for Indian Textiles, 546  
Lewis (Prof. F. J.), and Miss Gwynethe M. Tuttle, Seasonal Changes in Plants, 175  
Lewis (Prof. G. N.), Extremely Dry Liquids, 175  
Lewitt (E. H.), Hydraulics: a Text-book covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E., and A.M.I.Mech.E. Examinations in this Subject, 487  
Licent and Teilhard (Fathers), Discovery of Fossilised Human Remains in China, 204, 797  
Lindsay (Prof. A. D.), elected master of Balliol College, Oxford, 804  
Littlewood (J. E.), and A. Walfisz, The Lattice-points of a Circle, 878  
Lloyd (Prof. F. E.), Fluorescent Plant Pigments, 546  
Lodge (Sir Oliver), A Theory of Survival, 399; Acoustic Depth Sounding, 504; Colour Vision and Colour Vision Theories, 50; Darwin and Evolution, 866, 926; Origin of Solar Systems, 425; Problems of Hydron and Water, 193; Stationary Clouds in Interstellar Space, 307; The Kinetic Atom, 15; X-rays and the Atom, 22  
Loeb (Dr. J.), [death], 281; [obituary article], 574  
Logeman (Prof. W. H.), The Structure of the Atom, 64  
Longbottom (Prof. J. G.), [death], 933  
Longstaff (Jane), Gasteropoda, chiefly in the late Mrs. Robert Gray's Collection, from the Ordovician and Lower Silurian of Girvan, 513  
de Lorde (P. Barrau), Clay Figures of Palæolithic Age, 506  
Lorentz (Prof. H. A.), an honorary doctorate to be conferred upon, by Paris University, 512; The Radiation of Light, 608; and others, translated by Drs. W. Perrett and G. B. Jeffery, The Principle of Relativity: a Collection of Original Memoirs on the Special and General Theory of Relativity, 152



- Loring (F. H.), *The Chemical Elements*, 157
- Louis (Prof. H.), *Lead Mining in Northumberland and Durham*, 75; *The Origin of Ores*, 812
- Love (Prof. C. E.), *Analytic Geometry*, 598
- Lowe (C. W.), and J. Dearness, *Algæ and Fungi of the Canadian Arctic Regions*, 473
- Lowry (H. V.), *Approximate Integration*, 927
- Lowry (Prof. T. M.), presented with the Le Blanc medal of the French Chemical Society, 579; *The Electronic Theory of Valency*. Pt. IV., 409; and Dr. E. E. Walker, *Induced Asymmetry of Unsaturated Radicals in Optically Active Compounds*, 565
- Lucas (Dr. F. A.), appointed honorary director of the American Museum of Natural History, 400
- Lucas (R.), *Magnetisation by Rotation*, 368; *Piezoelectricity and Molecular Asymmetry*, 948
- Ludewig (P.), and F. Reuther, *The Coloration of Crystals by the Action of Radium*, 368
- Ludford (R. J.), *The Impregnation of the Golgi Apparatus by Means of Osmium and Tetroxide*, 913
- Ludlam (E. B.), *The Budde Effect in Bromine*, 914; and W. West, *Emission Spectra of the Halogens*, 914; *The Phosphorescence of Fused Transparent Silica*, 389
- Luff (B. D. W.), *The Chemistry of Rubber*, 268
- Lumière (L.), *Long-distance Projection of Large Autochromes*, 939; A. Lumière and A. Seyewetz, *The Development of the Latent Image after Fixing*, 915
- Luyten (W. J.), *The Hundred Nearest Stars*, 438
- Lyman (Prof. T.), *The Spectrum of Helium in the Extreme Ultra-violet*, 785
- Lyon (Prof. T. L.), and Prof. H. O. Buckman, *The Nature and Properties of Soils: a College Text of Edaphology*, 637
- MacBeth (Dr. A. K.), appointed reader in Chemistry in the Durham Colleges, 732
- MacBride (Prof. E. W.), *Experiments on *Ciona intestinalis**, 196; *Theories of Evolution and their Application to Human Affairs*, 667
- Macdonald (Mary), *The Training of Women in Engineering Works*, 471
- MacDougal (Dr. D. T.), and others, *Dendographic Records of Tree Growth*, 835
- Mace (H.), *Adventures among Bees*, 452
- Macelwane (J. B.), *The Periods of Earthquake-waves*, 582
- MacEwen (Sir William), [death], 468; [obituary article], 613
- Mach (Prof. E.), *Populär-wissenschaftliche Vorlesungen*. Fünfte Auflage, 488
- Machal (Mlle. Germaine), *Action of Silica and Alumina upon Calcium Sulphate*, 71
- Mackenzie (K. J. J.), [death], 865; [obituary article], 896
- MacLean (Dr. A. B.), *Use of Desensitisers in X-ray Photography*, 27
- Maclean (Prof. H.), awarded the William Julius Mickle fellowship, 32; *The Nucleic Acids*, 524
- Maclennan (K.), *The Microscopic Structure of Soap*, 27
- Macnamara (C.), *The "Bleeding" of Cut Trees*, 858
- Macpherson (Maj.-Gen. Sir W. G.), *History of the Great War: General History*. Vol. 2: *The Medical Services on the Western Front, and during the Operations in France and Belgium in 1914 and 1915*, 420
- McAdie (Prof. A.), *Making the Weather*, 486
- McBain (Prof. J. W.), *Liquid Crystals, Soap Solutions, and X-rays*, 534; *The Debt of Industry to Scientific Investigation*, 93
- McCarrison (Lt.-Col.), *Manuring and Vitamins*, 620; *Relation of Faulty Nutrition to *Epithelioma contagiosum**, 904
- McCarthy-Jones (C. H.), *Electricity applied to the Winning of Crude Petroleum*, 321
- McCaw (Capt. G. T.), *The Figure of the Earth*, 800
- McCollum (Prof. E. V.), presented with the John Scott medal, 797
- McCollum (L. R.), *The Rotary System of Oil-well Drilling*, 26
- McConnochie (A. I.), *The Deer and Deer Forests of Scotland: Historical, Descriptive, Sporting*, 265
- McDougall (Prof. W.), *An Outline of Psychology*, 154
- McEwen (Prof. R. S.), *Vertebrate Embryology*, 775
- McFarlane (Miss M. M.), a grant made to, from the Publication Fund of London University, 804
- M'Intosh (Prof. W. C.), elected president of the Ray Society, 437; presented with the gold medal of the Linnean Society, 832; *Some Scientific Aspects of Scottish Fisheries*, 509
- McKie (T.), bequest to Edinburgh University, 255
- McLare (J. P.), *The Repair of Worn Components by Electro-deposition*, 770
- McLennan (Prof. J. C.), and others, *The Spectra of the Lighter Elements*, 217
- McLuckie (J.), *Studies in Parasitism*, I., 843
- McMillan (W. G.), revised by W. R. Cooper, *A Treatise on Electro-metallurgy*. Fourth edition, 851
- McMurrich (Prof. J. P.), presidential address to the American Association, 248
- Maggini (M.), *Measurement of the Distances of Double Stars by Means of the Micrometer and of the Interferometer*, 772
- Magnus (L.), *The Jubilee Book of the Girls' Public Day School Trust, 1873-1923*, 9
- Mahin (Prof. E. G.), and Prof. R. H. Carr, *Quantitative Agricultural Analysis*, 347
- Maignon (F.), *The Constitution and Mode of Action of the Biological Catalysts or Diastases*, 259; *The Effects of Electrolysis on Tissue Diastases of Animal Origin*, 375
- Malebranche (N.), translated by Dr. M. Ginsberg, *Dialogues on Metaphysics and on Religion*, 116
- Malek (E. M.), *Recent Hydro-electrical Development in France*, 399
- Malinowski (Dr. B.), *New and Old Anthropology*, 299; *Psycho-analysis and Anthropology*, 656; *The Deeper Criticism of the Bible*, 633
- Malloch (J. R.), *Notes on Australian Diptera, with Descriptions*, 147
- Mallock (A.), *Refractive Index of Gums and a Simple Method of determining Refractive Indices*, 159, 643; *Specific and Latent Heats of Iron and Steel*, 566; *The Effects of Temperature on the Properties of Metals*, 213; *The Eyes of Spiders*, 45; *Water-waves produced by Earthquakes*, 270
- Mallory (G. L.), [death], 934
- Mangenot (Dr. G.), *Recherches sur les constituants morphologiques du cytoplasma des algues*, 155
- Manley (J. J.), *Preliminary Measurement of a Primary Gas-grown Skin*, 734; *Removal of Gas-grown Skins from a Sprengel Pump*, 734
- Mann (C. E. T.), *Determination of Coefficients of Diffusion in Gels by Means of Chemical Analysis*, 293
- Maracineanu (Mlle. St.), *Penetration of Radioactive Substances in Metals*, 35
- Marage (Dr.), *L'Audition et ses variations*, 488
- Marchal (P.), *The Migrations in Eriosoma*, 447
- Margary (I. D.), *Glaisher Stand versus Stevenson Screen*, 591
- Mark (H.), and M. Polanyi, *Single Crystals of Tin*, 441
- Marryat, *Electric Passenger Lifts*, 176
- Marshall (Dr. F. H. A.), Kenneth J. J. Mackenzie, 896; *The Embryology of Vertebrates*, 775
- Marshall (Sheina), *Behaviour and Structure of Hydra*, 728
- Martel (E. A.), *The Largest Cavern in Europe (Eis-Riesenswelt)*, 735
- Martin (E. A.), elected secretary of the South-eastern Union of Scientific Societies, 136, 876
- Martin (Dr. G.), *The Modern Soap and Detergent Industry, including Glycerol Manufacture*. Vol. I., 669
- Martin (H. M.), *The Critical Velocity in Pipes*, 643
- Martin (Dr. L. C.), *A Convenient Bench for Testing Object Glasses*, 553; and D. Baxandall, *Early Optical Instruments*, 27
- Martin (T.), *The Tensile Properties of Aluminium at High Temperatures*, 478
- Martin (Dr. W.), *The Film as an Educator*, 876
- Martinet (Prof. J.), et Mlle. P. Alexandre, *Couleur et constitution chimique: Cours professé à la Faculté des Sciences de Besançon*, 739
- de Martonne (Prof. E.), *Transylvania*, 99
- Marvin (F. S.), *A Synthesis of Science and Religion*, 885; *Oxford and Aristotle*, 776; *The History of Technology*, 40
- Marwick (J.), *Glycymeris in the Tertiary of New Zealand*, 728



- Masson (Dr. I.), appointed professor of chemistry and director of the Science Department in the Durham Colleges of Durham University, 477; The Genesis of the Royal Society, 197
- Matheson (C.), Fish Exhibits in Museums, 546
- Mathews (Dr. E. B.), and Miss Grace E. Reed, Bibliography of Geology, 368
- Matignon (C.), Action of High Temperatures upon some Refractory Substances, 71; The Existence of Carborundum in certain Crystals of Aluminium Nitride, 842
- Matsumoto (A.), elected a foreign member of the Royal Aeronautical Society, 687
- Matula (Prof. J.), Eine Einführung in der Allgemeine Chemie, 158
- Maubert (A.), L. Jaloustre, P. Lemay, and C. Guilbert, Influence of X-rays on the Catalase of the Liver, 515
- Mauguin (C.), Arrangement of the Atoms in the Crystals of Calomel, 948
- Maw (Dr. W. H.), [obituary article], 468
- Maxwell (Sir Herbert), Pictorial Ornithology, 526; Scottish Red Deer, 265; The Stoat's Winter Pelage, 196
- Maxwell (M.), Exhibition of Photographs of Big Game, 544
- Mazzuchelli (Prof. A.), Elementi di chimica fisica, 455
- de Mecquenem (R.), Stone Implements at Susa, 727
- Meinzer (Dr. O. E.), Ground-water Hydrology, 175; Ground Water in the United States, 835
- Meisinger (Dr. C. Le Roy), Free-ballooning for Meteorological Inquiries, 652; Weather in the Higher Atmosphere, 404; [death], 868
- Meitner (L.), The  $\beta$ -rays of Uranium-X<sub>1</sub>, 290
- Mellanby (Prof. E.), awarded the Stewart prize of the British Medical Association, 688
- Mellish (J. E.), D'Arrest's Comet, 206
- Mellor (Dr. J. W.), A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vol. 4, 525
- Mendenhall (Prof. T. C.), [death], 685
- Mendes-Corrêa (the late Dr. A. A.), The Origin of Man, 761
- Merrifield (F.), [death], 828; [obituary article], 933
- Merrill, Distribution of the Diptero-carpaceæ, 290
- Metcalf (Dr. M. M.), Undergraduate Training for Scientific Research, 588
- Metcalf (E. P.), and B. Venkatesachar, Selective Absorption by Luminous Mercury Vapour, 213
- Michelson (T.), re-elected president of the Anthropological Society of Washington, 758
- Mie (Prof. G.), The Radiation of Light by Excited Atoms, 586
- Miers (Sir Henry), and others, Interchange of University Teachers and Students, 730
- Milankovitch (M.), The End of the Julian Calendar, 580
- Milham (Prof. W. I.), Time and Timekeepers: including the History, Construction, Care, and Accuracy of Clocks and Watches, 415
- Millar (A.), Magnetic Boreholes, 14
- Millard (W. A.), Crown Rot of Rhubarb, 904
- Miller (Prof. F. R.), The Cardio-inhibitory Centre, 715
- Miller (Prof. G. A.), Mathematics in America, 251
- Miller (Prof. W. L.), "Bios," 546
- Millington (W. E. W.), and F. C. Thompson, A Fatigue Failure of Brass Tubes in a Feed Water Heater, 478
- Mills (J.), reappointed to the Nita King Research scholarship at Cambridge University, 768
- Mills (W. H.), reappointed a university lecturer in Chemistry in Cambridge University, 877; and E. H. Warren, The Configuration of the Ammonium Radical, 294
- Milne (E. A.), Recent Work in Stellar Physics, 258; The Temperature of Reversing Layers of Stars, 534
- Milner (H. B.), Bell's American Petroleum Refining, 78; Redwood and Eastlake's Petroleum Technologist's Pocket-book, 120; The Use of the Microscope in the Petroleum Industry, 258
- Mitchell (J.), New Trilobites from Bowning, with Notes on Encrinurus and Cordania, 843
- Mitchell (Prof. S. A.), Eclipses of the Sun, 703
- Modjeski (Dr. R.), presented with the John Scott medal, 797
- Moffett (Rear-Admiral W. A.), The U.S.S. *Shenandoah*, 313
- Moir (J. Reid), The Geological and Cultural Age of the Harrisonian Eoliths, 461
- Molinari (Prof. E.), Treatise on General and Industrial Organic Chemistry. Second English edition, translated from the third Italian edition by T. H. Pope. Part 2, 455
- Molliard (M.), Effect of the Mineral Composition of the Nutritive Medium on the Structure of *Sterigmatocystis nigra*, 947; New Researches on the Formation of Organic Acids by *Sterigmatocystis nigra* in Media with Constituents in Abnormal Proportions, 146
- Molteno (Mr. and Mrs.), further gift to the Institute for Research in Parasitology at Cambridge, 181
- Monge (G.), Géométrie descriptive, augmentée par B. Brisson. Vol. I, 456
- Monod (T.), A New Type of Crustacea, *Thermosbæna mirabilis*, 947
- Monro (C. C. A.), A New Polychæte Worm, *Mercierella enigmatica* Fauvel, 33; Polychæta from the *Alert* Expeditions, 947
- Montet (Prof. P.), Archæological Discoveries at Byblos, 207
- Mookerjee (Sir Asutosh), [death], 794; [obituary article], 897
- Mookerjee (Sir Rajendranath), elected president of the Asiatic Society of Bengal, 471
- Moore (B.), conferment upon, of the degree of Ph.D. by Manchester University, 69
- Moreux (l'Abbé Th.), Les Confins de la science et de la foi, Tome premier, 709
- Morfitt (W.), [obituary article], 57
- Morgan (J. Pierpont), gift of the Morgan library of books and manuscripts, 284; presentation to Cambridge University of the photographic reproduction of Coptic manuscripts, 443
- Morgan (Prof. T. H.), Inheritance of Embryonic Characters, 175; and others, The Mechanism of Mendelian Heredity, 518
- Morison (Sir Theodore), and others, Directions in which Universities might profitably develop at the Present Time, were Funds available, 730
- Morrell (Dr. R. S.), Varnishes and their Components, 743
- Morris (E. H.), Ancient Indian Cultures on the San Juan River, 439
- Morris (Sir Malcolm), [obituary article], 397
- Morrison (L. H.), Diesel Engines, 485
- Mosharrafa (A. M.), Half-integral Quantum Numbers in the Theory of the Stark Effect and a General Hypothesis of Fractional Quantum Numbers, 590
- Mossman (R. C.), Indian Monsoon Rainfall in Relation to South American Weather, 1875-1914, 250
- Mott (B.), elected president of the Institution of Civil Engineers, 798
- Mott (Sir F. W.), elected a member of the Athenæum Club, 545
- Moullin (E. B.), Atmospheric and their Effect on Radio Receivers, 287
- Mountain (E. D.), Crystals of Calcite from Holywell, Flintshire, 374
- Moureu (C.), and C. Dufraisse, Autoxidation and Anti-oxidising Action, 514, 947; and J. Panier des Touches, Auto-oxidation and Anti-oxygen Action, 807
- Mouriquand (G.), and P. Michel, The Relations between Age, Appearance, and Evolution of the Symptoms of C avitaminosis, 375; and M. Bernheim, Sensitising of the Organism towards Defective Diets, 592
- Moynihan (Sir Berkeley), elected president of the Science Masters' Association, 69
- Mullaly (J. M.), Some Measurements of Gaseous Diffusion, 711
- Muller (A.), Determination of the Crystal-axes in "Single-crystal" Aluminium Bars by means of X-rays, 446
- Muller (Dr. J. J. A.), Dutch Pendulum Observations in Submarines, 308, 641
- Mulliken (Dr. R. S.), Isotope Effects in the Band Spectra of Boron Monoxide and Silicon Nitride, 423; The Isotope Effect as a means of identifying the Emitters of Band Spectra: Application to the Bands of the Metal Hydrides, 489; The Isotope Effect in Line and Band Spectra, 820
- Mulock (Sir William), elected chancellor of the University of Toronto, 698
- Murby (Thos.) and Co., Geology of Ireland, 713



- Murray (J. K.), and V. Weston, The Bacteriology, Titratable Acidity, and H-ion Concentration of some Creams, 104
- Myddleton (Dr. W. W.), and T. H. Barry, Fats: Natural and Synthetic, 669
- Myers (Dr. C. S.), The Use of Vocational Tests in the Selection of a Vocation, 362
- Nábělek (Dr. F.), Iter Turcico-Persicum, 760
- Nagaoka (Prof. H.), and Y. Sugiura, Spectroscopic Evidence of Isotopic Elements, 532; and T. Mishima, Binding of Electrons in the Nucleus of the Mercury Atom, 567; Isotopes of Mercury and Bismuth revealed in the Satellites of their Spectral Lines, 459
- Nance (R. M.), Modern Stone Implements in Cornwall, 473
- Nayanar (Prof. A. L.), Underblown Pipes, 536
- Needham (G. H.), Styxax and its Refractive Index, 785
- Needham (N. J. T. M.), re-elected to the Benn W. Levy research studentship in biochemistry in Cambridge University, 324
- Négris (P.), The Improbability of a Drift of Continents, 627
- Nelson (J. A.), A. P. Sturtevant, and B. Lineburg, The Growth and Feeding of Honey-bee Larvæ, 727
- Nelson (Prof. T. C.), On the Application of Science to the Fishing Industry, 675
- Nernst (Prof.), appointed director of the Physikalisches Institut of Berlin University, 471; elected a corresponding member of the Russian Academy of Science, 436
- Nettleton (L. L.), Effective Radii of Gas Molecules, 843
- Neville (Prof. E. H.), Srinivasa Ramanujan, 426
- Newall (Prof. H. F.), Hale's Magnetic Vortices, 112
- Newcombe (Prof. F. C.), and others, Reversal of Geotropism, 657
- Newton (E. T.), re-elected president of the Palæontographical Society, 689
- Newton (F. G.), The Temple of the Moon God at Ur, 834
- Newton (H. W.), Variation of Solar Faculæ in the Sun-spot Cycle, 137
- Niblack (Rear-Admiral A. P.), elected a director of the International Hydrographic Bureau, 401
- Nicol (E. W. L.), Coke and its Uses: in Relation to Smoke Prevention and Fuel Economy, 810
- Nicolle (C.), P. Durand, and E. Conseil, New Experimental Data on the Prevention, Treatment, and Ætiology of Acute Conjunctivitis caused by Weeke's Bacillus, 146
- Nicholls (G. E.), and D. F. Milner, A New Freshwater Isopod allied to Phreatoicus, 103
- Nicholls (J. R.), Oysters and their Nutritive Value, 358
- Nichols (Dr. E. F.), [death], 721; [obituary article], 828
- Nicholson (F.), History of the Manchester Literary and Philosophical Society during its First Seventy Years, 770
- Nietz (A. H.), The Theory of Development, 634
- Nijland (A. A.), Approaching Maximum of Mira Ceti, 137
- Niwa (T.), Japanese Methods of dwarfing Trees, 554; The Forms cultivated in Japan from the Original Types of *Chrysanthemum indicum* Linn. and *C. sinense* Sabine, 293
- Nodon (A.), Relations between Terrestrial Magnetism and the State of the Atmosphere, 699; The Radioactivity of Living Cells, 592; The Radioactivity of Radium in Relation to Solar Radiation, 443; and D. Berthelot, Researches on Cellular Disintegration, 295
- Nolan (Prof. J. J.), Origin of Atmospheric Electricity in Thunderstorms, 354; Relation between the Potential Gradient and the Number of Large Ions in the Atmosphere, 493
- Norbury (A. L.), Solid Solutions and Inter-atomic Relationships, 271
- Nordstedt (Prof. C. F. O.), [obituary article], 576
- Norman (J. R.), The Greenland Halibut (*Reinhardtius hippoglossoides*), 258
- Norris (P. W.), and W. S. Legge, Mechanics via the Calculus, 600
- Norrish (R. G. W.), awarded the Gordon Wigan prize for research in chemistry, 181; The Mechanism of Molecular Activation, 294
- Northumberland (Duke of), re-elected president of the Royal Institution, 688
- Noyes (Prof. W. A.), Building for Peace. II.: International Letters, 563
- Nutt (A. E. W.), awarded the John Bernard Seely prize by Cambridge University, 32
- Oberthür (C.), [death], 933
- O'Brien (Col.), The Electrification of Main Lines of British Railways, 577
- Oertel (Prof. H.), The Pancreas and Diabetic Metabolism, 126
- Offner (J.), and R. Heim, Pleurotus in the Alpine Meadows, 259
- Ogilvie (L.), "Slime-fluxes" of Trees, 691
- Oldham (R. D.), and Col. H. McCowie, Orographical Compensation in Northern India, 211
- 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 trois: Mouvements vibratoires, acoustique, optique, physique, ondes électromagnétiques, électro-optique, effets optiques du mouvement. Deuxième édition, 635
- Omang (S. O. F.), Norwegian Hawkweeds, 319
- Omoni (Prof. F.), [death], 57; [obituary article], 133
- Oppenheimer (Prof. C.), Kurzes Lehrbuch der Chemie in Natur und Wirtschaft, 158
- Orékhoff (A.), and M. Tiffeneau, The Semi-pinacolic Transposition of the Arylhydrobenzoin, 842
- Ormandy (Dr. W. R.), elected president of the Institution of Automobile Engineers, 505
- Ormsby (H.), London on the Thames: a Study of the Natural Conditions that influenced the Birth and Growth of a Great City, 780
- Orr (M. Y.), Nitrogen Fixation in Leaf Glands, 834
- Orr (Prof. W. McF.), Integrals and Series of Generalised Fourier-type in associated-Legendre-functions, 410
- Ortlepp (Dr. R. J.), *Dirofilaria immitis* from the Cat, 691
- Orton (Dr. J.-H.), An Experimental Effect of Light on the Sponge, *Oscarella*, 924; The Cause or Causes of the Unusual Mortality among Oysters in English Oyster Beds during 1920 and 1921, 359; and Prof. W. H. Lewis, A Plea for Continuous Fundamental Research on the Problems of River Pollution, 236
- Osborn (Prof. H. F.), Discoveries during the Season of 1923 by the Third Asiatic Expedition in Mongolia, 448
- Oswald (U. A.), and A. G. Tarrant, A New Photo-electric and Ionisation Effect, 590
- Osgood (Prof. W. F.), and Prof. W. C. Graustein, Plane and Solid Analytic Geometry, 598
- Ostenfeld (Prof. C. H.), Flowering Plants of Greenland collected by Dr. T. Wulff, 823
- O'Sullivan (Prof. A. C.), [death], 360
- Oswald (M.), and R. Pinta, The Treatment of Coals with Liquid Naphthalene, 807
- Oughton (E. L.), Gas Lighting, 724
- Overton (G. L.), Catalogue of the Collections in the Science Museum, South Kensington, with Descriptive and Historical Notes and Illustrations—Water Transport. I.: Sailing Ships, 510
- Owen (Capt. B. J.), appointed director of a new institute of agricultural engineering at Oxford, 578
- Owen (E. A.), and G. D. Preston, The Atomic Structure of Two Intermetallic Compounds, 914; The X-ray Analysis of Zinc-copper Alloys, 33
- Oxley (Dr. A. E.), Physical Research in the Cotton Industry, 662
- Page (H. J.), The Soybean: a Crop of the Future, 813
- Pagenstecher (Dr. G.), Past Events Seership, 871
- Paget (Sir Richard), Fused Silica, 748; The Nature and Artificial Production of Consonant Sounds, 878
- Palazzo (Prof.), Eruption of Stromboli, 618
- Palmer (Dr. L. S.), and Lt.-Col. J. H. Cooke, Pleistocene Deposits of the Portsmouth District, 250
- Palmer (W. G.), The Stability of Gas Films adsorbed on Tungsten, 294
- Paltauf (Prof. R. A. F.), [death], 865
- Pantin (C. F. A.), Physiology of Amœboid Movement, 174
- Paranjpe (M. R.), The Teaching of Science, 444



- Parker (R. N.), and others, "Tung" Oil, 872  
Parkin (J.), The "Bleeding" of Cut Trees in Spring, 604  
Parnell (F. R.), appointed plant breeder under the Empire Cotton Growing Corporation, 247  
Parr (G.), Principles and Practice of Wireless Transmission, 420  
Parsons (Hon. Sir Charles A.), elected president of the Institute of Physics, 830; The Interrelation between Physics and Industrial Research, 839  
Parsons (Dr. F. G.), The Study of Type Contours of Skulls, 554  
Partington (Prof. J. R.), and A. B. Howe, The Ratio of the Specific Heats of Nitrogen and of Oxygen, 213  
Parvulesco (C.), The Constitution of Star Clusters, 259  
Pascal (P.), The Constitution and Evolution of Precipitates of Alumina, 295; The "Insoluble" Alkaline Metaphosphates, 183  
Paschen (Prof.), Spectra and Atomic Structure, 209  
Pascoe (Dr. E. H.), Monazite Sands and other Sources of Thoria, 238, 607  
Patchell (W. H.), Modern Developments in Electrical Generation, 578  
Patel (M. L.), Cotton Selection in India, 835  
Paton (D. J.), A Eucalyptus "Scrub," 581  
de Paula (F. R. M.), appointed University reader in accounting and business organisation at the London School of Economics, 804  
Paulson (R.), Field Observations on Mycorrhiza, 33; Teasel-cups, 876  
Pauthenier (M.), The Isotropic Augmentation of the Index of Liquids in the Electric Field, 948  
Pavlov (Prof. A. P.), The Ice Age and Man, 61  
Payne (Cecilia H.), On the Spectra and Temperatures of the B Stars, 783  
Pearl (Prof. R.), Introduction to Medical Biometry and Statistics, 563; Starvation Life Curves, 854; and Agnes L. Bacon, The Absolute Weight of the Heart and the Spleen, 375; and Sylvia Parker, Duration and Life in *Drosophila*, 937; and Prof. L. Reed, The Mathematical Theory of Population Growth, 322  
Pearman (J. V.), and others, New or Rare Species of Insects from Great Britain, 728  
Pearsall (Dr. W. H.), Problems of River Pollution, 460  
Peddie (Prof. W.), Colour Vision and Colour Vision Theories, 50; Colour Vision Nomenclature: De-fatigue and Enhancement, 387  
Peek (F. W.), Lightning and High-voltage Phenomena, 312  
Peirce (the late C. S.), Edited with an Introduction by M. R. Cohen. With a Supplementary Essay on the Pragmatism of Peirce by J. Dewey. Chance, Love, and Logic: Philosophical Essays, 383  
Pekko (J.), The Work of Kruis and Satava on Reduced Forms of Yeasts and the Alternation of Generations, 553  
Pellizzi (C.), The Problems of Religion for the Italian Idealists, 590  
Pelosse (J.), The Thermal régime of the Lake of Bourget (Savoie), 71  
Pendred (L.), The Value of Technological History, 40  
Penfold (A. R.), The Essential Oil of *Backhousia angustifolia*, 295; The Essential Oil of *Darwinia grandiflora* and the Presence of a New Acetic Acid Ester, 103  
Péringuey (Dr. L.), [death], 397; [obituary article], 541  
Perkin (Prof. W. H.), elected to the Board of the British Dyestuffs Corporation, Ltd., 363  
Perkins (Dr. R. C. L.), The Control of Injurious Insects in the Hawaiian Islands by their Natural Enemies, 402  
Perot (A.), Experimental Verification of the Principle of Wladimir Michelsen, and of the Doppler-Fizeau Principle, 259  
Perrakis (N.), Influence of the Neighbourhood of the Critical State of Miscibility on Volumes, 411; Volumes in the Neighbourhood of the Critical State of Miscibility, 771; and A. Massol, A Method of Determination of Micro-miscibilities, 215  
Perrier (Col.), The Meridian of France, 56  
Perrin (Prof. J.), Mit Autorisation der Verfassers Deutsch; herausgegeben von Prof. A. Lottermoser. Dritte Auflage. Die Atome, 383  
Perry (J. W.), Determination of Aberrations as expressed in Geometrical Optics from the Indications of the Hilger Interferometer, 145  
Perry (W. J.), The Children of the Sun: a Study in the Early History of Civilisation, 299  
Petavel (Capt. J. W.), Unemployment and the Poverty Problem, 181  
Petrie (Dr. G. F.), Major R. E. Todd, and others, Plague Investigations in Egypt, 403  
Petrunkevitch (Prof. A.), Classification of Spiders, 762  
Petterson (D.), Long-range Particles from Radium-active Deposit, 641  
Petterson (H.), Structure of the Atomic Nucleus and the Mechanism of its Disintegration, 446  
Petterson (O. S.), presented with the Agassiz medal, 798  
Phillips (L. W.), Essential Oils of Certain West Australian Plants, 103  
Phillips (P.), Variation in the Level of Lake Victoria (Central Africa), 440  
Pick (W. H.), and S. P. Peters, The Vertical Visibility (estimated looking downwards) at Cranwell, February 1922 to June 1923, 34  
Pickering (J. W.), and J. A. Hewitt, The Action of "Peptone" and of Nucleic Acids on the Coagulability of the Blood, 256  
Picon (M.), The Hydrates of Sodium Thiosulphate, 411  
Pierantoni (M.), Luminescence and Symbiosis. II., 843  
Piettre (M.), Separation of the Proteids of White of Egg by the Acetone Method, 146  
Pinsent (Mrs.), and others, offer to Cambridge University for a studentship, 212  
Pionchon (J.), and Mlle. F. Démora, The Formation, in the Wet Way, of Layers of Cuprous Oxide possessing Photo-electric Properties, 947  
Piper (C. V.), and W. J. Morse, The Soybean, 813  
Pitt-Rivers (Capt.), Aua Island, Bismarck Archipelago, 903  
Plancher (Prof. G.), The Life and Work of G. Ciamician, 363  
Planck (Prof. Max), elected an honorary fellow of the Physical Society of London, 316; Vorlesungen über die Theorie der Wärmestrahlung. Fünfte Auflage, 561  
Plotz (H.), and M. Schoen, Changes of the Reaction of Serums, 948  
Pocock (L. C.), Distortion in Radio Telephony, 801  
Pocock (R. I.), A New Genus of Monkeys, 374; The Gorilla's Foot, 458  
Pocklington (Dr. H. C.), The Thirty-two Classes of Crystal Symmetry, 195  
Polonovski (M.), Sulphochromic Oxidation and  $\beta$ -oxidation, 327  
Ponselle (A.), Culture of the Pathogenic Trypanosomes, 627  
Ponte (G.), Magmatic Gas of the Lava of Mount Etna, 843  
Pontremoli (A.), Electrical Conductivity of Flames containing Salts of the Alkali Metals, 843  
Poole (Dr. H. H.), A Mechanical Device for sealing off Radium Emanation Tubes, 735; A Telephone Method of Photo-electric Photometry for use at Sea, 258  
Pope (Sir William J.), elected a corresponding member of the Academy of Sciences of the Institut de France, 758; The Preparation of Sulphuryl Chloride, 293; and R. T. M. Haines, Colloidal Ferric Hydroxide, 369  
Poplewell (W. C.), and H. Carrington, The Properties of Engineering Materials, 564  
Porlezza (C.), Arc Spectrum of Silicon in Relation to Spectrographic Analysis, 772; New Regularities in the Spectrum of Silicon Tetrafluoride, 915; and A. Donati, Application of Spectrographic Analysis to the Detection of Rare Metals in Italian Materials, 843  
Porter (Dr. Annie), Effects of Cold on Vitality of Bladder-worms, 138  
Porter (Dr. A. W.), appointed professor of physics at University College, 212  
Porter (Prof. C. W.), The Carbon Compounds: a Text-book of Organic Chemistry, 887  
Poucher (W. A.), Perfumes and Cosmetics: with especial Reference to Synthetics, 780  
Pownall (J. F.), Standardisation of Scientific and Technical Publications, 275  
Prain (Sir David), The Rev. Gilbert White and Moral History, 866; The Supply of Quinine, 899  
Prasad (Dr. G.), appointed Hardinge professor of higher mathematics in Calcutta University, 102



- Price (Dr. T. Slater), The Application of the Selenium Cell to Photometric Measurements, 351
- Prideaux (E. B. R.), and W. E. Crooks, The Diffusion Potentials and Ionic Mobilities of Benzoates and Salicylates, etc., 410
- Priestley (Prof. J. H.), Fat Metabolism in Plants, 581; The "Bleeding" of Cut Trees in Spring, 492; Vegetative Propagation of Flowering Plants, 626
- Priestley (R. E.), appointed secretary of the Board of Research Studies of Cambridge University, 291; Physiography (Robertson Bay and Terra Nova Bay Regions), 777
- Prince (Dr. Morton), lectures on advanced psychology, 246; the work of, 205
- Pringsheim (P.), Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie. Zweite Auflage, 9
- Procopiu (S.), Appearance of the Ultimate Lines in Electric Arc Spectra, 699
- Proudman (Prof. J.), and Dr. A. T. Doodson, The Principal Constituent of the Tides of the North Sea, 293
- Przibram (Prof. K.), The Colours produced by Becquerel Rays, 658
- Pugsley (H. H.), An Undescribed Static from Pembrokeshire, 293
- Pupin (Prof. M.), From Immigrant to Inventor, 186
- Pybus (W. M.), [death], 57; [obituary article], 169
- Quincke (Prof. G. H.), [death], 202; [obituary article], 280
- Rabaud (E.), The Brain and the Retina of the Anencephalus, 72
- Rabut (C.), The Conditions of Security of Massive Barrages, 842
- Radcliffe-Brown (Prof. A.), The Methods of Ethnology and Social Anthropology, 64
- Raethjen (Dr. P.), Electrons in Metals, 692
- Rainich (G. Y.), Electrodynamics in the General Relativity Theory, 843
- Raman (Prof. C. V.), The Effect of Dispersion on the Interference Figures of Crystals, 127; and Dr. K. R. Ramanathan, X-ray Diffraction in Liquids, 320
- Ramart (Mme. P.),  $\alpha$ - $\alpha$ - $\beta$ -Triphenylpropionic Acid and some of its Derivatives, 147; The General Preparation of the Diphenylalkylacetates of Benzyl by means of Sodium Amide and the Alkyl Iodides as well as the corresponding Acids, 259
- Ramon (G.), The Flocculating Power and Immunising Properties of a Diphtheria Toxin rendered Anatoxic (anatoxin), 72
- Ramsay (Col. R. G. W.), with a Biographical Memoir by Dr. W. Eagle Clarke, Guide to the Birds of Europe and North Africa, 228
- Ramsbottom (J.), The Fungus Flora of British Woodlands, 258
- Ramsey (F. P.), elected to the Allen scholarship in Cambridge University, 511
- Rankine (Prof. A. O.), An Anomaly in Frictional Electricity, 914
- Rashdall (Dr. H.), [death], 245
- Rastall (Dr. R. H.), The Geology of the Metalliferous Deposits, 812
- Rathbone (E. P.), [death], 933
- Rautenfeld (F. v.), Electric Conductivity of Crystals, 404
- Rayleigh (Lord), The late Lord Rayleigh's Scientific Papers, 570
- Raymon (G.), The Anatoxins, 735
- Redmayne (Sir R. A. S.), Deferred Annuities (Two Rates of Interest), 84
- Redwood and Eastlake's Petroleum Technologist's Pocket-book. Revised by A. W. Eastlake. Second edition, 120
- Reece (Surg.-Col. R. J.), [death], 616
- Reenen (R. J. van), and others, Symposium on Drought, 65
- Regan (C. Tate), Frequency Curves of Genera and Species, 822; Mendelism and Evolution, 50, 569; The Morphology of *Stylophorus chordatus* Shaw, 325
- de Regny (Prof. P. V.), Survey Work in Eritrea, 938
- Reid (Sir Archibald), [death], 169
- Reid (L. A.), Creative Morality, 410
- Reid (W.), Discovery of a New Comet, 545
- Reilly (Dr. J.), Allen's Commercial Organic Analysis. Vol. I. Fifth edition, 815; Luff's The Chemistry of Rubber, 268; Morrell's Varnishes and Their Components, 743; Sherrill's Laboratory Experiments on Physics—Chemical Principles, 348; Thurston's Pharmaceutical and Food Analysis, 886
- Remnant (E.), National Boarding Schools, 769
- Rendle (Dr. A. B.), elected president of the Linnean Society, 833; Plant-pitchers and their Work, 876; The Work of Linnaeus in Holland, etc., 879
- Rey (Prof. A.), La Théorie de la physique chez les physiciens contemporains: Exposé des théories. Deuxième édition, 269
- Reyner (J. H.), Modern Radio Communication: a Manual of Modern Theory and Practice, covering the Syllabus of the City and Guilds Examination and suitable for Candidates for the P.M.G. Certificate, 779
- Reynolds (J. H.), The Problem of the Nebulae, 690
- Reynolds (Prof. S. H.), British Geological Photographs, 88; and E. Greenly, The Geological Structure of the Clevedon-Portishead (Somerset), 182
- Rhodes (E. C.), appointed reader in statistics at the London School of Economics, 212
- Riccomanni (C.), Relationships between Chemical Constitution and Taste, 772
- Rice (J.), the title of associate professor conferred upon, by Liverpool University, 877
- Richards (R. C.), appointed Quain lecturer in physics at University College, London, 877
- Richards (T. W. and W. T.), Preliminary Attempt to measure gravimetrically the Distance-effect of Chemical Affinity, 216
- Richardson (E. G.), Æolian Tones, 326
- Richardson (H.), Noyes's Building for Peace. II., 563
- Richardson (L. F.), The Aerodynamic Resistance of Spheres shot upward to measure the Wind, 33
- Richardson (Prof. O. W.), appointed a Yarrow research professor of the Royal Society, 542; Thermodynamics of Electron Emission, 373; and T. Tanaka, The Continuous Spectrum of Hydrogen, 192
- Richardson (R. K.), The Oil Geology of South-west Persia, 872
- Riche (Prof. C.), Pour et contre la survie, 399; Raw Meat Juice in the Treatment of Human Tuberculosis and the Reconstruction of the Muscles, 879; Regular and Irregular Antiseptics, 71
- Richmond (F. G.), Problems of River Pollution, 676
- Rideal (Dr. E. K.), Electrode Reactions and Equilibria, 20; Protecting and sensitising Colloidal Sols, 294
- Rigge (Rev. W.), Frequency of Total Solar Eclipses, 249
- Rignano (Prof. E.), translated by Winifred A. Hall, The Psychology of Reasoning, 44
- Ritchie (J.), Preservation of Zoological Specimens in Fluid, 319
- Rivers (the late Dr. W. H. R.), the memorial to, 363
- Rivet (Dr. P.), a bibliography of current Americanist literature, 402
- Roaf (Prof. H. E.), Colour-blindness in Wave-lengths, 834
- Roberts (A.), South African Birds, 439
- Roberts (H. A.), Commercial Poultry Raising, 269
- Roberts (J. K.), The Thermal Expansion of Bismuth Crystals, 275
- Roberts (O. F. T.), appointed Cruickshank lecturer in astronomy and meteorology in Aberdeen University, 144
- Robertson (Principal G.), and others, Universities and Research in Relation to the Development of the Natural Resources and the Industries of the Empire, 730
- Robertson (Prof. J. K.), Comparison of Wave-lengths with a Fabry and Perrot Étalon, 926
- Robin (P.), The Chloramides, 71
- Robinson (W. L.), Tetracarbon and Hexacoralla, 139
- Robison (L. MacD.), Geographical Instruction, 99
- Robson (G. C.), A Cephalopod (*Histioteuthis bonelliana*, Fér.), with Abnormal Reproductive System, 374
- Rogers (I. H.), Electric Method of Staining Radulae, 734
- Rolton (Winifred L.), and R. S. Troop, Effect of a Magnetic Field on the Surface Tension of a Liquid of High Susceptibility, 446



- de Romilly (P. Worms), Quelques réflexions sur la Relativité, 152
- Ronaldshay (Earl of), Exploration in 1923 and in Progress, 832
- Root (C. J.), Is Snowfall decreasing? 61
- Roscoe (Rev. Canon J.), Racial Migrations in Central Africa (Frazer Lecture), 903
- Rose (J. G.), Alternative Fuel for Internal Combustion Engines, 866
- Rose (W. N.), Line Charts for Engineers, 453; Mathematics for Engineers. Part 2. Second edition, 453
- Rosenhain (Dr. W.), Solid Solutions and Inter-atomic Relationships, 271
- Rosenthal (L.), gift for the promotion of scientific research, 733
- Ross (Prof. A. D.), A Critical Examination of the Einstein Eclipse Tests, 103
- Ross (Sir E. Denison), The Origin of the Turk, 734
- Ross (F. E.), Shrinkage of Photographic Film, 175
- Ross (J. F. S.), An Introduction to the Principles of Mechanics, 420
- Ross (Sir Ronald), The Encouragement of Medical Discovery, 569, 710; The Transmission of Human Malaria, 353
- Ross (Prof. W. D.), Aristotle, 776
- Roth (H. Ling), The Maori Mantle: and Some Comparative Notes on N.W. American Twined Work, 638
- Roughton (F. J. W.), elected University lecturer in biochemistry in Cambridge University, 254
- Roussel (J.), authorised translation, Wireless for the Amateur, 456
- Routledge (Mrs. S.), The Austral Islands and Mangareva, S.E. Pacific, 879
- Rowe (F. W.), Effect of Casting Temperature on the Physical Properties of a Sandcast Zinc-bronze, 479
- Rowell (H. S.), On the Centroid of a Circular Arc, 927
- Rowledge (A. J.), Aero Engines, 98
- Royer (L.), Mesomorph States and Magnetic Double Refraction, 592
- Runge (Prof. C.), Isotopes of Mercury and Bismuth and the Satellites of their Spectral Lines, 781
- Ruska (Prof.), Jābir ibn Hayyān, 207
- Russell (Dr. A.), Michael Pupin, 186; The Work of Prof. H. L. Callendar, 246
- Russell (A.), Topaz from Cornwall, etc., 214
- Russell (Dr. A. S.), The Atom, 652
- Russell (B.), Icarus, or the Future of Science, 740
- Russell (Dr. E. S.), Report on Seasonal Variation in the Chemical Composition of Oysters, 358
- Russell (Prof. H. N.), Singlet Series in the Spark Spectrum of Aluminium, 163
- Russell (Sir John), Agricultural Conditions in the Sudan, 651; Farm Soil and its Improvement, 482; and others, The Micro-organisms of the Soil, 482
- Russo (A.), Varying Rhythm of the Division of the Micro-nuclei during True Conjugation in *Cryptochilum Echini* Maupas, 915
- Rutherford (Sir Ernest), awards to, by the Franklin Institute, 900; and Dr. J. Chadwick, The Bombardment of Elements by  $\alpha$ -Particles, 457
- Ruttan (Dr.), The Baillie Library of Chemistry of McGill University, 70
- Ryan (Prof. H.), appointed chief state chemist for the Irish Free State Government, 653; and P. J. Cahill, Condensation of Aldehydes with Methyleneethylketone, 555; and N. Cullinane, Action of the Oxides and Oxyacids of Nitrogen on Diphenylene Oxide, 71; Some Derivations of Stilbene, 410; and P. J. Drumm, Action of the Oxides and Oxyacids of Nitrogen on Diphenylether, 71; and M. Egan, Action of Nitrous Acid and Nitrous Fumes on Urethanes and other Bodies, 555; and M. Egan, Condensation of Nitrosophenylurethane with Toluylenedramine, 555; and J. Keane, Action of the Oxides and Oxyacids of Nitrogen on Ethyl- $\beta$ -naphthylether, 71; and J. Keane, Action of the Oxides and Oxyacids of Nitrogen on Phenylbenzylether, 70; and T. Kenny, Action of the Oxides and Oxyacids of Nitrogen on Diphenylethylene-ether, 71; and M. J. Shannon, Condensation of Aldehydes with Butylacetoacetic Ester, 555
- S. (R. A.), John Harrison, 570
- Sabbatani (L.), Pharmacological Investigations of Iron. V., 771
- Sadler (Sir Michael), portrait of, to be painted and presented to Leeds University, 840
- Sadtler (Prof. S. P.), [death], 169
- Salaman (Dr. R. N.), An Analysis of the Jewish Race, 659
- Saleeby (Dr. C. W.), Sunlight and Glass: an Inquiry for Hygiene, 747
- Salet (M.), The Absorbing Power of the Atmospheres of the Stars, 771
- Salmon (E. S.), and W. M. Ware, Winter Stage of the Apple Scab Fungus, 691
- Samman (C.), and Prof. J. B. Gatenby, Acarine or Isle of Wight Bee Disease, 735
- Sampson (Dr. J.), Migrations of the Gypsies, 319
- Sampson (Prof. R. A.), Studies in Clocks and Timekeeping. No. 3, 146
- Sanden (Prof. H. von), with Notes by the Translator, Prof. H. Levy, Practical Mathematical Analysis, 453
- Sanders (R. Y.), Foreign Trade and Shipbuilding, 326
- Sandford (K. S.), The Fossil Elephants of the Upper Thames Basin, 591
- Sands (Dr. I. J.), and Dr. Phyllis Blanchard, Abnormal Behaviour, Pitfalls of our Minds: an Introduction to the Study of Abnormal and Anti-social Behaviour, 919
- Sands (W. N.), Mistletoes in Malaya, 872
- Saunders (Prof. F. A.), The Origin of Spectra, 321
- Saunders (J. T.), Relation of Flagellates and Ciliates to  $P_{H_2}$ , 555
- Saunders (V. T.), Practical Mathematics, 709; and G. H. Benham, Definitions and Nomenclature, 62
- Sauveur (Prof. A.), awarded the Bessemer gold medal of the Iron and Steel Institute, 247
- Savage (Dr. W. G.), and R. F. Hunwicke, Canned Fruits, 139
- Sayce (Prof.), The Atlas of Sargon of Akkad, 727
- Scarborough (E. M.), appointed reader in pharmacology at the London School of Medicine for Women, 32
- Schafer (Sir Edward Sharpey), elected a corresponding member of the French Academy of Medicine, 544
- Schäferna (Dr. K.), Freshwater Amphipoda of the Balkan Peninsula, 439
- Schaffran (Dr. K.), Influence of Propeller Revolutions upon the Propulsive Efficiency of Merchant Ships, 27
- Schall (W. E.), X-rays: their Origin, Dosage, and Practical Application, 600
- Scheelde (A.), Phosphorescence and Crystal Structure, 26
- Schiller (Dr. K.), Einführung in das Studium der veränderlichen Sterne, 349
- Schmidt (G. C.), and R. Walter, Electric Conductivity of the Vapour of Cadmium Iodide, 27
- Schmidt (Dr. Johs.), elected a foreign member of the Linnean Society of London, 724; Consumption of Fish by Porpoises, 310; The Transatlantic Migration of the Eel-larvae, 12
- Schulte-Vaerting (Dr. H.), Die soziologische Abstammungslehre, 74
- Schuster (Sir Arthur), Prof. G. H. Quincke, 280
- Schwarz (Prof. E. H. L.), The Kalahari Scheme as the Solution of the South African Drought Problem, 539
- Scott (Dr. D. H.), Extinct Plants and Problems of Evolution: Founded on a Course of Public Lectures delivered at the University College of Wales, Aberystwyth, in 1922, 596
- Scott (Dr. H. H.), Life History of *Hymenolepis*, 439
- Scott (Prof. W. B.), and others, Inheritance of Acquired Characters, 138
- Scourfield (D. J.), The Physical Factors involved in the Problems of Microscopic Aquatic Biology, 437
- Scripture (Prof. E. W.), The Theory of Hearing, 605, 925; Three Biological Principles observed in Speech Inscriptions, 386
- Searle (A. B.), The Chemistry and Physics of Clays and other Ceramic Materials, 599
- Searle (G. O.), Methods of Mass-production in sectioning Flax Stems, 626
- Sebelien (Prof. J.), The Chemical Composition of Pre-historic Bronzes, 100
- Séguy (E.), Faune de France: Diptères anthomyides, 816



- Sekiguchi (R.), The North and South Currents in the Sun's Reversing Layer, 726
- Seligman (Prof. C. G.), Psychological Types of the Human Race, 322
- Semon (R.), translated by Bella Duffy, Mnemic Psychology, 303
- Senderens (J. B.), The Catalytic Dehydration of the Aromatic Alcohols, 35; The Catalytic Preparation of Benzyl Ethers, 735
- Sergent (E.), and H. Rougebif, Dissemination of Yeasts in Vineyards by Insects, 411
- Seshachar (C.), Weather in Mysore, 139
- Seton (Dr. W.), conferment upon, of a doctorate by the Bohemian (Charles') University, 912
- Seward (Prof. A. C.), Fossil Plants and Climatic Changes, 904; Outposts of Vegetation, 823; The History of the Plant World, 596
- Sexton (E. W.), Guide to the Plymouth Aquarium, 487
- Shantz (Dr. H. L.), elected an honorary corresponding member of the American Geographical Society, 654
- Shapley (Prof. H.), Star Distribution, 760; The most distant Celestial Object ever measured, 206; The Relative Velocity of Blue and Yellow Light, 206
- Shattock (Prof. S. G.), [death], 721; [obituary article], 754
- Shaw (H. K.), appointed Radcliffe observer at Oxford, 724
- Shaw (Sir Napier), A. Angot, 793; Forecasting Weather. Second edition, 151
- Shaxby (J. H.), A Method of increasing the Effective Sensitiveness of Galvanometers, etc., 926; and E. J. Evans, Certain Properties of the Osglim Neon-filled Lamp, 590
- Shearer (Prof. C.), The Oxygen Composition Rate of Parts of the Chick Embryo and Fragments of the Earthworm, 182
- Shedd (J. G.), gift of an aquarium to Chicago, 618
- Sheehy (E. J.), The Accessory Food Factors on the Quantity of Milk and Butter Fat, 411
- Sheppard (Dr. S. E.), Gelatin in Photography. Vol. i., 634
- Sheppard (T.), Geological Museum, London, 239; Government Publications and their Distribution, 83
- Sherrill (Prof. M. S.), A Course of Laboratory Experiments on Physico-chemical Principles, 348
- Sherrington (Sir Charles), Problems of Muscular Receptivity (Linacre Lecturer), 732, 892, 929; and E. G. T. Liddell, Reflexes in Response to Stretch (Myotatic Reflexes), 589
- Sherwood (G. H.), appointed acting director of the American Museum of Natural History, 400
- Shipley (Sir Arthur), and others, The Imperial College of Tropical Agriculture, 370
- Shirokogoroff (Dr. S. M.), Chinese Physical Types, 367; Social Organisation of the Manchus, 656; Tungus Shamanism, 937
- Shrum (G. M.), The Doublet Separation of the Balmer Lines, 145
- Siceloff (L. P.), G. Wentworth, and D. E. Smith, Analytic Geometry, 349
- Siegbahn (M.), and A. Láček, Measurement of the Intensity of X-ray Spectral Lines, 62
- Siegmund (Prof. G.), [death], 541
- Silberstein (Dr. L.), Éléments de la théorie électromagnétique de la lumière. Traduit de l'anglais par G. Matisse, 488; Radial Velocities, and the Curvature of Space-time, 818; Further Determinations of the Curvature Radius of Space-time, 602; Radial Velocities of Globular Clusters, and de Sitter's Cosmology, 350
- Simon (F.), and Fräulein C. v. Simson, Crystal Structure of Hydrogen Chloride, 441
- Simon (L. J.), The Argento-sulphochromic Oxidation of Coal, 447; The Oxidation of Acetic Acid by different Metallic Chromates compared with Oxidation by Silver Bichromate in the Silver Chromate-sulphuric Acid Method for the Determination of Carbon, 915; The Sulpho-chromatic Oxidation of Coal, 295; Viscosity of Aqueous Mixtures of Chromic Anhydride and Alkalies, 842; Viscosity of Mixtures, taken in Pairs, of Sulphuric Acid, Potash, and Soda, 592; and M. Frèrejacque, Action of Bromine on the Sulphomethyl Esters of Phenols, 662; The Methylation of Tertiary Amines and of Alkaloids by Means of Sulphomethyl Esters derived from Phenols, 515
- Simonnet (H.), Are the Requirements the same for the two Sexes during Growth? 183
- Simpson (Dr. G. C.), Ball Lightning, 677; Losses in the Arctic by the Norwegian Meteorological Service, 248; Thunderstorms, Mammato Clouds, and Globular Lightning, 82; Weather Forecasts, 151
- Simpson (J. W.), elected a member of the Athenæum Club, 400
- Sinnatt (F. S.), appointed assistant director of Fuel Research, 401; resignation of the lectureship in fuels in Manchester University, 324
- Skinner (C. A.), Half-shade Polarisers and Analysers, 12
- Skinner (H. D.), The Moa and Man in New Zealand, 367
- Slater (F. P.), A Sensitive Method for observing Changes of Electrical Conductivity in Single Hydropscopic Fibres, 325
- Slater (Dr. G.), The Dravidian Element in Indian Culture, 816
- Slater (Dr. J. C.), Radiation and Atoms, 307
- Slee (Comdr. J. A.), Direction Finding by Wireless, 441, 676
- Sleen (Dr. W. G. N. v. d.), and Dr. T. J. Stomps, Rhine Plants and Animals in Eastern England, 208
- Small (Prof. L. L.), Elements of the Theory of Infinite Processes, 487
- Small (Miss J. L.), bequest to Edinburgh University, 255
- Smith (A. H.), elected an honorary member of the Yorkshire Philosophical Society, 171
- Smith (Dr. A. L.), [death], 576; [obituary article], 650
- Smith (Prof. C. A.), The Life and Work of M. F. Maury, 315
- Smith (D.), Industrial Administration, 406
- Smith (Dr. E. F.), Jacob Green, 364
- Smith (Eng.-Capt. E. C.), appointed guide lecturer at the Science Museum, 505
- Smith (F. E.), elected a member of the Athenæum Club, 401; elected president of the Physical Society of London, 317
- Smith (Prof. G. Elliot), Prof. J. Symington, 462; Problems of Race (Galton Lecture), 291; The Human Brain, 390
- Smith (Prof. S.), The Gorilla's Foot, 83
- Smith (Dr. S.), and R. G. Carruthers, Lead and Zinc Ores of Northumberland and Alston Moor, 75
- Smith (S.), Electrically exploded Wires in High Vacuum, 447
- Smith (S. W. J.), A. A. Dee, and W. V. Mayneard, The Magnetism of Annealed Carbon Steels, 913
- Smith (T.), A Reference System for Primary Aberrations, 806; The Addition of Aberrations, 373; The Primary and Secondary Constant Magnification Surfaces of Thin Lenses, 33; The Relation between Aperture, Axial Thickness, and Form of a Single Lens, 145
- Smith (W. Campbell), with analysis by G. T. Prior, Compact Chlorite from Bernstein, Burgenland, Austria, 554
- Smith (W. G.), Prof. J. E. B. Warming, 683
- Smithells (Prof. A.), Sir William Crookes, 227; the memorial to, at Leeds University, 945; The Teaching of Science, 68
- Smits (Prof. A.), The Complexity of the Solid State, 855
- Smuts (Gen.), The Central Herbarium at Pretoria, 134
- Somerville (Rear-Admiral B. T.), Ocean Passages for the World: Winds and Currents, 349
- Sommelet (M.), The Preparation of Methylamine, 183
- Sommerfeld (Prof. A.), translated by H. L. Brose, Atomic Structure and Spectral Lines, 263; traduit par H. Bellenot, La Constitution de l'atome et les raies spectrales. Premier fasc. et deux. fasc., 263
- Southwell (R. V.), and Sylvia W. Skan, The Stability under Shearing Forces of a Flat Elastic Strip, 513
- Spalding (K. J.), The Presuppositions of Philosophy, 257
- Speakman (J. B.), appointed lecturer in textile chemistry in Leeds University, 804
- Spemann (Dr. H.), elected a foreign member of the Linnean Society of London, 724
- Spencer (Dr. L. J.), Allopathium from British Guiana, 554
- Speyer (E. R.), and O. Owen, The Effect of Naphthalene Vapour on Red Spider Mite (*Tetranychus telarius*, L.), 820
- Spielmann (Dr. P. E.), The Genesis of Petroleum, 638
- Spinks (G. T.), Propagation of Fruit Trees on their own Roots, 626
- Spoehr (Dr.), Photosynthesis and Respiration, 871



- Sprague (T. A.), Seedling of *Galium Aparine* with three Branches in the Axil of each Cotyledon, 293
- Spratt (Dr. E. R.), Chemistry and Physics for Botany Students, 233
- Squire (W. B.), elected a member of the Athenæum Club, 247
- Stakman (E. C.), The Rust Problem in America, 33
- Stanton (Dr. T. E.), Fluid Motion in Theory and Practice, 520
- Stapf (Dr. O.), Interesting Flowering Plants, 473; New Flowering Plants, 61
- Starling (Prof. E. H.), Discovery and Research, 606; and others, The Action of Alcohol on Man, 3
- Stead (A.), Twenty Years of Chemical Progress in South Africa, 64; Vitamins, Succulence, and Prickly Pear, 727
- Stephen (J. M. E.), [death], 202; [obituary], 281
- Stephenson (Dr. J.), The Fauna of British India, including Ceylon and Burma. Oligochaeta, 455
- Stewart (B.), Experiments on *Ciona intestinalis*, 14
- Stewart (Dr. J. Q.), The Temperature of Reversing Layers of Stars, 388
- Stieglitz (Prof. J.), Colour Production and Chemical Constitution, 141
- Stigand (Major C. H.), Equatoria: The Lado Enclave, 44
- Stiles (Dr. C. W.), Zoological Nomenclature: Official List of certain Generic Names, 821
- Stiles (Prof. W.), Permeability, 139
- Still (W. J.), The Still Engine, 369
- Stillman (Prof. J. M.), [death], 169
- Stockdale (D.), The Aluminium-copper Alloys: Alloys of Intermediate Composition, 479
- Stockman (Sir Stewart), and Miss Marjory Garnett, Bird Migration and the Introduction of Foot-and-mouth Disease, 52
- Stoklasa (J.), The Physiological Function of Iodine in the Organism of the Sugar Beet, 147
- Stone (H.), Étude descriptive sur les bois utiles de la Guyane française, 528
- Stoneman (Dr. Bertha), The Search for Crucial Instances in Botanical Procedure, 64
- Stott (V.), An Apparatus for calibrating Burette Tubes, 103
- Strachan (R.), [obituary article], 684
- Stradling (Dr. R. E.), appointed director of research of the Building Materials and Construction Research Board, 579
- Straelin (V. van), and M.-E. Denaeyer, Eggs of Extinct Reptiles, 368
- Strahan (Sir Aubrey), Geology of the Middle Thames, 904; Temperature Gradient in the Earth's Crust, 623
- Strangeways (T. S. P.), The Formation of Bi-nuclear Cells, 325
- Strathcona (Lady), gift to McGill University, 324
- Strong (Prof. C. A.), A Theory of Knowledge, 121
- Stunkard (H. W.), North American Blood-flukes, 175
- Subrahmaniam and Gunnaiya, suggestion that the name Newton should be substituted for the term "horse-power," 869
- Suckan (C. A.), The Supervision and Maintenance of Steam-raising Plant, 810
- Sullivan (J. W. N.), Atoms and Electrons, 378
- Sumner (Lord), Scientific Inventions, 794
- Sumner (F. B.), Size-factors and Size-inheritance, 216
- Sund (Dr. O.), Snow and the Survival of Cod Fry, 163
- Sunier (Dr. A. L. J.), The Marine Station at Batavia, 364
- Svedberg (Prof. The.), and others, Reversal in Photographic Plates, 905
- Svedelius, Distribution of Marine Algæ, 800
- Swaine (W.), A suggested Standard Trial Case and Simplification in Ophthalmic Policy, 33
- Swann (H. Kirke), A Bibliography of British Ornithology from the Earliest Times. Supplement: A Chronological List of British Birds, 531
- Swartz (C. K.), and others, The Silurian Strata and Ostracoda of Maryland, 403
- Swasey (A.), awarded the John Fritz gold medal, 282
- Swift (J.), and Son, Ltd., Catalogue of Microscopes and Accessories, 285
- Swinhoe (Col. C.), [obituary article], 21
- Swinerton (Prof. H. H.), Outlines of Palæontology, 922
- Symington (Prof. J.), [death], 360; [obituary article], 432
- Szegvari (Dr. A.), Oblique Illumination in Ultramicroscopic Work, 547
- Székely (Fraülein Angelika), The Passage of Electricity between Metals in Light Contact, 836
- Taliaferro (W. H.), The Interaction of Host and Parasite, 447
- Talman (C. F.), Meteorology, The Science of the Atmosphere, 486
- Tansley (A. G.), The Unification of Pure Botany, 85; and others, Soil Sourness, 179
- Tattersfield (F.), and H. M. Morris, An Apparatus for testing Contact Insecticides, 762
- Taylor (A. J.), Feeding Value of South African Grasses, 761
- Taylor (Clara M.), The Discovery of the Nature of the Air, and of its Changes during Breathing, 118
- Taylor (C. M'Kenzie), Control of the Pink Boll-worm on Cotton, 745
- Taylor (E.), Wireless Reception without a Crystal, 136
- Taylor (E. W.), A New, Perfectly Anallactic Internal Focussing Telescope, 662
- Taylor (Prof. Griffith), British (*Terra Nova*) Antarctic Expedition, 1910-1913, The Physiography of the McMurdo Sound and Granite Harbour Region, 417
- Taylor (Prof. G. I.), The Singing of Wires in a Wind, 536
- Taylor (H. D.), Feasibility of Cinema Projection from a continuously moving Film, 662
- Taylor (Dr. H. O.), Freedom of the Mind in History, 885
- Taylor (J.), and W. Clarkson, The Critical Resistance for Flashing of the Low-voltage Neon Discharge Tube, 590
- Taylor (Sister Monica), Division of the Nucleus in *Amaba proteus*, 691
- Taylor (T. H.), An Improved Form of Pipette, 84
- Temple (G.), A Generalisation of Whitehead's Theory of Relativity, 446
- Terazawa (K.), The Decay of Vortical Motion in a Viscous Fluid, 140
- Terroine (E. F.), R. Bonnet, R. Jacquot, and G. Vincent, Comparative Energy Yields in the Development of Moulds at the Expense of Carbohydrates or of Proteids and Specific Dynamical Action, 515
- Terry (Prof. C. S.), elected a member of the Athenæum Club, 545
- Thayer (G. H.), Camouflage in Nature and in War, 207
- Théry (A.), The Genus *Synechocera*, with Description of a New Species, 36
- Thomas (H. H.), and A. H. Cox, The Volcanic Series of Roch, Trefgar, and Sealyham (Pembrokeshire), 699
- Thomas (Dr. J. S. G.), The Gas Industry, 622
- Thomas (Dr. T.), and J. J. P. Kent, Revision Arithmetic and Mensuration. Third edition, 853
- Thomas (V.), M. Bathiat, and A. Génét, The Knowledge of Picryl Sulphide: the Action of the Alkalis, 662
- Thompson (F. C.), and W. H. Dearden, An Experiment in Solid Diffusion, and its possible Bearing on the Structure of Solid Solutions, 770
- Thompson (Prof. J. McLean), awarded the Neill prize of the Royal Society of Edinburgh, 471
- Thompson (R. Campbell), Assyrian Medical Texts, 529; The Plants of the Assyrian Medical Tablets, 478
- Thompson (Prof. R. R.), [death], 169
- Thompson (T. W.), Gypsy Burial Customs, 727
- Thomson (A.), and C. C. Farr, Apia Observatory, Samoa, 355
- Thomson (Dr. A. L.), Bird Migration in Relation to Foot-and-mouth Disease, 52
- Thomson (Dr. E.), awarded the Kelvin gold medal, 282
- Thomson (Dr. G. A.), and the Hon. G. M. Thomson, Research in New Zealand, 471
- Thomson (Hon. G. M.), Naturalised Plants and Animals of New Zealand, 439
- Thomson (G. P.), The Cathode Fall of Potential in a High Voltage Discharge, 914
- Thomson (Prof. H. A.), [death], 397
- Thomson (Prof. J. A.), Everyday Biology, 780; Speculative Bio-sociology, 74; The Biology of Birds, 121; What is Man? 266
- Thomson (Sir J. J.), An Appreciation of Lord Kelvin, 934; to deliver the University lecture in science in Aberdeen University, 372
- Thomson (Sir St. Clair), "Butyn," 368
- Thorburn (A.), Game Birds and Wild-fowl of Great Britain and Ireland, 526



- Thornton (Prof. W. M.), *Electricity in Mines*, 251  
 Thorpe (Prof. J. F.), *Chemical Research in India*, 928  
 Thorpe (W. H.), *Earthquake Buildings*, 176  
 Thurston (A.), *Pharmaceutical and Food Analysis: a Manual of Standard Methods for the Analysis of Oils, Fats, and Waxes, and Substances in which they Exist: together with Allied Products*, 886  
 Tian (A.), *Measurement of the Intensity of Small Sources of Heat*, 411; and J. Cotie, *The Utilisation in Biology of the Microcalorimetric Method*, 699  
 Tiffenau (M.), and C. Torres, *The Hypnotic Properties of Hydrobenzoin and its Alkyl Homologues (Symmetrical Diarylglycols)*, 183  
 Tigerstedt (Prof. R.), [obituary article], 359  
 Tilley (Dr. C. E.), appointed demonstrator in petrology in Cambridge University, 32  
 Tillyard (Dr. R. J.), *Mesozoic Insects of Queensland*. No. 10, 36  
 Tizard (Capt. T. H.), [death], 281; [obituary article], 395  
 Todd (Dr. R. H.), awarded the medal of the Federal Committee of the British Medical Association, 172  
 Tokugawa (I.), *The Japanese Earthquake*, 473  
 Tolman (R. C.), *Duration of Molecules in Upper Quantum States*, 663  
 Totton (A. K.), *Antarctic Antipatharia and Gastropoda*, 319  
 Toy (F. C.), and S. O. Rawling, *A New Electrical Density Meter*, 321  
 Tozawa (T.), *The Pearl Organ of the Goldfish*, 250  
 Trail: James William Helenus, a Memorial Volume, 636  
 Treggold (Dr. A. F.), *Evolution and Eugenics*, 876  
 Trelease (Dr. S. F.), *The Third Cincinnati Meeting of the American Association for the Advancement of Science*, 288  
 Tressler (Dr. D. K.), with collaborators, *Marine Products of Commerce*, 529  
 Trier (Dr. G.), *Chemie der Pflanzenstoffe*, 882  
 Trotter (A. P.), *Mrs. Ayrton's Work on the Electric Arc*, 48; *The Language (if any) of Insects*, 747  
 Troup (Prof. R. S.), *Our Tropical Forests and their Economic Significance*, 213  
 Trowbridge (C. C.), *Spectra of Meteor Trails*, 448  
 Truffaut (G.), and N. Bezsanoff, *The most favourable Form of Nitrogen for the Higher Plants*, 411  
 Turner (C.), *Investigations on Desmids*, 626  
 Turner (Prof. H. H.), *A Four-year Seismic Period*, 763; *Dr. O. Klotz*, 90; *The Study of Earthquakes*, 248  
 Turner (Prof. W. E. S.), *Specifications in the Glass Industry*, 103, 294  
 Tutton (Dr. A. E. H.), *The Natural History of Crystals*, 562  
 Tweedy (Sir John), [death], 57  
 Twiss (D. F.), *Refractive Index of Indiarubber*, 822  
 Tyrrell (G. W.), *The Geology of Prince Charles Foreland, Spitsbergen*, 411
- Urbain (E. and G.), *The Simultaneous Presence of Cesium and Yttrium Earths in some Zirconium Minerals*, 215
- Vallée (H.), *The Tubercle Bacillus and an Irresorbable Excipient*, 147  
 Van Manen (J.), *Tibetan Bibliography*, 96  
 Varnum (W. B.), *Systematic Errors in Boss's Proper Motions*, 318  
 Vegard (Prof. L.), *The Auroral Spectrum and the Upper Atmosphere*, 716; *The Emission of Light by Solid Nitrogen and the Origin of the Spectrum of the Aurora*, 627  
 Veil (Mlle. Suzanne), *Evolution of the Molecule of Nickel Hydroxide in the Presence of Water*, 514  
 Vermooten (V.), *The Long Bones of the South African Bushman*, 948  
 Verneau (Dr. R.), *The Baras of Madagascar*, 871  
 Vernon (W. H.), *First Report to the Atmospheric Corrosion Research Committee of the British Non-ferrous Metals Research Association*, 34; *The Tarnishing and Fogging of Metals*, 178  
 Viale (G.), *Behaviour of the Catalase in the Blood on Variation of the surrounding Temperature*, 916  
 Vila (A.), *Estimation of small Quantities of Molybdenum*, 35  
 Vincent (H. C. G.), *Chemical Analyses of Microgranite from Dufton, Westmoreland, and of Mica from Burma*, 554
- Vincent (Prof. Swale), *The Islands of Langerhans*, 834  
 Visser (Dr. S. W.), *The Location of Earthquake Epicentres*, 692  
 Vogt (T.), *Plant Remains in Norway*, 620  
 Volmar (M.), *Photolysis and the Law of Photochemical Equivalence*, 411; and Stahl, *The Influence of Agitation on the Formation of Precipitates*, 627  
 Vosburgh and Eppley, *Mercury Standard Cells*, 404
- Wade (C. F.), *A Manual of Fuel Economy: for Engineers and others in charge of Boiler and Furnace Plants*, 810  
 Wade (E. B. H.), *River Discharge Measurement*, 872  
 Wagner (Prof. A.), *Das Zweckgesetz in der Natur: Grundlinien einer Metamechanik des Lebens*, 266  
 Wagner (Dr. P. A.), and T. G. Trevor, *Platinum in the Transvaal*, 621  
 Wagstaff (J. E. P.), *An Electrical Method of determining the Velocity of Detonation of Explosives*, 373; appointed professor of physics in Durham University, 877; *The Duration of Impacts, mainly of Bars with Rounded Ends, in Elucidation of the Elastic Theory*, 513  
 Waite (E. R.), *The Fishes of South Australia*, 189  
 Walcott (Dr. C. D.), an honorary doctorate to be conferred upon, by Paris University, 512  
 Waldram (P. J.), *Daylight Illumination*, 723  
 Wales (Prince of), awarded the Albert medal of the Royal Society of Arts, 798  
 Walker (Dr. G. T.), *Correlations in Seasonal Variations of Weather: a Preliminary Study of World Weather*, 131; *Rainfall over India*, 836; the work of, 795  
 Walker (Prof. W. H.), Prof. W. K. Lewis, and Prof. W. H. McAdams, *Principles of Chemical Engineering*, 5  
 Wall (Dr. T. F.), *Intense Magnetic Fields and the Disturbance of Electronic Orbits in Magnetic Materials*, 568  
 Wallis (F. S.), *The Avonian of the Tytherington-Totworth-Wickwar Ridge (Gloucestershire)*, 182  
 Wallis (T. E.), *Analytical Microscopy: its Aims and Methods*, 601  
 Walmsley (Dr. R. M.), [obituary article], 932  
 Walsham (Dr. H.), [death], 721  
 Ward (Sir Adolphus William), [death], 933  
 Ward (Capt. F. K.), *The Mystery Rivers of Tibet*, 450  
 Wardlaw (C. W.), *Size in Relation to Internal Morphology*. I., 514  
 Wardle (H. N.), *Ceremonial Objects in Stone and Algonkin Symbolism*, 506  
 Warming (Prof. J. E. B.), [death], 541; [obituary article], 683  
 Warnes (A. R.), *Coal Tar Distillation and Working-up of Tar Products*. Third edition, 778  
 Warnock (Dr. J.), *Responsibility in Insanity*, 286  
 Washington (Prof. H. S.), *The Basaltic Lavas of Hawaii*, 97  
 Watson and Sons (Electro-Medical), Ltd., *An Exposure Table for Radiographic Work*, 365; *List of Dental X-ray Apparatus*, 284  
 Watson (A. T.), [obituary article], 576  
 Watson\* (Prof. D. M. S.), *The Origin of the Amphibia (Croonian Lecture)*, 841  
 Watson\* (Dr. Katherine M.), *Early Development of the Mammalian Heart*, 319  
 Watson (W.), and Sons, Ltd., *Microscope Record*, 901  
 Watt (H. J.), *Dimensions of the Labyrinth correlated*, 806  
 Wayland (E. J.), *The Structure of the Great Rift Valley*, 388  
 Weatherburn (Dr. C. E.), *Advanced Vector Analysis: with Application to Mathematical Physics*, 671  
 Webb (R. A.), elected to the Charles Abercrombie Smith research studentship at Peterhouse, 212  
 Webber (W. J.), awarded a Smith's prize by Cambridge University, 408  
 Webster (T. A.), and Prof. L. Hill, *Effects of breathing "Activated" Air*, 761  
 Wedd (Dr. B. H.), [death], 360  
 Weiss (Prof. F. E.), *A Tri-hybrid Primula*, 699  
 Weiss (P.), and R. Forrer, *The Magnetic Isotherms of Nickel*, 591; *The Magnetocaloric Phenomenon and the Specific Heat of Nickel*, 699; *Magnetocaloric Phenomenon*, 771  
 Welch (C.), [obituary], 133



- Welch (M. B.), Occurrence of Secretory Canals in certain Myrtaceous Plants, 148; W. McGlynn, and F. A. Coombs, Some Notes on Wattle Barks, 295
- Wellington (S. N.), and W. R. Cooper, Low Temperature Carbonisation, 920
- Wells (G. J.), Standards of Comparison in Connexion with the Thermal Efficiency of Internal Combustion Engines, 651
- Wells (H. G.), The Story of a Great Schoolmaster: being a Plain Account of the Life and Ideas of Sanderson of Oundle, 559
- Welsford (E. J.), Diseases of Cloves, 553
- Wentworth (G.), D. E. Smith, and H. D. Harper, Fundamentals of Practical Mathematics, 453
- West (G. H.), Condensation Bands formed during the Explosion of Hydrogen and Air, 712
- Westell (W. P.), British Mammals; British Birds; British Reptiles, Amphibians, and Fresh-water Fishes; British Butterflies and Moths; British Insects (General), 8
- Westgren (Dr. A.), and G. Phragmén, On the Structure of Solid Solutions, 122
- Weston Chemical Co., "Westrosol," etc., 836
- Weston (Dr. E.), awards to, by the Franklin Institute, 900
- Wheeler (Prof. W. M.), presented with the Daniel Giraud Elliot medal, 798; Social Life among the Insects, 452
- Whipple (F. J. W.), Rainfall of 1923, 206; The Propagation of Sound, 801; The Significance of Regression Equations in the Analysis of Upper Air Observations, 591
- Whipple (Prof. G. C.), Vital Statistics: an Introduction to the Science of Demography. Second edition, 269
- Whipple (R. S.), Recent Advances in the Design of Temperature Measuring Instruments, etc., 555
- White (C. T.), An Elementary Text-book of Australian Forest Botany, 601
- White (Gilbert), unveiling of a seat in memory of, 722
- White (H. G. E.), invited to take the field-direction of an archaeological expedition in Egypt, 255
- Whitehead (Prof. A. N.), appointed to a chair in the faculty of philosophy at Harvard University, 504; the work of, 542
- Whittaker (Prof. E. T.), The Theory of Graduation, 146
- Widdowson (W. P.), Standardisation of Scientific and Technical Publications, 51
- Wild (F.), awarded the David Livingstone gold medal of the American Geographical Society, 689
- Wilder (F. A.), Gypsum, 97
- Wilder (Prof. I. W.), Laboratory Studies in Mammalian Anatomy, 923
- Wilkinson (G.), The Theory of Hearing, 781
- Wilkinson (Prof. J. A.), elected president of the South African Association, 66
- Will (W. J.), appointed assistant lecturer in agriculture in Leeds University, 181
- Williams (C. B.), Pink Boll-worm in Egypt, 800
- Williams (Prof. E. C.), The Aims and Future Work of the Ramsay Memorial Laboratory of Chemical Engineering, 134
- Williams (May M.), A Contribution to our Knowledge of the Fucaceæ, 148
- Willoughby (E. P.), appointed James Watt fellow in Birmingham University, 408
- Willoughby (Rev. Prof. W. C.), Race Problems in the New Africa: a Study of the Relation of Bantu and Britons in those parts of Bantu Africa which are under British Control, 455
- Willstätter (Prof.), elected a corresponding member of the Russian Academy of Science, 436
- Wilson (C. T. R.), A Simple Form of Stereoscope and its Applications, 70; reappointed reader in electrical meteorology in Cambridge University, 876
- Wilson (Prof. E.), and E. F. Herroun, The Electrical Conductivity of Magnetite, 293
- Wilson (Prof. E. B.), The Development of a Frequency Function and some Comments on Curve Fitting, 628; The Physical Basis of Life, 742
- Wilson (E. B.), and W. J. Luyten, A Statistical Discussion of Sets of Precise Astronomical Measurements: Parallaxes, 843
- Wilson (Prof. H. A.), appointed professor of natural philosophy in Glasgow University, 912
- Wilson (J. D.), appointed professor of education at King's College, London, 511
- Wilson (S. H. J.), Effect of Cold-drawing and Annealing on some Electro-chemical Properties of Low-tin Bronze, 478
- Wilson (W. J.), The Crude Oils of Burma and Assam, 657
- Winchell (W. H.), and A. N. Winchell, Elements of Optical Mineralogy; an Introduction to Microscopic Petrography. Entirely rewritten and much enlarged by Prof. A. N. Winchell. Second edition. Part I., 600
- Winge, Sex Chromosomes in the Hop, 208
- Winger (Prof. R. M.), An Introduction to Projective Geometry, 598
- Winogradsky (S.), The Autochthone Microflora of Arable Earth, 662
- Winter (L. B.), and W. Smith, Carbohydrate Metabolism, I., 256
- Wolf (Prof. Max), A Faint Star with Large Proper Motion, 318
- Woo (Y. H.), Absorption Measurements of the X-rays reflected from a Calcite Crystal, 844
- Wood (A.), reappointed University lecturer in experimental physics in Cambridge University, 839
- Wood (E. F. L.), appointed a member of the Medical Research Council, 400
- Wood (H. E.), and F. J. Morshead, Comets, 249
- Wood (Canon T.), [obituary article], 21; proposed memorial to, 543
- Woodcock (Dr. H. M.), The Origin of Foot-and-mouth Disease, 165; Foot-and-mouth Disease, 239
- Woodhouse (T.), Jacquards and Harnesses: Card-cutting, Lacing and Repeating Mechanism, 742
- Woodland (Dr. W. N. F.), *Hymenolepis nana* and *H. fraterna*, 675; Monozoa, 286; The Modus Operandi of Kidney Secretion, 891
- Woodring (W. P.), Orthaulax from the Tertiary Deposits of the West Indies, 581
- Woodruff (Prof. L. L.), Foundations of Biology, 269
- Woods (Mrs. Ethel Gertrude), and Miss Margaret Chorley Crossfield, The Silurian Rocks of the Clwydian Range, from Moel Arthur to Gyrn, 806
- Woodward (Dr. A. Smith), A Hybodont Shark (*Tristychius*) from the Calceiferous Sandstone Series of Eskdale (Dumfriesshire), 257; impending retirement of, 204; the work of, 398
- Woodward (B. B.), Scientific Names of Greek Derivation, 51
- Woolley (C. L.), Excavations at Tel-el-Obeid, 174; Excavations at Ur, 286
- Wright (Sir Almoth E.), New Methods for the Study of Infection and the Treatment of Tuberculosis, 183
- Wright (C. S.), Physiography of the Beardmore Glacier Region, 777; and R. E. Priestley, British (*Terra Nova*) Antarctic Expedition, 1910-1913. Glaciology, 417
- Wright (F. E.), Geological Photographs, 835
- Wright (N. C.), Action of Rennet on Milk, 547
- Wright (Prof. W.), an honorary doctorate to be conferred upon, by Paris University, 512
- Wright (W. B.), Age and Origin of the Lough Neagh Clays, 446
- Wyatt (W. F.), appointed demonstrator in chemistry in Sheffield University, 733
- Wycherley (S. R.), Fibres, Analytical and Economic, 734
- Wyon (Dr. G. A.), [obituary], 502
- Yardley (Kathleen), The Crystalline Structure of Succinic Acid, etc., 446
- Yermoloff (N.), Y a-t-il continuité dans le monde physique? 158
- Yolton (L. W.), The Effects of cutting the Giant Fibres in the Earthworm *Eisenia fetida* (Sav.), 216
- Young (R. K.), and W. C. Harper, Spectroscopic Parallaxes from the Dominion Observatory, 472
- Yovanovitch (D.), and J. d'Espine, The Magnetic Spectrum of the  $\beta$ -rays of Mesothorium-2, 915
- Yule (G. U.), A Mathematical Theory of Evolution, 256; Inheritance Ratios in Peas, 208
- Zacharov (G.), The Variable AC Herculis, 833
- Zeeman (Prof. P.), The Optical Effects of Motion, 796, 838
- Zeipel (H. v.), The Reddest Star known, 870



## TITLE INDEX.

- a-a*- $\beta$ -Triphenylpropionic Acid and some of its Derivatives, Mme. P. Ramart, 147
- Aberdeen University : O. F. T. Roberts appointed Cruickshank lecturer in astronomy and meteorology, 144 ; Dr. W. Blackadder appointed professor of engineering, 181 ; Sir J. J. Thomson to deliver the University lecture in science ; honorary degrees to be conferred, 372
- Aberrations : The Addition of, T. Smith, 373 ; The determination of, as expressed in Geometrical Optics, from the Indications of the Hilger Interferometer, J. W. Berry, 145
- Abnormal Behavior, Pitfalls of our Minds : an Introduction to the Study of Abnormal and Anti-social Behavior, Dr. I. J. Sands and Dr. Phyllis Blanchard, 919
- Abrams' Cult in Medicine, The, 809
- Acacia Seedlings. Pt. IX., R. H. Cambage, 295
- Acetates and Tri-chloracetates, The Electrolysis of a Mixture of, R. E. Gibson, 914
- Acetic Acid, The Oxidation of, by different Metallic Chromates, L. J. Simon, 915
- AC Herculis, The Variable, G. Zacharov, 833
- Acids, The Displacement of, by Diffusion, E. Demoussy, 183
- Acoustic : Depth Sounding, 463 ; Sir Oliver Lodge, 504 ; Spectroscopy, An, Dr. E. E. Fournier d'Albe, 939
- Acoustical Energy, The Degradation of, M. D. Hart, 145
- Acquired Characters, Inheritance of, Prof. W. B. Scott and others, 138
- Acrolein, Absorption of Ultra-violet Light by, V. Henri, 514
- Actinometer, A Self-recording Thermo-electric, M. Henry, 71
- " Activated " Air, Effects of breathing, T. A. Webster and Prof. L. Hill, 761
- a-d*-Mannosidase, The Synthetic Action of, in the Presence of Ordinary Glycol and of Glycerol, H. Hérissé and J. Cheymol, 699
- Admiralty, Director of Naval Construction of the, W. J. Berry appointed, 436
- Æolian Tones, E. G. Richardson, 326
- Aerial Haze and its Effect on Photography from the Air, 634
- Aero Engines, A. J. Rowledge, 98
- Aeronautical Research, Reorganisation for the Control of, 134
- Aeroplanes to survey the Forest Wealth of Ontario, 363
- Afghanistan : The Climate of the East of, R. Furon, 147 ; The Movements in, of M. Foucher, 58
- Africa, Central, Racial Migrations in, Rev. Canon J. Roscoe, 903
- Agar, Sols and Gels of, Certain Differences between, E. Hatschek and R. H. Humphry, 410
- Agricultural : Analysis, Quantitative, Prof. E. G. Mahin and Prof. R. H. Carr, 347 ; Botany, National Institute of, Report of the, for 1922-23, 24 ; Education and Research in Scotland, appointment of a committee on, 204 ; *Progress*, No. 1, 687 ; Research at Rothamsted, 482 ; Science, Research Workers in, award of travelling research fellowship to, 759
- Agriculture, The Prosperity of, and the Agricultural Labourer, Report of Investigators on, 867
- Agriolimax agrestis*, Influence of the Cooking of Food on the Development of, H. Cardot, 35
- Air, The Discovery of the Nature of the, and of its Changes during Breathing, Clara M. Taylor, 118
- Alcohol : on Man, The Action of, Prof. E. H. Starling and others, 3 ; Problem, The, 3
- Aldebaran, Occultations of, 505
- Aldehydes, Condensation of : with Butylacetoacetic Ester, Prof. H. Ryan and M. J. Shannon, 555 ; with Methyl ethyl ketone, Prof. H. Ryan and P. J. Cahill, 555
- Aleri* Expeditions, Polychæta from the, C. C. A. Monro, 947
- Algal Cells, Morphological Constituents of, 155
- Algal Variable, An Interesting, K. F. Bottlinger and P. Guthnick, 173
- Algues, Cytoplasma des, Recherches sur les constituants morphologiques du, Dr. G. Mangenot, 155
- Alignment Charts for Engineers and Students : a Text-book explaining the Theory and Construction of Alignment Charts, W. J. Kearton and G. Wood, 887
- Alkaline : Bisulphites and Mercuric Chloride, The Reaction of, A. Graire, 915 ; Lakes, Dr. G. de P. Cotter, 547 ; Metaphosphates, The " Insoluble," P. Pascal, 183
- Allen's Commercial Organic Analysis. Vol. I. Fifth edition, 815
- Allopalladium from British Guiana, Dr. L. J. Spencer, 554
- Alloys resistant to Corrosion : a General Discussion held jointly by the Faraday Society and the Sheffield Section of the Institute of Metals, April 1923, 191
- Alternating Current Bridge Methods for the Measurement of Inductance, Capacitance, and Effective Resistance at Low and Telephonic Frequencies : a Theoretical and Practical Handbook for the Use of Advanced Students, B. Hague, 530
- Alumina, Precipitates of, Constitution and Evolution of, P. Pascal, 295
- Aluminium : at High Temperatures, The Tensile Properties of, T. Martin, 478 ; Bars, The Determination of the Crystal-axes in " Single-crystal," by means of X-rays, A. Muller, 446 ; -copper Alloys, The, D. Stockdale, 479 ; Spark Spectrum of, Singlet Series in the, Prof. H. N. Russell, 163
- Amateur Aquarist*, The, No. 1, 832
- Amblystoma, Extraneous Medulla in, Effects of replacing the Cephalic End of the Embryonic Spinal Cord by an, R. S. Detwiler, 628
- American : Science, The Development of, Prof. J. P. McMurrich, 248 ; Agriculture, Economic History of, Prof. E. L. Bogart, 531 ; and British Coal Production, 225 ; Association : offer of a prize for a paper on the advancement of science, 23 ; award of a prize to Prof. L. E. Dickson, 204 ; The Third Cincinnati Meeting of the, Dr. S. F. Trelease, 288 ; Dr. J. McKeen Cattell, elected president of the, 289 ; a prize awarded to Prof. R. B. Dixon, 936 ; Astronomical Society, Publications of the, 285 ; Chemical Society, Dr. L. H. Baekeland elected president of the, 136 ; Geographical Society : award of gold medals to Prof. J. Cvijic, Col. C. H. Birdseye, and F. Wild, 689 ; election as honorary corresponding members of Dr. E. R. Heath, Dr. H. L. Shantz, and P. Le Coite, 654 ; Intelligence, A Study of, Prof. C. C. Brigham, 158 ; Museum of Natural History : Dr. F. A. Lucas appointed honorary director ; G. H. Sherwood, acting director, 400 ; Fifty-fourth Annual Report, 1922, 141 ; The Expeditions of the, 135
- Americanist Literature, Current, Bibliography of, Dr. P. Rivet, 402
- Ammines, Stability of, G. L. Clark, 209
- Ammonia, The Decomposition of, by Ultra-violet Light. Influence of Temperature on, W. Kuhn, 411
- Ammonites, Type, S. S. Buckman. Vol. 4, 232
- Ammonium Radical, The Configuration of the, W. H. Mills and E. H. Warren, 294
- Amæba proteus*, Division of the Nucleus in, Sister Monica Taylor, 691
- Amœboid Movement, Physiology of, C. F. A. Pantin, 174
- Ampère Testing Laboratory, The, M. d'Arsonval, 103, 246
- Amphibia, The Origin of the, Prof. D. M. S. Watson, 841
- Amsterdam, A Colonial Institute in, 245
- Anæsthetic, A New, Sir St. Clair Thomson, 367
- Analcitic Lavas of North Africa, The, A. Lacroix, 327
- Anatoxins, The, G. Raymon, 735
- a-n*-Butylpyrrolidine, A New Synthesis of, E. E. Blaise and A. Corrilion, 842
- Ancient : Man in North America, Dr. W. K. Gregory and M. Hellman, 25 ; Monuments and Sites in Great Britain, Protection of, Conference upon the, 476
- Anencephalus, Brain and the Retina of the, E. Rabaud, 72
- Anions, The Influence of, in the Coagulation of a Negative Colloidal Sol, D. C. Henry and V. A. Morris, 410



Annual Register, The, A Review of Public Events at Home and Abroad for the Year 1923. Edited by Dr. M. Epstein, 816

Annuities, Deferred (Two Rates of Interest): W. Palin Elderton, 50; Sir R. A. S. Redmayne, 84

Antarctic: Antipatharia and Gastropoda, A. K. Totton, 319; Ascidians, Sir William Herdman, 139; Glacial Geology, Lessons of, 417; Sea-Ice, R. W. James, 475

Antarctica, East, Physiography of, 777

Anthropology: and Colonial Administration, 42; New and Old, Dr. B. Malinowski, 299

Antiseptic Action of Compounds of the Apocyanine, Carbocyanine, and Isocyanine Series, C. H. Browning, Prof. J. B. Cohen, S. Ellingworth, and R. Gulbransen, 805

Antiseptics: on Bacteria and on Leucocytes, A Comparison of the Activities of, A. Fleming, 409; Regular and Irregular, C. Richet, 71

$\alpha$ -Particles: Emission of, by Radium, H. Geiger and A. Werner, 474; The Bombardment of Elements by, Sir Ernest Rutherford and Dr. J. Chadwick, 457

Apia Observatory, Samoa, A. Thomson and C. C. Farr, 355

Apple Scab Fungus, Winter Stage of the, E. S. Salmon and W. M. Ware, 691

Apprentices, the technical training of, in France, 512

Approximate Integration: On, Prof. M. Fréchet, 714; H. V. Lowry, 927

Arachnida from the Rhynie Chert, S. Hirst, 33

Arcetri Observatory, The, Florence, 902

Argon, Krypton, and Xenon: Excitation of the Spectra of, G. Déjardin, 729; The Higher Order Spectra of, L. Bloch, E. Bloch, and G. Déjardin, 447; L. and E. Bloch, 508

Aristotle, Prof. W. D. Ross, 776

Aristotelian Society. Supplementary Vol. 3, 156

Arithmetic: and Mensuration, Revision, Dr. T. Thomas and J. J. P. Kent. Third edition, 853; for Engineers, C. B. Clapham, 453; Technical, R. W. M. Gibbs, 79

Army Officer, Science and the, 413

Aromatic: Alcohols, The Catalytic Dehydration of the, J. B. Senderens, 35; and Aliphatic Derivations, Reactions of certain, 771

Arsenic: Acid, The Reduction of, by Sulphurous Acid in the Presence of Vanadic Acid, V. Auger and Mlle. L. Odinot, 183; Sulphide, Influence on the Properties of Sols of, of some Physical Factors intervening during their Preparation, A. Boutaric and M. Vuillaume, 515

Art: -forms in Nature, E. Heron-Allen, 847; Works of, Application of Optical Methods to the Examination of, E. Bayle and H. George, 146

Arylhydrobenzoin, The Semi-pinacolic Transposition of the, A. Qrékhoff and M. Tiffeneau, 842

Asiatic Society of Bengal, election of officers and council, 471

Asphalt and Related Bitumens, K. W. Cottrell, 26

Assyrian Medical: Tablets, The Plants of the, R. Campbell Thompson, 478; Texts, R. Campbell Thompson, 529

Astronomical: Contributions to Ancient Chronology, Prof. Langdon, 285; Measurements: A Statistical Discussion of Sets of Precise, Parallaxes, E. B. Wilson and W. J. Luyten, 843; Object-glasses, New Large, 831; Photographs, 496

ASTRONOMICAL NOTES.

Comets:  
Comets, 24; D'Arrest's Comet, J. E. Mellish, 206; Comets, H. E. Wood; F. J. Morshead, 249; New Comet, W. Reid, 545; Elements of Reid's New Comet, 1924 *a*, 580; Orbit of Mellish's Comet, 1917 I., S. Asklöf, 619

Instruments:  
The Photo-electric Photometer at the Lick Observatory, Edith J. Cummings, 285

Meteors:  
The January Meteoric Shower, W. F. Denning, 60; Earthquake or Meteor? 137; Prevalence of Fireballs in January, W. F. Denning, 285; June Meteors, W. F. Denning, 902

Observatories:  
Another Harvard Station in South America, 366; Stonyhurst Observatory in 1923, 619; Greenwich Observations, 1920, 690; Norman Lockyer Observatory, Sidmouth, Report, April 1, 1923, to March 31, 1924, 902; The Arcetri Observatory, Florence, 902

Planets:  
Conjunction of Mars and Jupiter, 137; Occultation of a Star by Jupiter, 173; Total Eclipse of the Moon, 249; Mars, 366; Rotation Period of Neptune, 366; The Planet Saturn, W. F. Denning, 402; Comet or Minor Planet? 402; Minor Planets, 438; Planetary Rotations, H. Kaul; H. Troeger-Wohlau, 472; Mercury, 505; Rotation Periods of Mercury and Venus, A. Danjon, 580; The Lunar Eclipse of February 24, A. Danjon, 619; Jupiter, 655; Rotation Periods of Saturn's Satellites, K. Graff, 690; The Transit of Mercury on May 8, 760; Spots on Venus, 799; Transit of Mercury, 833; Colour Photography of the Moon, F. J. Hargreaves, 833

Stars:  
Stellar Photometry at Yale Observatory, 24; Parallax and Proper Motion of RR Lyræ, 24; Differential Latitude Observations at Helwan, 60; Status of the Spiral Nebulæ, Prof. H. D. Curtis, 60; Distribution of Temperature in Stellar Spectra, Dr. C. G. Abbot, 95; Approaching Maximum of Mira Ceti, A. A. Nijland, 137; The Companion of Mira Ceti, Dr. A. H. Joy, 173; An Interesting Algol Variable, K. F. Bottlinger and P. Guthnick, 173; The most distant Celestial Object ever measured, Prof. H. Shapley, 206; Faint Stars with large Proper Motion, Dr. Innes; Prof. Max Wolf, 318; Systematic Errors in Boss's Proper Motions, W. B. Varnum, 318; Distances of Stars, E. A. Kreiken, 402; The Masses and Luminosities of the Stars, Prof. A. S. Eddington, 438; The Hundred Nearest Stars, W. J. Luyten, 438; Spectroscopic Parallaxes from the Dominion Observatory, R. K. Young and W. C. Harper, 472; Occultations of Aldebaran, 505; Distances of certain Stars, F. C. Leonard and P. Doig, 545; Stellar Mass as a Function of Absolute Magnitude, Prof. A. S. Eddington, 655; The Problem of the Nebulæ, J. H. Reynolds, 690; Proper Motions with the Blink Microscope, Dr. Innes, 726; Density of Dwarf Stars, Prof. A. S. Eddington, 760; Star Distribution, Prof. H. Shapley, 760; The Variable AC Herculis, G. Zacharov, 833

Sun:  
Variation of Solar Faculæ in the Sun-spot Cycle, H. W. Newton, 137; Frequency of Total Solar Eclipses, Rev. W. Rigge, 249; The Mount Wilson Work on Solar Magnetism, Prof. G. E. Hale, 726; The North and South Currents in the Sun's Reversing Layer, R. Sekiguchi, 726; Solar Activity and its Effects, 799; The Velocity of Solar Prominences, Dr. W. Anderson, 799

Miscellaneous:  
Annuaire of the Bureau des Longitudes, 1924, 95; Sydney Astrographic Catalogue, 95; Another Einstein Eclipse Result, G. F. Dodwell, 173; The Relative Velocity of Blue and Yellow Light, 206; Dark Nebulæ, Prof. G. E. Hale, 249; Astronomical Contribution to Ancient Chronology, 285; Publications of the American Astronomical Society, 285; The Stationary Calcium Clouds in Interstellar Space, Dr. J. Evershed, 318; The Cape Catalogue, 318; Photographing the Zodiacal Light, J. Dufay, 545; The End of the Julian Calendar, Milankovitch, 580; Cape Astrographic Catalogue Zones  $-46^\circ$  and  $-47^\circ$ , 655

Astronomy: Early, in Oxford, Dr. J. L. E. Dreyer, 38; Elementary Mathematical, C. W. C. Barlow and Dr. G. H. Bryan. Eighth Impression (Third edition), 7; for All, Rev. A. L. Cortie, 884

Athenæum Club: Sir John Bland-Sutton, Dr. J. C. Irvine, and W. B. Squire, elected members of the, 247; R. Anning-Bell, J. W. Simpson, and F. E. Smith, elected members of the, 400; E. K. Chambers, Sir F. W. Mott, and Prof. C. S. Terry, elected members of the, 545

Atlantic, Western North, Ice in the, 620



- Atmosphere : Attempt at an Optical Test of the, Mlle. Eugénie Bellemin, 71 ; Relation between the Potential Gradient and the Number of Large Ions in the, Prof. J. J. Nolan, 493 ; The Selective Absorption of the, at the Observatory of the Pic du Midi, J. Baillaud, 915 ; The Semi-diurnal Oscillation of the, Prof. S. Chapman, 326
- Atmospheric : Corrosion Research Committee of the British Non-ferrous Metals Research Association, First Report to the, W. H. Vernon, 34 ; Electric Currents, Normal and Abnormal, and their Relation to the Growth of Plants, V. D. Blackman, 554 ; Electricity : and Atmospheric Pollution, Dr. C. Chree, 855 ; in Thunderstorms, Origin of, Prof. J. J. Nolan, 354 ; Utilisation of, K. P. Bhattacharyya, 287 ; Pollution and Potential Gradient at Kew Observatory, 1921 and 1922, Dr. C. Chree and R. E. Watson, 293
- Atmospherics : and their Effect on Radio Receivers, E. B. Moullin, 287 ; The Origin of, R. Bureau, 441
- Atom : The, Dr. A. S. Russell, 652 ; and the Bohr Theory of its Structure : an Elementary Presentation, Drs. H. A. Kramers and H. Holst. Translated by R. B. Lindsay and Rachel T. Lindsay, 378 ; Structure of the, Prof. W. H. Logeman, 64, 263 ; The Kinetic, Sir Oliver Lodge, 15 ; The Static, Dr. W. H. Davey, 905
- Atome, Die, Prof. J. Perrin. Mit Autorisation der Verfassers Deutsch ; herausgegeben von Prof. A. Lottemoser. Dritte Auflage, 383
- L'Atome : La constitution de, et les raies spectrales, Prof. A. Sommerfeld. Traduit par H. Bellenot. Premier et deuxième fasc., 263 ; Les nouvelles conceptions de la matière et de, Prof. A. Berthoud, 191
- Atomic : Nucleus, Structure of the, and the Mechanism of its Disintegration, H. Pettersson, 446 ; Species and their Abundance on the Earth, Dr. F. W. Aston, 393 ; Structure and Spectral Lines, Prof. A. Sommerfeld. Translated by H. L. Brose, 263
- Atoms : and Electrons, J. W. N. Sullivan, 378 ; Radiation and, Dr. J. C. Slater, 307 ; The Artificial Disintegration of, Drs. G. Kirsch and H. Pettersson, 603
- Atomtheorie des festen Zustandes (Dynamik der Kristallgitter), Prof. Max Born. Zweite Auflage, 232
- Aua Island, Bismarck Archipelago, Capt. Pitt-Rivers, 903
- Auroral Spectrum, The, and the Upper Atmosphere, Prof. L. Vegard, 716
- Austral Islands, The, and Mangareva, S.E. Pacific, Mrs. S. Routledge, 879
- Australia, South : The Fauna and Flora of, 189 ; The Fishes of, E. R. Waite, 189 ; The Mammals of, Dr. F. Wood Jones. Part I., 189
- Australian : Coleoptera, Notes and New Species, No. 3, H. J. Carter, 843 ; Diptera, Notes on, with Descriptions, J. R. Malloch, 147 ; Forest Botany, An Elementary Text-book of, C. T. White, 601 ; Formicidæ, J. Clark, 103 ; *Journal of Experimental Biology and Medical Science*, Part I., 725 ; Neuroptera, Parts IV. and V., P. Esben-Petersen, 36
- Autochtone Microflora of Arable Earth, The, S. Winogradsky, 662
- Automobile : Engineering Diplomas, 840 ; Engineers, Institution of : award of the medal of the, to Dr. F. W. Lanchester, 23 ; Dr. W. R. Ormandy elected president, 505 ; Engines, Elementary Thermodynamics of, E. H. Hamilton, 79
- Auto-obituaries, F.R.S., 389
- Auto-oxidation and Anti-oxygen Action : C. Moureu, C. Dufraisse, and J. Panier des Touches, 807 ; C. Moureu and C. Dufraisse, 514, 947
- Ayrton's, Mrs., Work on the Electric Arc, A. P. Trotter, 48
- Backhousia angustifolia*, The Essential Oil of, A. R. Penfold, 295
- Bacteria, The Latent Fermenting Powers of, Pts. I., II., III., E. C. Grey, 257
- Bacteriology, A Study of Micro-organisms and their Relation to Human Welfare, Drs. H. W. and H. J. Conn, 853
- Baillie Library of Chemistry, McGill University, The, Dr. Ruttan, 70
- Bakerian Lecture, Prof. A. Fowler, 802
- Balances and Weights, F. E. Becker and Co.'s Catalogue of, 759
- Ball Lightning, Dr. G. C. Simpson, 677
- Balmer : Lines, The Doublet Separation of the, G. M. Shrum, 145 ; Series of Hydrogen, The, A. E. M. Geddes, 146
- Band Spectra : The Isotope Effect as a means of Identifying the Emitters of, Application to the Bands of the Metal Hydrides, Dr. R. S. Mulliken, 489 ; The Quantum Theory of, 874
- Bankfield Museum, Halifax, gift to, by Sir William Bulmer, 618
- Banting Research Foundation, establishment of a, 618
- Barley, Inheritance in, F. L. Engledow, 904
- Barrages, Massive, The Conditions of Security of, C. Rabut, 842
- Barytes in Ireland, T. Hallissy, 440
- Batavia : Laboratory for Marine Biological Research at, 203 ; The Marine Station at, Dr. A. L. J. Sunier, 364
- Bavarian Academy of Science, Dr. M. von Gruber appointed president of the, 362
- Bear, The Brain of the, at Birth, R. Anthony and Mlle. F. Coupin, 515
- Béchamp or Pasteur ? a Lost Chapter in the History of Biology, E. D. Hume. Founded upon MS. by Dr. M. R. Leveson, 121
- Becquerel Rays, The Colours produced by, Prof. K. Przibram, 658
- Bee Anatomy : Practical, with Notes on the Embryology, Metamorphoses, and Physiology of the Honey Bee, Annie D. Betts, 79
- Bees, Adventures among, H. Mace, 452
- Beeswax : The Acids of, A. Gascard and G. Damoy, 35 ; The Alcohols and Hydrocarbons of, A. Gascard and G. Damoy, 103
- Beggiatoa alba*, The Intimate Structure and the Main Features in the Life-history of, D. Ellis, 294
- Belfast, the Queen's University : new statutes for a Faculty of Agriculture, 324 ; proposed new buildings for the Faculty of Agriculture, 588
- Belgian Biology, 41
- Bench, a Convenient, for testing Object Glasses, Dr. L. C. Martin, 553
- Benzene, Forthcoming Centenary Celebration of the Discovery of, 899
- Benzoates and Salicylates, The Diffusion Potentials and Ionic Mobilities of, E. B. R. Prideaux and W. E. Crooks, 410
- Benzyl Ethers, The Catalytic Preparations of, J. B. Senderens, 735
- Berlin, The Physikalisches Institut of the University of, Prof. Nernst appointed director of, 471
- Bessemers : gold medal of the Iron and Steel Institute, The, awarded to Prof. A. Sauveur, 247 ; Steel, Prof. H. C. H. Carpenter, 51
- Bethshean, Excavations at, C. S. Fisher, 937
- Betula lenta*, True Nature of the Glucoside with Methyl Salicylate existing in the Bark of, M. Bridel, 663
- Bharaut Epithets, Five, B. M. Barua, 699
- Bible, The Deeper Criticism of the, Dr. B. Malinowski, 633
- "Big Bud" of Black Currant, 439
- Bi-nuclear Cells, the Formation of, T. S. P. Strangeways, 325
- Biochemie in Einzeldarstellungen, Die, herausgegeben von A. Kanitz. Nr. V., 524
- Biological Catalysts or Diastases, The Constitution and Mode of Action of the, F. Matignon, 259
- Biologischen Arbeitsmethoden, Handbuch der, 901
- Biology : Everyday, Prof. J. A. Thomson, 780 ; Experimental, Conference of the Society of, 94 ; Foundations of, Prof. L. L. Woodruff, 269 ; General, Profs. L. L. Burlingame, H. Heath, E. G. Martin, and G. J. Peirce, 301 ; Progress in, Dr. W. Bateson, 644, 681
- Biomathematics : Being the Principles of Mathematics for Students of Biological Science, Dr. W. M. Feldman, 484
- Bioradioactivity ? Is there a, P. Becquerel, 447
- "Bios," Prof. W. L. Miller, 546
- Bio-sociology, Speculative, Prof. J. A. Thomson, 74



- Bird : Migration in Relation to Foot-and-mouth Disease, Sir Stewart Stockman and Miss Marjory Garnett ; Dr. A. L. Thomson, 52 ; Sanctuaries Committee, Report of the, 470 ; Studies, 228
- Birds : and their Young, T. A. Coward, 228 ; in Legend, Fable, and Folklore, E. Ingersoll, 564 ; of Dumfriesshire : Notes on the, a Continuation of the Birds of Dumfriesshire, H. S. Gladstone, 228 ; of Europe and North Africa, Guide to the, Col. R. G. W. Ramsay. With a Biographical Memoir by Dr. W. Eagle Clarke, 228 ; Protection of, Bill for the, second reading of a, 722 ; International Experimental Station for the Protection of, in Belgium, 92 ; The Biology of, Prof. J. A. Thomson, 121
- Birkbeck College, A Short History of (University of London), C. D. Burns, 670
- Birmingham : Joint Board of Research for Mental Disease, Report of the, 935 ; University, Dr. W. J. Hickinbottom appointed assistant lecturer in chemistry ; approval of a Board of Mining Research, 254 ; Report for 1922-23 ; E. P. Willoughby appointed James Watt research fellow ; Dr. P. T. Hughes reappointed lecturer in mental diseases, 408 ; appointments in ; bequest to, by Miss Caroline Harrold, 552 ; impending conferment of honorary degrees, 768 ; Dr. C. Batho appointed professor of civil engineering, 876
- Birth Control : and Racial Progress, Society of Constructive, 505 ; Social Biology and, 773
- Bismuth : Alloys, The Thermo-electric Properties of, with Special Reference to the Effect of Fusion, C. R. Darling and R. H. Rinaldi, 734 ; Crystals, The Thermal Expansion of, J. K. Roberts, 275 ; in the Organism, the Circulation of, I. A. Christiansen, G. Hevesy, and S. Lomholt, 663
- Bison, American, Survival of the, F. H. Kitto, 761
- Bladderworms, Vitality of, Effects of Cold on, Dr. Annie Porter, 138
- Blair, Robert, fellowships in applied science and technology, 877
- Bleaching, Castner-Kellner Alkali Co., 836
- " Bleeding " of Cut Trees in Spring, The : C. W. Folkard ; Prof. J. H. Priestley, 492 ; J. Parkin, 604 ; C. Macnamara, 858
- Blood : the Coagulability of the, The Action of " Peptone " and of Nucleic Acids on, J. W. Pickering and J. A. Hewitt, 256 ; -flukes, North American, H. W. Stunkard, 175
- Blue and Yellow Light, The Relative Velocity of, Prof. H. Shapley, 206
- Bombay University, gift to, by Sir Currimbhoy Ebrahim, 661
- Boron : Nitride, The Band Spectrum of, W. Jevons, 744 ; the Oxide and Nitride of the Band Spectra of, W. Jevons, 785 ; Monoxide and Silicon Nitride, Isotope Effects in the Band Spectra of, Dr. R. S. Mulliken, 423
- Boss's Proper Motions, Systematic Errors in, W. B. Varnum, 318
- Botanic Gardens at Singapore and Penang, The, 934
- Botanical : Conference, Imperial, forthcoming, 503 ; Procedure, Crucial Instances in, The Search for, Dr. Bertha Stoneman, 64
- Botany, Pure, The Unification of, A. G. Tansley, 85
- Bourget, Lake of, The thermal régime of the, J. Pelosse, 71
- Bovine Pleuro-pneumonia, Contagious, G. G. Heslop, 147
- Bow Instruments, their Form and Construction, J. W. Giltay. Issued into English by the author in co-operation with E. van der Straeton, 852
- $\beta$ -oxybutyric Acid, Mechanism of the Production of, by the Biochemical Method, M. Lemoigne, 592
- Boys' Own Book of Science, The, F. L. Darrow, 488
- Brachiopods, Fossil, Shells of, W. E. Alkins, 657
- Brain : and Speech, Dr. Tudor Jones, 498 ; The Human, Prof. G. Elliot Smith, 390
- Braxy and Thyroid Activity, An Apparent Connexion between, Ruth C. Bamber (Mrs. Bisbee), 161
- Breccia-bed, A Recently Discovered, Underlying Nechells (Birmingham), and its Relations to the Red Rocks of the District, W. S. Boulton, 257
- Bridge, A New, and Potentiometer, Crompton and Co., Ltd., 287
- Bristol : Museum, Report of the, for 1923, 619 ; University, Dr. J. A. Hanley appointed agricultural information officer, 32
- Britain, The Protection of Nature in, 557
- British : American and, Coal Production, 225 ; Association : Toronto meeting of the, 177, 401, 682, 792 ; Dr. H. Lamb to be nominated president of the Southampton meeting of the, 471 ; meeting at Liverpool, grants for research and education, 759 ; prospective arrangements of the, 899 ; Climate : Geographical Instruction and, 99 ; in Historic Times, Sir Richard Gregory, 99, 938 ; Dyestuffs : Prof. W. M. Gardner, 352 ; Corporation, Ltd., Prof. W. H. Perkin elected to the Board of the, 363 ; Industry, The, 595 ; Earthworms and how to identify them, Rev. H. Friend, 158 ; Electrical and Allied Industries Research Association, Report of the, 134 ; Empire : Campaign against Leprosy, The, 185 ; Leprosy Relief Association, The, 203 ; Cancer Campaign, an Advisory Committee to administer the Funds of the, 284 ; The Mineral Resources of the, T. Crook, 752 ; Exhibition : The, 144, 648 ; Chemical Exhibits at the, 503 ; The Opening of the, 616 ; Chemistry at the, (1) Fine Chemicals and Scientific Exhibits, 678 ; Royal Visit to the, 689 ; Chemistry at the, (2) Heavy Chemicals, 719 ; Handbook of the Pure Science Exhibit, 756 ; Electrical Exhibits at the, 788 ; Engineering at the, 825 ; The Scientific Exhibit of the Chemical Section, 831 ; Primitive Races within the, a Problem in Adaptation, 845 ; Exhibition of Pure Science arranged by the Royal Society, I., 863, II., 894 ; Guiana, Filariasis in, Prof. R. T. Leiper and others, 871 ; Geological Photographs, Prof. S. H. Reynolds, 88 ; Hemiptera-Heteroptera, A Biology of the, E. A. Butler, 156 ; Hymenoptera, A. S. Buckland, L. N. Staniland, and E. B. Watson, 531 ; Industries Fair, The, 689 ; Journal Photographic Almanac and Photographer's Daily Companion, The, 1924, edited by G. E. Brown, 44 ; Mammals ; British Birds ; British Reptiles, Amphibians, and Fresh-water Fishes ; British Butterflies and Moths ; British Insects (General), W. P. Westell, 8 ; Medical Association : Congress in Melbourne, 172 ; the Stewart prize of the, awarded to Prof. E. Mellanby, 688 ; Bradford meeting of the, 911 ; Museum : Lord Chalmers elected a trustee of the, 94 ; Dr. H. R. Hall appointed successor to Sir E. A. Wallis Budge, 361 ; retirement of Sir E. A. Wallis Budge, 542 ; (Natural History) : Calendar for 1924, 23 ; Dr. F. A. Bather appointed successor to Dr. A. Smith Woodward, 361 ; retirement of Dr. A. Smith Woodward ; bequest to, by H. R. Hogg, 398 ; Staff Association, Conversazione of the, 436 ; picture postcards of the, 725 ; Non-ferrous Metals Research Association, fourth annual report of the, 723 ; Ornithology, A Bibliography of, from the Earliest Times. Supplement : A Chronological List of British Birds, H. Kirke Swann, 531 ; Rainfall, 1922, 268 ; Science Guild : Science News Service, Inauguration of the, 245 ; and Educational Administration, 261 ; Annual Report for 1923-4, 797 ; (*Terra Nova*) Antarctic Expedition, 1910-1913 : Glaciology, C. S. Wright and R. E. Priestley ; The Physiography of the McMurdo Sound and Granite Harbour Region, Prof. Griffith Taylor, 417 ; The Physiography of the Ross Archipelago, F. Debenham ; Physiography of the Beardmore Glacier Region, C. S. Wright ; Physiography (Robertson Bay and Terra Nova Bay Regions), R. E. Priestley, 777 ; University Statistics, 584 ; Universities and Empire Development, Sir Theodore Morison and others, 730
- Broadcasting Board, appointment of a, 136
- Broken Hill District, Geology of the, E. C. Andrews, 697
- Bromine : Action of, on the Sulphomethyl Esters of Phenols, L. J. Simon and M. Frèrejacque, 662 ; determination of the Boiling-point of A. Bouzat and G. Leluan, 374
- Bronze : Age in Essex, The, C. H. Butcher, 403 ; Low-tin, Effect of Cold-drawing and Annealing on some Electro-chemical Properties of a, S. H. J. Wilson, 478



- Bronzes : Ancient, Nickel in, Prof. R. A. Dart, 888 ; Prehistoric, The Chemical Composition of, Prof. J. Sebelien, 100
- Brooklyn Museum, New Natural History Groups in the, 726
- Browning, Elizabeth Barrett, and Scientific Achievement, G. C. Frankland, 462
- Brussels, Royal Academy of Medicine, Sir William M. Bayliss elected a corresponding member of the, 471
- Budde Effect in Bromine, The, E. B. Ludlam, 914
- Building Materials and Construction Research Board, Dr. R. E. Stradling appointed director of research of the, 579
- Burette Tubes, calibrating, An Apparatus for, V. Stott, 103
- Butter-fat, separating the Constituents of, A Physical Method of, F. E. Hackett and T. A. Crowley, 735
- Butterfly Lore, Dr. H. Eltringham, 531
- Byblos, Archæological Discoveries at, Prof. P. Montet, 207
- Cadmium : Lead-zinc System, The, M. Cook, 478 ; Iodide, Electric Conductivity of the Vapour of, G. C. Schmidt and R. Walter, 27
- Calamités, Matériaux pour l'étude des*, proposed publication of, 653
- Calcite and Aragonite, The Refractive Indices of, Prof. W. L. Bragg, 446
- Calcium : and Sodium, Cosmic Clouds of, Prof. B. Gerasimovič, 458 ; Chloride and Concrete, 441 ; Clouds, The Stationary, in Interstellar Space, Dr. J. Evershed, 318 ; Oxalate-dilute Hydrochloric Acid, Equilibrium of the System, E. Carrière and M. Auméras, 71 ; The Estimation of, by the Nephelometric Method, C. Chêneveau and R. Boussu, 71
- Calculus for Schools, R. C. Fawdry and C. V. Durell, 672
- Calcutta : The Breeding of some Common Birds in the Vicinity of, S. C. Law, 700 ; University : Dr. G. Prasad appointed Hardinge professor of higher mathematics in, 102
- California, Native Culture in, A. L. Kroeber, 207
- Calomet, The Crystals of, Arrangement of the Atoms in, C. Mauguin, 948
- Cambridge : and Overseas Universities, Prof. H. S. Carslaw, 517 ; University : Dr. C. E. Tilley appointed demonstrator in petrology ; A. E. W. Nutt awarded the John Bernard Seely prize, 32 ; gift by the Rockefeller Foundation for the School of Pathology ; gift by Mr. and Mrs. Molteno for the Institute for Research in Parasitology, 181 ; The Gordon Wigan prize awarded to R. G. W. Norrish ; a Syndicate on the election of members of the council ; The Clarence Graft fellowship ; the George Henry Lewes studentship, 181 ; the tenure of officers ; offer by Mrs. Pinsent and others for research ; T. T. Barnard elected Anthony Wilkin student ; R. A. Webb, Charles Abercrombie Smith student ; the examination of Royal Engineer officers for engineer pay, 212 ; F. J. W. Roughton elected University lecturer in biochemistry ; grants awarded, 254 ; R. E. Priestley appointed secretary of the Board of Research studies, 291 ; regulations affecting affiliated students ; N. J. T. M. Needham re-elected to the Benn W. Levy research studentship in biochemistry ; proposed pension for Dr. H. J. H. Fenton, 324 ; Dr. C. F. Fox elected to a Bye fellowship at Magdalene College ; Annual Report of the Appointments Board, 372 ; award of Smith's prizes to T. M. Cherry and W. J. Webb, 408 ; gift by J. Pierpont Morgan of the photographic reproduction of Coptic manuscripts, 443 ; The Statutory Commissioners and ; Universities and University Colleges and Affiliation, 443 ; R. B. Braithwaite elected to a fellowship at King's College ; Annual Report of the General Board of Studies, 477 ; F. P. Ramsay elected to the Allen scholarship, 511 ; bequest to, by S. W. Graystone ; J. Barker elected to the Frank Smart University studentship in botany, 552 ; Dr. E. Lloyd Jones reappointed demonstrator of medicine, 660 ; gift of books to the Balfour Zoological Library ; report of the Local Examinations and Lectures Syndicate ; Report of the Board of Research Studies, 698 ; opening of the Sir William Dunn Institute of Biochemistry, 731 ; J. Mills reappointed Nita King research scholar ; the Pinsent-Darwin studentship ; report on pensions for holders of office ; grant from the Development Commission for land and buildings for agriculture, 768 ; forthcoming conferment of honorary degrees ; offer by the Royal Institute of British Architects of a scholarship ; H. M. Fox elected Balfour student ; J. Gray appointed demonstrator of comparative anatomy ; W. J. Harrison reappointed University lecturer in mathematics, 804 ; A. Wood reappointed University lecturer in experimental physics ; H. W. Florey elected to the John Lucas Walker studentship, 839 ; C. F. R. Wilson reappointed reader in electrical meteorology, 876 ; F. W. Dootson and W. H. Mills reappointed University lecturers in chemistry ; W. M. Smart reappointed John Couch Adams astronomer, 877 ; gifts to, by Sir Percival Maitland Laurence and Sir Jeremiah Colman ; appointments in, 911 ; appointments in ; Lieut. P. R. Antrobus awarded the Rex Moir Prize, 945
- Camouflage in Nature and in War, G. H. Thayer, 207
- Camphor Cultivation in India, S. H. Howard, W. A. Robertson, and J. L. Simonsen, 320
- Canada, Water Power Resources of, Dr. B. Cunningham, 803
- Canadian Arctic Regions, Algæ and Fungi of the, C. W. Lowe and J. Dearness, 473 ; Iron Ore, 582 ; Place Names, R. Douglas, 728 ; Tidal Stations, Dr. W. B. Dawson, 97
- Canal Rays, The Photographic Action of, Dr. M. Jabobson, 583
- Cancer and Tar, Dr. E. L. Kennaway, 620
- Canned Fruits, Dr. W. G. Savage and R. F. Hunwicke, 139
- Cape : Astrographic Catalogue Zones  $-46^{\circ}$ ,  $-47^{\circ}$ , 655 ; Catalogue, The, 318
- Capita Zoologica*, 472
- Carbohydrate Metabolism, I., L. B. Winter and W. Smith, 256
- Carbon : Bisulphide, The Destruction of, by the Ultra-violet Rays, G. Bruhat and M. Pauthenier, 807 ; Compounds, The, a Text-book of Organic Chemistry, Prof. C. W. Porter, 887 ; Steels, The Magnetism of Annealed, S. W. J. Smith, A. A. Dee, and W. V. Maynard, 913 ; The Heat of Vaporisation of, M. de Forcrand, 947 ; Ionised, The Series Spectrum of (C II), Prof. A. Fowler, 446 ; Monoxide, A New Re-agent for, A. Damiens, 514 ; The Volumetric Estimation of, J. F. Durand, 627
- Carborundum, Existence of, in certain Crystals of Aluminium Nitride, C. Matignon, 842
- Cardio-Inhibitory Centre, The, Prof. F. R. Miller, 715
- Carnegie : Foundation for the Advancement of Teaching, Annual Report of the, 625 ; Trust for the Universities of Scotland, The, Record of Fellows, etc., of grants ; Twenty-second Annual Report, 694 ; United Kingdom Trust, The, 900
- Cass, Sir John, Technical Institute, distribution of prizes ; address by Sir William Bragg, 255
- Catalase in the Blood, Behaviour of the, on Variation of the Surrounding Temperature, G. Viale, 916
- Catalysts, Impurities in, Effects of, M. Faillebin, 98
- Catalytic and Induced Reactions, A. K. Goard and Dr. E. K. Rideal, 213
- Cathode Fall of Potential in a High Voltage Discharge, G. P. Thomson, 914
- Caucasus, plea for excavation in the, Prof. R. A. Fessenden, 317
- Cavitaminosis, Relations between Age, Appearance, and Evolution of the Symptoms of, G. Mouriquand and P. Michel, 375
- Celestial Object, The Most Distant, ever measured, Prof. H. Shapley, 206
- Cells, Single, Growth *in vitro* of, A. Fischer, 208
- Cellular Disintegration, A Nodon ; D. Berthelot, 295
- Celtium and Yttrium Earths in some Zirconium Minerals, The Simultaneous Presence of, E. and G. Urbain, 215
- Ceremonial Objects in Stone and Algonkin Symbolism, H. N. Wardle, 506
- Chaldean Society, The Work of the, 470
- Challenger Society : and Marine Biological Stations, Joint Meeting of the, 172, 832
- Chambers's Encyclopædia : a Dictionary of Universal Knowledge, New edition, Edited by Dr. D. Patrick and W. Geddie, vol. 3, 191



- Chance, Love, and Logic : Philosophical Essays, the late C. S. Peirce. Edited by M. R. Cohen. With a Supplementary Essay on the Pragmatism of Peirce by J. Dewey, 383
- Charles' University, award of doctorates, 912
- Chemical : Affinity, the Distance-effect of, Preliminary Attempt to Measure Gravimetrically, T. W. Richards and W. T. Richards, 216 ; Analysis, Quantative, Dr. F. Clowes and J. B. Coleman. Twelfth edition, 488 ; Appointments, A List of Official, Compiled by Direction of the Council of the Institute of Chemistry and under the Supervision of the Publications Committee by the Registrar of the Institute. Fifth edition, 672 ; Catalogue of F. E. Becker and Co., new edition, 725 ; Compounds, A New Theory relating to the Molecular Constitution of, C. Bulow, 447 ; Constitution and Taste, Relationships between, C. Riecomanni, 772 ; Elements, Classification of the, with Explanatory Notes, W. Hughes, 137 ; F. H. Loring, 157 ; Engineering, Principles of, Profs. W. H. Walker, W. K. Lewis, and W. H. McAdams, 5 ; Industry : American Section of the Society of, award of the Perkin medal to Dr. F. M. Becket, 23 ; Society of, award of the Messel medal to Viscount Leverhulme, 204 ; Progress in South Africa, Twenty Years of, A. Stead, 64 ; Research in India, Prof. J. F. Thorpe, 928 ; Society, Annual General Meeting, 503 ; Synonyms and Trade Names : a Dictionary and Commercial Handbook, W. Gardner, 530
- Chemie : in Natur und Wirtschaft, Kurzes Lehrbuch der, Prof. C. Oppenheimer, Nebst einer Einführung in die allgemeine Chemie, Prof. J. Matula, 158 ; und Physiologie der Nukleinstoffe nebst Einführung in die Chemie der Purinkörper, Prof. R. Feulgen, 524
- Chemistry : and Physics, Prof. H. E. Armstrong, 577 ; for Botany Students, Dr. E. R. Spratt, 233 ; at the British Empire Exhibition. (1) Fine Chemicals and Scientific Exhibits, 678. (2) Heavy Chemicals, 719 ; General, an Elementary Survey, emphasising Industrial Applications of Fundamental Principles, Prof. H. G. Deming, 456 ; Inorganic and Theoretical, A Comprehensive Treatise on, Dr. J. W. Mellor, vol. 4, 525 ; Organic : Electrolytic Methods in, 63 ; for Advanced Students, Prof. J. B. Cohen. Fourth edition, 3 Parts, 380 ; Systematic, Modern Methods of Preparation and Estimation, M. M. Cumming, I. V. Hopper, and T. S. Wheeler, 380, 712 ; The Writer of the Review, 713 ; Treatise on General and Industrial, Prof. E. Molinari. Second English edition, translated from the third Italian edition by T. H. Pope, Part 2, 455 ; Physical, Practical, Prof. A. Findlay. Fourth edition, 9 ; Smith's General, for Colleges, revised and rewritten by Prof. J. Kendall, 79 ; The Fundamental Ideas of, Dr. A. Benrath, Translated by J. Bithell, 420
- Chemotaxis of Spermatozoa and its Questioned Occurrence in the Animal Kingdom, Prof. J. B. Gatenby, 275
- Chicago : gift of an aquarium to, by J. G. Shedd, 618 ; University, Establishment of a Seymour Coman research fund at, 255
- Children : of the Sun, The, a Study in the Early History of Civilisation, W. J. Perry, 299 ; Retarded and Defective, Native Mentality : Mental Testing, Dr. J. T. Dunston, 64
- Chimica fisica : Elementi di, Prof. A. Mazzucchelli, 455 ; Trattato di, Prof. H. C. Jones. Seconda edizione italiana a cura di Prof. M. Giua, 455
- Chimique, philosophie, Essai de, Prof. M. Delacre, 456
- China : Discoveries in the Pleistocene Deposits of, Licent and Teilhard, 797 ; North, Cretaceous Beds in, G. B. Barbour, 194 ; Northern, Anthropology of, Dr. S. M. Shirokogoroff, 367 ; Human Fossilised Remains in, Fathers Licent and Teilhard, 204 ; The Scientific Renaissance in, Prof. J. W. Gregory, 17 ; Western, Irene J. Curnow, 326
- Chinese : Physical Types, 367 ; Potter, The Art of the, from the Han Dynasty to the End of the Ming, R. L. Hobson and A. L. Hetherington, 524 ; Pottery and Porcelain, Early, W. Burton, 524 ; Tibet : The Geology and Physical Geography of, and its Relations to the Mountain System of South-Eastern Asia, Prof. J. W. Gregory and C. J. Gregory, 805 ; The Mountains and Rivers of, 6
- Chloramidines, The, P. Robin, 71
- Chlorine : Gas for the Treatment of Colds, 796 ; Hydrate of, Composition of the, A. Bouzat and L. Azinières, 103
- Chlorite, Compact, from Bernstein, Burgenland, Austria, W. Campbell Smith, with analysis by G. T. Prior, 554
- Chloropicrin, Action of, on Phenol, S. Berlingozzi and P. Badolato, 916
- Chromic Anhydride and Alkalis, Viscosity of Aqueous Mixtures of, L. J. Simon, 842
- Chromatic Aberration, Measurement of, on the Hilger Lens-testing Interferometer, R. Kingslake and Dr. L. C. Martin, 553
- Chromidia, Some Mycological, J. J. Clarke, 33
- Chrysanthemum indicum* Linn. and *C. sinense* Sabine, The forms cultivated in Japan from the Original Types of, T. Niwa, 293
- Ciamician, G., the Life and Work of, Prof. G. Plancher, 363
- Cilia to Oxygen, Relation of, J. Gray, 555
- Ciliated Infusoria, The Mobility of the, Action of some Chemical and Physical Agents on, E. and H. Biancani, 447
- Cinchona Plantation in Burma, 25
- Cinema Projection from a Continuously Moving Film, The Feasibility of, H. D. Taylor, 662
- Cinematograph Film to show the Chemical Changes in Coal when heated in a Closed Gas Retort, E. A. Dyer, 362
- Cinematography in Natural Colours, G. A. Brown, 368
- Ciona intestinalis*, Experiments on, B. Stewart, 14 ; J. T. Cunningham, 84 ; Prof. E. W. MacBride, 196
- Circular Arc, On the Centroid of a, H. S. Rowell, 927
- Circulation in the Upper Air to a Circumpolar Vortex, Relation of the, A. W. Lee, 35
- Civil : Engineers, Institution of, a Supplemental Charter of the, 58 ; awards of the, 724 ; B. Mott elected president, 798 ; Service and Revenue Estimates, 399
- Civilisations, Progress and Decay in, C. Dawson, 250
- Clay : Figures of Palæolithic Age, P. Barrau de Lorde, 506 ; Heads from the Gold Coast, R. Kerr, 473
- Clays and other Ceramic Materials, The Chemistry and Physics of, A. B. Searle, 599
- Clevedon-Portishead Area, Geological Structure of the, Prof. S. H. Reynolds and E. Greenly, 182
- Climatic Continentality and Oceanity, D. Brunt, 692
- Clocks : and Timekeeping, Studies in, No. 3, Prof. R. A. Sampson, 146 ; Watches and Chronometers, 415
- Cloud-heights at Melbourne Observatory, Capt. E. Kidson, 507
- Clouds : and Smokes : the Properties of Disperse Systems in Gases and their Practical Applications, Dr. W. E. Gibbs, 672 ; Stationary, in Interstellar Space, Sir Oliver Lodge, 307
- Cloves, Diseases of, Miss E. J. Welsford, 553
- Cluster Fly, Earthworms and the, Prof. T. D. A. Cockerell, 193
- Coal : and its Distillation Products, 778 ; Destructive Distillation of, E. V. Evans, 573 ; Gas, Sulphur Studies in, L. E. V. Evans and H. Stanier, 513 ; Powdered, in Furnaces, J. Blizard, 508 ; Production, American and British, 225 ; Tar Distillation and Working up of Tar Products, A. R. Warnes. Third edition, 778 ; The Argento-sulphochromic Oxidation of, L. J. Simon, 447 ; the Chemistry of, Researches on, Part III., Prof. W. A. Bone, A. R. Pearson, and R. Quarendon, 513 ; The Sulpho-chromic Oxidation of, L. J. Simon, 295
- Coals : Oxidisability of, Determination of the, G. Charpy and G. Decors, 842 ; The Treatment of, with Liquid Naphthalene, M. Oswald and R. Pinta, 607
- Coccidæ, The (Scale-insects and Mealy-bugs), of the Madeira Islands, Prof. T. D. A. Cockerell, 164
- Cod Fry, the Survival of, Snow and, Dr. O. Sund, 163
- Coke and its Uses : in Relation to Smoke Prevention and Fuel Economy, E. W. L. Nicol, 810
- Colliery Engineer*, The, 653
- Colloid Chemistry, Fifth Report on, 173



- Colloidal: Ferric Hydroxide, Sir William Pope and R. T. M. Haines, 369; Sols, Protecting and Sensitising, Dr. E. K. Rideal, 294
- Colonial University, The, at Antwerp, 255
- Colour: and Chemical Constitution, 739; Blindness in Wave-lengths, Prof. H. E. Roaf, 834; Production and Chemical Constitution, Prof. J. Stieglitz, 141; Vision: and Colour Vision Theories, Sir Oliver Lodge; Prof. W. Peddie, 50; Dr. F. W. Edridge-Green, 196; Nomenclature: Defatigue and Enhancement, Prof. W. Peddie, 387
- Comet: New, W. Reid, 545; or Minor Planet? 402
- Comets, 24; H. E. Wood and F. J. Morshead, 249; Nuclei of, Comparison of the various Radiations emitted by the, and of still Unknown Origin, with the Spectrum of the Mecker Burner, F. Baldet, 35
- Coniferæ: A Handbook of, including Ginkgoaceæ, W. Dallimore and A. B. Jackson, 707
- Conifers, A Handbook of, 707
- Consonant Sounds, The Nature and Artificial Production of, Sir Richard Paget, 878
- Continental Drift and the Stressing of Africa, Dr. J. W. Evans, 195
- Continents, a Drift of, The Improbability of, P. Négris, 627
- Coolidge X-ray Tube, Oscillographic Study of a, Dr. J. A. Crowther, 70
- Copper: -aluminium Alloys, X-ray Studies on the, E. R. Jette, G. Phragmén, and A. F. Westgren, 479; and Cadmium, the Alloys of, Constitution of, C. H. M. Jenkins and D. Hanson, 479; Commercially Pure, Relation between the Tensile Strength and the Electrical Resistivity of, W. E. Alkins, 478; -tin System, The Equilibrium Diagram of the, M. Ishihara, 479; -zinc Alloys which Expand on Solidification, K. Iokibe, 478
- Coppered Glass Mirrors, The Preparation of, E. A. H. French, 806

## CORRESPONDENCE.

- Aluminium, Spark Spectrum of, Singlet Series in the, Prof. H. N. Russell, 163
- Annuities, Deferred (Two Rates of Interest), W. Palin Elderton, 50
- $\alpha$ -Particles, The Bombardment of Elements by, Sir Ernest Rutherford and Dr. J. Chadwick, 457
- Apia Observatory, Samoa, A. Thomson and C. C. Farr, 355
- Atmosphere, the Potential Gradient and the Number of Large Ions in the, Relation between, Prof. J. J. Nolan, 493
- Atmospheric Electricity: and Atmospheric Pollution, Dr. C. Chree, 855; in Thunderstorms, Origin of, Prof. J. J. Nolan, 354
- Atoms: Radiation and, Dr. J. C. Slater, 307; The Artificial Disintegration of, Drs. G. Kirsch and H. Pettersson, 603
- Auto-obituaries, F.R.S., 389
- Ayrton's, Mrs., Work on the Electric Arc, A. P. Trotter, 48
- Band Spectra: The Isotope Effect as a Means of identifying the Emitters of; Application to the Bands of the Metal Hydrides, Dr. R. S. Mulliken, 489
- Bessemer Steel, Prof. H. C. H. Carpenter, 51
- Bismuth Crystals, The Thermal Expansion of, Dr. J. K. Roberts, 275
- "Bleeding" of Cut Trees in Spring, The, C. W. Folkard; Prof. J. H. Priestley, 492; J. Parkin, 604; C. Macnamara, 858
- Boron Nitride: The Band Spectrum of, W. Jevons, 744; the Oxide and Nitride of, The Band Spectra of, W. Jevons, 785
- Braxy and Thyroid Activity, An Apparent Connexion between, Ruth C. Bamber (Mrs. Bisbee), 161
- Brightness of Scintillations from H-particles and from  $\alpha$ -particles, Dr. Elizabeth Kara-Michailova and Dr. H. Pettersson, 715
- British Dyestuffs, Prof. W. M. Gardner, 352
- Browning, Elizabeth Barrett, and Scientific Achievement, Mrs. G. C. Frankland, 462
- Cardio-inhibitory Centre, The, Prof. F. R. Miller, 715
- "Chemistry, Systematic Organic," W. M. Cumming, I. V. Hopper, T. S. Wheeler, 713; The Writer of the Review, 713
- Chemotaxis of Spermatozoa and its questioned Occurrence in the Animal Kingdom, Prof. J. B. Gatenby, 275
- China, North, Cretaceous Beds in, G. B. Barbour, 194
- Ciona intestinalis*, Experiments on, B. Stewart, 14; J. T. Cunningham, 84; Prof. E. W. MacBride, 196
- Clouds, Stationary, in Interstellar Space, Sir Oliver Lodge, 307
- Coccidæ, The (Scale-insects and Mealy-bugs), of the Madeira Islands, Prof. T. D. A. Cockerell, 164
- Cod Fry, Snow and the Survival of, Dr. O. Sund, 163
- Colour Vision: and Colour Vision Theories, Sir Oliver Lodge; Prof. W. Peddie, 50; Dr. F. W. Edridge-Green, 196; Nomenclature, Defatigue and Enhancement, Prof. W. Peddie, 387
- Condensation Bands formed during the Explosion of Hydrogen and Air, G. H. West, 712
- Continental Drift and the Stressing of Africa, Dr. J. W. Evans, 195
- Cosmic Clouds of Calcium and Sodium, Prof. B. Gerasimović, 458
- Cretaceous Beds in North China, G. B. Barbour, 194
- Crookes, Sir William, Dr. E. E. Fournier d'Albe, 607
- Crystal Symmetry, The Thirty-two Classes of, Dr. J. W. Evans, 80; Dr. H. C. Pocklington, 195
- Crystals: the Elastic Limit and Strength of, Prof. A. Joffé, M. Kirpichewa, and M. Levitzky, 424; the Interference Figures of, The Effect of Dispersion on, Prof. C. V. Raman, 127
- Cumulus Cloud among Bush-fires, The formation of, Prof. W. G. Duffield, 126
- Deferred Annuities (Two Rates of Interest), Sir R. A. S. Redmayne, 84
- Diabetic Metabolism, The Pancreas and, Prof. H. Oertel, 126
- Dielectrics, The Properties of, G. L. Addenbrooke, 490
- Direction: Finding by Wireless, Commander J. A. Slee; The Writer of the Note, 676; in Mathematics, Sense of, T. C. Hudson, 747
- Discovery and Research, Prof. E. H. Starling; The Writer of the Article, 606
- Dispersion, The Law of, and Bohr's Theory of Spectra, Dr. H. A. Kramers, 673
- Dolphins, The Food of, Sir Sidney F. Harmer, 532; R. Legendre, 819
- Dutch Pendulum Observations in Submarines, Dr. J. J. A. Muller, 308, 641
- Earthquakes, Water-waves produced by, A. Mallock, 270
- Earth Tides and Ocean Tides, W. D. Lambert, 889
- Earthworms and the Cluster Fly, Prof. T. D. A. Cockerell, 193
- Earth's Potential Gradient, Rapid Variations of the, Dr. E. V. Appleton, R. A. Watson Watt, and J. F. Herd, 237
- Eel-larvæ, The Transatlantic Migration of the, Dr. Johs. Schmidt, 12
- Electricity in Thunderstorms, the Origin of, Problems of Hydron and Water, Prof. H. E. Armstrong, 124
- Electromagnetic Waves, Short, of Wave-length up to 82 Microns, A. Glągolewa-Arkadiewa, 640
- Evolution, Mendelism and, C. Tate Regan; J. S. Huxley, 569, 822; C. Dover, 712
- Feldspar or Felspar, Prof. G. A. J. Cole, 274
- Ferromagnetic Substances, A Formula for the Specific Heat of, and its Discontinuity at the Critical Temperature, Dr. J. R. Ashworth, 13
- Fish: Consumption of, by Porpoises, Dr. J. Schmidt, 310; Otoliths from the Stomach of a Porpoise, J. A. Frost, 310
- Fishing Industry, On the Application of Science to the, Prof. T. C. Nelson, 675
- Foot-and-mouth Disease, The Origin of, Dr. H. M. Woodcock, 165, 239
- French Physical Society's Exhibition, The, Dr. Ch. Ed. Guillaume, 127; T. Cellerier, 353
- Frequency Curves of Genera and Species, C. Tate Regan, 822
- Gaseous Diffusion, Some Measurements of, J. M. Mullaly, 711
- Geological Museum, London, T. Sheppard, 239



- Glass : Sunlight and, an Inquiry for Hygiene, Dr. C. W. Saleeby, 747
- Globular Clusters, The Radial Velocities of, and de Sitter's Cosmology, Dr. L. Silberstein, 350
- Golgi Apparatus, The, in the Avian Oocyte, F. W. R. Brambell, 493
- Gorilla's Foot, The, Sir E. Ray Lankester, 10, 457; Prof. S. Smith; Sir Arthur Keith, 83; Dr. W. K. Gregory, 421; R. I. Pocock, 458
- Government Publications and their Distribution, Dr. F. A. Bather; T. Sheppard, 83
- Great Rift Valley, The Structure of the, E. J. Wayland; Prof. J. W. Gregory, 388
- Gulf of Suez a Rift Valley? Is the, Dr. W. F. Hume; Prof. J. W. Gregory, 49
- Gums, Refractive Index of, and a Simple Method of determining Refractive Indices, A. Mallock, 159, 643
- Hafnium Content of some Historical Zirconium Preparations, Prof. G. Hevesy, 384
- Harrison, John, A. R. Hinks; R. A. S., 570; Lieut.-Commr. R. T. Gould, 857
- Harrisonian Eoliths, The Geological and Cultural Age of the, J. Reid Moir, 461
- Hearing, The Theory of, Prof. E. W. Scripture, 605; Dr. H. Hartridge, 713; G. Wilkinson, 781
- Heliotherapy and Phototherapy, Dr. W. Cramer, 80
- Helium, The Spectrum of, in the Extreme Ultra-violet, Prof. T. Lyman, 785
- Hydrogen, The Continuous Spectrum of, Prof. H. B. Lemon, 127, 570; Prof. O. W. Richardson and T. Tanaka, 193; Prof. F. Horton and Dr. A. C. Davies, 273
- Hydron and Water, Problems of: the Origin of Electricity in Thunderstorms, Prof. H. E. Armstrong, 124; Luminous Ice, Prof. H. E. Armstrong, 163; Sir Oliver Lodge, 193
- Hymenolepis nana* and *H. fraterna*, Dr. W. N. F. Woodland, 675
- Indian Scorpion, Spermatogenesis of an, Prof. D. R. Bhattacharya and Prof. J. B. Gatenby, 858
- Indiarubber, Refractive Index of, D. F. Twiss, 822
- Indium, The Mass-spectrum of, Dr. F. W. Aston, 192
- Inheritance of Characters acquired by Grafting, Prof. W. Johannsen, 536
- Insects, The Language (if any) of, A. P. Trotter, 747
- Insulin, The Influence of Temperature on the Action of, J. S. Huxley and J. F. Fulton, 234
- Integration, An Approximate, Prof. M. Fréchet, 714
- Ireland, Geology of, Thos. Murby and Co., 713
- Iron : and Steel, Specific and Latent Heat of, A. Mallock, 566; Lines, Relation between Pressure Shift, Temperature Class, and Spectral Terms of the, Dr. M. A. Catalán, 889; The Spectrum of, S. Goudsmit, 604
- Isotope : Effect in Line and Band Spectra, The, Dr. R. S. Mulliken, 820; Effects in the Band Spectra of Boron Monoxide and Silicon Nitride, Dr. R. S. Mulliken, 423
- Isotopes of Mercury and Bismuth : revealed in the Satellites of their Spectral Lines, Prof. H. Nagaoka, Y. Sugiura, and T. Mishima, 459; and the Satellites of their Spectral Lines, Prof. C. Runge, 781
- Isotopic Elements, Spectroscopic Evidence of, Prof. H. Nagaoka and Y. Sugiura, 532
- Junior Teaching Appointments at Universities, Prof. G. H. Hardy and Major A. G. Church, 746
- Kidney Secretion, The Modus Operandi of, Dr. W. N. F. Woodland, 891
- Lead, Common, Fractional Crystallisation of, R. H. Atkinson, 495
- Liquid Crystals, Soap Solutions, and X-rays, Prof. J. W. McBain, 534
- Long-range Particles from Radium-active Deposit, D. Pettersson, 641
- Lunar Eclipses, The Brightness of, Prof. W. J. Fisher, 783
- Magnetic : Boreholes, A. Millar, 14; Fields, Intense, and the Disturbance of Electronic Orbits in Magnetic Materials, Dr. T. F. Wall, 568
- Malaria, Human, The Transmission of, Prof. B. Grassi, 304, 458; Sir Ronald Ross, 353
- Mammato-cloud, Formation of, Lt.-Col. E. Gold, 235; Capt. C. K. M. Douglas, 462
- Manganese, The Spectrum of, Dr. S. Goudsmit, 238
- Mass-spectrograph, Recent Results obtained with the, Dr. F. W. Aston, 856
- Mathematics, Sense of Direction in, T. C. Hudson, 747
- Medical Discovery, The Encouragement of, Sir Ronald Ross, 569, 710
- Mendelism and Evolution : C. Tate Regan, 50, 569; J. S. Huxley, 569, 822; C. Dover, 712
- Mercury : Atom, Binding of Electrons in the Nucleus of the, Prof. H. Nagaoka, Y. Sugiura, and T. Mishima, 567; Seals on Ground Joints in Horizontal or Inverted Positions, A Device for using, J. A. Carroll, 858
- Metal Films, X-ray Examination of, Sir William H. Bragg, 639
- Microscope, Measuring, A Small, T. F. Connolly and E. H. Coumbe, 535
- Migrant, An Early, Dr. H. O. Forbes, 239
- Milk, Clean, W. Buckley, 127
- "Missing Element," The, between Cadmium and Mercury, Prof. W. M. Hicks, 642
- Monazit Sands and other Sources of Thoria, Dr. E. H. Pascoe; The Writer of the Article, 238, 607
- Naphthalene Vapour, The Effect of, on Red Spider Mite (*Tetranychus telarius*, L.), E. R. Speyer and O. Owen, 820
- Newton, On Editing, Sir Joseph Larmor, 744
- Nickel in Ancient Bronzes, Prof. R. A. Dart, 888
- North Polar Land, The Hypothetical, L. Hawkes, 275
- Occluded Gases from Iron, Temperature Periods in the Emission of, Prof. G. Borelius and F. Gunneson, 82
- Ocean Tides, Earth Tides and, W. D. Lambert, 889
- Palaeolithic Flakes, H. Bury, 310
- Pancreas, The, and Diabetic Metabolism, Prof. H. Oertel, 126
- Pea-weevil, Insect Parasite of the, Dorothy J. Jackson, 353
- Philosophical Magazine*, 1914-23, B. M. Headicar, 607
- Photoelectric and Selenium Cells, The Research Staff of the G.E.C., Ltd., 606
- Photoelectrons and a Corpuscular Quantum Theory of the Scattering of X-rays, Prof. G. E. M. Jauncey, 196
- Photographic : Densities, Apparatus for Measuring, G. M. B. Dobson, 494; Plates, Densities of, O. Bloch, 643; Records, Measurement of, W. H. George, 387
- Photometric Measurements, The Application of the Selenium Cell to, Dr. T. Slater Price, 351
- Physics and Relativity, Dr. N. R. Campbell, 784
- Pink Boll-worm on Cotton, Control of the, C. McKenzie Taylor, 745
- Pipes, The Critical Velocity in, H. M. Martin, 643
- Pipette, An Improved Form of, T. H. Taylor, 84
- Polarisers and Analysers, Half-shade, C. A. Skinner, 12
- Quincke, Prof. G. H., Reminiscences of, Dr. G. E. Allan, 426
- Radial Velocities and the Curvature of Space-time, Prof. A. S. Eddington, 746; Dr. L. Silberstein, 818
- Radiations and Atoms, Dr. J. C. Slater, 307
- Radium Therapy, A New Technique in, Dr. W. H. Brown and J. P. McHutchison, 274
- Ramanujan, Srinivasa, Prof. E. H. Neville, 426
- Rayleigh's, The late Lord, Scientific Papers, Lord Rayleigh, 570
- Red Sea Crab, The Migration of a, through the Suez Canal, H. Munro Fox, 714
- Reg-i-Ruwan, Sand and Rock Specimens from, C. Carus-Wilson, 274
- Relativity, Physics and, Dr. N. R. Campbell, 784
- Research, Discovery and, Prof. E. H. Starling; The Writer of the Article, 606
- River Pollution, the Problems of : A Plea for Continuous Fundamental Research on, Dr. J. H. Orton and Prof. W. H. Lewis, 236; J. H. Coste, 354; K. Carpenter, 385; Dr. W. H. Pearsall, 460; P. A. Aubin, 461; F. G. Richmond, 676; Prof. A. E. Boycott; J. W. H. Johnson, 817
- Sand and Rock Specimens from Reg-i-Ruwan, C. Carus-Wilson, 274
- Sap and Latex Flows, Influence of Weather Conditions on, Dr. H. E. Annett, 821
- Sarsen Stones, Tubular Cavities in, F. Chapman, 239
- Scientific : and Technical Publications, Standardisation of, W. P. Widdowson, 51; J. F. Pownall, 275; Names of Greek Derivation, B. B. Woodward, 51
- Silica, Fused Transparent, The Phosphorescence of, D. L. Chapman and L. J. Davies, 309; Dr. E. B. Ludlam and W. West, 389; Dr. W. E. Curtis, 495



- Snow and the Survival of Cod Fry, Dr. O. Sund, 163  
Sodium Chloride, Large, Clear, Cubical Crystals of, The Production of, Dr. W. E. Gibbs and W. Clayton, 492  
Solar Systems, Origin of, Sir Oliver Lodge; Dr. J. H. Jeans, 425  
Solid: Solutions: and Inter-atomic Relationships, A. L. Norbury; Dr. W. Rosenhain, 271; On the Structure of, Dr. A. Westgren and G. Phragmén, 122; State, The Complexity of the, Prof. A. Smits, 855  
Space-time: Radial Velocities and the Curvature of, Prof. A. S. Eddington, 746; Dr. L. Silberstein, 818; the Curvature Radius of, Further Determinations of, Dr. L. Silberstein, 602  
Speech Inscriptions, Three Biological Principles observed in, Prof. E. W. Scripture, 386  
Spiders, The Eyes of, A. Mallock, 45  
Stars: B, On the Spectra and Temperatures of the, Cecilia H. Payne, 783; Reversing Layers of, The Temperature of, Dr. J. Q. Stewart, 388; E. A. Milne, 534  
Starvation Life Curves, Prof. Raymond Pearl, 854  
Stoat's Winter Pelage, The, Sir Herbert Maxwell, 106  
Styrax and its Refractive Index, G. H. Needham, 785  
Sunlight and Glass: an Inquiry for Hygiene, Dr. C. W. Saleeby, 747  
Sunshine and Health in Different Lands, L. C. W. Bonacina, 494, 674, 891; Cicely M. Botley, 674; W. H. Dines, 784  
Symington, Prof. J., Prof. G. Elliot Smith, 462  
Temperature, The Influence of, on the Action of Insulin, J. S. Huxley and J. F. Fulton, 234  
Termites, a Growth-regulating Substance in, The Possible Existence of, J. B. S. Haldane, 676  
Three-colour Process, The, and Modern Painting, Prof. T. D. A. Cockerell, 606  
Thunderstorms, Mammato Clouds, and Globular Lightning, Dr. G. C. Simpson, 82  
Twinkling: of Distant Light-points, The, C. Carus-Wilson 426; of the Stars, The, in Relation to the Constitution of the Upper Strata of the Atmosphere, Prof. V. Conrad, 352  
Underblown Pipes, Prof. A. L. Narayan, 536  
Unsaturated Radicals in Optically Active Compounds, Induced Asymmetry of, Prof. T. M. Lowry and Dr. E. E. Walker, 565; E. J. Holmyard, 785  
Vector Quantum, The, Prof. F. W. Bubb, 237  
Vibrations, Forced, produced by Tuning-forks, W. N. Bond, 355  
Volcanic Gases, Emission of, Prof. A. W. Conway, 891  
Water-waves produced by Earthquakes, A. Mallock, 270  
Well-worms and their Allies, Rev. H. Friend, 272  
Whitehead's and Einstein's Formulæ, A Comparison of, Prof. A. S. Eddington, 192  
Wires in a Wind, The Singing of, Prof. G. I. Taylor, 536  
X-ray: Phosphorescence, A Test for Possible, J. A. Bearden, 857; Quanta, Scattering of, and the J Phenomena, Prof. A. H. Compton, 160  
X-rays, Photoelectrons and a Corpuscular Quantum Theory of the Scattering of, Prof. G. E. M. Jauncey, 196  
Zoological Nomenclature: Official List of Generic Names, Dr. C. W. Stiles, 821
- Corrosion: Alloys Resistant to, a General Discussion held jointly by the Faraday Society and the Sheffield Section of the Institute of Metals, April, 1923, 191; Atmospheric, of Non-ferrous Metals, W. H. J. Vernon, 178  
Cortex of Suprarenal Glands, Effects of the, on the Somatic Growth of Young Guinea-pigs, L. Castaldi, 771  
Cotton: Chemical Analysis of, 693; Dusting from Aeroplanes, B. R. Coad, E. Johnson, and Lieut. C. L. McNeil, 506; -growing in Australia, W. H. Johnson, 652; Hair, The Structure of the, Dr. W. L. Balls, 910; Industry, Physical Research in the, Dr. A. E. Oxley, 662; Selection in India, M. L. Patel, 835  
Couleur et constitution chimique: Cours professé à la Faculté des Sciences de Besançon, par Prof. J. Martinet et Mlle. P. Alexandre, 739  
Creams, Bacteriology, Titratable Acidity, and H-ion Concentration of some, J. K. Murray and V. Weston, 104  
Creative Morality, L. A. Reid, 410  
Croonian Lecture, The, Prof. D. M. S. Watson, 841  
Crookes: Sir William: Prof. A. Smithells, 227; The Life of, Dr. E. E. Fournier d'Albe, 227, 607  
Crown-gall, Report on, by the American Phytopathological Society, 758  
*Cryptochilum Echini* Maupas, Varying Rhythm of the Division of the Micro-nuclei during True Conjugation in, A. Russo, 915  
Crystal: Structure, Prof. W. L. Bragg, 294, 302; Symmetry, The Thirty-two Classes of: Dr. J. W. Evans, 80; Dr. H. C. Pocklington, 195  
Crystallography: Elementary, Dr. J. W. Evans and G. M. Davies, 562; The Science of, 562  
Crystals: Coloured Rock Salt, Photo-electric Action in, J. Bingel, 508; Electric Conductivity of, F. v. Rautenfeld, 404; of Ammonium Iodide, Orientation of, by the Cleavage Plates of Mica, P. Gaubert, 514; of Calcite from Holywell, Flintshire, E. D. Mountain, 374; Photoelectric Conductivity of, B. Gudden and R. Pohl, 254; The Coloration of, by the Action of Radium, P. Ludewig and F. Reuther, 368; The Elastic Limit and Strength of, Prof. A. Joffé, M. Kirpichewa and M. Lavitzky, 424; the Interference Figures of, The Effect of Dispersion on, Prof. C. V. Raman, 127; The Natural History of, Dr. A. E. H. Tutton, 562  
Cumulus Cloud above Bush-fires, The Formation of, Prof. W. G. Duffield, 126  
Cuprous Oxide possessing Photo-electric Properties, The Formation, in the Wet Way, of Layers of, J. Pionchon and Mlle. F. Démora, 947  
Current and Wind: The Relationship between, C. S. Durst, 326, 905  
Cyclohexanol, The Esterification of, and of some of its Homologues, Mlle. G. Cauquil, 215  
Cyclones: The Cause of, Dr. H. Jeffreys, 35; and Typhoons, Cause and Origin of, F. E. Fournier, 514  
Cyclonic Vortices of Cirrus which do not extend to the Level of the Ground, E. Fournier, 735  
Cytinus of Madagascar, The, H. Jumelle, 103  
Cytology, Experimental, Some Problems in, J. Gray, 806
- Daedalus, or Science and the Future, J. B. S. Haldane, 740  
Dagan, The Cult of, Prof. Legrain, 319  
D'Arrest's Comet, J. E. Mellish, 206  
Dartmoor Granite, Gold and Silver as Accessory Minerals in the, A. Brammall and H. F. Harwood, 214  
Darwin and Evolution, Sir Oliver Lodge, 866, 926  
*Darwinia grandiflora*, The Essential Oil of, and the Presence of a New Acid Ester, A. R. Penfold, 103  
Darwinism and Catholic Thought, Canon Dorlodot. Translated by the Rev. E. Messenger. Vol. I.: The Origin of Species, 8  
Datura, Distinction between Primary and Secondary Chromosomal Mutants in, A. F. Blakeslee, 663  
Daturas, Configuration and Size of the Chromosomes in the Trivalents of 25-chromosome, J. Belling and A. F. Blakeslee, 663  
"Davon" Metallurgical Microscope, 939  
Daylight Illumination, P. J. Waldram, 723

## DEATHS.

- Andrews (Dr. C. W.), 794, 827  
Angot (C. A.), 685, 793  
Annandale (Dr. T. N.), 576, 615  
Bailey (Dr. G. H.), 865  
Ball (Rev. C. J.), 397  
Beal (Prof. W. J.), 933  
Bell (Prof. F. Jeffrey), 541  
Bertrand (Capt. A.), 245  
Bigelow (Prof. F. H.), 685, 721  
Birch (Dr. W. de Gray), 468  
Bonaparte (Prof. Roland), 616, 755  
Bonney (Prof. T. G.), 201  
Buchanan (Sir Walter James), 541  
Buckle (P.), 169  
Caborne (Capt. W. F.), 933  
Cappel (Sir A. J. Leppoc), 685  
Carmichael (Prof. H.), 502  
de Chardonnet (Count Hilaire), 501  
Clarke (Prof. C. K.), 202  
Clowes (Dr. F.), 57



- Cole (Prof. G. A. J.), 616, 649  
 Cragg (Major F. W.), 685, 720  
 Dalziel (Sir Kennedy), 245  
 Deane (H.), 616, 865  
 Dobbie (Sir James J.), 933  
 Duncan (L. L.), 91  
 Eiffel (G.), 21  
 Emrys-Roberts (Prof. E.), 169  
 Eneström (G.), 169  
 Ewald (Prof. A.), 541  
 Fowler (Canon J. T.), 616  
 Froude (Dr. R. E.), 468, 501  
 Gabriel (Prof. S.), 865  
 Geitel (H.), 432  
 Godfrey (Prof. C.), 541, 685  
 de Gramont (A.), 244  
 Gray (Mrs. R.), 397  
 Grubenmann (Dr. U.), 502  
 Hall (Dr. G. Stanley), 685, 794  
 Hamburger (Prof. H. J.), 57, 244  
 Harkness (Prof. J.), 91  
 Hartog (Prof. M.), 169, 243  
 Hensen (Prof. V.), 865  
 Hitchcock (Prof. R.), 615  
 Hofman (Prof. H. O.), 828  
 Irvine (A. C.), 934  
 Jack (Prof. W.), 468, 540  
 Jackson (Dr. W. H.), 360, 433  
 Jamieson (T.), 721  
 Jones (A. H.), 360, 502  
 Jude (Dr. R. H.), 933  
 Kennedy (Prof. R.), 865  
 Klotz (Dr. O.), 21, 90  
 Loeb (Prof. J.), 281, 574  
 Longbottom (Prof. J. G.), 933  
 Macewen (Sir William), 468, 613  
 Mackenzie (K. J. J.), 865, 896  
 Mallory (G. L.), 934  
 Maw (Dr. W. H.), 468  
 Meisinger (Dr. C. Le Roy), 868  
 Mendenhall (Prof. T. C.), 685  
 Merrifield (F.), 828, 923  
 Mookerjee (Sir Asutosh), 794, 897  
 Morfitt (W.), 57  
 Morris (Sir Malcolm), 397  
 Nichols (Prof. E. F.), 721, 828  
 Nordstedt (Prof. C. F. O.), 576  
 Oberthür (C.), 933  
 Omori (Prof. F.), 57, 133  
 O'Sullivan (Prof. A. C.), 360  
 Paltauf (Prof. R. A. F.), 865  
 Péringuey (Dr. L.), 397, 541  
 Pybus (W. M.), 57, 169  
 Quincke (Prof. G. H.), 202, 280  
 Rashdall (Dr. H.), 245  
 Rathbone (E. P.), 933  
 Reece (Surg.-Col. R. J.), 616  
 Reid (Sir Archibald), 169  
 Sadtler (Prof. S. P.), 169  
 Shattock (Prof. S. G.), 721, 754  
 Siegmund (Prof. G.), 541  
 Smith (Dr. A. L.), 576, 650  
 Stephan (J. M. E.), 202, 281  
 Stillman (Prof. J. M.), 169  
 Strachan (R.), 684  
 Swinhoe (Col. C.), 21  
 Symington (Prof. J.), 360, 432  
 Thompson (Prof. R. R.), 169  
 Thomson (Prof. H. A.), 397  
 Tigerstedt (Prof. R.), 359  
 Tizard (Capt. T. H.), 281, 395  
 Tweedy (Sir John), 57  
 Walmsley (Dr. R. M.), 932  
 Walsham (Dr. H.), 721  
 Ward (Sir Adolphus William), 933  
 Warming (Prof. J. E. B.), 541, 683  
 Watson (A. T.), 576  
 Wedd (Dr. B. H.), 360  
 Welch (C.), 133  
 Wood (Canon T.), 21  
 Wyon (Dr. G. A.), 502
- Decimal Association, Annual Meeting of the, 60  
 Decorative Design of the Hallstadt Period, S. Casson, 138  
 Deer, The, and Deer Forests of Scotland: Historical, Descriptive, Sporting, A. I. McConnochie, 265  
 Defective Diets, The Sensitising of the Organism towards, G. Mouriquand, P. Michel, and M. Bernheim, 592  
 Definitions and Nomenclature, V. T. Saunders and G. H. Benham, 62  
 Deinosaure Egg, A, to be sold by Auction in America, 93  
 Denmark, Agricultural Production in, 1909-13 and 1922, H. Faber, 34  
 Dental X-ray Apparatus, Specifications of, Watson and Sons (Electro-Medical), Ltd., 284  
 Depth Sounding for Navigation Purposes, The Acoustic Method of, 463  
 Descent, The Present Outlook on, Prof. F. O. Bower, 356  
 Deserts, Heat, Moisture, and Animal Life in, P. A. Buxton, 182  
 Desmids, Investigations on, C. Turner, 626  
 Development: Commission, Thirteenth Report, 377; The Theory of, A. H. Nietz, 634  
 Devon, Wild Life in, D. Gordon, 228  
 Diabetic: Metabolism, The Pancreas and, Prof. H. Oertel, 126; Ration, The Fatty Bodies in the, A. Desgrez, H. Bierry, and F. Rathery, 915  
 Diagnostic Methods, Prof. H. T. Brooks. Fourth edition, 488  
 Diamond, A Transformation of the, G. Friedel and G. Ribaud, 627, 693  
 Dibasic Acids of Ether-oxide Function, Some Syntheses of, M. Godchot, 35  
 Dichromone and Dibenzoyldichromone, J. Algar, F. Fogarty and H. Ryan, 410  
 Dielectrics, The Properties of, G. L. Addenbrooke, 490  
 Diesel Engines, L. H. Morrison, 485  
 Difference-periodogram, The—a Method for the Rapid Determination of Short Periodicities, C. E. P. Brooks, 293  
 Differential Latitude Observations at Helwan, 60  
 Diffusion in Gels, Determination of Coefficients of, C. E. T. Mann, 293  
 Dinoflagellates and Echinoderms, Investigations on, Prof. J. Johnstone and others, 286  
 Diphenylalkylacetates of Benzyl, The General Preparation of the, Mme. Pauline Ramart, 259  
 Diphtheria: its Bacteriology, Pathology, and Immunology, Sir Frederick W. Andrewes and others, 527; Toxin rendered Anatoxic (anatoxin), The Flocculating Power and Immunising Properties of a, G. Ramon, 72  
 Direction Finding by Wireless: Comdr. J. A. Slee, 441; Comdr. J. A. Slee; The Writer of the Note, 676  
*Dirofilaria immitis* from the Cat, Dr. R. J. Ortlepp, 691  
 Discharge Tubes, The Pressure Effect in, Dr. I. Langmuir, 320  
*Discovery*, Dr. S. W. Kemp appointed director of research on the, 504  
*Discovery*, continuance of, 22, 135  
 Discovery and Research, Prof. E. H. Starling, 606; The Writer of the Article, 607  
 Dispersion: The Effect of, on the Interference Figures of Crystals, Prof. C. V. Raman, 127; The Law of, and Bohr's Theory of Spectra, H. A. Kramers, 673  
*Dixmude*, The French Airship, M. A. Giblett, 435  
 Dogger Bank, Preliminary Investigation of the, F. M. Davies, 442  
 Dolphins, The Food of: Sir Sidney F. Harmer, 532; R. Legendre, 819  
*Doratosepion confusa*, Histology and Function of Certain Sex-limited Characters in, H. M. Carleton and G. C. Robson, 589  
 Dravidian Element in Indian Culture, The, Dr. G. Slater, 816  
 Drosophila, Duration of Life in, Prof. R. Pearl and Sylvia Parker, 937  
 Drought, Symposium on, R. J. van Reenen and others, 65  
 Drying Process, The Discontinuity of the, E. A. Fisher, 590  
 Dryopithecus, Jaws of, Dr. W. K. Gregory, 757  
 Duddell Memorial medal, the, presented to Prof. H. L. Callendar, 246  
 Dunn, Sir William, Institute of Biochemistry, Cambridge University, opening of the, 731



- Durham University: Dr. I. Masson appointed professor of chemistry and director of the science department in the Durham Colleges of, 477; Dr. A. K. MacBeth appointed reader in chemistry and H. J. E. Dobson lecturer in chemistry in the Durham Colleges, 732; J. E. P. Wagstaff appointed professor of physics; Dr. B. M. Griffiths appointed reader in botany and Dr. A. Holmes reader in geology, 877
- Dutch: East Indies, Rainfall in the, 763; House, enclosed box showing the representation of the interior of a, presented to the National Gallery, 245; Pendulum Observations in Submarines, Dr. J. J. A. Muller, 308, 641
- Dwarfing Trees, Japanese Methods of, Teizo Niwa, 554
- Dyestuff Industry, The British, 595
- Dyestuffs, British, Prof. W. M. Gardner, 352
- Dynamics, Prof. H. Lamb. Second edition, 9
- Early Scientific Instruments in Oxford, 346
- Earth: The Figure of the, Capt. G. T. McCaw; A. R. Hinks, 800; the Surface History of the, The Influence of Radioactivity on, Prof. J. Joly, 829; -shake in Nottinghamshire and Derbyshire, 578; Tides and Ocean Tides, W. D. Lambert, 889
- Earthquake: Buildings, W. H. Thorpe, 176; Epicentres, The Location of, Dr. S. W. Visser, 692; in South Devon, 59; near Hereford, 282; or Meteor, 137; -waves, The Periods of, J. B. Macelwane, 582
- Earthquakes: in the Philippine Islands, 653; The Study of, Prof. H. H. Turner, 248; Water-waves produced by, A. Mallock, 270
- Earth's Potential Gradient, Rapid Variations of the, Dr. E. V. Appleton, R. A. Watson Watt, and J. F. Herd, 238
- Earthworm, the Chick Embryo and Fragments of the, Oxygen Consumption Rate of Parts of, Prof. G. Shearer, 182
- Earthworms: and the Cluster Fly, Prof. T. D. A. Cockerell, 193; British, and How to Identify Them, Rev. H. Friend, 158
- Eclipses of the Sun, Prof. S. A. Mitchell; C. P. Butler, 703
- Economics, The Background of, Prof. M. H. Hunter and Prof. G. S. Watkins, 348
- Ectocarpaceæ, Alternation of Generations in the, Miss Margery Knight, 143
- Edinburgh: Royal Society of, election of fellows, 363; University: institution of railway courses of lectures, 32; bequests to, by T. McKie and Miss J. L. Small, 255
- Education: The Object of, Viscount Leverhulme, 945; The Rising Cost of, 912
- Educational: Administration, Scientific Method in, 261; Policy, Lord Emmott, 406
- Eel: Common, The Natural History of the, J. T. Cunningham, 199; -larvæ, The Transatlantic Migration of the, Dr. Johs. Schmidt, 12; Sex in the, Differentiation of, M. d'Ancona, 843
- Egg-laying Qualities of Poultry, Breeding Experiments and the, 246
- Egyptian Anthropological Collection, Catalogue of, 95
- Eidamia, A New Species of, A. S. Horne and G. N. Jones, 33
- Einstein: and Mach, Prof. B. Brauner, 927; Deviation of Light Rays by the Sun, The, E. Esclançon, 183; Eclipse: Result, Another, G. F. Dodwell, 173; Tests, The, Prof. A. D. Ross, 103
- Eisenia fetida* (Sav.), Effects of Cutting the Giant Fibres in, L. W. Yoltou, 216
- Eis-Riesenwelt, The Largest Cavern in Europe, and the Circulations of Subterranean Waters in High Mountains, E. A. Martel, 735
- El Dorado, In Quest of, Stephen Graham, 887
- Electric: Arc: Mrs. Ayerton's Work on the, A. P. Trotter, 48; Spectra, Appearance of the Ultimate Lines in, St. Procopiu, 699; Discharge: at very High Frequency, C. Gutton, 295; The Spontaneous Rotation of the, C. E. Guye, 71; Furnaces for Hardening Steel, 658
- Electrical: Conductivity in Single Hygroscopic Fibres, Changes of, F. P. Slater, 325; Conductivity of Flames Containing Salts of the Alkali Metals, S. Pontremoli, 843; Density Meter, An, F. C. Toy and S. O. Rawling, 321; Energy, Practical Control of, A. G. Collis, 9; Engineers, Institution of: award of the Faraday medal of the, to Dr. S. Z. de Ferranti, 204; New By-law of the, 545; Exhibits at the British Empire Exhibition, 788; Generation, Modern Developments in, W. H. Patchell, 578; Heating, An Arrangement Permitting, to a High Temperature in a Vacuum, P. Lebeau and M. Picon, 627; Measuring Instruments and Supply Meters, D. J. Bolton, 79
- Electrically Exploded Wires in High Vacuum, S. Smith, 447
- Electricity: in Mines, Prof. W. M. Thornton, 251; in Thunderstorms, the Origin of, Problems of Hydrone and Water, Prof. H. E. Armstrong, 124; the Passage of, between Metals in Light Contact, Fraülein Angelika Székely, 836
- Electro-deposition, Repair of Worn Components by, J. P. McLare, 770
- Electrode Reactions and Equilibria, Dr. E. K. Rideal, 20
- Electrolysis of Fused Chlorides, Conditions of the Appearance of Anode Effect in the, T. A. Heppenstall and W. J. Shutt, 770
- Electrolytes at very high Frequencies, The Conductivity of, J. Granier, 807
- Electromagnetic Waves, Short, of Wave-length up to 82 Microns, A. Glagolewa-Arkadiewa, 640
- Electro-metallurgy, A Treatise on, W. G. McMillan; revised by W. R. Cooper. Fourth edition, 851
- Electron Emission: from Incandescent Substances, A. Goetz, 63; Thermodynamics of, Prof. O. W. Richardson, 373
- Electrons: Affinity of Neutral Iodine Atoms for, W. Gerlach and F. Gromann, 140; in Metals, Dr. P. Raethjen, 692; the Emission of, under the Influence of Chemical Action, M. Brotherton, 145
- Electro-plating, Modern, W. E. Hughes, 851
- Elements, Lighter, The Spectra of the, Prof. J. C. McLennan and others, 217
- Embryonic: Characters, Inheritance of, Prof. T. H. Morgan, 175; Differentiation, Early, J. S. Huxley, 276
- Empire: Cotton Growing: Corporation, F. R. Parnell appointed plant breeder under the, 247; *Review*, The, No. 1, 283; Mining and Metallurgical Congress, The, 170, 767, 906; of Man, The, 629; Study, Scheme of, 324
- Endermic Floras, Merrill, and others, 290
- Engineering: at the British Empire Exhibition, 825; Materials, The Properties of, W. C. Popplewell and H. Carrington, 564; Mathematics, R. W. M. Gibbs. Part I., 121
- Engineers, Society of, awards of the, 24
- Engines and Mechanical Vehicles, 485; Tests of, a joint committee on, 436
- Epithelioma contagiosum*, Relation of Faulty Nutrition to, Lt.-Col. R. McCarrison, 904
- Equatoria: The Lado Enclave, Major C. H. Stigand, 44
- Erdteil: Zum sechsten, Die zweite deutsche Sudpolar Expedition, Dr. W. Filchner, 382
- Eriosoma, the Migration in, P. Marchal, 447
- Eritrea, Survey Work in, Prof. P. V. de Regny, 938
- Errera, Léo, Recueil d'œuvres de, Pédagogie: Biographies, 41
- Esculetol, A New Crystallised Chromogen, extracted from the Horse Chestnut, G. Bertrand and Mlle. Y. Djoritch, 662
- Esquerquis Bank, The Geological Nature of the, L. Dangeard and M. Solignac, 71
- Essential Oils of certain West Australian Plants, L. W. Phillips, 103
- Esterid Crustacean, The Development of an, H. G. Cannon, 182
- Ethereal Sulphate in the Body, Synthesis of, Dr. T. S. Hele, 581
- Ethnology and Social Anthropology, Methods of, Prof. A. Radcliffe-Brown, 64
- Ethyl Chloride, The Thermal Properties of, Prof. C. F. Jenkin and D. N. Shortrose, 284
- Etna, Mount, Magmatic Gas of the Lava of, G. Ponte, 843
- Étoiles, L'Évolution des, J. Bosler, 303
- Eucalyptus "Scrub," A. D. J. Paton, 581
- Euclidean Theory of Parallels, Dr. T. Greenwood, 547



- Euclid's Modern Rivals, 881  
 Eugenics, The International Commission on, 757  
 Europe, A Literary and Historical Atlas of, Dr. J. G. Bartholomew, 303  
 Everest, Mount, Expedition: staff and programme of the, 93; Deaths of G. L. Mallory and A. C. Irvine, 934  
 Evolution: A Mathematical Theory of, G. U. Yule, 256; and Eugenics: Dr. A. F. Tredgold, 876; Studies in, Prof. S. J. Holmes, 667; Darwin and, Sir Oliver Lodge, 926; Mendelism and: C. Tate Regan; J. S. Huxley, 569; C. Dover, 712; J. S. Huxley, 822; Theories of, and their Application to Human Affairs, Prof. E. W. MacBride, 667  
 Evolutional Palæontology in Relation to the Lower Palæozoic Rocks, Dr. Gertrude L. Elles, 37  
 Excitable Tissues, Chronaxie of, Lapicque's Investigations on the, J. F. Fulton, 427  
 Exhibition of 1851, Award of senior studentships, 946  
 Explosion, Reaction, Mechanism of the, M. Audibert, 662  
 Explosions, The Experimental, in France, 135; Dr. C. Davison, 660  
 Explosives, The Velocity of Detonation of, an Electrical Method of Determining, J. E. P. Wagstaff, 373  
 Extinct Reptiles, Eggs of, V. van Straelen and M.-E. Denaeayer, 368  
 Fabre, The Human Side of, P. F. Bicknell, 709  
 Fagaceæ, The Cuticles of some Recent and Fossil, Helena Bandulska, 446  
 Farbenindiatoren, Der Gebrauch von, Dr. I. M. Kolthoff, Zweite Auflage, 157  
 Far Eastern Association of Tropical Medicine, The Fifth Congress of the, 434  
 Farm: Implements and Machinery, J. R. Bond, 264; Soil and its Improvement, Sir John Russell, 482  
 Farmer, Mechanical Aids for the, Dr. B. A. Keen, 264  
 Farne Islands, Appeal for the Purchase of the, and Preservation as a Bird Sanctuary, 58  
 Fat Metabolism in Plants, Prof. J. H. Priestley, 581  
 Fatigue Failure of Brass Tubes in a Feed Water Heater, W. E. W. Millington and F. C. Thompson, 478  
 Fats: Natural and Synthetic, Dr. W. W. Myddleton and T. H. Barry, 669  
 Fatty Acids and of Alkalis, The Surface Tension exerted at the Surface of Separation of Water and an Organic Liquid in the Presence of the, R. Dubrisay and P. Picard, 183  
 Faune de France: Diptères anthomyides, E. Séigny, 816; 5: Polychètes errantes, Prof. P. Fauvel, 528  
 Feestbundel aangeboden aan, F. A. H. Schreinemakers, ter herdenking van den dag, waarop hem voor 25 Jahren het Doctoraat honoris causa werd verleend (7 Juli, 1898-1923), 190  
 Feldspar or Felspar, Prof. G. A. J. Cole, 274  
 Ferns, Cavity Parenchyma and Tyloses in, H. S. Holden, 626  
 Ferromagnetic Substances, A Formula for the Specific Heat of, and its Discontinuity at the Critical Temperature, Dr. J. R. Ashworth, 13  
*Festuca ovina* L., sensu ampliss. Hack. in Britain, Occurrence and Distribution of, W. O. Howarth, 626  
 Fibræ, Analytical and Economic, S. R. Wycherley, 734  
 Fibrous Tissue, the Swelling of a, A Histological and Chemical Investigation of, Madge Kaye and Dorothy Jordan Lloyd, 805  
 Field Museum of Natural History, gifts to the, 363  
 Film, The, as an Educator, Dr. W. Martin, 876  
 Finance, Mathematical Principles of, Prof. F. C. Kent, 853  
 Fireballs in January, Prevalence of, W. F. Denning, 285  
 Fish: Exhibits in Museums, C. Matheson, 546; of the Tai-Hu, Kiangsu Province, China, H. W. Fowler, 663; of the Talé Sap, Peninsula of Siam, S. L. Hora, Part II., 663; Otoliths from the Stomach of a Porpoise, G. A. Frost, 310  
 Fisheries, The Effects of Washings from Tared Roads on, 315  
 Fishes: A Bibliography of, Dr. B. Dean. Extended and edited by Dr. E. W. Gudger; with the co-operation of A. W. Henn, Vol. 3, Prof. J. Graham Kerr, 344; of the Genus Garra, Certain Local Names of the, S. L. Hora, 663; of the Irish Atlantic Slope, Seventh Report on the, G. P. Farran, 258  
 Fishing Industry, On the Application of Science to the, Prof. T. C. Nelson, 675  
 Fissicorn Tachinidæ, with Description of New Forms from Australia and South America, M. Bezzi, 148  
 Flagellates and Ciliates, Relation of, to P<sub>H</sub>, J. T. Saunders, 555  
 Flax: Retting, When to Stop, Dr. J. V. Eyre and C. R. Nodder, 939; Stems, Methods of Mass-production in Sectioning, G. O. Searle, 626  
 Flints, Chipped, Rev. H. G. O. Kendall, 362  
 Florida, U.S.A., The Archaeology of, J. W. Fewkes, 138  
 Flowering Plants: collected by Dr. T. Wulfi, Prof. C. H. Ostenfeld, 823; Interesting, Dr. O. Stapf, 473; Vegetative Propagation of, Prof. J. H. Priestley, 626  
 Fluid Motion in Theory and Practice, Dr. T. E. Stanton, 520  
 Fluids: The Mechanical Properties of, a Collective Work, Dr. C. V. Drysdale and others, 520; The Principle of Minimum Energy and the Motion of, W. Hovgaard, 215; The Resistance of, G. Grèzes, 879  
 Fluorescence of some Organic Compounds, E. Bayle and R. Fabre, 374  
 Fluorescent Light, Polarised, A. Carrelli, 735  
 Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie, P. Pringsheim, Zweite Auflage, 9  
 Fluxes and Slags in Non-ferrous Metal Melting and Working, Discussion on, 696  
 Food: Factors (Vitamins), Report on the Present State of Knowledge of Accessory, 718; Preservation, W. B. Hardy, 96; Substances in the Plant, The Transport of, 168  
 Foot-and-mouth Disease: Bird Migration in Relation to, Sir Stewart Stockman and Miss Marjory Garnett; Dr. A. L. Thomson, 52; The Origin of, Dr. H. M. Woodcock, 165, 239; appointment of a Committee on, 247, 315, 401; 537; Discovery of the Virus of, Profs. Frosch and Dahmen, 685  
 Foraminifera of the Atlantic Ocean, Part 4, J. A. Cushman, 139  
 Foreign: Student, The, in Italy and Elsewhere, 342; Trade and Shipbuilding, R. Y. Sanders, 326  
 Forest Fires, Meteorological Factors and, in the United States, 659  
 Forest Officers' Handbook of the Gold Coast, The, Ashanti, and the Northern Territories, Major T. F. Chipp, 153  
 Forests and Rainfall, 511  
 Forthcoming Books of Science, 548  
 Fossil: Men, Elements of Human Palæontology, Prof. M. Boule. Translated, with an Introduction, by Jessie E. Ritchie and Dr. J. Ritchie, 382; Plants: and Climatic Changes, Prof. A. C. Seward, 904; from Mingenew and Irwin River, L. Glauert, 103  
 Fossilised Human Skull of Tertiary Age in Patagonia, The Reputed, Dr. Imbelloni, 58  
 Fossils: and Strata, Dr. F. A. Bather, 37; in the National Museum, New or little known, Pt. XXVII., F. Chapman and F. A. Cudmore, 147  
 Foster Optical Pyrometry, Foster Instrument Co., 801  
 Foucault Knife-edge Test when applied to Refracting Systems, Significance of the, Miss H. G. Conrady, 553  
 Four-wheel Brakes for Motor Cars, F. A. S. Acres, 508  
 France: some Prehistoric Sites of, Dr. H. M. Ami, 129; The Meridian of, Col. Perrier; Sir C. F. Close, 56  
 Franklin medals and certificates of honorary membership of the Franklin Institute awarded to Sir Ernest Rutherford and Dr. E. Weston, 900  
 Fraunhofer Diffraction, The Quantum Theory of the, P. S. Epstein and P. Ehrenfest, 843  
 Free: Ballooning for Meteorological Inquiries, Dr. C. Le Roy Meisinger, 652; Pendulum, The, F. Hope-Jones, 873  
 French: Academy of Medicine, Sir Edward Sharpey Schafer elected a corresponding member of the, 544; Experimental Explosion: of May 15, 756; of May 23, 796; Physical Society's Exhibition, The: 31; Dr. Ch.-Éd. Guillaume, 127; T. Cellerier, 353  
 Frequency Function, Development of a, and some Comments on Curve Fitting, E. B. Wilson, 628  
 Freshwater Amphipoda of the Balkan Peninsula, 439  
 Frictional Electricity, An Anomaly in, Prof. A. O. Rankine, 914



- Fritz, John, gold medal, the, awarded to A. Swasey, 282
- Fruit Trees, Propagation of, on their own Roots, G. T. Spinks, 626
- Fucaceae, A Contribution to our Knowledge of the, May M. Williams, 148
- Fuel : Alternative, for Internal Combustion Engines, J. G. Rose, 866; and the Future, 917; Economy : A Manual of, for Engineers and others in charge of Boiler and Furnace Plants, C. F. Wade, 810; Pulverised : D. Brownlie, 62; and Colloidal, Dr. J. T. Dunn, 810; Research, F. S. Sinnatt appointed assistant director of, 401
- Fuels, The Utilisation of Low Grade and Waste, W. F. Goodrich, 810
- Fukuoka Imperial University destroyed by fire, 32
- Fungus Flora of British Woodlands, The, J. Ramsbottom, 258
- $\gamma$ -rays, Absorption : of Hard, by Elements, N. Ahmad, 513; and Scattering of, N. Ahmad and E. C. Stoner, 878
- Galileo Telescopes, Two, D. Baxandall, 145
- Galium Aparine*, Seedling of, with Three Branches in the Axil of each Cotyledon, T. A. Sprague, 293
- Galton Lecture of the Eugenics Education Society, The, Prof. G. Elliot Smith, 291
- Galvanomagnetic and Thermomagnetic Effects : the Hall and Allied Phenomena, Prof. L. L. Campbell, 743
- Galvanometers, etc., A Method of Increasing the Effective Sensitiveness of, J. H. Shaxby, 926
- Game Birds and Wild-Fowl of Great Britain and Ireland, A. Thorburn, 526
- Ganges : A Working Model of the Origin of the, in a Temple in Ganjam, Dr. N. Annandale, 700; Boats of the, J. Hornell, 663
- Gas : Examiners, The appointment of, 686; Films Adsorbed on Tungsten, The Stability of, W. G. Palmer, 294; -grown Skin, a Primary, Preliminary Measurement of, J. J. Manley, 734; -grown Skins, Removal of, from a Sprengel Pump, J. J. Manley, 734; Industry, The, Dr. J. S. G. Thomas, 622; Lighting, E. L. Oughton, 724; Manufacture, Dr. W. B. Davidson, 157; Molecules, Effective Radii of, L. L. Nettleton, 843
- Gaseous : Ammonia, The Ultra-violet Absorption Spectrum of, M. Ferrières, 183; Combustion at High Pressures. Pt. IV., Prof. W. A. Bone, D. M. Newitt, and D. T. A. Townend, 373; Diffusion, some Measurements of, J. M. Mullaly, 711; Sulphur Dioxide, The Photochemical Decomposition of, R. A. Hill, 770
- Gases : at High Pressure, Prof. P. W. Bridgman, 404; Behaviour of, in Contact with Glass Surfaces, D. H. Bangham and F. P. Burt, 293; Density and Diffusion of, measured by Displacement Interferometry, Prof. C. Barus, 844; Disengaged by Solid Combustibles under the Action of Heat and a Vacuum; The Quantity and the Nature of the Coals, P. Lebeau, 259; Five, under High Pressures, The Volume Changes of, P. W. Bridgman, 215; The Specific Heats of, and the Velocity of Sound, A. Leduc, 627
- Gasoline Engine, Mechanics of the, H. A. Huebotter, 485
- Gasteropoda, chiefly in the late Mrs. Robert Gray's Collection, from the Ordovician and Lower Silurian of Girvan, Jane Longstaff, 513
- Gelatin, the Penetration of Hydroxyl Ions into, J. Gray, 555
- Genera and Species, Frequency Curves of, C. Tate Regan, 822
- Genetics, Recent, R. P. Gregory, Miss D. de Winton, Dr. W. Bateson, and others, 252
- Geographical : Exploration in 1923 and in Progress, Earl of Ronaldshay, 832; Instruction : L. MacD. Robison, 99; and British Climate, 99
- Geography, Railway, L. Rodwell-Jones and C. B. Fawcett, 99
- Geological : Palaeontological, and Mineralogical Societies of America, annual meetings of the, 248; Museum, London, T. Sheppard, 239; Photographs : British, Prof. S. H. Reynolds, 88; F. E. Wright, 835; Society : awards of the, 94; election of officers and council, 436
- Geologie und Bodenschätze Deutschlands, Handbuch der, herausgegeben von Prof. E. Krenkel. Abt. 2, 815; von Württemberg nebst Hohenzollern, Prof. E. Hennig, 815
- Geology : Bibliography of, Dr. E. B. Mathews and Miss Grace E. Reed, 368; of Ireland, Thos. Murby and Co., 713; of the Metalliferous Deposits, The, Dr. R. H. Rastall, 812; Museum of Practical, 758
- Geometrie : analytischen, Lehrbuch der, Prof. L. Heffter. Band 2, 598; Descriptive, G. Monge. Augmentée . . . par B. Brisson, 456
- Geometry : Analytic : L. P. Siceloff, G. Wentworth, and D. E. Smith, 349; Prof. C. E. Love, 598; Plane and Solid, Profs. W. F. Osgood and W. C. Graustein, 598; Elementary, The Teaching of, 881; in Schools : The Teaching of, a Report prepared for the Mathematical Association, 230, 881; Projective : An Introduction to, Prof. R. M. Winger, 598; and Analytical, 598
- Geotropism, Reversal of, Prof. F. C. Newcombe and others, 657
- Girls' Public Day School Trust, The Jubilee Book of the, 1873-1923, L. Magnus, 9
- Givers of Life and their Significance in Mythology, Prof. M. A. Canney, 601
- Glaisher Stand *versus* Stevenson Screen, I. D. Margary, 591
- Glasgow University : conferment of degrees, 660; Prof. H. A. Wilson appointed professor of natural philosophy, 912
- Glass : Colourless, The Production of, in Tank Furnaces with Special Reference to the Use of Selenium, A. Cousen and Prof. W. E. S. Turner, 294; Industry, Specifications in the, Prof. W. E. S. Turner, 103; Sintered, Filter Plates of, Schott and Co., 579; Specifications for, Prof. W. E. S. Turner, 294; Sunlight and, an Inquiry for Hygiene, Dr. C. W. Saleeby, 747; Technology, Society of, election of officers and council, 654; Trade, Efficiency in the, E. Farmer, 103
- Globular Clusters, The Radial Velocities of, and de Sitter's Cosmology, Dr. L. Silberstein, 350
- Glycimeris in the Tertiary of New Zealand, J. Marwick, 728
- Gold Coast, Forests of the, 153
- Goldfish, The Pearl Organ of the, T. Tozawa, 250
- Golgi Apparatus : The, in the Avian Oocyte, F. W. R. Brambell, 493; in the Nerve Cells of Helix, F. W. R. Brambell and Prof. J. B. Gatenby, 762; the Impregnation of the, by means of Osmium Tetroxide, R. J. Ludford, 913
- Gorilla's Foot, The : Sir E. Ray Lankester, 10; Prof. S. Smith; Sir Arthur Keith, 83; Dr. W. K. Gregory, 421; Sir Ray Lankester, 457; R. I. Pocock, 458
- Göttingen Academy of Sciences, Profs. Bohr, Einstein, and von Kries elected foreign members of the, 23
- Government Publications : and their Distribution, Dr. F. A. Bather; T. Sheppard, 83; Prices of, 407
- Graduation, The Theory of, Prof. E. T. Whittaker, 146
- Graft-inheritance, L. Daniel, 174
- Graham, Thomas, the Life and Work of, W. B. Hardy, 171
- Grain Elevators, Pneumatic, Prof. W. Cramp and A. Priestley, 176
- Gravitation Einsteinienne : Champ de gravitation d'une sphère matérielle et signification physique de la formule de Schwarzschild, Prof. J. Becquerel, 152; Relativity and, 152
- Gray's Spicilegia Zoologica. Conclusion, O. E. Janson, J. R. le B. Tomlin, and Dr. F. A. Bather, 348
- Great Rift Valley, The Structure of the, E. J. Wayland; Prof. J. W. Gregory, 388
- Green, Jacob, Life and Work of, Dr. E. F. Smith, 364
- Greenland : Halibut, The (*Reinhardtius hippoglossoides*), J. R. Norman, 258; The Supposed Westerly Drift of, Sir Charles Close, 319
- Greenwich : Observations, 1920, 690; Royal Observatory, Annual Visitation, 910
- Grid for British Maps, The Choice of a, 469
- Grimselgegend, Vegetationsverhältnisse der, Dr. E. Frey, 585
- Gueugnon, L'Enregistreur, 587
- Gums, Refractive Index of : and a simple method of determining Refractive Indices, A. Mallock, 159, 643



- Guyane française, Étude descriptive sur les bois utiles de la, H. Stone, 528
- Gypsies, Migrations of the, Dr. J. Sampson, 319
- Gypsy Burial Customs, T. W. Thompson, 727
- Hæmoglobin of Vertebrates, Relation between the Affinity for certain Gases and the Position of the Spectral Bands in the, M. L. Anson and others, 554
- Hafnium Content of some Historical Zirconium Preparations, The, Prof. G. Hevesy, 384
- Hale's Magnetic Vortices, Prof. H. F. Newall, 112
- Halley Lecture, The, Prof. J. Joly, 829
- Halogens, Emission Spectra of the, E. B. Ludlam and W. West, 914
- Hardwood Cuttings, The Rooting of, R. C. Knight, 626
- Harrison, John: A. R. Hinks; R. A. S., 570; Lieut.-Commdr. R. T. Gould, 857
- Harrisonian Eoliths, The Geological and Cultural Age of the, J. Reid Moir, 461
- Harvard: Station in South America, Another, 366; University: Prof. A. N. Whitehead appointed to a chair in the faculty of philosophy at, 504, 542; gift to, from G. F. Baker, 840
- Hastings and St. Leonards Natural History Society, The, 365
- Hawaii, The Basaltic Lavas of, Prof. H. S. Washington, 97
- Hawaiian Islands, Control of Injurious Insects in the, by their Natural Enemies, Dr. R. C. L. Perkins, 402
- Hearing, The Theory of: Dr. H. Hartridge, 713; G. Wilkinson, 781; Prof. E. W. Scripture, 605, 925
- Heart, The, and the Spleen, The Absolute Weight of, Prof. R. Pearl and Agnes L. Bacon, 375
- Heat: in Solids, Conduction of, An Introduction to the Mathematical Theory of the, Prof. H. S. Carslaw. Second edition, 742; Small Sources of, Measurement of the Intensity of, A. Tian, 411; Transmission and Wall Insulation, Dr. E. Griffiths, 240
- Heating and Ventilation, Calculations in, Dr. G. S. Coleman, 816
- Heliotherapy and Phototherapy, Dr. W. Cramer, 80
- Helium: A Static Model for, Prof. H. S. Allen, 914; -filled Airships, 313; Low Voltage Arc in, R. Bär, M. von Laue, and E. Mayer, 251; The Spectrum of, in the Extreme Ultra-violet, Prof. T. Lyman, 785
- Hemiptera-Heteroptera, A Biology of the British, E. A. Butler, 156
- Hen, the Right Rudimentary Genital Gland in the, Signification of, J. Benoit, 215, 439
- Herpetomonas in Flies, Specificity of, E. R. Becker, 937
- Hevea Latex, Coagulation of, W. N. C. Balgrave, 440
- High: Power Three Electrode Valves with Removable Parts, Improvements in, M. Holweck, 915; Temperature Measurements, Continuous, in Glass Works, W. M. Clark, 555
- Hippuris vulgaris*, Linn., Germination of, R. D'O. Good, 33
- Histioteuthis bonelliana*, Fér., with Abnormal Reproductive System, G. C. Robson, 374
- Histoire Naturelle Illustrée: Les Plantes, Profs. J. Costantin et F. Faideau; Les Animaux, Les Invertébrés, Prof. L. Joubin; Les Vertébrés, A. Robin, 119
- Historja Naturalna Lodu (Histoire naturelle de la glace), A. B. Dobrowolski, 923
- Hive, The Mystery of the, E. Evrard. Translated by B. Miall, 452
- Honey-bee Larvæ, The Growth and Feeding of, J. A. Nelson and A. P. Sturtevant and B. Lineburg, 727
- Horniman Museum, Catalogue of specimens in the, Milligan. New edition, 402
- Host and Parasite, the Interaction of, W. H. Taliaferro, 447
- Hull Municipal Museums, issue of picture post-cards by the, 364
- Human: Embryo: Histogenesis of Formations and Secondary Organs in the, G. Lambertini, 735; The Early Development of the, Prof. T. H. Bryce, 914; Heart, The Radiographic Kinematography of the, Comandon and Lomon, 556; Intercourse by Means of Speech, Prof. H. Wildon Carr, 257; Race, Psychological Types of the, Prof. C. G. Seligman, 322
- Hutchinson's Splendour of the Heavens: a Popular Authoritative Astronomy. Edited by Rev. T. E. R. Phillips, assisted by leading astronomers, 884
- Hybodont Shark, A (*Tristychius*), from the Calciferous Sandstone Series of Eskdale (Dumfriesshire), Dr. A. Smith Woodward, 257
- Hydra, Behaviour and Structure of, Sheina Marshall, 728
- Hydraulic Turbines, Standard Tests for, preliminary report on, 652
- Hydraulics, E. H. Lewitt, 487
- Hydrobenzoin and its Alkyl Homologues (Symmetrical Diarylglycols), The Hypnotic Properties of, M. Tiffenau and C. Torres, 183
- Hydro-electrical Development in France, Recent, E. M. Malek, 399
- Hydrogen: and Air, Explosion of, Condensation Bands formed during the, G. H. West, 712; Chloride, Crystal Structure of, F. Simon and Fräulein C. v. Simon, 441; The Band-spectrum of, Prof. H. S. Allen, 878; The Continuous Spectrum of: Prof. H. B. Lemon, 127, 570; Prof. O. W. Richardson and T. Tanaka, 192; Prof. F. Horton and Dr. A. C. Davies, 273; Thermionic Currents in, M. Laporte, 369; Ions, The Determination of, an Elementary Treatise on the Hydrogen Electrode, Indicator and Supplementary Methods, with an Indexed Bibliography on Applications, Prof. W. M. Clark. Second edition, 157
- Hydrology, Ground-water, Dr. O. E. Meinzer, 175
- Hydrone and Water, Problems of: Sir Oliver Lodge, 193; the Origin of Electricity in Thunderstorms, Prof. H. E. Armstrong, 124; Luminous Ice, Prof. H. E. Armstrong, 163
- Hygiene and Medicine, Industrial, Dr. E. W. Hope, in collaboration with Drs. W. Hanna and C. O. Stallybrass, 188
- Hymenolepis: Life History of, Dr. H. H. Scott, 439; *nana* and *H. fraterna*, Dr. W. N. F. Woodland, 675
- Icarus, or the Future of Science, B. Russell, 740
- Ice: Age, The, and Man, Prof. A. P. Pavlov, 61; in the Arctic Seas, 657; in the Western North Atlantic, 620; Luminous, Problems of Hydrone, etc., Prof. H. E. Armstrong, 163
- Illuminating Engineering: Society, Report of the, 868; the Value of, to the Electrical Industry, L. Gaster, 450
- Illumination, Standardisation in, impending committee on, 725
- Illuminator, A new, for examining Metals, R. and J. Beck, Ltd., 658
- Immigrant to Inventor, From, Prof. M. Pupin, 186
- Impact Ionisation in Gases, Dr. L. Heis, 547
- Impacts, the Duration of, Experiments on, J. E. P. Wagstaff, 513
- Imperial: Cancer Research Fund, Eighth Scientific Report on the Investigations of the, 233; College of Tropical Agriculture: O. F. Boyd appointed Sugar Technologist, 477; Dr. H. M. Leake appointed principal of the, 946; Institute: Gift to the, by Lord Cowdray, 543; The, Dr. C. Christy, 617; the Exhibition Galleries to be kept open, 505; Wireless Services, appointment of a committee on the, 247
- India: etc., the Fauna of the Fresh and Brackish Waters of, Dr. N. Annandale, 437; Chemical Research in, Prof. J. F. Thorpe, 928; Director-General of Observatories, J. H. Field appointed, 829; Education in, Progress of, 1917-22, 946; Northern, Orographical Compensation in, R. D. Oldham and Col. H. McCowie, 211; Rainfall over, Dr. G. T. Walker, 836; Survey of, Report of the, for 1922-23, 900; Zoological Survey of, Report of the, for the years 1920 to 1923, 1
- Indian: Agriculture, The Foundations of, Dr. H. M. Leake. Second edition, 743; "Antiquary," Index to Volumes 1-50 (1872-1921), Lavinia Mary Anstey. 3 Parts, 672; Cultures, Ancient, on the San Juan River, E. H. Morris, 439; Scorpion, Spermatogenesis of an, Profs. D. R. Bhattacharya and J. B. Gatenby, 858; Textiles, Block Prints for, A. B. Lewis, 546
- Indiarubber, Refractive Index of, D. F. Twiss, 822
- Indium, The Mass-spectrum of, Dr. F. W. Aston, 192
- Indo: -Gangetic Alluvial Plain, Changes in the, W. H. Arden-Wood, 143; -Pacific Bopyridæ, B. Chopra, 367



- Industrial: Administration, D. Smith, 406; Medicine, 188; Research Associations, Work of the, 22; Testing Apparatus, Catalogue of, A. Gallenkamp and Co., Ltd., 140
- Industry, Productive, School and University Preparation for, 297
- Infectious Diseases, Local Immunity in, Prof. Besredka, 242
- Infinite Processes, Elements of the Theory of, Prof. L. L. Smail, 487
- Influenza Returns, 315
- Infra-red Radiations, Permeability of Synthetic Resin to the, G. Kimpflin, 879
- Inheritance of Characters acquired by Grafting, Prof. W. Johannsen, 536
- Insanity, Responsibility in, Dr. J. Warnock, 286
- Insecticides, Contact, An Apparatus for Testing, F. Tattersfield and H. M. Morris, 762
- Insects, New or Rare, from Great Britain, J. V. Pearman and others, 728; Social Behaviour among, 452; Social Life among the, Prof. W. M. Wheeler, 452; The Language (if any) of, A. P. Trotter, 747
- Inspection and Testing of Materials, Apparatus, and Lines, The, F. L. Henley, 638
- Institut de France, Academy of Sciences of the, Sir William J. Pope elected a corresponding member of the, 758
- Institute of Chemistry, election of officers and council, 401
- Insulation Tester, New, Evershed and Vignoles, Ltd., 63
- Insulin: Improvements in the Preparation of, H. W. Dudley and W. W. Starling, 546; The Action of, The Influence of Temperature on, J. S. Huxley and J. F. Fulton, 234
- Integrals and Series of Generalised Fourier-type in Associated-Legendre-functions, Prof. W. McF. Orr, 410
- Interférences lumineuses, Les Applications des, Prof. C. Fabry, 120
- Intermetallic Compounds, the Atomic Structure of Two, E. A. Owen and G. D. Preston, 914
- Internal Combustion Engines, the Thermal Efficiency of, Standards of Comparison in Connection with, G. J. Wells, 651
- International: Hydrographic Bureau, Rear-Adml. A. P. Niblack elected a director of the, 401; Scientific Unions, The National Union of Scientific Workers and the, 868
- Invisible Rays of Destruction, H. Grindell-Matthews, 617
- Iodosalicylic, A new, P. Brenans and C. Prost, 556
- Ireland: Geology of, Thos. Murby and Co., 713; the North-West of, The Glacial Geology of, J. K. Charlesworth, 214
- Irish Free State Government, Prof. H. Ryan appointed Chief State Chemist for the, 653
- Iron: Age, The, Dr. J. Newton Friend, 25; and Steel: Institute, Report of the, for 1923, 757; Notes on, Brig.-Gen. R. K. Bagnall-Wild, 867; Specific and Latent Heats of, A. Mallock, 566; Lines, Relation between Pressure Shift, Temperature Class, and Spectral Terms of the, M. A. Catalan, 889; Pharmacological Investigations on, V., L. Sabbatani, 771; the Rusting of, The Mechanism of, U. R. Evans, 294; The Spectrum of, S. Goudsmit, 604
- Isle of Wight Bee, Disease, Acarine or, C. Samman and Prof. J. B. Gatenby, 735
- Isopod allied to Phreatoicus, A new Freshwater, G. E. Nicholls and D. F. Milner, 103
- Isotopic Elements, Spectroscopic Evidence of, Prof. H. Nagaoka and Y. Sugiura, 532
- Italian Idealists, The Problems of Religion for the, C. Pellizzi, 590
- "Iter Turcico-Persicum," Dr. F. Nábělek, 760
- Jābir ibn Hayyān, Prof. Ruska, 207
- Jacksonian Essay, The Effect of Radium upon Living Tissues: with Special Reference to its Use in the Treatment of Malignant Disease, Dr. S. Forsdike, 601
- Jacquards and Harnesses: Card-cutting, Lacing, and Repeating Mechanism, T. Woodhouse, 742
- Japan, the Imperial University of, Assistance to the Library of, 469
- Japanese Earthquake of September 1, The: 135; Prof. S. Fujiwara, 254; I. Tokugawa, 473
- Jerusalem: Artichoke, Heredity of an Acquired Character by Grafting in the, L. Daniel, 103; Scientific Papers Published in, 935
- Jewish Race, An Analysis of the, Dr. R. N. Salaman, 659
- Johnson, Martin, Corporation, The, 436
- J Phenomena, Scattering of X-ray Quanta and the, Prof. A. H. Compton, 160
- Julian Calendar, The End of the, M. Milankovitch, 580
- Junior Teaching Appointments at Universities, Prof. G. H. Hardy and Major A. G. Church, 746
- Jupiter: 655; Occultation of a Star by, L. J. Comrie, 173
- Kalahari: Scheme, The, as the Solution of the South African Drought Problem, Prof. E. H. L. Schwarz, 539; The Ancient River System of the, and the Possibility of its Renewal, Prof. J. W. Gregory, 539
- Kant, Immanuel: Bicentenary of the Birth of, 651; Memorial Oration on, Prof. A. von Harnack, 723
- Kaolin, Dehydration of, The Product of the, W. Vernadsky, 592
- Kaolins: and Fused Bauxites, A. Bigot, 327; Clays, etc., A. Bigot, 146
- Kelvin, Lord: an Appreciation of, Sir J. J. Thomson, 934; Birth, the Centenary of, 170; Gold Medal, award of the, to Prof. Elihu Thomson, 282, 688
- Kew, Royal Botanic Gardens: New Illustrated Official Guide to the, 689; Work of the, Dr. A. W. Hill, 442
- Kidney Secretion, The *modus operandi* of, Dr. W. N. F. Woodland, 891
- Kinematograph: Demonstration by the Selborne Society, A, 94; Films for Use in Schools, "New Era Films, Ltd.," 831
- Kinetic Atom, The, Sir Oliver Lodge, 15
- King's Birthday Honours, The, 829
- Kish, Excavations at, Prof. Langdon, 174
- Kitchener Memorial Medical School at Khartum, Opening of the, 372
- Knossos: Gift of Property at, to the British School at Athens, by Sir Arthur Evans, 205; New Discovery at, Sir Arthur Evans, 898
- Knowledge, A Theory of, Prof. C. A. Strong, 121
- Koch Bacillus, Action of the Various Constituents of the, on the Evolution of Experimental Tuberculosis in the Rabbit and the Guinea-pig, A. Boquet and L. Nègre, 515
- Korea, Weather in, 26
- Kristalle und Röntgenstrahlen, Prof. P. P. Ewald, 302
- "Kugelblitz, Der," Dr. W. Brand, 677
- Kunstformen der Natur, Prof. E. Haeckel. Zweite Auflage. Niedere Tiere, 847
- Labour, Science and, 737
- Labyrinth Correlated, Dimensions of the, H. J. Watt, 806
- La Courtine, The Explosive Wave of, H. Deslandres, 879; A. Dufour, 880
- Lake Victoria (Central Africa), Variation in the Level of, P. Phillips, 440
- Langerhans, The Islands of, Prof. Swale Vincent, 834
- Lango: The, a Nilotic Tribe of Uganda, J. H. Driberg, 42
- Lankester, Ray, Investigator at the Laboratory of the Marine Biological Association, Dr. L. Hogben appointed, 504
- Lapicque's Investigations on the Chronaxie of Excitable Tissues, J. F. Fulton, 427
- Larch Manna, Prof. A. Henry, 904
- Latent Image after Fixing, Development of the, L. Lumière, A. Lumière, and A. Seyewetz, 915
- Laterite and Bauxite, C. S. Fox, 658
- Lattice-points of a Circle, The, J. E. Littlewood and A. Walfisz, 878
- L'Audition et ses variations, Dr. Marage, 488
- Lead: and Zinc Ores: of Durham, Yorkshire, and Derbyshire, with Notes on the Isle of Man, R. G. Carruthers and Sir Aubrey Strahan, 75; of Northumberland and Alston Moor, Dr. S. Smith and R. G. Carruthers, 75; -cadmium and Lead-tin Alloys, Hardness of, Clara di Capua and Maria Arnone, 916; Common, Fractional Crystallisation of, R. H. Atkinson, 495; Mining in Northumberland and Durham, Prof. H. Louis, 75



- League of Nations. Committee on Intellectual Co-operation. Report on Scientific Property submitted by Senator F. Ruffini and approved by the Committee, 593
- Least Squares, Practical, O. M. Leland, 158
- Leaves, Phototropic Movements of, N. G. Ball, 70
- Le Blanc medal of the French Chemical Society, The, presented to Prof. T. M. Lowry, 579
- Leeds University: gift by E. W. Cockerlyne; W. J. Will appointed assistant lecturer in agriculture, and C. H. Chalmers demonstrator in agricultural botany, 181; H. G. E. White invited to take the field-direction of an archaeological expedition in Egypt, 255; Dr. C. K. Ingold appointed professor of organic chemistry; gift by the Leeds and District Leather Trades Association; forthcoming jubilee of the Yorkshire College, and the coming of age of the University, 324; Report on University Extension Lectures and Tutorial Classes, 444; the Woodall Experimental Gas Plant handed over to, 503; new Agricultural Building at the, 550; new Library arrangements; Dr. N. Comber elected professor of agricultural chemistry; a portrait of Sir Michael Sadler to be painted by H. Lamb, 840; the memorial to Prof. A. Smithells, 945
- Leib und Seele: eine Untersuchung über das psychophysische Grundproblem, Prof. H. Driesch. Dritte Auflage, 233
- Lens, Single, Relation between Aperture, Axial Thickness, and Form for a, T. Smith, 145
- Lenses, Thin, The Primary and Secondary Constant Magnification Surfaces of, T. Smith, 33
- Leprosy: The British Empire Campaign against, 185; Relief Association, The British Empire, 203
- Leuna Works, Explosion at the, 171
- Libyan Desert, Hassanein Bey's Journey in the, 59
- Life: The Physical Basis of, Prof. E. B. Wilson, 742; without Oxygen, Dr. W. M. Clark, 656
- Lifts, Electric Passenger, Marryat, 176
- Light: Artificial, The Applications of, J. S. Dow, 170; on Metals, The Electro-motive Forces produced by, immersed in Solutions of their Salts, G. Athanasiu, 259; -quanta: Collisions between, H. Bateman, 924; The Problem of, Duc de Broglie, 474; The Radiation of: by Excited Atoms, Prof. G. Mie, 586; Prof. H. A. Lorentz, 608
- Lightning: and High-voltage Phenomena, F. W. Peek, 312; Ball, Dr. G. C. Simpson, 677
- Limbs, the Heteroplastic Transplantation of, Some Unexpected Results of, R. G. Harrison, 628
- Lime-rocks in the United States, F. A. Wilder and others, 97
- Linnæa: Habitats of, Dr. W. R. G. Atkins and Dr. Marie Lebour, 656; *truncatula* and *L. pereger*, The Habitats of, in Relation to Hydrogen Ion Concentration, Drs. W. R. G. Atkins and Marie V. Lebour, 258
- Limulus, The Predecessors of, C. O. Dunbar, 96
- Linacre Lecture, The, Sir Charles Sherrington, 732
- Line: and Band Spectra, The Isotope Effect in, Dr. R. S. Mulliken, 820; Charts for Engineers, W. N. Rose, 453
- Linkage of Dutch, English, and Angora in Rabbits, W. E. Castle, 663
- Linnæus in Holland, etc., The Work of, Dr. A. B. Rendle, 879
- Linnean Society: of London, Prof. H. O. Juel, Dr. H. Spemann, and Dr. Johs. Schmidt elected foreign members of the, 724; the gold medal of the, presented to Prof. W. C. McIntosh, 832; election of officers, 833; Lt.-Col. A. T. Gage appointed librarian and assistant secretary of the, 936
- Linsed Selection Experiments in India, Mrs. G. L. C. Howard and Abdur Rahman Khan, 872
- Liquid: Crystals, Soap Solutions, and X-rays, Prof. J. W. McBain, 534; Oxygen and its Uses, Prof. H. Briggs, 166
- Liquids: Extremely Dry, Prof. G. N. Lewis, 175; in the Electric Field, The Isotopic Augmentation of the Index of, W. Pauthenier, 948
- Lister, Lord, The Memorial to, 430
- Liverpool: Geological Society, Proceedings of the, 365; University: grant from the Darwin Fund to Dr. Margery Knight, 102; J. C. Burkill appointed professor of pure mathematics; the title of associate professor conferred on J. Rice, 877
- Living Beings and Mechanical Engines, Comparison between, L. Kahn, 327
- Livingstone College Commemoration Day, 899
- Lobster, The Moulting of the, R. Elmhirst, 367
- Local Immunity in Infectious Diseases, Prof. Besredka, 242
- Lockyer, Norman, Observatory, Sidmouth, Annual Report, 902
- "Locusts, Only Way to tackle," F. W. Fitzsimons, 686
- Loess, Some Properties of, V. Agafonoff, 147
- Logic, Dr. W. E. Johnson. Part 3: The Logical Foundations of Science, 522
- London: County Council, proposed Sir Robert Blair fellowships, 372; on the Thames: a Study of the Natural Conditions that influenced the Birth and Growth of a Great City, H. Ormsby, 780; School of Hygiene and Tropical Medicine, A Royal Charter granted to the, 545; Underground Electric Railways, Bacterial Content of the Atmosphere of the, Dr. J. G. Forbes, 691; University: Prof. G. B. Jeffery appointed Astor professor of mathematics at University College; Miss Eleanor M. Scarborough appointed reader in pharmacology at the London School of Medicine for Women; conferment of a doctorate on M. Ginsberg; Prof. H. MacLean awarded the W. J. Mickle fellowship; H. Cloughton appointed financial officer and secretary to the Senate, 32; award of doctorates, 102; Dr. A. W. Porter appointed professor of physics at University College; E. C. Rhodes appointed reader in statistics at the London School of Economics; conferment of doctorates, 212; the Bloomsbury site of, 281; award of doctorates; gift by Brunner, Mond and Co., Ltd., 324; conferment of doctorates; new fellows of University College and King's College, 372; award of doctorates, 477; Prof. A. E. Jolliffe appointed professor of mathematics at King's College; J. D. Wilson appointed professor of education at King's College, 511; the proposed revival of State scholarships; grants from the Publication Fund; conferment of a doctorate, 511; F. R. M. de Paula appointed reader in accounting and business organisation at the London School of Economics, 804; conferment of doctorates; a grant made from the Publication Fund to Miss M. M. McFarlane; Report of the Principal Officer for 1923-1924, 804; P. J. Baker appointed to the Sir Ernest Cassel chair of International Relations at the London School of Economics, 804; R. C. Richards appointed Quain lecturer in physics at University College, 877; proposed course of study leading to an M.Sc. degree, 898; award of doctorates, 912; Zoological Society's Aquarium, The, 571
- Long: -distance Projection of Large Autochromes, L. Lumière, 939; -range Particles from Radium-active Deposit, D. Petterson, 641
- Longitudes, Bureau des, Annuaire of the, 1924, 95
- Longstaff medal of the Chemical Society presented to Prof. F. G. Donnan, 503
- Loricates, Relation of the, to the Country Rock, A. F. Basset Hull, 843
- Los Islands (Guinea), The Nephelene Syenites of the, A. Lacroix, 626
- Lough Neagh Clays, Age and Origin of the, W. B. Wright, 446
- Low Temperature Carbonisation, S. N. Wellington and W. R. Cooper; Dr. C. H. Lander and R. F. McKay, 920
- Lumière: Éléments de la théorie électromagnétique de la, Prof. L. Silberstein. Traduit de l'anglais par G. Matisse, 488; monochromatique, La, sa production et son emploi en optique pratique, Prof. C. Fabry, 120
- Luminescence and Symbiosis, II., M. Pierantoni, 843
- Lunar: Atmospheric Tide at Mauritius and Tiflis, The, Prof. S. Chapman, 326; Eclipse of February 24, The, A. Danjon, 619; Eclipses, The Brightness of, Prof. W. J. Fisher, 782
- Lupinus, Seedling Anatomy of some Species of, H. S. Holden and A. Evelyn Chesters, 626
- Luxor and its Temples, Dr. A. M. Blackman, 600



- McGill University, gift by Lady Strathcona, 324  
Mach, Einstein and, Prof. B. Brauner, 927  
Madagascar, The Baras of, Dr. R. Verneau, 871  
Madeira Islands, The Coccidæ (Scale-insects and Mealybugs) of the, Prof. T. D. A. Cockerell, 164  
Madras Government Museum, re-opening of the Invertebrate and Fish Galleries, 901  
Magnetic Anomalies, Laws of the, caused by Electric Currents, or by Magnetic Deposits, P. Lasareff, 374;  $\beta$ -ray Spectra, The Absolute Energies of the Groups in, C. D. Ellis and H. W. B. Skinner, 145; Boreholes, A. Millar, 14; Fields, Strong, A Method of producing, P. L. Kapitza, 878; Hysteresis, The Control Field in, R. C. Gray, 146; Materials, Intense Magnetic Fields and the Disturbance of Electronic Orbits in, Dr. T. F. Wall, 568; Variation in North Polar Regions, H. Spencer Jones, 139  
Magnetisation by Rotation, R. Lucas, 368  
Magnetite, The Electrical Conductivity of, Prof. E. Wilson and E. F. Herroun, 293  
Magnetocaloric Phenomenon, The, and the Specific Heat of Nickel, P. Weiss and R. Forrer, 699, 771  
Main Line Electrification, Col. O'Brien, 577  
Malaria: Film, Demonstration of a, Dr. A. Balfour, 898; Human, The Transmission of: Prof. B. Grassi, 304, 458; Sir Ronald Ross, 353  
Malayan Blattidæ, Dr. R. Hanitsch, 506  
Malebranche, Prof. H. Wildon Carr, 116  
Malta, Neanderthal Man in, Sir Arthur Keith, 405  
Mammalian: Anatomy, Laboratory Studies in, Prof. I. W. Wilder, 923; Heart, Early Development of the, Dr. Katherine M. Watson, 319  
Mammato-cloud, Formation of: Lt.-Col. E. Gold, 235; Capt. C. K. M. Douglas, 462  
Man: The Empire of, 629; The Making and Ministry of, 266; The Origin of, Dr. A. A. Mendes-Corrêa, 761; What is, Prof. J. A. Thomson, 266  
Manchester: Literary and Philosophical Society: election of officers, 758; History of the, during its First Seventy Years, F. Nicholson, 770; Museum, Report for 1922-23, 364; University: the degree of Ph.D. conferred on B. Moore, 69; unveiling of a bust of Prof. H. B. Dixon, 255; conferment of honorary degrees, 477  
Manchus, Social Organisation of the, Dr. Shirokogoroff, 656  
Mandan Music, F. Densmore, 800  
Manganese, The Spectrum of, Dr. S. Goudsmit, 238  
Man's Antiquity and Origin, 382  
Manuring: and Vitamins, Col. McCarrison, 620; for Profitable Production, F. E. Corrie, 470; of Grass Land for Hay, Dr. Winifred E. Brechley, 482  
Maori: Mantle: The, and some Comparative Notes on N.W. American Twined Work, H. Ling Roth, 638; String Games, J. C. Anderson, 937  
Maps, Old, Watermarks of, E. Heawood, 761  
*Marchantia polymorpha*, Sexual Reproduction in, in its Relations with Cellular Structure, P. A. Dangeard, 215  
Marine: Algæ, Distribution of, Svedelius, 800; Chronometer: The, its History and Development, Lt.-Comdr. R. T. Gould, 415; *Observer*, The June, 868; Products of Commerce, Dr. D. K. Tressler (with collaborators), 529; Teleosteans, The Remarkable Constancy of the Internal Medium of the, M. Duval, 147  
Marlborough College Natural History Society, Report of the, for 1923, 833  
Mars: 366; and Jupiter, Conjunction of: 137; W. Gornold, 756  
Maryland, The Silurian Strata and Ostracoda of, C. K. Swartz and others, 403  
Mass-spectrograph, Recent Results obtained with the, Dr. F. W. Aston, 856  
Mathematical: Analysis, Practical, Prof. H. von Sanden, with Notes by the Translator, Prof. H. Levy, 453; Biology, 484; Philosophy, a Study of Fate and Freedom: Lectures for Educated Laymen, Prof. C. J. Keyser, 741; Physics in University and School, 665; Tables: Prof. G. H. Bryan, 637; Four-figure, F. Castle, 637  
Mathematics: Elementary, A Course in, for Schools, Dr. H. E. J. Curzon. Books 3 and 4, 638; for Engineers, W. N. Rose. Part 2. Second edition, 453; for Three-year Advanced Courses and Leaving Certificate Courses, Note as to, and a Syllabus of Study, 882; in America, Prof. G. A. Miller, 251; Practical: Dr. S. Brodetsky, 453; V. T. Saunders, 709; Elementary Experiments in, R. C. Fadwry, 709; Fundamentals of, G. Wentworth, D. E. Smith, and H. D. Harper, 453; Sense of Direction in, T. C. Hudson, 747  
Maury, M. F., The Life and Work of, Prof. C. A. Smith, 315  
Mechanics: An Introduction to the Principles of, J. F. S. Ross, 420; Applied: International Conference on, 172; International Congress on, 802; Experimental, A Course of, H. J. E. Bailey, 780; *via* the Calculus, P. W. Norris and W. S. Legge, 600  
Mechanism, A Polemic against, J. Y. T. Greig, 154  
Medical: Biometry and Statistics, Introduction to, Prof. R. Pearl, 563; Discovery, The Encouragement of, Sir Ronald Ross, 569, 710; History of the War, 42; Research: in Great Britain, 481; Council: E. F. L. Wood and Major A. G. Church, appointed members of the, 400; Diphtheria: its Bacteriology, Pathology, and Immunology, Sir Frederick W. Andrewes and others, 527; Report of the, for the year 1922-1923, 481; Year-book, The, 1924. Edited by C. R. Hewitt, 44  
Melanism, Inheritance of, Dr. H. Harrison, 96  
Melbourne University, Dr. J. N. Greenwood appointed professor of metallurgy, 32  
Meldola medal, the, awarded to C. N. Hinshelwood, 363  
Mellish's Comet, 1917 I., Orbit of, S. Asklöf, 619  
Mendel, Centenary of the Birth of, 172  
Mendelian Heredity, The Mechanism of, Prof. T. H. Morgan and others. Revised edition, 518  
Mendelism and Evolution: C. Tate Regan, 50, 569; J. S. Huxley, 518, 569, 822; C. Dover, 712  
*Mercierella enigmatica* Fauvel, A New Polychæte Worm, C. C. A. Monro, 33  
Mercury: 505; and Bismuth, Isotopes of: and the Satellites of their Spectral Lines, Prof. C. Runge, 781; revealed in the Satellites of their Spectral Lines, Prof. H. Nagaoka, Y. Sugiura, and T. Mishima, 459; and Venus, Rotation Periods of, A. Danjon, 580; Atom, Binding of Electrons in the Nucleus of the, Prof. H. Nagaoka, Y. Sugiura, and T. Mishima, 567; Seals, Advice for using, on Ground Joints in Horizontal or Inverted Positions, J. A. Carroll, 858; Standard Cells, Vosburgh and Eppley, 404; The Transit of: on May 8, 760, 833; H. Deslandres, 842; P. Stroobant and others, 879; Vapour, Luminous, Selective Absorption by, E. P. Metcalfe and B. Venkatesachar, 213  
Meridian of France, The, Col. Perrier; Sir C. F. Close, 56  
Mesomorph States and Magnetic Double Refraction, L. Royer, 592  
Mesothorium-2, the  $\beta$ -rays of, The Magnetic Spectrum of, D. Yovanovitch and J. d'Espine, 915  
Mesozoic Insects of Queensland, No. 10, Dr. R. J. Tillyard, 36  
Mesures électriques, Appareils de, M. Chirol, 349  
Metabolism: Abnormal, 595; Inborn Errors of, Sir Archibald E. Garrod. Second edition, 595  
Metal Films, X-ray Examination of, Sir W. H. Bragg, 639  
Metallic Vapours, The Absorption Spectra of Mixed, S. Barratt, 213  
Metallurgy: Medieval, M. L. Becker, 258; The Applications of Physics to, Prof. C. H. Desch, 283  
Metals: disintegrated by an Electric Discharge? Are, Prof. Harkins and S. K. Allison, 729; in the Solid State, The Removal of Sulphur from, B. Bogitch, 514; Institute of, The Journal of the. Edited by G. Shaw Scott. Vol. 29, 120; Properties of, Effects of Temperature on the, A. Mallock, 213; The Electrodeposition of, 851; The Tarnishing and Fogging of, Prof. H. C. H. Carpenter, 178  
Metaphysics, Dialogues on, and on Religion, N. Malebranche. Translated by Dr. M. Ginsberg, 116  
Meteor: Showers probably associated with Comets, W. F. Denning, 870; Trails, Spectra of, C. C. Trowbridge, 448  
Meteoritic Shower, The January, W. F. Denning, 60



- Meteorological : Factors and Forest Fires in the U.S., 659 ;  
Instruction, G. M. B. Dobson and others, 99 ;  
Literature, Bibliography of, No. 5, 901
- Météorologie pratique, *Études élémentaires* de, A. Baldit.  
Deux. édition, 43
- Meteorology : Popular, 486 ; and Sun-spots, Dr. C. Chree,  
214 ; The Science of the Atmosphere, C. F. Talman,  
486
- Meteors, June, W. F. Denning, 902
- Methane Gas, Behaviour of Low Velocity Electrons in,  
G. Glockler, 844
- Methyl Alcohol : Commercial Synthesis of, 251 ; The  
Detection of, in the Presence of Ethyl Alcohol,  
A. Kling and A. Lassieur, 556
- Methylamine, The Preparation of, M. Sommelet, 183
- Metric : Standards Bill, A, introduced in the House of  
Representatives of the U.S.A., 245 ; System in  
Russia, The, 93
- Mexico, Temperature of, J. Hernandez, 582
- Mica Group, The Chemical Classification of the, A. F.  
Hallimond, 214
- Michelson, Wladimir, Experimental Verification of the  
Principle of, and of the Doppler-Fizeau Principle,  
A. Perot, 259
- Michelson's Experiment, The Precision of, E. Brylinski, 35
- Microcalorimetric Method, The Utilisation in Biology of  
the, A. Tian and J. Cotie, 699
- Microgranite from Dufton, Westmorland, and of Mica  
from Burma, Chemical Analyses of, H. C. G. Vincent,  
554
- Micro : -miscibilities, A Method of Determination of, N.  
Perrakis and A. Massol, 215 ; -organisms from  
Samples of Water, A Simple Apparatus for the  
Extraction of, W. E. Hall, 374
- Micropalæontology of Post-glacial Deposits in Northern  
Scotland, G. Erdtman, 947
- Microseisms, Rev. E. Gherzi, 835
- Microscope : A Small Measuring, T. F. Connolly and  
E. H. Coumbe, 535 ; Baker's New Model R.M.S., 658 ;  
Corneal, A New Form of, with Combined Slit-lamp  
Illuminating Device, E. F. Fincham, 374 ; for  
Observation of Interference Fringes, C. W. Hawksley,  
326 ; in Metallurgy, Use of the, Sir Robert Hadfield,  
170 ; the Petrological, Design of, Prof. F. J. Cheshire,  
214 ; The Practical Use of the, in the Bee-keeping  
Industry, Annie D. Betts, 734
- Microscopes and Accessories, Catalogue of, J. Swift and  
Son, Ltd., 285
- Microscopic Aquatic Biology, The Physical Factors  
involved in the Problems of, D. J. Scourfield, 437
- Microscopy : Analytical, its Aims and Methods, T. E.  
Wallis, 601
- Migrant, An Early, Dr. H. O. Forbes, 239
- Migration of the Chromosomes, Supposed, towards the  
Poles during the Ana-phase of Karyokinesis, E.  
Giglio-Tos, 916
- Milk : and Butter Fat, Effect of the Accessory Food  
Factors on the Quantity of, E. J. Sheehy, 411 ; Clean,  
W. Buckley, 127 ; Testing by Hydrogen-ion Deter-  
minations, Coledge, 209
- Mill Hill School, The New Science Department of, W. H.  
Brown, 323
- Mind in History, Freedom of the, Dr. H. O. Taylor, 885
- Mineral Resources of the British Empire, The, T. Crook,  
752
- Mineralogy : Optical, Elements of, an Introduction to  
Microscopic Petrography, N. H. Winchell and A. N.  
Winchell. Entirely re-written and much enlarged  
by Prof. A. N. Winchell. Second edition. Part I,  
600
- Mining and Metallurgy, Institution of, award of the gold  
medal of the, to H. W. Gepp and G. Rigg, 317
- Mira Ceti : Approaching Maximum of, A. A. Nijland, 137 ;  
The Companion of, Dr. A. H. Joy, 173
- Miscibility on Volumes, Influence of the Neighbourhood  
of the Critical State of, N. Perrakis, 411, 771
- "Missing Element" between Cadmium and Mercury,  
The, Prof. W. M. Hicks, 642
- Mistletoes in Malaya, W. N. Sands, 872
- Moa, The, and Man in New Zealand, H. D. Skinner, 367
- Model Engineers' Exhibition, The, 59
- "Modern Technique in Treatment," 900
- Moléculaires : Volumes, Applications, Prof. A. Leduc, 383
- Molecular Activation, The Mechanism of, R. G. W.  
Norrish, 294
- Molecules in Upper Quantum States, Duration of, R. C.  
Tolman, 663
- Mollusca damaging Brickwork, Dr. N. Annandale, 250
- Molybdenum, Estimation of Small Quantities of, A. Vila,  
35
- Monazite Sands and other Sources of Thoria, Dr. E. H.  
Pascoe ; The Writer of the Article, 238, 607
- Mongolia, the Third Asiatic Expedition in, Discoveries  
during the Season of 1923 by, Prof. H. F. Osborn, 448
- Monkeys, A New Genus of, R. I. Pocock, 374
- Monozoa, Dr. W. N. F. Woodland, 286
- Montefiore, Fondation George, The triennial prize of  
the, 205
- Moon : Colour Photography of the, F. J. Hargreaves and  
the Rev. T. E. R. Phillips, 833 ; Total Eclipse of the :  
249 ; E. Esclançon, 515 ; The Photometric Study of,  
A. Danjon, 591 ; God at Ur, The Temple of the,  
F. G. Newton, 834
- Morgan Library, Gift of the, by J. Pierpont Morgan, 284
- Mortality Statistics of Sweden and of England and Wales,  
M. Greenwood, 806
- Mosaic Diseases, The Virus of the, B. M. Duggar and  
Joanne K. Armstrong, 835
- Motion, The Optical Effects of, Prof. P. Zeeman, 796, 838
- Moulds, Comparative Energy Yields in the Development  
of, at the Expense of Carbohydrates or of Proteids  
and Specific Dynamical Action, E. F. Terroine, R.  
Bonnét, R. Jacquot, and G. Vincent, 515
- Mummies, Radiography of, 623
- Muscular Receptivity, Problems of, Sir Charles Sherring-  
ton, 732, 892, 929
- Museums in Relationship to Schools, L. V. Coleman, 869
- Mycorrhiza, Field Observations on, R. Paulson, 33
- Myrtaceous Plants, certain, Occurrence of Secretory Canals  
in, M. B. Welch, 148
- Mysore, Weather in, C. Seshachar, 139
- Naga Hills, The Use of Stone in the, J. H. Hutton, 591
- Naphthalene Vapour : Analysis of the Absorption spec-  
trum of, V. Henri and H. de László, 878 ; the Effect of,  
on Red Spider Mite (*Tetranychus telarius*, L.), E. R.  
Speyer and O. Owen, 820 ; The Ultra-violet Absorp-  
tion Spectrum of, V. Henri and H. de László, 556
- Naples : the University of, the 700th Anniversary of, 687 ;  
the Zoological Station at, 449, 469
- Natal, The Vegetation of, Prof. Bews and R. D. Aitken, 440
- National : Boarding Schools, E. Remnant, 769 ; Physical  
Laboratory, Collected Researches of the, for 1922,  
934 ; Union of Scientific Workers, Annual Council  
Meeting ; Prof. G. H. Hardy elected president of the  
Union and Dr. J. W. Evans president of the Research  
Council, 211
- Native Education in British Tropical African Depend-  
encies, appointment of members of the advisory com-  
mittee on, 70
- Natur : Das Zweckgesetz in der Grundlinien einer Meta-  
mechanik des Lebens, Prof. A. Wagner, 266
- Natural History, 119
- Nature : and Human Nature : Essays Metaphysical and  
Historical, H. B. Alexander, 564 ; Art-forms in, E.  
Heron-Allen, 847 ; The Protection of : in Britain,  
557 ; Proposed Central Correlating Committee for, 136
- Naturwissenschaften, Ergebnisse der exakten, Zweiter  
Band, 303
- Neanderthal Man in Malta, Sir Arthur Keith, 405 ; The  
Brain of, Prof. R. Anthony, 207
- Nebulae : The Problem of the, J. H. Reynolds, 690 ; Dark,  
Prof. G. E. Hale, 249
- "Nebulium," The Spectrum of, H. B. Lemon, 764
- Nematode : Life-history, Recent Work on, T. Goodey,  
734 ; Parasites of Plants, Dr. T. Goodey, 250
- Neolithic Painted Pottery from the Bukovina, V. G.  
Childe, 656
- Neon : Discharge Tube, the Low-voltage, The Critical  
Resistance for Flashing of, J. Taylor and W. Clarkson,  
590 ; Lamp, Some Electrical Properties of the, U. A.  
Oschwald and A. G. Tarrant, 590



- Neo-vitalism, Philosophic, A Defence of, Prof. D. Fraser Harris, 759
- Nephridia of Worms, Prof. K. M. Bahl, 937
- Neptune, Rotation period of, 366
- Netherland Indies: Cloud and Sunshine in, 692; Rain in the, 209
- Newcomen Society, Transactions of the, Vol. 2, 40
- New Mexico: Pre-Columbian Ruins in, J. A. Jeancon, 403; The Mimbres Valley, Prehistoric Pottery from, Dr. J. W. Fewkes, 367
- New South Wales: Public Health, Report for 1922 of the Director-General of, 726; Vegetation of Arid and Semiarid. Pt. II., Marjorie I. Collins, 843
- Newton: On Editing, Sir Joseph Larmor, 744; Suggestion that the Name should be substituted for the Term "Horse-power," Subrahmanian and Gunnaiya, 869
- Newton's "Principia," The Printing of, 618
- New Year Honours, 22
- New Zealand: Naturalised Plants and Animals of, Hon. G. M. Thomson, 439; Research Activities in, Dr. J. A. Thomson and the Hon. G. M. Thomson, 471; The Dominion Museum, Report of, 437
- Nickel: Hydroxide, Evolution of the Molecule of, in the presence of Water, Mlle. Suzanne Veil, 514; in Ancient Bronzes, Prof. R. A. Dart, 888; The Magnetic Isotherms of, P. Weiss and R. Forrer, 591
- Nicotiana Tabacum*, Inheritance in, V., R. E. Clausen and Margaret C. Mann, 843
- Nile Flood of 1913, The, 97
- Nitrogen: Action of the Oxides and Oxyacids of, Prof. H. Ryan and J. Keane and others, 70, 71; and of Oxygen, The Ratio of the Specific Heats of, Prof. J. R. Partington and A. B. Howe, 213; Fixation in Leaf Glands, M. Y. Orr, 834; for the Higher Plants, The most favourable Form of, G. Truffaut and N. Bezssonoff, 411; Solid, Emission of Light by, and the Origin of the Spectrum of the Aurora, L. Vegard, 627
- Nitrosophenylurethane, Condensation of, with Toluylendramine, Prof. H. Ryan and M. Egan, 555
- Nitrous Acids and Nitrous Fumes, Action of, on Urethanes and other Bodies, Prof. H. Ryan and M. Egan, 555
- "Nomenclator animalium generum et subgenerum," the, 543
- Non: -ferrous Metals, Melting and Working, 696; -resident Students, Principal Coles, 406
- North: American Later Tertiary and Quaternary Bryozoa, F. Cann and R. S. Bassler, 139; Atlantic, The Ice Drift in the, 543; Polar Land, The Hypothetical, L. Hawkes, 275; Sea, Bottom Fauna of the, Prof. J. Stanley Gardiner, 442
- Northern Greenland, Vegetation in, 762
- Norway, Plant Remains in, T. Vogt, 620
- Norwegian: Hawkweeds, S. O. F. Omang, 319; Meteorological Service, Losses of the, Dr. G. C. Simpson, 248
- "Nuclear" Characters in classifying Marine Gastropods, Dr. W. H. Dall, 903
- Nucleic Acids, The, Prof. H. Maclean, 524
- Numbers, The Theory of: 76; History of, Prof. L. E. Dickson, Vol. 3: Quadratic and Higher Forms. With a chapter on the Class Number by G. H. Crease, 76
- Nummulites, The Earliest, in the Eocene of Béarn, H. Douvillé, 146
- Nuyts Archipelago, Fauna of, Prof. F. Wood Jones, 800
- Oblique Illumination in Ultramicroscopic Work, Dr. A. Szegvari, 547
- Occluded Gases from Iron, Temperature Periods in the Emission of, Prof. G. Borelius and F. Gunneson, 82
- Ocean: Passages of the World: Winds and Currents. Compiled by Rear-Admiral B. T. Somerville, 349; Tides, Earth Tides and, W. D. Lambert, 889
- Odontoglossum, Dendrobium, Cattleya, and Cymbidium, Seedlings of, germinated without Fungal Aid, E. Clement, 806
- Official Publications, 203
- Officers, the Education and Training of, Report of the Committee on, 413
- Oil: and Grease, Extraction of, Weston Chemical Co., 836; Engines, A. L. Bird, 268; for U.S. National Requirements, appointment of a special commission on, 722; Geology of South-west Persia, The, R. K. Richardson, 872; Reservoirs, Natural, as "Stock-tanks," Hon. T. G. Cochrane, 657; Well Drilling, The Rotary System of, L. R. McCollum, 26; Field Development, Electrical Power in, 321
- Oils, The Crude, of Burma and Assam, W. J. Wilson, 657
- Old: Red Sandstone: of Scotland, Fossil Plants from the, Dr. R. Kidston and Prof. W. H. Lang, 513; of the Cardiff District, The, A. Heard and R. Davies, 513; Testament: Folk-lore in the, Studies in Comparative Religion, Legend, and Law, Sir James George Frazer. Abridged edition, 633
- Oligochaeta (The Fauna of British India, including Ceylon and Burma), Dr. J. Stephenson, 455
- Olivine-rhyolite from Eastern Iceland, An, L. Hawkes, 699
- Oocyte, the Avian, The Golgi Apparatus in, F. W. R. Brambell, 493
- Ophryoscolecidæ, Evolution in the Ciliate Family, H. Crawley, 691
- Ophthalmic Policy, A Suggested Standard Trial Case and Simplification in, W. Swaine, 33
- Optical: Dispersion and Selective Reflection, with Application to Infra-red Natural Frequencies, Prof. T. H. Havelock, 589; Effects of Motion, Prof. P. Zeeman, 838; Instruments, Early, Dr. L. C. Martin and D. Baxandall, 27; Revolution Counter, B. K. Johnson, 33; Society: election of officers and council, 363; Report of the, for 1923, 282
- Orchid Seeds, the Germination of, without Fungal Aid, E. Clement, 554
- Ores, The Origin of, Prof. H. Louis, 812
- Organic Substance in the Sea, the Melting of the Snow as the chief of the Main Causes of the Increasing Production of, H. H. Gran, 215
- Ornithology, Pictorial, Sir Herbert Maxwell, 526
- Orographical Compensation in Northern India, R. D. Oldham and Col. H. McCowie, 211
- Orthaulax from the Tertiary Deposits of the West Indies, W. P. Woodring, 581
- Ortho-stereoscopy, Wide-angle, Col. L. E. W. van Albada, 899
- Oscarella, the Sponge, An Experimental Effect of Light on the, Dr. J. H. Orton, 924
- Oscillograph, an Electrostatic, Dr. J. A. Crowther, 70
- Osglim Neon-filled Lamp, Certain Properties of the, J. H. Shaxby and E. J. Evans, 590
- Osmic, the Science of Smell, J. H. Kenneth. No. 2, 743
- Osmunda regalis*, Some Deviations from the Normal Morphology of the Shoot in, Prof. W. H. Lang, 770
- Otago University, Dr. J. E. Holloway appointed lecturer on botany in, 291
- Oxford: and Aristotle, F. S. Marvin, 776; Early Science in: R. T. Gunther, Vol. 2: Astronomy, 38; Parts 3 and 4: Physics and Surveying, 346; Radcliffe Observer, H. K. Shaw appointed, 724; University: A Natural Science Scholarship at Keble College, 181; A Separate School of Forestry; Impending Extension of the Science Department, 291; the gift of the Rockefeller Foundation; the gift of L. Evans; New Statutes; the death of Dr. Hatchett Jackson, 372; site for the extension of the Science Department, 408; grants to, 444; Capt. B. J. Owen appointed director of the Institute of Agricultural Engineering in, 578; bequest by A. H. Jones to the Hope Department, 661; Expedition to Spitsbergen, Plans of an, 796; Prof. A. D. Lindsay elected Master of Balliol College, 804; H. W. B. Joseph appointed Herbert Spencer lecturer for 1924, 912
- Oxidation Processes in Tissues, A. Fleisch, 727; Dorothy Mary Moyle, 728
- Oxidisability of Organic Bodies at the Ordinary Temperature, M. Gompel, A. Meyer, and R. Wurmser, 556
- Oysters: and their Nutritive Value, J. R. Nicholls, 358; Chemical Composition of, Seasonal Variation in the, Dr. E. S. Russell, 358; Unusual Mortality among, in English Oyster Beds during 1920 and 1921, Investigations into the Cause or Causes of the, Dr. J. H. Orton, 359



- Pacific: Cultural History of the, Dr. A. C. Haddon, 286 ;  
Ethnological Work in the, Scheme for, 135  
Paints, Pigments, and Varnishes, The Chemistry of, J. G. Bearn, 383  
Palaeolithic: Flakes, H. Bury, 310 ; Period in Hungary, The, L'Abbé Breuil, 61  
Palaeontographical Society, election of officers of the, 689  
Palaeontological Society of America, Dr. F. A. Bather elected a correspondent of the, 248  
Palaeontology, Outlines of, Prof. H. H. Swinnerton, 922 ;  
The Teaching of, Dr. F. A. Bather, 922  
Paläontologische Methoden und ihre Anwendung auf die paläobiologischen Verhältnisse des Steinheimer Beckens, Dr. H. Klähn, 8  
Palgrave's Dictionary of Political Economy. Edited by H. Higgs. Vol. 2, 233  
Pallor of White Men in the Tropics, Dr. C. Eijkman, 757  
Pancreas, The, and Diabetic Metabolism, Prof. H. Oertel, 126  
Pan-Pacific Science Congress, The, Australia, 1923, Dr. A. C. Haddon, 28  
Parasites of Injurious Insects, Retarded Establishment of Introduced, Dr. L. O. Howard, 447  
Parasitic Worms, Longevity of, Dr. J. B. Christopherson, 903  
Parasitism, Studies in, I., J. McLuckie, 843  
Paris: Academy of Sciences: Loutreuil Foundation, 101 ; prize awards of the, 66 ; University, honorary degrees to be conferred on Prof. H. A. Lorentz, Dr. C. D. Walcott, Prof. W. Wright, and Prof. Ramón y Cajal, 512  
Parthenogenesis, Rudimentary, Dr. A. M. Frederikse, 872  
Passiflora, Tropical American Species of, E. P. Killip, 547  
Past Events Seership, Dr. G. Pagenstecher, 871  
Peace, Building for, II.: International Letters, Prof. W. A. Noyes, 563  
Pearl, A Fine Auriferous, R. Dubois, 72  
Peas, Inheritance Ratios in, G. U. Yule, 208  
Pea-weevil, Insect Parasite of the, Dorothy J. Jackson, 353  
Pelagic Nudibranch, A, Dr. H. P. K. Agersborg, 834  
Pendulum Observations, Dutch, in Submarines, Prof. J. J. A. Muller, 308  
Penrose's Annual: the Process Year-book and Review of the Graphic Arts. Edited by W. Gamble. Vol. 26, 1924, 43  
Perfumes and Cosmetics: with Especial Reference to Synthetics, W. A. Poucher, 780  
Permalloy, 583  
Permanganic Acid, The Action of, on the Different Forms of Carbon, J. F. Durand, 915  
Permeability, Prof. W. Stiles, 139  
Persian Crude Oil, Dr. A. E. Dunstan, 176  
Petra, Sir Alexander Kennedy, 174  
Petrograd, Academy of Science, New Geological Museum, 363  
Petrographic Methods and Calculations, Dr. A. Holmes. 3 Parts, 923  
Petrol Engines, High-speed, Exhaust-valve and Cylinder-head Temperatures in, Prof. A. H. Gibson and H. W. Baker, 63  
Petroleum: Crude, Electricity applied to the Winning of, C. H. McCarthy-Jones, 321 ; History of, Prof. M. Haney, 62 ; Industry, The Use of the Microscope in the, H. B. Milner, 258 ; Refining, American, H. S. Bell, 78 ; The Genesis of, Dr. P. E. Spielmann, 638  
Pflanzenstoffe, Chemie der, Dr. G. Trier, 882  
Pharmaceutical and Food Analysis, A. Thurston, 886  
Phenological Observations in the British Isles, Dec. 1922 to Nov. 1923, J. E. Clark, I. D. Margary, and R. Marshall, 841  
Phenology in Sweden, Dr. H. W. Arnell, 728  
Phenyl Oxymhomocampholic Acid, A New Mode of Preparation of, and its Constitution, A. Haller and L. Palfray, 879  
Pherosphæra, Life-history of, A. A. Lawson, 36  
Philosophical Magazine, 1914-1923, B. M. Headicar, 607  
Philosophy: Mathematical, 741 ; Science and, Prof. H. Wildon Carr, 612, 646 ; The Presuppositions of, K. J. Spalding, 257  
Phocenic and Valerianic Acids, Identity of, E. André, 627  
Phosphorescence and Crystal Structure, A. Scheelde, 26  
Photochemical Reactions, The Velocity of, under the Action of a Light of Periodic Intensity, P. Lasareff, 103  
Photo: -electric: and Ionisation Effect, A New, U. A. Oswald and A. G. Tarrant, 590 ; Cells, Amplification of the Current of, by means of Lamps with several Electrodes, G. Ferrié, R. Jouast, and R. Mesny, 626 ; and Selenium Cells, The Research Staff of the G.E.C., Ltd., 606 ; Conductivity, Dr. B. Gudden and Prof. R. Pohl, 476 ; Effect, The Influence of Gases on the, R. Dämpfungmann and W. Hein, 801 ; Photometer at the Lick Observatory, The, Edith J. Cummings, 285 ; Photometry, A Telephone Method of, for Use at Sea, Dr. H. H. Poole, 258 ; -electrons and a Corpuscular Quantum Theory of the Scattering of X-rays, Prof. G. E. M. Jauncey, 196  
Photographic: Densities, Apparatus for Measuring, G. M. B. Dobson, 494 ; Film, Shrinkage of, F. E. Ross, 175 ; Plates: Densities of, O. Bloch, 643 ; Reversal in, Prof. The. Svedberg, O. H. Schunk and H. Andersson, 905 ; Process, The Physical Chemistry of the, 267 ; Records, Measurement of, W. H. George, 387  
"Photography: Foresight in," 936 ; Gelatin in, Vol. I., Dr. S. E. Sheppard, 634 ; Scientific, 634  
Photoluminescence of Dyestuffs in Viscous Media, A. Carrelli and P. Pringsheim, 98  
Photolysis and the Law of Photochemical Equivalence, M. Volmar, 411  
Photomotor Reflex, The, J. Couvreur, 259  
Photosynthesis and Respiration, 871  
Phototherapy, Heliotherapy and, Dr. W. Cramer, 80  
Phylloxera, Inconsistency of the two Species of Vine, distinguished by Börner, B. Grassi and M. Topi, 771  
Physical: and Optical Societies' Exhibition, The, 67 ; Society of London: Prof. Max Planck elected an honorary fellow of the, 316 ; election of officers and council, 317 ; Jubilee Celebrations: 465 ; Prof. J. A. Fleming, 504  
Physico-chemical Principles, A Course of Laboratory Experiments on, Prof. M. S. Sherrill, 348  
Physics: A French Treatise on, 635 ; and Industrial Research, The Interrelation of, Hon. Sir Charles Parsons, 839 ; and Relativity, Dr. N. R. Campbell, 784 ; Institute of, Third Annual Report ; Hon. Sir Charles Parsons elected president, 830 ; Mathematical, in University and School, 665 ; Objective and Subjective, Prof. A. Haas, 829 ; The Applications of, to Metallurgy, Prof. C. H. Desch, 283  
Physiological Congress, the Twelfth International, The Proceedings of, 283  
Physiology, Thermodynamics in, Prof. A. V. Hill, 859  
Physique: depuis vingt ans, La, Prof. P. Langevin, 487 ; générale à l'usage des candidats au certificat de physique générale, au diplôme d'ingénieur-électricien et à l'agrégation des sciences physiques, Cours de, Prof. H. Ollivier. Tome trois. Deux. édition, 635 ; La théorie de la, chez les physiciens contemporains: Exposé des théories, Prof. A. Rey. Deux. édition, 269  
Phyto-pathology and Economic Entomology, Report of an International Conference of, 900  
Picryl Sulphide: Knowledge of, and the Action of the Alkalis, V. Thomas, M. Bathiat, and A. Génét, 662  
Piezo: -electric Effects with Dielectrics, R. Brain, 34 ; -electricity and Molecular Asymmetry, R. Lucas, 948  
Pilgrim's Way, The, E. Erwood, 876  
Pinetum, A New National, 898  
Pink Boll-worm: in Egypt, C. B. Williams, 800 ; on Cotton, Control of the, C. M'Kenzie Taylor, 745  
p-iodoxy-benzoic Acid, A New, P. Brenans and C. Prost, 807  
Pipes, The Critical Velocity in, H. M. Martin, 643  
Pipette, An Improved Form of, T. H. Taylor, 84  
Pitch Indians, The, P. E. Goddard, 581  
Pituitary Gland, Functions of, N. M. Dott, 207  
Plague Investigations in Egypt, Dr. G. F. Petrie, Major R. E. Todd, and others, 403  
Planck's Law and its Present-day Significance, 561  
Planetary Rotations, H. Kaul, 472  
Planets, Minor, 438  
Plankton Organisms, Food of, Dr. M. V. Lebour, 138



- Planorbidae in the Indian Museum, Calcutta, Dr. L. Germain, 507
- Plan Reading and Quantity Surveying, C. F. Dingman, 815
- Plant: -disease Survey, The Ministry of Agriculture's, A. D. Cotton, 554; Ecology in Switzerland, 585; Physiological Laboratory of Charles University, Studies from the, Vol. I., 655; Juices extracted by Pressure, Composition of, G. André, 147; Physiology, Chemical Aspects of, 882; Pigments, Fluorescent, Prof. F. E. Lloyd, 546; -pitchers and their Work, Dr. A. B. Rendle, 876; The Transport of Food Substances in the, 168; Surveys, Physiological Methods in, 440; World, The History of the, Prof. A. C. Seward, 596
- Plants: Artificial Infection of, with Parasitic Fungi, H. Klebahn, 440; Does the Respiratory Intensity of, obey the Law of Surfaces? A. Héé, 327; Extinct, and Problems of Evolution: Founded on a Course of Public Lectures delivered at the University College of Wales, Aberystwyth, in 1922, Dr. D. H. Scott, 596; New Flowering, Dr. O. Stapf, 61; Seasonal Changes in, Prof. F. J. Lewis and Miss Gwynethe M. Tuttle, 175; Vital Phenomena in, Sir Jagadis C. Bose, 247
- Platinum in the Transvaal, Dr. P. A. Wagner and T. G. Trevor, 621
- Pleistocene Deposits of the Portsmouth District, Dr. L. S. Palmer and Lt.-Col. J. H. Cooke, 250
- Pleurotus in the Alpine Meadows, J. Offner and R. Heim, 259
- Plural in Polite Address, The Use of the, A. M. Hocart, 96
- Plymouth Aquarium, Guide to the, E. W. Sexton, 487
- Poland: Copper Implements in, Dr. J. Kostrzewski, 903; Scientific Societies in, 179
- Polarisers and Analysers, Half-shade, C. A. Skinner, 12; Editor "Dictionary of Applied Physics," 13
- Polonium:  $\alpha$ -Particles from, W. Kutzner, 508; in Organs, An Auto-histo-radiographic Method for the Detection of, A. Lacassagne and Mme. J. S. Lattès, 295; injected into Organs, Chemico-physical Technique and the Detection of, Mme. J. S. Lattès and A. Lacassagne, 374; Particles of Long Range from, L. F. Bates and J. S. Rogers, 446
- Polychètes errantes, Prof. P. Fauvel, 528
- Polygonal Surface Markings, J. S. Huxley and N. E. Odell, 507
- Polyploidy, Prof. R. R. Gates, 286
- Populär-wissenschaftliche Vorlesungen, Prof. E. Mach. Fünfte Auflage, 488
- Population: and Longevity, 322; Growth, The Mathematical Theory of, Profs. R. Pearl and L. Reed, 322
- Porpoises, Consumption of Fish by, Dr. Johs. Schmidt, 310
- Portuguese East Africa, The Heterosomata of, C. von Bonde, 948
- Poultry Raising, Commercial, H. A. Roberts, 269
- Power within us, The, C. Baudouin. Translated by Eden and Cedar Paul, 121
- Prayer, Psychologically and Metaphysically considered, A. A. Cock, 770
- Precipitates: Electrolytic Purification of, A. Charriou, 515; the Formation of, Influence of Agitation on, Volmar and Stahl, 627
- Prehistoric: Sites of France, Some, Dr. H. M. Ami, 129; Trepanning, a New Method of, with Circular or Oval Openings, cut with Flint, M. Baudouin, 35
- Pretoria, speech at opening of a Central Herbarium at, Gen. Smuts, 134
- Prices, The Distribution and Inter-relation of, and their Incidence on the Problem of Price Stabilisation, N. Crump, 145
- Primary Aberrations, A Reference System for, T. Smith, 806
- Primitive Races within the British Empire: a Problem in Adaptation, 845
- Primula, A Tri-hybrid, Prof. F. E. Weiss, 699
- Prince Charles Foreland, Spitzbergen, Geology of, G. W. Tyrrell, 411
- Proboscidea, Remains of Extinct, in the Museums of Geology and Zoology in the University of Cambridge, C. F. Cooper, 555
- Production, The Census of, A. W. Flux, 479
- Propeller Revolutions, Influence of, upon the Propulsive Efficiency of Merchant Ships, Dr. K. Schaffran, 27
- Proper Motions with the Blink Microscope, Dr. Innes, 726
- Protective Colour, 207
- Pseudococcus sacchari* and its Associates in Madeira, Dr. M. Grabham, 213
- Psycho: -analysis: and Anthropology, Dr. B. Malinowski, 656; Applied, Essays in, Dr. E. Jones, 919; -biology, 266
- Psychology: Dr. M. Culpin, 919; Advanced, Lectures on, Dr. Morton Prince, 246; An Outline of, Prof. W. McDougall, 154; and Morals: an Analysis of Character, Dr. J. A. Hadfield. Second edition, 919; Individual, The Practice and Theory of, A. Adler. Translated by Dr. P. Radin, 919; Mnemic, R. Semon. Translated by Bella Duffy, 303
- Pueblo Bonito, The Exploration of the Ruins of, 899
- Pulverised Coal in America, Use of, L. C. Harvey, 763
- Pupa-larvæ in Pædogenic Diptera, Control of the Appearance of, R. G. Harris, 375
- Pupin, Michael, Dr. A. Russell, 186
- Pyocyanic Cultures, The Smell of, C. Gessard, 915
- Pyrometer Design, Reflections on, W. Bowen, 556
- Pyrometers: in Glass Works, Use of, E. A. Coad-Pryor, 555; Practical Applications of, to Glass Works, C. E. Foster, 555
- Quantum: Integral and Diffraction by a Crystal, The, Prof. A. H. Compton, 215; Numbers, Half-integral, in the Theory of the Stark Effect and a General Hypothesis of Fractional Quantum Numbers, A. M. Mosharafa, 590; Theory: 701; Prof. E. P. Adams, 369; and the Dielectric Constant, J. H. Jones, 589; of Band Spectra, The, 874; On the Application of the, to Atomic Structure, Prof. N. Bohr. Part I., 382
- Quartz, Transparent Fused, The Production of, 686
- Quill Tubes, Vibration in Spark-blown Closed, Electric Oscillation, Prof. C. Barus, 447
- Quincke, Prof. G. H., Reminiscences of, Dr. G. E. Allan, 426
- Quinine, The Supply of, Sir David Prain, 899
- Rabbit, Microsporidiosis of the, its Relations with Hydrophobia, C. Levaditi, S. Nicolau, and Mlle. R. Schoen, 183
- Race, Problems of: Prof. G. Elliot Smith, 291; in the New Africa: a Study of the Relation of Bantu and Britons in those parts of Bantu Africa which are under British Control, Rev. Prof. W. C. Willoughby, 455
- Radial Velocities and the Curvature of Space-time: Prof. A. S. Eddington, 746; Dr. L. Silberstein, 818
- Radiation: and Atoms, Dr. J. C. Slater, 307; and the Quantum Theory, Report on, Dr. J. H. Jeans. Second edition, 702; from the Sun, On Continuous, Dr. W. Anderson, 143; of Light by Excited Atoms, The, Prof. G. Mie, 586; The Calorific Action of, on Metals Dipped in Solutions of their Salts, G. Athanasiu, 327
- Radio: für Alle, 654; Communication: Modern, a Manual of Modern Theory and Practice, covering the Syllabus of the City and Guilds Examination and suitable for Candidates for the P.M.G. Certificate, J. H. Reyner, 779; Signal Fading, Dellinger, 140; Telephony: Distortion in, L. C. Pocock, 801; in Australia, 364; Limits and Conditions for Good Reception in, O. M. Corbino, 915
- Radioactive Substances in Metals, The Penetration of, Mlle. St. Maracineanu, 35
- Radioactivity of Living Cells, Researches on the, A. Nodon, 592
- Radiographic Work, An Exposure Table for, Watson and Sons (Electro-medical), Ltd., 365
- Radiography of Mummies, 623
- Radium: -B and Radium-C, the  $\beta$ -ray Spectrum of, C. D. Ellis and H. W. B. Skinner, 145; Beryllium, and Mercury, 525; Distribution of the Active Deposit of, in Helium and Argon in the Electric Field, G. H. Briggs, 104; Emanation Tubes, A Mechanical Device for Sealing off, Dr. H. H. Poole, 735; Industry of Cornwall, The, 436; L'Institut du, and La Fondation Curie, 365; The Radioactivity of, in Relation to Solar Radiation, Dr. A. Nodon, 443; Therapy, A New Technique in, Dr. W. H. Brown and J. P. McHutchison, 274; Twenty-fifth Anniversary of the Discovery of, 172



Radon, The Radioactive Constant of, Mlles. Irène Curie and C. Chamié, 915  
 Radulæ : Staining, Electric Method of, T. H. Rogers, 734 ;  
 The Mounting and Photomicrography of, E. W. Bowell, 913  
 Railway Surveying by Photography, J. W. Gordon, 62  
 Rainfall : Forests and, 511 ; of 1923, F. J. W. Whipple, 206  
 Ramanujan, Srinivasa, Prof. E. H. Neville, 426  
 Ramsay : fellowships in chemical science, award of, 181 ;  
 Laboratory of Chemical Engineering, The Aims and Future Work of the, Prof. E. C. Williams, 59, 134  
 Raw Meat Juice in the Treatment of Human Tuberculosis and the Reconstruction of the Muscles, C. Richet, 879  
 Ray Society, election of officers, 437  
 Rayleigh's, The Late Lord, Scientific Papers, Lord Rayleigh, 570  
 Reasoning, The Psychology of, Prof. E. Rignano. Translated by Winifred A. Holl, 44  
 Receivers in Wireless Telegraphy, The Meteorological Origin of certain Disturbances of the, R. Bureau, 327  
 Red Jena Glass, The Fraction of the Intensity of the Solar Radiation Transmitted, for various Wave-lengths, by L. Gorczyński, 259  
 Red Sea Crab, The Migration of a, through the Suez Canal, H. M. Fox, 714  
 Reddest Star known, The, H. v. Zeipel, 870  
 Redwood and Eastlake's Petroleum Technologist's Pocket-book. Revised by A. W. Eastlake. Second edition, 120  
 Reflecting Telescope for Simeis Observatory, Crimea, 550  
 Reflex Contractions of Spinal and Decerebrate Preparations, The Electric Response in, E. D. Adrian and Sybil Cooper, 409  
 Reflexes in Response to Stretch (Myotatic Reflexes), Sir Charles Sherrington and E. G. T. Liddell, 589  
 Refractive Index of Gums and a Simple Method of determining Refractive Indices, A. Mallock, 159  
 Refractory Substances, Action of High Temperatures upon some, C. Matignon, 91  
 Reid Comet : (1923c), Observations of the, P. Chofardet, 71 ; (1924a), Elements of, 580  
 Reinforced Concrete Chimneys, 79  
 Relativité, Quelques réflexions sur la, P. Worms de Romilly, 152  
 Relativity : and Gravitation, 152 ; Physics and, Dr. N. R. Campbell, 784 ; The Principle of, a Collection of Original Memoirs on the Special and General Theory of Relativity, H. A. Lorentz, A. Einstein, H. Minkowski, and H. Weyl ; with Notes by A. Sommerfeld. Translated by W. Perrett and G. B. Jeffery, 152 ; The Theory of, Three Lectures for Chemists, E. Freundlich. Translated by H. L. Brose, 638 ; Theory, the General, Electrodynamics in, G. Y. Rainich, 843  
 Rennet, Action of, on Milk, N. C. Wright, 547  
 Research : Discovery and, Prof. E. H. Starling, 606 ; The Writer of the Article, 607 ; Work and its Applications, Sir William Bragg, 311  
 Resonance, Reflection, and Diffusion of, E. Fermi, 771

REVIEWS AND OUR BOOKSHELF.

**Agriculture, Forestry, and Horticulture :**

Bogart (Prof. E. L.), Economic History of American Agriculture, 531  
 Bond (J. R.), Farm Implements and Machinery, 264  
 Brenchley (Dr. Winifred E.), Manuring of Grass Land for Hay, 482  
 Chipp (Major T. F.), The Forest Officers' Handbook of the Gold Coast, Ashanti, and the Northern Territories, 153  
 Dallimore (W.), and A. B. Jackson, A Handbook of Coniferae : including Ginkgoaceae, 707  
 Fryer (P. J.), Successful Spraying and how to achieve it, 780  
 Leake (Dr. H. M.), The Foundations of Indian Agriculture. Second edition, 743  
 Lyon (Prof. T. L.), and Prof. H. O. Buckman, The Nature and Properties of Soils : a College Text of Edaphology, 637

Piper (C. V.), and W. J. Morse, The Soybean, 813  
 Roberts (H. A.), Commercial Poultry Raising, 269  
 Royal Botanic Gardens, Calcutta, Annals of the, Vol. XI., Appendix, Dr. O. Beccari ; Supplement to Part I., 120  
 Russell (Sir John) : Farm Soil and its Improvement, 482 ; and others, The Micro-organisms of the Soil, 482  
 Stone (H.), Étude descriptive sur les bois utiles de la Guyane française, 528  
 White (C. T.), An Elementary Text-book of Australian Forest Botany. Vol. I., 601.

**Anthropology and Archæology :**

Anstey (Lavinia Mary), Index to Volumes 1-50 (1872-1921) " Indian Antiquary," 3 pts., 672  
 Blackman (Dr. A. M.), Luxor and its Temples, 600  
 Boule (Prof. M.), translated, with an Introduction, by Jessie Elliot Ritchie and Dr. J. Ritchie, Fossil Men : Elements of Human Palæontology, 382  
 Canney (Prof. M. A.), Givers of Life and their Significance in Mythology, 601  
 Driberg (J. H.), The Lango : a Nilotic Tribe of Uganda, 42  
 Frazer (Sir James George), Folklore in the Old Testament : Studies in Comparative Religion, Legend, and Law, 633  
 Perry (W. J.), The Children of the Sun : a Study in the Early History of Civilisation, 299  
 Roth (H. Ling), The Maori Mantle : and some Comparative Notes on N.W. American Twined Work, 638  
 Slater (Dr. G.), The Dravidian Element in Indian Culture, 816  
 Stigand (Major C. H.), Equatoria : The Lado Enclave, 44

**Biology :**

Betts (Annie D.), Practical Bee Anatomy : with Notes on the Embryology, Metamorphoses, and Physiology of the Honey Bee, 79  
 Bicknell (P. F.), The Human Side of Fabre, 709  
 Borradaile (Dr. L. A.) : A Manual of Elementary Zoology. Fourth edition, 78 ; Elementary Zoology for Medical Students, 78  
 Buckland (A. S.), L. N. Staniland, and E. B. Watson, British Hymenoptera, 531  
 Burlingame (Prof. L. L.), and others, General Biology, 301  
 Butler (E. A.), A Biology of the British Hemiptera-Heteroptera, 156  
 Costantin (Prof. J.), and Prof. F. Faideau, Histoire naturelle illustrée : Les Plantes, 119  
 Coward (T. A.) : Birds and their Young, 228 ; Life of the Wayside and Woodland : When, Where, and What to Observe and Collect, 191  
 Dean (Dr. B.), extended and edited by Dr. E. W. Gudger, with the co-operation of A. W. Henn, A Bibliography of Fishes. Vol. 3, 344  
 Deegener (Prof. G.), Handbuch für das mikroskopisch-zoologische Praktikum der wirbellosen Tiere. Erste Lief., 564  
 Delsman (Dr. H. C.), The Ancestry of Vertebrates as a Means of Understanding the Principal Features of their Structure and Development, 708  
 Dorlodot (Canon), Darwinism and Catholic Thought. Translated by the Rev. E. Messenger. Vol. 1 : The Origin of Species, 8  
 Eltringham (Dr. H.), Butterfly Lore, 531  
 Errera (Léo), Recueil d'œuvres de, Pédagogie : Biographies, 41  
 Evrard (E.), translated by B. Miall, The Mystery of the Hive, 452  
 Fabre (J. H.), translated by A. Teixeira de Mattos and B. Miall, The Life of the Scorpion, 303  
 Fauvel (P.), Faune de France 5 : Polychètes errantes, 528  
 Fitzsimons (F. W.), The Natural History of South Africa. Birds. In 2 vols., 228  
 Friend (Rev. H.), British Earthworms and how to identify them, 158



- Gladstone (H. S.), Notes on the Birds of Dumfriesshire : a Continuation of the Birds of Dumfriesshire, 228  
 Gordon (D.), Wild Life in Devon, 228  
 Haeckel (Prof. E.), Kunstformen der Natur. Zweite Auflage. Niedere Tiere, 847  
 Holmes (Prof. S. J.), Studies in Evolution and Eugenics, 667  
 Ingersoll (E.), Birds in Legend, Fable, and Folklore, 564  
 Janson (O. E.), J. R. le B. Tomlin, and F. A. Bather, Gray's Spicilegia Zoologica. Conclusion, 348  
 Jones (Dr. F. Wood), The Mammals of South Australia. Part I., 189  
 Joubin, (Prof. L.), and A. Robin, Histoire naturelle illustrée : Les Animaux, 119  
 Kearton (R.), Wild Bird Adventures : a Nature Story Book for Boys and Girls, 228  
 Klähn (Dr. H.), Paläontologische Methoden und ihre Anwendung auf die paläobiologischen Verhältnisse des Steinheimer Beckens, 8  
 Latter (O. H.), Elementary Zoology, 269  
 Mace (H.), Adventures among Bees, 452  
 Mangenot (Dr. G.), Recherches sur les constituants morphologiques du cytoplasma des algues, 155  
 McConnochie (A. I.), The Deer and Deer Forests of Scotland : Historical, Descriptive, Sporting, 265  
 McEwen (Prof. R. S.), Vertebrate Embryology, 775  
 Morgan (Prof. T. H.), A. H. Sturtevant, Prof. H. J. Muller, and C. B. Bridges, The Mechanism of Mendelian Heredity. Revised edition, 518  
 Ramsay (Col. R. G. W.), with a Biographical Memoir by Dr. W. Eagle Clarke, Guide to the Birds of Europe and North Africa, 228  
 Schulte-Vaerting (Dr. H.), Die soziologische Abstammungslehre, 74  
 Scott (Dr. D. H.), Extinct Plants and Problems of Evolution : Founded on a Course of Public Lectures delivered at the University College of Wales, Aberystwyth, in 1922, 596  
 Séguy (E.), Faune de France : Diptères anthomyides, 816  
 Sexton (E. W.), Guide to the Plymouth Aquarium, 487  
 Swann (H. Kirke), A Bibliography of British Ornithology from the Earliest Times. Supplement : A Chronological List of British Birds, 531  
 Thomson (Prof. J. A.) : Everyday Biology, 780 ; The Biology of Birds, 121 ; What is Man ? 266  
 Thorburn (A.), Game Birds and Wild Fowl of Great Britain and Ireland, 526  
 Tiere Deutschlands, Biologie der, herausgegeben von Prof. P. Schulze. Lief 2, 3, 4, 5, 6, 853  
 Trail, James William Helenus : a Memorial Volume, 636  
 Tressler (Dr. D. K.), and others, Marine Products of Commerce, 529  
 Waite (E. R.), The Fishes of South Australia, 189  
 Westell (W. P.), British Mammals ; British Birds ; British Reptiles, Amphibians, and Fresh-water Fishes ; British Butterflies and Moths ; British Insects (General), 8  
 Wheeler (Prof. W. M.), Social Life among the Insects, 452  
 Wilder (Prof. A. W.), Laboratory Studies in Mammalian Anatomy, 923  
 Wilson (Prof. E. B.), The Physical Basis of Life, 742  
 Woodruff (Prof. L. L.), Foundations of Biology, 269
- Chemistry :**
- Aerial Haze and its Effect on Photography from the Air, 634  
 Allen's Commercial Organic Analysis, Vol. I. Fifth edition, 815  
 Bearn (J. G.), The Chemistry of Paints, Pigments, and Varnishes, 383  
 Benrath (Dr. A.), translated by J. Bithell, The Fundamental Ideas of Chemistry, 420  
 Berthoud (Prof. A.), Les nouvelles conceptions de la matière et de l'atome, 191  
 Chemical Appointments, A List of Official, compiled, by direction of the Council of the Institute of Chemistry, and under the supervision of the Publications Committee, by the Registrar of the Institute. Fifth edition, 672  
 Clark (Prof. W. M.), The Determination of Hydrogen Ions : an Elementary Treatise on the Hydrogen Electrode, Indicator and Supplementary Methods, with an Indexed Bibliography on Applications. Second edition, 157  
 Clowes (Dr. F.), and J. B. Coleman, Quantitative Chemical Analysis : Adapted for use in the Laboratories of Colleges, of Technical Institutes, and of Analysts. Twelfth edition, 488  
 Cohen (Prof. J. B.), Organic Chemistry for Advanced Students. Fourth edition. Parts 1, 2, 3, 380  
 Cumming (W. M.), I. V. Hopper, and T. S. Wheeler, Systematic Organic Chemistry : Modern Methods of Preparation and Estimation, 380  
 Delacre (Prof. M.), Essai de philosophie chimique, 456  
 Deming (Prof. H. G.), General Chemistry : an Elementary Survey, emphasising Industrial Applications of Fundamental Principles, 456  
 Ewald (Prof. P. P.), Kristalle und Röntgenstrahlen, 302  
 Feulgen (Prof. R.), Die Biochemie in Einzeldarstellungen herausgegeben von Aristides Kanitz. Nr. V : Chemie und Physiologie der Nukleinstoffe nebst Einführung in die Chemie der Purinkörper, 524  
 Findlay (Prof. A.), Practical Physical Chemistry. Fourth edition, 9  
 Fournier d'Albe (Dr. E. E.), The Life of Sir William Crookes, O.M., F.R.S., 227  
 Gardner (W.), Chemical Synonyms and Trade Names : a Dictionary and Commercial Handbook, 530  
 Gibbs (Dr. W. E.), Clouds and Smokes : the Properties of Disperse Systems in Gases and their Practical Applications, 672  
 Jones (Prof. H. C.), Trattato di chimica fisica. Seconda edizione italiana a cura di Prof. M. Giua, 455  
 Kolthoff (Dr. I. M.), Der Gebrauch von Farbenindikatoren : ihre Anwendung in der Neutralisationsanalyse und bei der colorimetrischen Bestimmung der Wasserstoffionenkonzentration. Zweite Auflage, 157  
 Loring (F. H.), The Chemical Elements, 157  
 Luff (B. D. W.), The Chemistry of Rubber, 208  
 Mahin (Prof. E. G.), and Prof. R. H. Carr, Quantitative Agricultural Analysis, 347  
 Martin (Dr. G.), The Modern Soap and Detergent Industry, including Glycerol Manufacture. Vol. I. : Theory and Practice of Soap Making, 669  
 Martinet (Prof. J.), and Mlle. P. Alexandre, Couleur et constitution chimique : Cours professé à la Faculté des Sciences de Besançon, 739  
 Matula (Prof. J.), Eine Einführung in die allgemeine Chemie, 158  
 Mazzucchelli (Prof. A.), Elementi di chimica fisica, 455  
 Mellor (Dr. J. W.), A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vol. 4, 525  
 Molinari (Prof. E.), Treatise on General and Industrial Organic Chemistry. Translated by T. H. Pope. Part 2. Second English edition, 455  
 Myddleton (Dr. W. W.), and T. H. Barry, Fats : Natural and Synthetic, 669  
 Nietz (A. H.), The Theory of Development, 634  
 Oppenheimer (Prof. C.), Kurzes Lehrbuch der Chemie in Natur und Wirtschaft. Nebst einer Einführung in die allgemeine Chemie, von Prof. J. Matula, 158  
 Perrin (Prof. J.), German translation by Prof. A. Lottermoser. Die Atome. Dritte Auflage, 383  
 Photographic Process : The Physical Chemistry of the, a General Discussion held by the Faraday Society, May 1923, 267  
 Porter (Prof. C. W.), The Carbon Compounds : a Text-book of Organic Chemistry, 887  
 Poucher (W. A.), Perfumes and Cosmetics : with especial reference to Synthetics, 780  
 Schreinemakers (F. A. H.), Feestbundel aangeboden aan, ter herdenking van den dag, waarop hem voor 25 Jahren het Doctoraat honoris causa werd verleend (7 Juli, 1898-1923), 190  
 Searle (A. B.), The Chemistry and Physics of Clays and other Ceramic Materials, 599  
 Sheppard (Dr. S. E.), Gelatin in Photography, 634  
 Sherrill (Prof. M. S.), A Course of Laboratory Experiments on Physico-chemical Principles, 348



Smith's General Chemistry for Colleges. Revised and rewritten by Prof. J. Kendall, 79  
Sommerfeld (Prof. A.): traduit par H. Bellenot, La Constitution de l'atome et les raies spectrales. Premier fasc. et deux. fasc., 263; translated by H. L. Brose, Atomic Structure and Spectral Lines, 263  
Spielmann (Dr. P. E.), The Genesis of Petroleum, 638  
Spratt (Dr. E. R.), Chemistry and Physics for Botany Students, 233  
Thurston (A.), Pharmaceutical and Food Analysis: a Manual of Standard Methods for the Analysis of Oils, Fats, and Waxes, and Substances in which they exist: together with Allied Products, 886  
Trier (Dr. G.), Chemie der Pflanzenstoffe, 882  
Tutton (Dr. A. E. H.), The Natural History of Crystals, 562  
Valency: The Electronic Theory of, a General Discussion held by the Faraday Society, July 1923, 267  
Van Nostrand's Chemical Annual: a Handbook of Useful Data for Analytical, Manufacturing, and Investigating Chemists, Chemical Engineers, and Students. Edited by Prof. J. C. Olsen, 1922, 191  
Walker (Prof. W. H.), Prof. W. K. Lewis, and Prof. W. H. McAdams, Principles of Chemical Engineering, 5  
Warnes (A. R.), Coal Tar Distillation and Working up of Tar Products. Third edition, 778

**Engineering:**

Bird (A. L.), Oil Engines, 268  
Bolton (D. J.), Electrical Measuring Instruments and Supply Meters, 79  
Brownlie (D.), Mechanical Stoking, 923  
Coleman (Dr. G. S.), Calculations in Heating and Ventilation, 816  
Conradi (C. G.), Mechanical Road Transport, 485  
Dalby (Prof. W. E.), Strength and Structure of Steel and other Metals, 779  
Davey (N.), Studies in Tidal Power, 115  
Dingman (C. F.), Plan Reading and Quantity Surveying, 815  
Drysdale (Dr. C. V.), and others, The Mechanical Properties of Fluids: A Collective Work, 520  
Gibbs (R. W. M.), Engineering Mathematics. Part 1, 121  
Hague (B.), Alternating Current Bridge Methods for the Measurement of Inductance, Capacitance, and Effective Resistance at Low and Telephonic Frequencies, 530  
Hamilton (E. H.), Elementary Thermodynamics of Automobile Engines, 79  
Henley (F. L.), The Inspection and Testing of Materials, Apparatus, and Lines, 638  
Huebotter (H. A.), Mechanics of the Gasoline Engine, 485  
Jansky (Prof. C. M.), and Prof. H. P. Wood, Elements of Storage Batteries, 853  
Kearton (W. J.), and G. Wood, Alignment Charts for Engineers and Students: a Text-book explaining the Theory and Construction of Alignment Charts, 887  
Lewitt (E. H.), Hydraulics, 487  
Mitchell (W. G. W.), Time and Weather by Wireless, 530  
Morrison (L. H.), Diesel Engines, 485  
Parr (G.), Principles and Practice of Wireless Transmission, 420  
Poplewell (W. C.), and H. Carrington, The Properties of Engineering Materials, 564  
Reyner (J. H.), Modern Radio Communication: a Manual of Modern Theory and Practice, covering the Syllabus of the City and Guilds Examination and suitable for Candidates for the P.M.G. Certificate, 779  
Roussel (J.), Translated. Wireless for the Amateur, 456

**Geography and Travel:**

Bartholomew (Dr. J. G.), A Literary and Historical Atlas of Europe, 303  
Boulnois (Helen Mary), Into Little Thibet, 450  
Brandt (Dr. B.), Südamerika, 420  
British (*Terra Nova*) Antarctic Expedition, 1910-13. The Physiography of the Ross Archipelago, F. Debenham; Physiography of the Beardmore Glacier Region, C. S. Wright; Physiography (Robertson Bay and Terra Nova Bay Regions), R. E. Priestley, 277

Filchner (Dr. W.), Zum sechsten Erdteil. Die zweite deutsche Sudpolar-Expedition, 382  
Graham (Stephen), In Quest of El Dorado, 887  
Gregory (Prof. J. W.), and C. J. Gregory, To the Alps of Chinese Tibet: an Account of a Journey of Exploration up to and among the Snow-clad Mountains of the Tibetan Frontier, 6  
Ormsby (H.), London on the Thames: a Study of the Natural Conditions that influenced the Birth and Growth of a Great City, 780  
Somerville (Rear-Admiral B. T.), Ocean Passages for the World: Winds and Currents, 349  
Statesman's Year Book, The: Statistical and Historical Annual of the States of the World for the Year 1924. Edited by Sir John Scott Keltie and Dr. M. Epstein, 887  
Ward (Capt. F. Kingdon), The Mystery Rivers of Tibet: a Description of the Little-known Land where Asia's Mightiest Rivers gallop in Harness through the Narrow Gateway of Tibet; its Peoples, Fauna, and Flora, 450

**Geology and Mineralogy:**

British (*Terra Nova*) Antarctic Expedition, 1910-13. Glaciology, C. S. Wright and R. E. Priestley; The Physiography of the McMurdo Sound and Granite Harbour Region, Prof. G. Taylor, 417  
Buckman (S. S.), Type Ammonites. Vol. 4, 232  
Carruthers (R. G.), and Sir Aubrey Strahan, Lead and Zinc Ores of Durham, Yorkshire, and Derbyshire, with Notes on the Isle of Man, 75  
Evans (Dr. J. W.), and G. M. Davies, Elementary Crystallography, 562  
Geologie und Bodenschätze Deutschlands, Handbuch der, herausgegeben von Prof. E. Krenkel. Abt. 2: Regionale Geologie Deutschlands. Geologie von Württemberg nebst Hohenzollern, Prof. E. Hennig, 815  
Hatch (Dr. F. H.), and Dr. R. H. Rastall, The Petrology of the Sedimentary Rocks: a Description of the Sediments and their Metamorphic Derivatives. Revised edition, 886  
Hennig (Prof. E.), Geologie von Württemberg nebst Hohenzollern, 815  
Holmes (Dr. A.), Petrographic Methods and Calculations. 3 Parts, 923  
Rastall (Dr. R. H.), The Geology of the Metalliferous Deposits, 812  
Smith (Dr. S.), with contributions by R. G. Carruthers, Lead and Zinc Ores of Northumberland and Alston Moor, 75  
Swinnerton (Prof. H. H.), Outlines of Palæontology, 922  
Tutton (Dr. A. E. H.), The Natural History of Crystals, 562  
Winchell (N. H.), and A. N. Winchell, Elements of Optical Mineralogy: an Introduction to Microscopic Petrography. Entirely rewritten and much enlarged by Prof. A. N. Winchell. Second edition, Part 1, 600

**Mathematical and Physical Science:**

Andoyer (Prof. H.), Tables logarithmiques à treize décimales, 637  
Bailey (H. J. E.), A Course of Experimental Mechanics, 780  
Barlow (C. W. C.), and Dr. G. H. Bryan, Elementary Mathematical Astronomy. Eighth impression (third edition), 7  
Becquerel (Prof. J.), Gravitation Einsteinienne: Champ de gravitation d'une sphère matérielle et signification physique de la formule de Schwarzschild, 152  
Bohr (Prof. N.), On the Application of the Quantum Theory to Atomic Structure. Part 1, 382  
Born (Prof. Max), Atomtheorie des festen Zustandes (Dynamik der Kristallgitter). Zweite Auflage, 232  
Bosler (J.), L'Évolution des étoiles, 303  
Bryan (Prof. G. H.), Mathematical Tables, 637  
Campbell (Prof. L. L.), Galvanomagnetic and Thermomagnetic Effects: the Hall and Allied Phenomena, 743



- Carslaw (Prof. H. S.), *An Introduction to the Mathematical Theory of the Conduction of Heat in Solids*. Second edition, 742
- Castle (F.), *Four-figure Mathematical Tables*, 637
- Chirol (M.), *Appareils de mesures électriques*, 349
- Clapham (C. B.), *Arithmetic for Engineers: including Simple Algebra, Mensuration, Logarithms, Graphs, Trigonometry, and the Slide Rule; with an Appendix on Verniers and Micrometers*, 453
- Collis (A. G.), *Practical Control of Electrical Energy*, 9
- Curzon (Dr. H. E. J.), *A Course in Elementary Mathematics for Schools*. Books 3 and 4, 638
- Dickson (Prof. L. E.), *History of the Theory of Numbers*. Vol. 3: *Quadratic and Higher Forms*, with a Chapter on the Class Number by G. H. Cresse, 76
- Fabry (Prof. C.), *La Lumière monochromatique, sa production et son emploi en optique pratique; Les Applications des interférences lumineuses*, 120
- Fawdry (R. C.), *Elementary Experiments in Practical Mathematics*, 709; and C. V. Durell, *Calculus for Schools*, 672
- Feldman (Dr. W. M.), *Biomathematics: being the Principles of Mathematics for Students of Biological Science*, 484
- Geometry in Schools: The Teaching of*, a Report prepared for the Mathematical Association, 230
- Gibbs (R. W. M.), *Technical Arithmetic*, 79
- Gould (Lt.-Comdr. R. T.), *The Marine Chronometer: its History and Development*, 415
- Gunther (R. T.), *Early Science in Oxford*. Vol. 2: *Astronomy*, 38
- Heffter (Prof. L.), *Lehrbuch der analytischen Geometrie*. Band 2, 598
- Hutchinson's *Splendour of the Heavens: a Popular Authoritative Astronomy*; 24 fortnightly parts. Edited by Rev. T. E. R. Phillips, assisted by leading astronomers, 884
- Jeans (Dr. J. H.), *Report on Radiation and the Quantum Theory*. Second edition, 702
- Kent (Prof. F. C.), *Mathematical Principles of Finance*, 853
- Kramers (H. A.), and H. Holst. Translated by R. B. Lindsay and Rachel T. Lindsay, *The Atom and the Bohr Theory of its Structure: an Elementary Presentation*, 378
- Lamb (Prof. H.), *Dynamics*. Second edition, 9
- Langevin (Prof. P.), *La Physique depuis vingt ans*, 487
- Leduc (Prof. A.), *Volumes moléculaires: Applications*, 383
- Leland (O. M.), *Practical Least Squares*, 158
- Lorentz (Prof. H. A.), and others. Translated by Drs. W. Perrett and G. B. Jeffery, *The Principle of Relativity: a Collection of Original Memoirs on the Special and General Theory of Relativity*, 152
- Love (Prof. C. E.), *Analytic Geometry*, 598
- Mach (Prof. E.), *Populär-wissenschaftliche Vorlesungen*. Fünfte Auflage, 488
- Milham (Prof. W. I.), *Time and Timekeepers: including the History, Construction, Care, and Accuracy of Clocks and Watches*, 415
- Mitchell (Prof. S. A.), *Eclipses of the Sun*, 703
- Monge (G.), *augmentée . . . par B. Brisson, Géométrie descriptive*. 2 vols., 456
- Naturwissenschaften*. exakten, *Ergebnisse der Zweiter Band*, 303
- Norris (P. W.), and W. S. Legge, *Mechanics via the Calculus*, 600
- Ollivier (Prof. H.), *Cours de physique générale*. Tome trois. Deux. édition, 635
- Osgood (Prof. W. F.), and Prof. W. C. Graustein, *Plane and Solid Analytic Geometry*, 598
- Planck (Prof. Max), *Vorlesungen über die Theorie der Wärmestrahlung*. Fünfte Auflage, 561
- Pringsheim (P.), *Fluoreszenz und Phosphoreszenz im Lichte der neueren Atomtheorie*. Zweite Auflage, 9
- Rey (Prof. A.), *La Théorie de la physique chez les physiciens contemporains: Exposé des théories*. Deux. édition, 269
- Rose (W. N.): *Line Charts for Engineers*, 453; *Mathematics for Engineers*. Part 2. Second edition, 453
- Ross (J. F. S.), *An Introduction to the Principles of Mechanics*, 420
- Royal Astronomical Society, 1820-1920, *History of the*. Edited by Dr. J. L. E. Dreyer and Prof. H. H. Turner, 343
- Sandén (Prof. H. von), *Practical Mathematical Analysis, with Notes by the Translator, Prof. H. Levy*, 453
- Saunders (V. T.), *Practical Mathematics*, 709
- Schiller (Dr. K.), *Einführung in das Studium der veränderlichen Sterne*, 349
- Siceloff (L. P.), G. Wentworth, and D. E. Smith, *Analytic Geometry*, 349
- Silberstein (Prof. L.), traduit par G. Matisse, *Éléments de la théorie électromagnétique de la lumière*, 488
- Smail (Prof. L. L.), *Elements of the Theory of Infinite Processes*, 487
- Stellar Parallaxes, Determinations of*, from Photographs taken with the 24-inch Refractor of the Radcliffe Observatory, Oxford, under the direction of Dr. Arthur A. Rambaut, 349
- Sullivan (J. W. N.), *Atoms and Electrons*, 378
- Thomas (Dr. T.), and J. J. P. Kent, *Revision Arithmetic and Mensuration*. Third edition, 853
- Weatherburn (Dr. C. E.), *Advanced Vector Analysis: with Application to Mathematical Physics*, 671
- Wentworth (G.), D. E. Smith and H. D. Harper, *Fundamentals of Practical Mathematics*, 453
- Winger (Prof. R. M.), *An Introduction to Projective Geometry*, 598
- Worms de Romilly (P.), *Quelques réflexions sur la Relativité*, 152
- Yermoloff (N.), *Y a-t-il continuité dans le monde physique? 158*

**Medical Science:**

- Andrewes (Sir Frederick W.), and others, *Diphtheria: its Bacteriology, Pathology, and Immunology*, 527
- Brooks (Prof. H. T.), *Diagnostic Methods*. Fourth edition, 488
- Conn (Dr. H. W.), and Dr. H. J. Conn, *Bacteriology: a Study of Micro-organisms and their Relation to Human Welfare*, 853
- Forsdike (Dr. S.), *The Effects of Radium upon Living Tissues: with special reference to its Use in the Treatment of Malignant Disease*, 601
- Garrod (Sir Archibald E.), *Inborn Errors of Metabolism*. Second edition, 595
- Hope (Dr. E. W.), in collaboration with Drs. W. Hanna and C. O. Stallybrass, *Industrial Hygiene and Medicine*, 188
- Hume (E. D.), founded upon MS. by Dr. M. R. Levenson, *Béchamp ou Pasteur? a Lost Chapter in the History of Biology*, 121
- Imperial Cancer Research Fund, *Eighth Scientific Report on the Investigations of the*, 233
- Kenneth (J. H.), *Osmics, the Science of Smell*, No. 2, 743
- Macpherson (Maj.-Gen. Sir W. G.), *The Medical Services on the Western Front, and during the Operations in France and Belgium in 1914 and 1915*, 420
- Marage (Dr.), *L'Audition et ses variations*, 488
- Medical Year Book, The, 1924*, edited by C. R. Hewitt, 44
- Pearl (Prof. R.), *Introduction to Medical Biometry and Statistics*, 563
- Schall (W. E.), *X-rays: their Origin, Dosage, and Practical Application*, 600
- Starling (Prof. E. H.), and others, *The Action of Alcohol on Man*, 3
- Thompson (R. Campbell), *Assyrian Medical Texts*, 529
- Ventilation, Report of the New York State Commission on*, 77
- War: *History of the Great, Based on Official Documents. Medical Services: Pathology*. Edited by Maj.-Gen. Sir W. G. Macpherson, Maj.-Gen. Sir W. B. Leishman, and Col. S. L. Cummins, 42

**Metallurgy:**

- Alloys Resistant to Corrosion: a General Discussion held jointly by the Faraday Society and the Sheffield Section of the Institute of Metals*, April 1923, 191



Hughes (W. E.), Modern Electro-plating, 851  
 McMillan (W. G.), A Treatise on Electro-Metallurgy,  
 revised by W. R. Cooper. Fourth edition, 851  
 Metals, Institute of, Journal of the, edited by G. Shaw  
 Scott. Vol. 29, 120

**Meteorology :**

Baldit (A.), Études élémentaires de météorologie  
 pratique. Deux. édition, 43  
 British Rainfall, 1922, The Sixty-second Annual Volume  
 of the British Rainfall Organisation, 268  
 Dobrowolski (A. B.), Historia Naturalna Lodu (Histoire  
 naturelle de la glace), 923  
 Humphreys (Dr. W. J.), Weather Proverbs and Para-  
 doxes, 486  
 McAdie (Prof. A.), Making the Weather, 486  
 Shaw (Sir Napier), Forecasting Weather. Second  
 edition, 151  
 Talman (C. F.), Meteorology. The Science of the Atmo-  
 sphere, 486

**Miscellaneous :**

Annual Register, The : a Review of Public Events at  
 Home and Abroad for the Year 1923. Edited by  
 Dr. M. Epstein, 816  
 Brown (E. W.), and others, edited by L. L. Woodruff,  
 The Development of the Sciences, 419  
 Burns (C. D.), A Short History of Birkbeck College  
 (University of London), 670  
 Chambers's Encyclopædia. New edition. Edited by  
 Dr. D. Patrick and W. Geddie. Vol. 3, 191  
 Gunther (R. T.), Early Science in Oxford. Parts 3 and  
 4 : Physics and Surveying, 346  
 Haldane (J. B. S.), Daedalus, or Science and the Future,  
 740  
 Hammond (D. B.), Stories of Scientific Discovery, 118  
 Hart (I. B.), Makers of Science : Mathematics, Physics,  
 Astronomy, 118  
 Hunter (Prof. M. H.), and Prof. G. S. Watkins, The  
 Background of Economics, 348  
 Johnson (Dr. W. E.), Logic, Part 3, 522  
 Magnus (L.), The Jubilee Book of the Girls' Public Day  
 School Trust, 1873-1923, 9  
 Moreux (L'Abbé Th.), Les Confins de la science et de la  
 foi. Tome premier, 709  
 Noyes (W. A.), Building for Peace. II. : International  
 Letters, 563  
 Palgrave's Dictionary of Political Economy. Edited by  
 H. Higgs. Vol. 2, 233  
 Pupin (Prof. M.), From Immigrant to Inventor, 186  
 Ross (Prof. W. D.), Aristotle, 776  
 Russell (B.), Icarus, or the Future of Science, 740  
 Subject Index to Periodicals, The, 1920. K : Science and  
 Technology, 530  
 Taylor (Clara M.), The Discovery of the Nature of the  
 Air, and of its Changes during Breathing, 118  
 Universities of the Empire, The Year-book of the, 1924.  
 Edited by W. H. Dawson, 597  
 Wells (H. G.), The Story of a Great Schoolmaster :  
 being a Plain Account of the Life and Ideas of Sander-  
 son of Oundle, 559  
 Whipple (Prof. G. C.), Vital Statistics : an Introduction  
 to the Science of Demography. Second edition, 269

**Philosophy and Psychology :**

Adler (A.), translated by Dr. P. Radin, The Practice and  
 Theory of Individual Psychology, 919  
 Alexander (H. B.), Nature and Human Nature : Essays  
 Metaphysical and Historical, 564  
 Aristotelian Society. Supplementary Vol. 3, 156  
 Baudouin (C.), translated by Eden and Cedar Paul, The  
 Power Within Us, 121  
 Brigham (Prof. C. C.), A Study of American Intelligence,  
 158  
 Driesch (Prof. H.) : Leib und Seele : eine Untersuchung  
 über das psychophysische Grundproblem. Dritte  
 Auflage, 233 ; Wissen und Denken : ein Prolegomenon  
 zu aller Philosophie. Zweite Auflage, 233

Freundlich (E.), translated by H. L. Brose, The Theory  
 of Relativity : Three Lectures for Chemists, 638  
 Hadfield (Dr. J. A.), Psychology and Morals : an  
 Analysis of Character. Second edition, 919  
 Jones (Dr. E.), Essays in Applied Psycho-analysis, 919  
 Keyser (Prof. C. J.), Mathematical Philosophy, a Study  
 of Fate and Freedom : Lectures for Educated Lay-  
 men, 741  
 Malebranche (N.), translated by M. Ginsberg, Dialogues  
 on Metaphysics and on Religion, 116  
 McDougall (Prof. W.), An Outline of Psychology, 154  
 Peirce (the late C. S.), edited with an Introduction by  
 M. R. Cohen. Chance, Love, and Logic : Philo-  
 sophical Essays. With a Supplementary Essay on  
 the Pragmatism of Peirce by J. Dewey, 383  
 Rignano (Prof. E.), translated by Winifred A. Holl, The  
 Psychology of Reasoning, 44  
 Sands (Dr. I. J.), and Dr. P. Blanchard, Abnormal  
 Behavior, Pitfalls of our Minds : an Introduction to  
 the Study of Abnormal and Anti-social Behavior, 919  
 Semon (R.), Mnemic Psychology. Translated by Bella  
 Duffy, 303  
 Strong (Prof. C. A.), A Theory of Knowledge, 121  
 Taylor (Dr. H. O.), Freedom of the Mind in History, 885  
 Wagner (Prof. A.), Das Zweckgesetz in der Natur :  
 Grundlinien einer Metamechanik des Lebens, 266

**Technology :**

Bell (H. S.), American Petroleum Refining, 78  
 British Journal Photographic Almanac and Photo-  
 grapher's Daily Companion, 1924, edited by G. E.  
 Brown, 44  
 Davidson (Dr. W. B.), Gas Manufacture, 157  
 Dunn (Dr. J. T.), Pulverised and Colloidal Fuel, 810  
 Giltay (J. W.), Bow Instruments, their Form and Con-  
 struction. Issued into English by the author in  
 co-operation with E. van der Straeton, 852  
 Goodrich (W. F.), The Utilisation of Low Grade and  
 Waste Fuels, 810  
 Hobson (R. L.), and A. L. Hetherington, The Art of the  
 Chinese Potter from the Han Dynasty to the End of  
 the Ming, 524  
 Lander (Dr. C. H.), and R. F. McKay, Low Temperature  
 Carbonisation, 920  
 Morrell (Dr. R. S.), Varnishes and their Components, 743  
 Newcomen Society, Transactions of the, Vol. 2, 40  
 Nicol (E. W. L.), Coke and its Uses : in Relation to  
 Smoke Prevention and Fuel Economy, 810  
 Penrose's Annual : the Process Year-book and Review  
 of the Graphic Arts. Edited by W. Gamble. Vol. 26,  
 1924, 43  
 Redwood and Eastlake's Petroleum Technologist's  
 Pocket-Book, revised by A. W. Eastlake. Second  
 edition, 120  
 Suckan (C. A.), The Supervision and Maintenance of  
 Steam-raising Plant, 810  
 Wade (C. F.), A Manual of Fuel Economy : for Engineers  
 and Others in charge of Boiler and Furnace Plants, 810  
 Wallis (T. E.), Analytical Microscopy : its Aims and  
 Methods, 601  
 Wellington (S. N.), and W. R. Cooper, Low Temperature  
 Carbonisation, 920  
 Woodhouse (T.), Jacquards and Harnesses : Card-  
 cutting, Lacing and Repeating Mechanism, 742

Rhine Plants and Animals in Eastern England, Dr.  
 W. G. N. v. d. Sleen, 208  
 Rhubarb, Crown Rot of, W. A. Millard, 904  
*Rhytisma acerinum* and *R. Pseudoplatani*, R. Bracher, 33  
 Richards, Ellen, research prize, the, awarded to Dr. Mary  
 Evelyn Laing, 935  
 River : Discharge Measurement, E. B. H. Wade, 872 ;  
 Pollution, the Problems of : J. H. Coste, 354 ; K.  
 Carpenter, 385 ; Dr. W. H. Pearsall, 460 ; P. A. Aubin,  
 461 ; F. G. Richmond, 676 ; Prof. A. E. Boycott ;  
 J. W. H. Johnson, 817 ; A Plea for Continuous  
 Research on, Dr. J. H. Orton and Prof. W. H. Lewis,  
 236  
 Road Transport, Mechanical, C. G. Conradi, 485



- Root, The Respiratory Quotient of the, R. Cerighelli, 374  
 "Ross Deep" of the Southern Ocean, The, Lt.-Comdr. R. T. Gould, 507
- Rossel Island Money, W. E. Armstrong, 325
- Rotating Liquid, A Spherical Source in a, S. F. Grace, 590
- Rothamsted: Agricultural Research at, 482; Experimental Station, Annual Inspection of the, 943
- Royal: Academy: of Arts, 1924, Exhibition of the, 791; of Belgium, Prof. E. Bataillon elected associate of the, 900; Aeronautical Society, A. C. von Baumhauer, R. T. Hurley, and A. Matsumoto elected foreign members of the, 687; Anthropological Institute, Institution of Rivers Memorial Medals, 23; Astronomical Society: award of the gold medal of the, to Prof. A. S. Eddington, 171, 797; Centenary of the, 343; election of officers and council, 317; History of the, 1820-1920. Edited by Dr. J. L. E. Dreyer and Prof. H. H. Turner, 343; Botanic Gardens, Calcutta, Annals of the. Vol. XI., Appendix. Asiatic Palms—Lepidocarpaceae, Dr. O. Beccari. Supplement to Part I.: The Species of Calamus, 120; Geographical Society awards, 401; Institution, election of officers of the, 688; Irish Academy, meeting of the, in Belfast, 136; Meteorological Society, election of officers and council of the, 284; Microscopical Society, election of officers and council, 205; Observatory, Greenwich: W. M. H. Greaves appointed chief assistant at the, 282; Annual Visitation, 910; Society: Anonymous Gift to the, for the Prosecution of Research in Medicine, 544; Conversazione, The, 766; Early Science at the: 212, 256, 292, 325, 373, 409, 445, 477, 512, 553, 589, 625, 661, 733, 769, 805, 841, 877, 913, 946; Dr. Birch's History of the, 203; recommended candidates for the fellowship of the, 314; The Genesis of the, Dr. I. Masson, 197; of Arts, award of the Albert Medal to the Prince of Wales, 798; of Edinburgh, award of the Keith prize to Prof. J. W. Gregory and of the Neill prize to Prof. J. McLean Thompson, 471
- RR Lyræ, Parallax and Proper Motion of, 24
- Rubber: New Uses for, P. J. Burgess, 583; The Chemistry of, B. D. W. Luff, Dr. J. Reilly, 268
- Rugby School Natural History Society, Report of the, 725
- Russia, The Position of Scientific Workers in, 142
- Russian: Academy of Science, Profs. Nernst and Willstätter elected corresponding members of the, 436; zoologists, anatomists, and histologists, Congress of, 435
- Rust Problem in America, The, E. C. Stakman, 33
- Routine, The Biochemical Hydrolysis of, C. Charaux, 663
- Sailing Ships, Models of, in the Science Museum, 510
- St. Andrews University, conferment of honorary degrees, 661
- Salicaceae, Cytology of the, Kathleen B. Blackburn and J. W. H. Harrison, 938
- Salt Range, Punjab, Mollusca from the, Dr. S. L. Hora, 208
- Salton Sea Region, The, J. S. Brown, 938
- San Cuicuilco, Excavations at, 756
- Sand and Rock Specimens from Reg-i-Ruwan, C. Carus-Wilson, 274
- Sanderson of Oundle, The Story of a Great Schoolmaster: being a plain account of the Life and Ideas of, H. G. Wells, 559
- Sap and Latex Flows, Influence of Weather Conditions on, Dr. H. E. Annett, 821
- Sarawak, Crude Oil of, J. Kewley, 208
- Sargasso and Mediterranean, Plankton of the, 506
- Sargon of Akkad, The Atlas of, Prof. Sayce, 727
- Sarsen Stones, Tubular Cavities in, F. Chapman, 239
- Saturn, The Planet, W. F. Denning, 402
- Saturn's Satellites, Rotation Periods of, K. Graff, 690
- Scenery, The Scientific Interpretation of, Dr. G. L. Elles, 180
- Scholarships, State, and others, 149
- School and University: Preparation for Productive Industry, 297; Science, 113
- Schoolmaster, The Story of a Great: being a Plain Account of the Life and Ideas of Sanderson of Oundle, H. G. Wells, 559
- Schreinemakers, Prof., A Tribute to, 190
- Science: A Temple of, 940; and Labour: 737; Conference on, 837; and Philosophy, Prof. H. Wildon Carr, 612, 646; and Religion, A Synthesis of, F. S. Marvin, 885; and the Army Officer, 413; and the Future, 740; for the People, 378; Forthcoming Books of, 548; General Elementary, The New Method of Approaching, C. A. Carus-Wilson, 180; History of, 419; in Civilisation, Sir Richard Gregory, 876; Les Confins de la, et de la foi, l'Abbé Th. Moreux. Tome premier, 709; Makers of, Mathematics, Physics, Astronomy, I. B. Hart, 118; Masters' Association: Annual Meeting, 68; Sir Berkeley Moynihan elected president of the, 69; Museum: South Kensington, Catalogue of the Collections in the, with Descriptive and Historical Notes and Illustrations. Water Transport: I. Sailing Ships, G. L. Overton, 510; Eng.-Capt. E. C. Smith appointed guide lecturer at the, 505; School and University, 113; The Foundations of, Prof. H. Wildon Carr, 522; The Teaching of: Prof. A. Smithells, 68; M. R. Paranjpe, 444; The Visioning of, 559; The Wonderland of, 92
- Sciences, The Development of the, E. W. Brown and others, 419
- Scientific and Technical: Books, Recent: (January 26) Suppt. v., (February 23) Suppt. iii., (March 29) Suppt. v., (April 26) Suppt. v., (May 31) Suppt. v.; Publications, Standardisation of: W. P. Widdowson, 51; J. F. Pownall, 275; Discovery: Stories of, D. B. Hammond, 118; The Protection of: 593, 631; Instruments: and Research, 253; Early, L. Evans's, housed in the Old Ashmolean Museum, 400; Investigation, The Debt of Industry to, Prof. J. W. McBain, 93; Men, Proposed royalties to, on their Discoveries, 281; Names of Greek Derivation, B. B. Woodward, 51; Novelties Exhibition, The: 22, 92; Societies: in Poland, 179; Publication of Proceedings of, Prof. W. H. Gibson, 92; Workers in an Historical Setting, 118
- Scintillations from H-particles and from  $\alpha$ -particles, The Brightness of, Dr. Elisabeth Kara-Michailova and Dr. H. Pettersson, 715
- Scorpion, The Life of the, J. H. Fabre. Translated by A. Teixeira de Mattos and B. Miall, 303
- Scott, John, Medal, presented to Prof. F. G. Banting, Dr. W. W. Coblenz, Prof. E. V. McCollum, and Dr. R. Modjeski, 797
- Scottish: Fisheries, Some Scientific Aspects of, Prof. W. C. McIntosh, 509; Marine Biological Association, Annual Report for 1922, 435; Red Deer, Sir Herbert Maxwell, 265; Sea Fisheries, Report of the Scottish Departmental Committee on Trawling and Policing of, 509
- Secondary and Tertiary Rays from Chemical Substances of Small Atomic Number due to Primary X-rays from a Molybdenum Target, G. L. Clark, W. Duane, and W. W. Stifler, 844
- Sedentary Game, A Type of, prevalent in many Parts of India, H. C. Das-Gupta, 699
- Sedimentary Rocks: The Petrology of the, a Description of the Sediments and their Metamorphic Derivatives, Drs. F. H. Hatch and R. H. Rastall. Revised edition, 886
- Sediments, The Mechanical Analysis of, by Means of the Automatic Balance, R. A. Fisher and S. Odén, 294
- Seedling Blight of Cereals, Nature of Resistance to, J. G. Dickson, Sophia H. Eckerson, and K. P. Link, 375
- Seismic: Disturbances in Nottinghamshire and Derbyshire, 544; Period, A Four-year, Prof. H. H. Turner, 763; Sea-waves in Hawaii, 61
- Selenium Cell, The Application of the, to Photometric Measurements, Dr. T. Slater Price, 351
- Sensation and Thought, R. G. Collingwood, 34
- Serum, the Proteins of, Dimensions of the Molecules and the Molecular Weights of, P. Lecomte du Noüy, 948
- Serums, Reaction of, Changes of the, H. Plotz and M. Schoen, 948
- Sex Chromosomes in Plants, Winge, 208
- Sexes during Growth? Are the Requirements the same for the Two, H. Simonnet, 183



- Sheffield University: G. M. Bennett appointed lecturer in Organic Chemistry, 912; W. F. Wyatt appointed demonstrator in Chemistry, and R. R. S. Cox, curator of the Observatory, 733
- Shell-sculpture in the Viviparidae, Evolution of, Dr. N. Annandale, 581
- Shenandoah*, the U.S.S., Rear-Admiral W. A. Moffett, 313
- Ship Waves, Theory of, E. Hogner, 287
- Sicily, Corn Crops and Rainfall in, Prof. F. Eredia, 763
- "Sights of London," Aitchison and Co., Ltd., 798
- Siju Cave, Fauna of the, Drs. S. Kemp and B. Chopra, 762
- Silene nutans* Linn., Sex-conditions in, E. J. Collins, 293
- Silica: Colloidal, F. Diénert and F. Wandenbulcke, 327; Fused: Sir Richard Paget, Bart., 748; Transparent, The Phosphorescence of: D. L. Chapman and L. J. Davies, 309; E. B. Ludlam and W. West, 389; Dr. W. E. Curtis, 495
- Silicon: Arc Spectrum of, in Relation to Spectrographic Analysis, C. Porlezza, 772; Iron Plates, Influence of Annealing on the Magnetic Properties of, employed in Electric Construction, R. Cazaud, 842; Oxide and Chloride, and Chlorides of Carbon, Boron, and Aluminium, The Band-spectra of, W. Jevons, 878; Tetrafluoride, New Regularities in the Spectrum of, C. Porlezza, 915; The Spectra of, at Successive Stages of Ionisation, Prof. A. Fowler, 802
- Silkworm Cocoons, The Fumigation of, by Chloropicrin, G. Bertrand, 879
- Silt and Current Velocity, A. B. Buckley, 371
- Silurian Rocks of the Clwydian Range, The, from Moel Arthur to Gyrn, Mrs. Ethel Gertrude Woods and Margaret Chorley Crossfield, 806
- Silver Bromide Emulsions, Sensitiveness of, W. Clark, 321; Iodide, The Sensitiveness of, to Light, F. E. E. Germann and M. C. Hylan, 369
- Size: -factors and Size-inheritance, F. B. Sumner, 216; General, Does the Inheritance of Differences in, depend upon General or Special Size Factors? W. E. Castle, 447; in Relation to Internal Morphology, I. C. W. Wardlaw, 514
- Skulls, Type Contours of, Dr. F. G. Parsons, 554
- Sky: Photographs, Whole, A Lens for, R. Hill, 591; The International Survey of the, Capt. C. J. P. Cave, 279
- Sleeping Sickness, Antidotes against, 467
- Sliding Friction, The Variation of the Coefficients of, with the State of the Surfaces in Contact, M. Fichter, 947
- "Slime-fluxes" of Trees, L. Ogilvie, 691
- Snow and the Survival of Cod Fry, Dr. O. Sunf, 163
- Snowfall: Decreasing? Is, C. J. Root, 61; and The Geographical Distribution of, L. C. W. Bonacina, 210
- Soap and Detergent Industry, The Modern, including Glycerol Manufacture, Dr. G. Martin, Vol. I., 669; in Practice and Theory, 669; The Microscopic Structure of, K. MacLennan, 27
- Social Biology and Birth-control, 773
- Société de géographie de Paris, award of the gold medal of the, to B. de Laborie, 317
- Soda Deposits of Lake Magadi, 320
- Sodium: Chloride, The Production of Large, Clear, Cubical Crystals of, Dr. W. E. Gibbs and W. Clayton, 492; Salts, Determination of the Molecular Mass of Some, by Cryoscopy in Hydrated and Fused Sodium Thiosulphate, A. Boutaric, E. Chauvenet, and Mlle. Y. Nabot, 327; Thiosulphate, The Hydrates of, M. Picon, 411
- Soil: Acidity, The Influence of, on Snails, Drs. W. R. G. Atkins and Marie V. Lebour, 320; Sourness, A. G. Tansley and others, 179; The Micro-organisms of the, Sir John Russell, and others, 482
- Soils: The Nature and Properties of, a College Text of Edaphology, Prof. T. L. Lyon and Prof. H. O. Buckman, 637
- Solar: Activity and its Effects, Dr. C. Chree and others, 799; Eclipses, Total, Frequency of, Rev. W. Rigge, 249; Faculae, Variation of, in the Sun-spot Cycle, H. W. Newton, 137; Magnetism, The Mount Wilson Work on, Prof. G. E. Hale, 726; Prominences, The Velocity of, Dr. W. Anderson, 799; Radiation: Dr. A. Angström, 873; The Radioactivity of Radium in Relation to, Dr. A. Nodon, 443; System: The Origin of the, Dr. J. H. Jeans, 314, 329; Origin of, Sir Oliver Lodge; Dr. J. H. Jeans, 425
- Solid: Diffusion, Experiment in, and its Possible Bearing on the Structure of Solid Solutions, F. C. Thompson and W. H. Dearden, 770; State, The Complexity of the, Prof. A. Smits, 855
- Solutions, Solid: and Inter-atomic Relationships, A. L. Norbury; Dr. W. Rosenhain, 271; On the Structure of, Dr. A. Westgren and G. Phragmén, 122
- Somatic Character, Acquired, Transmissibility of an, L. Cuénot, R. Lienhart, and P. Vernier, 627
- Sörenson Reaction, Application of the, to the Study of the Toxic Power of Tuberculin, E. Fernbach and G. Rullier, 183
- Sound: The Propagation of: E. Esclangon, 447; F. J. W. Whipple, 801; up to Great Distances, The Organisation of an Experiment on, G. Bigourdan, 146; The Velocity of, in Gases and Vapours, and the Ratio of the Specific Heats, Prof. H. B. Dixon and G. Greenwood, 213
- Sounding by Acoustical Methods, Dr. H. C. Hayes, 621
- South: Africa: Distribution of Animals in, J. Hewitt, 64; The Natural History of, Birds. In 2 Vols., F. W. Fitzsimons, 228; Weeds of, Miss K. A. Lansdell, 761; African: Association: The Bloemfontein Meeting of the, Prof. H. B. Fantham, 64; Prof. J. A. Wilkinson elected president of the, 66; Birds, A. Roberts, 439; Bushman, The Long Bones of the, V. Vermooten, 948; Grasses, Feeding Value of, A. J. Taylor, 761; Seas, The, Prof. J. D. F. Gilchrist, 64
- South Eastern: *Naturalist* for 1923, The, 135; Union of Scientific Societies: Comdr. E. A. Martin elected Secretary of the, 136, 876; Congress of the, 876
- Southern Hemisphere Meteorological Correlations, R. C. Mossman, 250
- Southport Weather Observations, J. Baxendell, 287
- South Wales and Monmouthshire, University College of, Gift to, by Lord Glanely, 201
- Soybean, The: C. V. Piper and W. J. Morse, 813; a Crop of the Future, H. J. Page, 813
- Soziologische Abstammungslehre, Die, Dr. H. Schulte-Vaerting, 74
- Space-time, the Curvature: Radius of, Further Determinations of, Dr. L. Silberstein, 602; Radial Velocities and, Prof. A. S. Eddington, 746; Dr. L. Silberstein, 818
- Spark Spectra of Lead, etc., Extension of the, L. and E. Bloch, 295
- Spectra: and Atomic Structure, Prof. Paschen, 209; The Origin of, Prof. F. A. Saunders, 321
- Spectral Lines produced by Electron Collisions, Dr. G. Hertz, 693
- Spectrographic Analysis, Application of, to the Detection of Rare Metals in Italian Materials, C. Porlezza and A. Donati, 843
- Spectroscopic Parallaxes from the Dominion Observatory, R. K. Young and W. C. Harper, 472
- Speech: and Cerebral Localisation, Dr. H. Head, 498; Brain and, Dr. Tudor Jones, 498; Inscriptions, Three Biological Principles observed in, Prof. E. W. Scripture, 386
- Spheres Shot Upward to Measure the Wind, The Aerodynamic Resistance of, L. F. Richardson, 33
- Spherometer, A Reflecting, B. K. Johnson, 553
- Spiders: Classification of, Prof. A. Petrunkevitch, 762; The Eyes of, A. Mallock, 45
- Spiral Nebulae: Status of the, Prof. H. D. Curtis, 60; The Proper Motions of the, J. Jackson, 870
- Spiritual Healing, 73
- Spraying, Successful, and how to Achieve it, P. J. Fryer, 780
- Stability under Shearing Forces of a Flat Elastic Strip, R. V. Southwell and Sylvia W. Skan, 513
- Stalking Big Game with a Camera in East Equatorial Africa, M. Maxwell, 544
- Star: Clusters, The Constitution of, C. Parvulesco, 259; Distribution, Prof. H. Shapley, 760; Spectra, The Distribution of Energy of Some, J. Baillaud, 842
- Stars: Atmospheres of the, Absorbing Power of the, M. Salet, 771; B, On the Spectra and Temperatures of the, Cecilia H. Payne, 783; Distances of: E. A.



- Kreiken, 402; Certain, F. C. Leonard and P. Doig, 545; Double, Measurements of the Distances of, by Means of the Micrometer and of the Interferometer, M. Maggini, 772; Dwarf, Density of, Prof. A. S. Eddington, 760; Faint, with Large Proper Motion, Dr. Innes; Prof. Max Wolf, 318; Reversing Layers of, The Temperature of, Dr. J. Q. Stewart, 388; E. A. Milne, 534; The Hundred Nearest, W. J. Luyten, 438; The Masses and Luminosities of the: Prof. A. S. Eddington, 438; The Relation between, Prof. A. S. Eddington, 786; The Twinkling of the, in Relation to the Constitution of the Upper Strata of the Atmosphere, Prof. V. Conrad, 352
- Starvation Life Curves, Prof. Raymond Pearl, 854
- State scholarships: and others, 149; for students from State-aided schools, 292
- Statesman's Year-book, The, 1924. Edited by Sir John Scott Keltie and Dr. M. Epstein, 887
- Steam-raising Plant, The Supervision and Maintenance of, C. A. Suckan, 810
- Steel: and other Metals, Strength and Structure of, Prof. W. E. Dalby, 779; Manufacture, Sir William Ellis, 722; Some Failures in, as revealed by the Microscope and recorded by Photography, J. W. Bamfylde, 257; Titanium and Silicon in, G. K. Burgess and G. W. Quick, 474
- Steinhart Aquarium of the Californian Academy of Science, The, Dr. B. W. Evermann, 434
- Stellar: Mass as a Function of Absolute Magnitude, 655; Parallaxes, Determinations of, from Photographs taken with the 24-inch Refractor of the Radcliffe Observatory, Oxford, under the direction of Dr. Arthur A. Rambaut. Vol. 53, 349; Photometry at Yale Observatory, 24; Physics, Recent Work in, E. A. Milne, 258; Spectra, Distribution of Temperature in, Dr. C. G. Abbot, 95
- Stereoscope, A Simple Form of, and its Applications, C. T. R. Wilson, 70
- Sterigmatocystis: a Species of, normally producing large numbers of Sclerotia, etc., Miss M. Brett, 553; *nigra*: Effect of the Mineral Composition of the Nutritive Medium on the Structure of, M. Molliard, 947; the Formation of Organic Acids by, in Media with Constituents in Abnormal Proportions, M. Molliard, 146
- Sterne veränderlichen, Einführung in das Studium der, Dr. K. Schiller, 349
- Stilbene, Some Derivatives of, H. Ryan and N. Cullinane, 410
- Still Engine, The, W. J. Still, 369
- Stoat's Winter Pelage, The, Sir Herbert Maxwell, 196
- Stoking, Mechanical, D. Brownlie, 923
- Stone: Battle-axes from Troy, V. G. Childe, 761; Celts from the Naga Hills, J. H. Hutton, 319; Implements: at Susa, R. de Mecquenem, 727; Modern, in Cornwall, R. M. Nance, 473
- Stonyhurst Observatory, Annual Report of, for 1923, 619
- Storage Batteries, Elements of, Profs. C. M. Jansky and H. P. Wood, 853
- Storms, The Periodicity of, J. Gabriel, 556
- Stresses, Secondary, 621
- Stromboli, Eruption of, Prof. Palazzo, 618
- Stylophorus chordatus* Shaw, morphology of, C. Tate Regan, 325
- Styphelia longifolia* (R.Br.), the Embryo Sac of, P. Brough, 148
- Styrax and its Refractive Index, G. H. Needham, 785
- Subject Index to Periodicals, 1920, The, K: Science and Technology, 530
- Succinic Acid, Succinic Anhydride, and Succinimide, The Crystalline Structure of, Kathleen Yardley, 446
- Südamerika, Dr. B. Brandt, 420
- Sudan, Agricultural Conditions in the, Sir John Russell, 651
- Suez, Is the Gulf of, a Rift Valley? Dr. W. F. Hume; Prof. J. W. Gregory, 49
- Sugar Beet, The Physiological Function of Iodine in the Organism of the, J. Stoklasa, 147
- Sulphochromic Oxidation and  $\beta$ -oxidation, M. Polonovski, 327
- Sulphuric Acid, Potash, and Soda, The Viscosity of Mixtures, taken in Pairs, of, L. J. Simon, 592
- Sulphuryl Chloride, The Preparation of, Sir William Pope, 293
- Summer Time, 504, 578
- Sun: Eclipses of the, Prof. S. A. Mitchell; C. P. Butler, 703; Observations of the, made at the Lyons Observatory, J. Guillaume, 327; On Continuous Radiation from the, Dr. W. Anderson, 143
- Sunlight and Glass: an Inquiry for Hygiene, Dr. C. W. Saleeby, 747
- Sun-pillar, Observation of a, W. A. Knight, 436
- Sun's: Atmosphere, Variability in the Absorption of the, A. Amerio, 735; Reversing Layer, The North and South Currents in the, R. Sekiguchi, 726
- Sunshine and Health in Different Lands: L. C. W. Bonacina, 494, 674, 891; Cicely M. Botley, 674; W. H. Dines, 784
- Sun-spots: as Magnets and the Periodic Reversal of their Polarity, Dr. G. E. Hale, 91, 105; the Magnetic Polarity of, Dr. G. E. Hale, a correction, 136
- Surface Tension of a Liquid of High Susceptibility, Effect of a Magnetic Field on the, Winifred L. Rolton and R. S. Troop, 446
- Surveying and other Field Instruments, Cooke, Troughton, and Simms' Catalogue of, 249
- Survival, A Theory of, Sir Oliver Lodge, 399
- Sydney: Astrographic Catalogue, 95; Harbour Bridge, The Projected, 470; National Herbarium: New or Noteworthy Plants from the, E. Cheel, 147; University: Dr. J. Kenner appointed professor of organic chemistry in, 512
- Syenite from Coutances, The Supposed, Mme. E. Jérémme, 147
- Symington, Prof. J., Prof. G. Elliot Smith, 462
- Synechocera, the Genus, with Description of a New Species, A. Théry, 36
- Syphilis, The Serum Diagnosis of, 19
- Swedish Graphic and Plastic Art, Exhibition of, 92
- Sweet-pea, A Mould causing a Disease of, W. J. Dowson, 33
- Switzerland, Plant Ecology in, 585
- Tables logarithmiques à treize décimales, Prof. H. Andoyer, 637
- Tadpoles, Euglena in, Prof. R. W. Hegner, 493
- Tan-bark, Fermenting, The High Temperature Organism of. Pt. IV., R. Greig-Smith, 148
- Tanganyika Territory, Bones of Dinosaurs in, Expedition to explore the Deposits of, 361
- Tavetschthal, Switzerland, Mineral Localities in the, F. N. Ashcroft, 374
- Taylor-Hobson F/2 Anastigmat, The, H. W. Lee, 806
- Teasel-cups, R. Paulson, 876
- Technical: Education, F. C. Clarke, 944; Staff Associations, A National Council of, 399; Institutions: The Association of, Annual Meeting, 406; Teachers in, Annual Conference of the Association of, 944
- Technological History, The Value of, L. Pendred, 40
- Technology, The History of, F. S. Marvin, 40
- Telegraphy and Telephony, Interference with, Bartholomew, 617
- Tel-el-Obeid, Excavations at, C. L. Woolley, 174
- Telephone Systems, Maintenance of, P. E. Erikson and R. A. Mack, 474
- Telescope: Internal Focussing, A New, perfectly Anallatic, E. W. Taylor, 662; Reflecting, for Simeis Observatory, Crimea, 550
- Telescopes, Achromatism in, The Choice of Wave-lengths for, J. W. Gifford, 373
- Telesismic Propagation, Harmonic Law of, G. Grablovitz, 736
- Temperature: Gradient in the Earth's Crust, Sir A. Strahan, 623; -measuring Instruments, etc., The Design of, R. S. Whipple, 555
- Temperatures: Constant, A Block giving a Series of, H. Cardot, H. Laugier, and R. Legendre, 146; in a Deep Bore-hole in South Africa, L. J. Krige and H. Pirow, 623
- Tennessee, Prehistoric Site in, 871
- Termite of Saintonge, The, J. Feytaud, 183



- Termites: and their Intestinal Protozoa, Symbiosis between, L. R. Cleveland, 375; Intestinal Flagellates of, L. R. Cleveland, 175; The Possible Existence of a Growth-regulating Substance in, J. B. S. Haldane, 676
- Terpenes, An Hypothesis on the Related Origins of the, and the crystallised Acids Constituting the Resins of Conifers, G. Dupont, 807
- Terrestrial Magnetism: and Electricity, The Section of, International Geodetic and Geophysical Union, Report of Rome Meeting, 364; and the State of the Atmosphere, Relations between, A. Nodon, 699; Anomalies of, and of Gravity in the Province of Koursk, Russia, P. Lasareff, 35; Department of, of the Carnegie Institution of Washington, Report for 1923, 869
- Tertiary Amines, Methylation of, and of Alkaloids by Means of Sulphomethyl Esters derived from Phenols, L. J. Simon and M. Frèrejacque, 515
- Testing, No. 1, 472
- Tetracoralla and Hexacoralla, W. L. Robinson, 139
- Thallose Thallic Halides, The, A. J. Berry, 294
- Thames, Middle, Geology of the, Sir Aubrey Strahan, 905
- Thermal Emission and Evaporation from Water, M. Allen, 663
- Thermodynamics in Physiology, Prof. A. V. Hill, 859
- Thermobæna mirabilis*, A New Type of Crustacea, T. Monod, 947
- Thibet, Into Little, Helen Mary Boulnois, 450
- Thomistic Outlook in Philosophy, The, Rev. Dr. F. Aveling, 770
- Thoria, Monazite Sands and other Sources of, Dr. E. H. Pascoe; The Writer of the Article, 238
- Thorium: Emanation: in Thermal Springs, A. Lepape, 729; (thoron), Search for, in Thermal Springs by the Method of Induced Activity, A. Lepape, 515; -X, Action of, on the Maturation of Eggs, the Germination of Seeds, and the Growth of Plants, Aversenq, Delas, Jaloustre, and Maurin, 771
- Three-colour Process, The, and Modern Painting, Prof. T. D. A. Cockerell, 606
- Thunderstorms: Atmospheric Electricity in, Origin of, Prof. J. J. Nolan, 354; Mammato Clouds, and Globular Lightning, Dr. G. C. Simpson, 82
- Thyroid Activity, Braxy and, An Apparent Connexion between, Ruth C. Bamber (Mrs. Absbee), 161
- Tibet: Chinese: To the Alps of, an Account of a Journey of Exploration up to and among the Snow-clad Mountains of the Tibetan Frontier, Prof. J. W. and C. J. Gregory, 6; and Little, 450; The Mystery Rivers of, Capt. F. K. Ward, 450
- Tibetan Bibliography, J. Van Manen, 96
- Tidal: Energy, The Utilisation of, 115; Power, Studies in, N. Davey, 115
- Tide Prediction, Dr. A. T. Doodson, 25
- Tides of the North Sea, The Principal Constituent of the, Prof. J. Proudman and Dr. A. T. Doodson, 293
- Tiere Deutschlands, Biologie der, Herausgegeben von Prof. P. Schulze. Lief. 2, 3, 4, 5, 6, 853
- Timbers of Guiana, The, 528
- Time: and Timekeepers: including the History, Construction, Care, and Accuracy of Clocks and Watches, Prof. W. I. Milham, 415; and Weather by Wireless, W. G. W. Mitchell, 530
- Tin, Single Crystals of, H. Mark and M. Polanyi, 441
- Tissue Diastases of Animal Origin, Effects of Electrolysis on, F. Maignon, 375
- Tomatoes Grafted on Potatoes and on *Lycium barbarum*, Variation of Chemical Composition in, S. Golinski, 183
- Topaz from Cornwall, A. Russell, 214
- Toronto: Meeting of the British Association, The, 792; University: gift to, by the Rockefeller Foundation, 877; Sir William Mulock elected chancellor of, 698
- Torsion, The Effect of, on the Thermal and Electrical Conductivities of Metals, J. E. Calthrop, 326
- Totemism in the Upper Nile Province, H. C. Jackson, 620
- Town Refuse: Apparatus for the Treatment of, A. Bigot, 627; The Treatment of, A. Bigot, 556
- Towy, The Upper, Drainage-system, O. T. Jones, 326
- Transmission Lines for very High Pressures, Mr. Lasprière, 544
- Transvaal, Platinum in the, Dr. P. A. Wagner and T. G. Trevor, 621
- Transylvania, Prof. E. de Martonne, 99
- Tree Growth, Dendrographic Records of, Dr. D. T. MacDougal and others, 835
- Trees and Subterranean Fungi, Relations between, J. Costantin, 182
- Trilobites, New, from Bowning, with Notes on Encrinurus and Cordania, J. Mitchell, 843
- Tropical: Agriculture: No. 1, 203; The Imperial College of, Sir Arthur Shipley and others, 370; Cyclones, Dr. S. K. Banerji, 939; Forests and their Economic Significance, Prof. R. S. Troup, 213
- Troughton Dividing Engine, The, D. Baxandall, 374
- Trypanocidal Drugs, a New Series of, E. Fourneau, J. Tréfouël, Mme. J. Tréfouël, and J. Vallée, 375
- Trypanosomes, The Pathogenic, Culture of, A. Ponselle, 627
- Tubercle Bacillus, The, and an Irresorbable Excipient, H. Vallée, 147
- Tuberculosis, gift for a campaign against, Lord Atholstan, 316
- "Tung" Oil, R. N. Parker and others, 872
- Tungsten, K Lines of, Change of Wave-length by Diffusion in the Case of the, M. de Broglie, 515
- Tungus Shamanism, Prof. Shirokogoroff, 937
- Tuning Forks, Forced Vibrations produced by, W. N. Bond, 355
- Tunisian Tattooing, Dr. E. Gobert, 834
- Turks, The Origin of the, Sir E. Denison Ross, 734
- Tutankhamen, Raising of the Lid of the Sarcophagus of, 282
- Twinkling: of Distant Light-points, C. Carus-Wilson, 426; of the Stars, The, in Relation to the Constitution of the Upper Strata of the Atmosphere, Prof. V. Conrad, 352
- Tytherington-Tortworth-Wickwar Ridge, The Avonian of the, F. S. Wallis, 182
- Uganda, Distribution of Rainfall over, with a Note on Kenya Colony, C. E. P. Brooks, 842
- Ultra-violet Emission Bands associated with Oxygen, R. C. Johnson, 878
- Underblown Pipes, Prof. A. L. Narayan, 536
- Undergraduate Training for Scientific Research, Dr. M. M. Metcalf, 588
- Unemployment and the Poverty Problem, Capt. J. W. Petavel, 181
- Universities: of Great Britain and Ireland, Annual Conference of the, 730; of the Empire, The Year-book of the, 1924. Edited by W. H. Dawson, 597
- University: *Bulletin*, March, 625; College, London, The New Engineering Laboratories of, 869; Science, School and, 113; Statistics, British, 584; Women, International Federation of: forthcoming Conference, 512; Report for 1922-23, 144
- Unsaturated: Molecules, The Fixing of, by Metals derived from their Organic Derivatives, A. Job and R. Reich, 103; Radicals in Optically Active Compounds, Induced Asymmetry of: Prof. T. M. Lowry and Dr. E. E. Walker, 565; E. J. Holmyard, 785
- Upper: Air Observations, Significance of Regression Equations in the Analysis of, F. J. W. Whipple, 591; Thames Basin, The Fossil Elephants of the, K. S. Sandford, 591
- Ur, Excavations at, C. L. Woolley, 286
- Uranium-X<sub>1</sub>, The  $\beta$ -rays of: L. Meitner, 290; Dr. C. D. Ellis, 404
- Uranyl Compounds, Supposed Isomorphism of, with those of Isomorphogenic Metals of the Magnesium Metals, G. Carobbi, 843
- Urinary Ionic Acidity in Normal Man, The, Le Noir and A. M. de Fossey, 842
- U.S.A.: fellowships in, 372; Game Laws for the Season 1923-24, G. A. Lawyer, 341; Ground Water in the, O. E. Meinzer, 835; History of Science Society in the, 434; Meteorological Factors and Forest Fires in the, 659; National Academy of Sciences: award of medals to O. S. Pettersson, Prof. A. S. Eddington, Prof. C. V. L. Charlier, Prof. B. Dean, Prof. W. M. Wheeler, and F. Canu, 798; and National Research Council, Dedication of the new building of the, 940;



- Scientific Education in the, 102; Survey Work, 582; The Preparation and Supervision of Rural School Teachers in the, and their Applicability to Indian Conditions, 102
- Ustilago, The Sexuality of, F. Howarth, 258
- Vacuome of the Lower Algæ, Researches on the, P. A. Dangeard and P. Dangeard, 591
- Vacuum Pump, A Metal, I. Backhurst and Dr. G. W. C. Kaye, 763
- Valency, The Electronic Theory of, 267; a Magnetic Theory of, Suggestions for, Prof. A. P. Laurie, 409; The Electronic Theory of, Part IV., Prof. T. M. Lowry, 409
- Van Nostrand's Chemical Annual. Edited by Prof. J. C. Olsen. Fifth issue, 1922, 191
- Variables, The Constitution of, such as Mira Ceti, M. La Rosa, 735
- Varnishes and their Components, Dr. R. S. Morell, 743
- Vector: Analysis: Advanced, with Application to Mathematical Physics, Dr. C. E. Weatherburn, 671; Quantum, The, Prof. F. W. Bubb, 237
- Vegetation, Outposts of, Prof. A. C. Seward, 823
- Ventilation, 77
- Venus, Spots on, 799
- Vercors, the Plateau of, An Important Tectonic Fault at the Southern Edge of, W. Kilian and G. Sayn, 295
- Vertebrate Embryology, Prof. R. S. McEwen, 775
- Vertebrates: The Ancestry of, as a Means of Understanding the Principal Features of their Structure and Development, Dr. H. C. Delsman, 708; The Embryology of, Dr. F. H. A. Marshall, 775; The Origin of, Prof. E. S. Goodrich, 708
- Veterinary Research Institute, The Foundation Stone of a New, laid by the Duke of Connaught, 830
- Victorian Graptolites (New Series), Pt. I., W. J. Harris, 147
- Violin, The, Scientifically Analysed, 852
- Viscous Fluids, Motion in, K. Terazawa, 140
- Visibility, Vertical, at Cranwell, during the Period Feb. 1922 to June 1923, W. H. Pick and S. P. Peters, 34
- Vision, Physiology of, Dr. H. Hartridge, 370
- Visual Sensations, Reflex, Prof. F. Allen, 370
- Vital Statistics: an Introduction to the Science of Demography, Prof. G. C. Whipple. Second edition, 269
- Vitamin A, The Chemical Nature of, Prof. J. C. Drummond and Miss K. H. Coward, 759
- Vitamins: Manuring and, Col. McCarrison, 620; Succulence, and Prickly Pear, A. Stead, 727; The Present State of Knowledge of the, 718
- Viviparidæ, Fresh-water Snails of the Family, Evolution of the Shell-sculpture in, Dr. N. Annandale, 182
- Vocational Tests in the Selection of a Vocation, The Use of, Dr. C. S. Myers, 362
- Volatile Liquids in Industry, Storage of, M. de Char-donnet, 183
- Volcanic: Gases, Emission of, Prof. A. W. Conway, 891; Series of Roch, Trefgarn, and Sealyham (Pembrokeshire), The, H. H. Thomas and A. H. Cox, 699; Steam in Italy, The Utilisation of, 54
- Wales, National Museum of, Report of the, for 1923, 619
- War, the Great, History of: Based on Official Documents. Medical Services: Pathology. Edited by Major-General Sir W. G. Macpherson, Major-General Sir W. B. Leishman, and Col. S. L. Cummins, 42; General History. Vol. 2: The Medical Services on the Western Front and during the Operations in France and Belgium in 1914 and 1915, Major-General Sir W. G. Macpherson, 420
- Wärmestrahlung, Vorlesungen über die Theorie der, Prof. Max Planck. Fünfte Auflage, 561
- Washington, Anthropological Society of, election of officers, 758
- Watch, marks awarded by the National Physical Laboratory to a, 172
- Water: Hydrone and, Problems of, Sir Oliver Lodge, 193; Power Resources of Canada, Dr. B. Cunningham, 803; -waves produced by Earthquakes, A. Mallock, 270
- Watson's: Experiments relating to the Expansion of Water under High Constant Pressure, Results of, L. Bochet, 327; *Microscope Record*, 655, 901
- Wattle Barks, M. B. Welch, W. McGlynn, and F. A. Coombs, 295
- Wave-lengths, Comparison of, with a Fabry and Perot Étalon, Prof. J. K. Robertson, 926
- Wayside and Woodland: Life of the, When, Where, and What to Observe and Collect, T. A. Coward, 191
- Weather: Abnormal, of Winter and Early Spring, C. E. P. Brooks, 873; at Eastbourne in 1923, A. H. Hookham, 905; at Falmouth in 1923, W. L. Fox and J. B. Phillips, 938; Correlation in Seasonal Variations of, VIII. A Preliminary Study of World Weather, Dr. G. T. Walker, 131; Forecasting: Sir Napier Shaw. Second edition, 151; Long-range, 131; Forecasts, Dr. G. C. Simpson, 151; in the Higher Atmosphere, C. Le Roy Meisinger, 404; Making the, Prof. A. McAdie, 486; of 1923, The, 94; Proverbs and Paradoxes, Dr. W. J. Humphreys, 486; The, and the Farmer, 283
- Weeks's Bacillus, The Prevention, Treatment, and Ætiology of Acute Conjunctivitis caused by, C. Nicolle, P. Durand, and E. Conseil, 146
- Well-worms and their Allies, Rev. H. Friend, 272
- Wendingen, 437
- West: Indian: Agricultural Conference, The, 495; University at Jamaica, Movement for the Founding of a, 408; Indies, Weather in, O. L. Fassig, 97
- Western: Australia, Flora of, Prof. K. Domin, 439; Mendips, The Avonian of the, Miss A. E. Bamber, 182
- White, Gilbert: Unveiling of a Memorial Seat to, 722; and Moral History, Sir David Prain, 866
- White of Egg, Separation of the Proteids of, by the Acetone Method, M. Piettre, 146
- Whitehead's: and Einstein's Formulæ, A Comparison of, Prof. A. S. Eddington, 192; Theory of Relativity, A Generalisation of, G. Temple, 446
- Wild: Bird Adventures: a Nature Story Book for Boys and Girls, R. Kearton, 228; Life, The Protection of, by Law, 341
- Winter, The Past, 577
- Wirbellosen Tiere, Handbuch für das mikroskopisch-zoologische Praktikum der, Prof. P. Deegener. Erste Lief., 564
- Wireless: Conference, Proposed International, 93; for the Amateur, J. Roussel. Authorised translation, 456; Reception without the Use of a Crystal, E. Taylor, 136; Telegraph Service between England and Austria inaugurated, 93; Telegraphy Committee, Imperial, Report of the, 361; Transmission, Principles and Practice of, G. Parr, 420
- Wires in a Wind, The Singing of, Prof. G. I. Taylor, 536
- Wissen und Denken: ein Prolegomenon zu aller Philosophie, Prof. H. Driesch. Zweite Auflage, 233
- Wistar Institute Index System, 723
- Witches and Vampires, Miss M. Edith Durham, 25
- Wool Fibre, The Nature of the, H. J. W. Bliss, 475
- Woolmen, The Company of, gold medal presented to Prof. J. Cossar Ewart, 935
- Women: in Engineering Works, The Training of, Mary Macdonald, 471; Science Teachers, Association of, Annual Meeting of the, 180
- World Power Conference at the British Empire Exhibition, 205
- World's Health, The*, 248
- X-radiation: reflection by a Crystal of its Characteristic, G. L. Clark and W. Duane, 448; Tertiary, G. L. Clark and W. Duane, 448
- X-ray: Diffraction in Liquids, Prof. C. V. Raman and Dr. K. R. Ramanathan, 320; Measurement, Prof. J. A. Crowther, 582; Phosphorescence, A Test for Possible, J. A. Bearden, 857; Photography, Use of Desensitisers in, Dr. A. B. MacLean, 27; Quanta, Scattering of, and the J Phenomena, Prof. A. H. Compton, 160; Spectral Lines, Intensity of, Measurement of the, M. Siegbahn and A. Láček, 62
- X-rays: and the Atom, Sir Oliver Lodge, 22; Influence of, on the Catalase of the Liver, A. Maubert, L. Jaloustré, P. Lemay, and C. Guilbert, 515; in Pyrites, Refraction of, B. Davis and R. von Nardroff, 627; reflected from a Calcite Crystal, Absorption Measurements of the, Y. H. Woo, 844; Reflection of, by Crystals, Dr.



- G. L. Clark, 621; Secondary: and Tertiary, from Germanium, etc., G. L. Clark and W. Duane, 663; Wave-lengths of, G. L. Clark and W. Duane, 375; The Action of, on Tissue Cells, Dr. J. A. Crowther, 325; The Scattering of: by Light Atoms, W. Friedrich and M. Bender, 692; and Bragg's Law, G. E. M. Jauncey, 627; Photo-electrons and a Corpuscular Quantum Theory of, Prof. G. E. M. Jauncey, 196; Their Origin, Dosage, and Practical Application, W. E. Schall, 600; Total Reflection of, Prof. P. Kirkpatrick, 98
- Y a-t-il continuité dans le monde physique? N. Yermoloff, 158
- Yarrow Research Professor, Prof. O. W. Richardson appointed a, 542
- Yeasts: in Vineyards, The Dissemination of, by Insects, E. Sergent and H. Rougebilf, 411; Reduced Forms of, The Work of Kruis and Satava on, J. Peklo, 553; The Life Histories of, K. Kruis and J. Satava, 947
- Yellow Light, The Sensation of, obtained by Mixture of Spectra, E. Haas, 259
- Yorkshire Philosophical Society, election of C. E. Keyser, Prof. P. F. Kendall and A. H. Smith as honorary members of the, 171
- Zinc: Acetate, A Basic, Analogous to the Acetate of Beryllium, V. Auger and Mlle. I. Robin, 807; and Lead, The Relative Corrosion of, in Solutions of Inorganic Salts, Dr. J. N. Friend and J. S. Tidmus, 478; -bronze, a Sand-cast, Effect of Casting Temperature in the Physical Properties of, F. W. Rowe, 479; -copper Alloys, The X-ray Analysis of, E. A. Owen and G. D. Preston, 33
- Zirconium and Hafnium, Separation of, Hevesy and Jantzen, 63
- Zodiacal Light, Photographing the, J. Dufay, 545
- Zoological: Nomenclature: 506; Interpretation of Rules of, A. J. and A. G. Campbell, 798; Official List of certain Generic Names, Dr. C. W. Stiles, 821; Specimens in Fluid, Preservation of, J. Ritchie, 319; Society of London, Report for 1923, 687; Society's Aquarium, The, 400, 571
- Zoology: Elementary: O. H. Latter, 269; A Manual of, Dr. L. A. Borradaile. Fourth edition, 78; for Medical Students, Dr. L. A. Borradaile, 78; in India, 1

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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
Zoology in India	1
The Alcohol Problem. By E. M.	3
Chemical Engineering. By E. C. W.	5
The Mountains and Rivers of Chinese Tibet	6
Our Bookshelf	7
Letters to the Editor :—	
The Gorilla's Foot. ( <i>Illustrated</i> ).—Sir E. Ray	10
Lankester, K. C. B., F. R. S.	10
The Transatlantic Migration of the Eel-larvæ. ( <i>With Diagram</i> ).—Dr. Johs. Schmidt	12
Half-shade Polarisers and Analysers.—C. A. Skinner; Editor "Dictionary of Applied Physics"	12
A Formula for the Specific Heat of Ferromagnetic Substances and its Discontinuity at the Critical Temperature.—Dr. J. R. Ashworth	13
Magn tic Boreholes.—Albert Millar	14
Experiments on <i>Ciona intestinalis</i> .—B. Stewart	14
The Kinetic Atom. ( <i>With Diagrams</i> ). By Sir Oliver Lodge, F. R. S.	15
The Scientific Renaissance in China. By Prof. J. W. Gregory, F. R. S.	17
The Serum Diagnosis of Syphilis	19
Electrode Reactions and Equilibria. By Dr. Eric K. Rideal	20
Obituary :—	
Col. C. Swinhoe. By J. J. W.	21
Canon Theodore Wood	21
M. Gustave Eiffel	21
Current Topics and Events	22
Our Astronomical Column	24
Research Items	25
The Pan-Pacific Science Congress, Australia, 1923. By Dr. A. C. Haddon, F. R. S.	28
The French Physical Society's Exhibition	31
University and Educational Intelligence	32
Societies and Academies	33
Official Publications Received	36
Diary of Societies	36

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Zoology in India.

THE Report of the Zoological Survey of India<sup>1</sup>—a phœnix which has arisen from the ashes of the old Indian Museum—gives first impressions of a peculiarly felicitous service. Looking cursorily over its pages we see visions of a zoological and ethnographical museum that might have been designed by Socrates for inclusion in Plato's Republic: a museum of which the Guardians are biologists—philosophers—and the fiduciary appanages of which occupy a minor position as Auxiliaries: a museum where the Guardians do not always work within walls and upon what fortune may bring, but have freedom (within the omnipotent tether of the Treasury) to wander where they will in order to study and collect for themselves from the living stream of Nature.

Closer attention to the Report, however, slightly qualifies these attractive visions. The officers of the Museum are indeed the field-officers of the Survey, and they can indeed work in commodious laboratories upon material that they have studied and gathered in its natural environment in fair places of their own choice. Yet they are not quite happy. There are, says the Director, so few of them, and they are so imperfectly furnished with trained and responsible assistance, that they cannot take enough advantage of their golden opportunities, but have to spend "an undue proportion of their time" in the mere mechanical care, not so much of the housed collections, as of the very bottles in which the specimens are preserved. So the young Department has to endure such bitter taunts as "that it does no solid work, but merely names specimens," and "has neglected its opportunities."

Analysis of the Report gives abundant evidence that these taunts are but wild and whirling words. The staff of the Survey, besides naming specimens, has in

<sup>1</sup> Report of the Zoological Survey of India for the years 1920 to 1923. (Calcutta: Superintendent of Government Printing, India, 1923.) One rupee, or 2s.



the three years under review produced, or caused to be produced, more than 150 scientific papers. Now we all are aware that mere outflow of printed matter from a Government department may have various significations and interpretations, according to circumstances, and also that a good deal of subsidised "research work" is not of very high character or of very serious purpose. Many of the publications here recorded, however, are additions of permanent value to the general stock of knowledge and also have important applications to practice. Among those of a more obvious scientific interest are the series of "notes" on Crustacea, by Dr. S. W. Kemp, which are really the finished material for a critical catalogue; the numerous and varied biological papers by Dr. B. Prashad; and the ichthyological series, also rich in biological interest, by Dr. S. L. Hora.

More particular attention may be directed to several papers on the gastropod molluscan fauna of the Indian Empire, which, in addition to their scientific value, have an important bearing upon practical affairs. In the economy of Nature, it is one of the distressing functions of gastropod molluscs to serve as nurses and distributors of a great tribe of parasitic trematodes, and, among these, of the terrible blood-flukes that so variously, so grievously, and so obstinately afflict mankind in many tropical and subtropical countries. The papers in question include, among others, the "materials" for a revision of the fresh-water gastropod mollusca, by Dr. Annandale, the "*Cercariæ Indicæ*" of Major R. B. Sewell, and the report on a survey of the molluscs and their trematode parasites by both authors in collaboration. Major Sewell's monograph, which extends to nearly 400 pages of text and is illustrated by 32 coloured plates and numerous text-figures, is in the opinion of an expert parasitologist the finest contribution to our knowledge of this important group of parasites that has ever been produced at one individual effort. Should the extending employment of Indian troops in neighbouring countries infected by blood-flukes threaten ulterior consequences for India, the knowledge embodied in these papers will enable the danger to be handled rationally.

Notwithstanding the home-keeping obstructions complained of, a large amount of well-conceived field-work has been accomplished. In connexion with the general survey of lacustrine life and the particular investigation of the fresh-water molluscan fauna, expeditions have visited various lakes in Burma, Kashmir, and Kumaon, in one case accompanied by an artist to figure living forms. An expedition of a mainly scientific character, and having rather unexpected scientific results, was made to the unexplored Siju cave in the Garo Hills of Assam.

The training, as subsidised "research assistants," of promising young Indians is a praiseworthy educational experiment that further illustrates the enterprising spirit that animates the Zoological Survey of India. So far as the supply of young men having the necessary aptitudes goes, the experiment has been justified, but the difficulty is to find employment for them afterwards. Here we meet, on another road, the Director's complaint of an insufficient staff: the harvest is plentiful, the labourers are there, but the Indian Government cannot supply the gear.

Those who like to think of zoology as essentially a humanising study—a science above all others whereby man may learn to know himself as he really is, an animal, although the beauty of the world and the paragon of animals—do not care to be for ever harping on its value for material ends. There is, however, one of the many economic applications of zoology, namely, its application to hygiene and the public health, in which its humane refinement suffers no perdition. From this aspect it is astonishing that a Government having the care of three hundred million souls, most of whom till the soil and live more or less at the mercy of the teeming populations of the jungle, is not supremely anxious to discover all that can possibly be known about that jungle life. For if we would name the diseases that, far beyond all others, undermine the health and shorten the life of the native inhabitants of India, we should have to specify diseases that are directly caused by, or spread by, or both caused and spread by animals, or animalcules, or by both in combination; *i.e.*, are caused in some way by jungle life that by taking thought can be mastered.

To argue that the causes of these preventable diseases were not discovered but were only corroborated and clarified by zoologists, and that since some particular facts are now known any service that zoology can render to the cause of public health is accomplished, is to misunderstand the lesson. The truer argument is that these discoveries have lifted the horizon over new and imperfectly surveyed tracts of pathology and hygiene, in the exploration and occupation of which enormous service can be rendered by concurrent accurate and comprehensive zoological investigations. The general value to India of the sanitary institutions of the West is beyond question; nor is there any doubt that in India, as in other parts of the British Empire that lie within the tropics, the sanitary principles that should find their widest and happiest application are those that are based on knowledge of the kind that is best gathered in the course of an adequate and well-administered zoological survey.

Of course, it may be argued that to the millions of India both zoology and hygiene are things equally



indifferent; that the uneducated masses do not know what zoology is, and, when they think of European dealings with their health, think now of quinine and of the miraculous surgery that restores the blind man's sight, and now of the tyrannical "Sirkar" who would defile them by vaccination; and, therefore, that in the presence of such deplorable ignorance it is almost impious to talk about zoology and its hygienic applications. These arguments, however, are merely the stock of the unbeliever. It may be argued that in times like the present a poor country like India cannot afford to spend money on a luxury like zoology, even with its distinct promise of help in elucidating the problems of human disease. This no doubt would be a good argument if a very large sum of money were required, or if parsimonious treatment of an enterprise holding out a rational and well-justified promise of that kind were really economy. As, however, neither of these alternatives is true, we hope that every encouragement will be afforded to the continued activities of the Zoological Survey of India.

### The Alcohol Problem.

*The Action of Alcohol on Man.* By Prof. E. H. Starling. With Essays on (1) Alcohol as a Medicine, by Dr. Robert Hutchison; (2) Alcohol and its Relations to Problems in Mental Disorders, by Sir Frederick W. Mott; (3) Alcohol and Mortality, by Prof. Raymond Pearl. Pp. vii+291. (London: Longmans, Green and Co., 1923.) 12s. 6d. net.

IN this book, Prof. E. H. Starling and his collaborators, Dr. R. Hutchison, Sir Frederick Mott, and Prof. Raymond Pearl, have described the action of alcohol on the body both in health and disease. Whereas most of the book is taken up with a scientific but popular discussion of the problem, Prof. Starling has come to certain definite conclusions, on the basis of the facts described, which will cause comment and possibly opposition, and these will be dealt with first. He states that "moderate quantities might be taken throughout adult existence without interfering with bodily health or efficiency, and are sufficient to obtain beneficial results and to produce the increased pleasure in living which are the objects of the employment of alcoholic beverages." It is important to add that 35 c.c. is regarded as a "moderate" quantity of alcohol. This is contained in half a bottle of light wine, or in a pint and a half of ale, or in three ounces of whisky (30 under proof). This "moderate" quantity may be drunk with impunity, according to Prof. Starling, after the work of the day is finished. It will diminish a man's power of muscular co-ordination

and other complex processes, but will not influence his behaviour or his powers of comporting himself with propriety as a member of society. On the other hand, if a man drinks alcoholic beverages during the day-time, he ought to take such quantities as will not materially influence his judgment and other mental processes, and in this case, not more than 12 c.c. of alcohol, in the form of a glass of beer or a wineglass of claret, should be taken at lunch. These are some of Prof. Starling's conclusions.

Many people would probably agree that, if all who now drink to excess took their liquor in these quantities and at the times recommended, there would be no such thing as an alcohol problem, and there would be no more reason for the publication of this book than one dealing, say, with the action of sausages on man. Unfortunately, alcohol is a big human problem because it is drunk in immoderate measure by large numbers of people, so that, as pointed out in the book, the expenditure on alcoholic drinks is 8 guineas per head per annum. If it is also true that only 16 guineas per head is spent annually on food, Prof. Starling will find it difficult to get great support for his statement that the expenditure on alcohol in Great Britain "does not seem disproportionate" even if we take into consideration that half of the 8 guineas reverts to the State. If the cares of the world are so intolerable that they require this expenditure on alcoholic beverages in order to increase the pleasure of life and to diminish the frets and worries of daily existence, then either those who do not drink to this extent have a very wrong view of life or else such an expenditure is a great social mistake.

It would be wrong, however, to emphasise too strongly Prof. Starling's conclusions on what might be described as the social problem of alcohol, for in most of the book he discusses in very readable and balanced language the physiological action of alcohol. It would be difficult for any one, whatever his views on the social problem, to have anything but praise for this part of the volume. Where necessary a certain amount of description of normal physiological processes is given in order to enable the general reader to understand how alcohol affects the body in a particular respect. Thus, in describing the action of alcohol on digestion, a brief but adequate account of the normal processes of digestion makes it possible for the reader to get a view of how the substance influences digestion at different stages, so far as our present knowledge goes. There is also an account of the functions of the nervous system in the chapter on "The Action of Alcohol on Human Behaviour." In this case, it would have been interesting if Prof. Starling had also discussed our present knowledge—slight though it be—



of the relation between the cerebral cortex and the thalamus, and how the former with its functions of judgment, fine sensitivity and inhibitions controls the latter, which serves rather the emotional side of a man's nature and the appreciation of coarser and more primitive stimuli. Such an account would probably have helped to make clearer what is not only a prominent physiological effect of alcohol, but is also the most difficult for the ordinary person to understand, namely, that a narcotic drug can have such apparent stimulant effects.

As regards the circulatory system, Prof. Starling states — a point upon which there will be general agreement—that this subject needs further investigation, for, apart from the irritant effect of alcohol on the mucous membrane of stomach and œsophagus, it is difficult to understand the basis for the beneficial effect believed by many clinicians and the general public to be produced by alcohol in cases of circulatory failure. The possibility that alcohol acts in these cases and in conditions of respiratory abnormality by paralysing inhibitory mechanisms has been advanced by Dale and is an interesting speculation, but at the present time remains a speculation. In a special appendix, Dr. R. Hutchison deals with the question of alcohol as a medicine, and in discussing its action in disorders of the circulatory system points out that, not only did older practitioners universally believe that alcohol had a stimulating effect on the heart in acute disease, but that many of their successors still hold the same belief. Nowadays, when all the better hospitals are endeavouring to introduce more scientific methods, both for diagnosis and treatment of disease, it should be possible to ascertain what real basis there is for these long-held beliefs. It is an unpleasant reflection that we should have had so long to wait for accurate information as to the action of a substance so extensively used as a therapeutic agent in circulatory disorder. Positive or negative evidence would be equally valuable. What we want in these cases is the application of a "ruler" to the problem and not simply a descriptive account of more or less casual observation.

In one small respect the book seems open to criticism, although, in fairness to the authors, the same criticism must be extended to the original discoverer of the facts. In Stockhard's work on the influence of breathing attenuated alcohol vapour on breeding guinea-pigs, it will be remembered that (1) a number of the progeny were defective, even two or three generations after the original guinea-pigs were exposed to the vapour, and that (2) ultimately, after elimination of the unfit through three generations, the surviving animals were very superior in their records as compared with normal guinea-pigs. Stockhard suggests that these results

may explain the superiority of those European races who indulge freely in alcohol. This may be so, but, on the basis of the first result above described, alcohol may also be responsible for many of the physical and mental defects of these races. Unfortunately, unlike his defective guinea-pigs, which could be easily thrown aside, subnormal and defective human beings, unless very abnormal, often breed as vigorously as any of the supermen. Alcohol is probably a weed-producer and is certainly a weed-killer. Stockhard's results suggest it may also be a superman producer, but, in the meantime, the weed-producer influence is superficially more obvious. In any case these experiments are of prime importance whether considered from the point of view of the action of toxic substances on the germ plasm or because of their sociological significance.

In an essay, Prof. Raymond Pearl discusses the relationship between "Alcohol and Mortality." This is mainly a summary of his previously published statistical observations directed to show that "moderate" drinking does not shorten life, while "heavy and steady" drinking brings about a significantly lower duration of life. We see here again the word "moderate" cropping up, and it is important to notice that Prof. Pearl's "moderate" drinker and Prof. Starling's "moderate" drinker are quite different people; in fact, any person who makes a habit of taking wine or beer with meals even in the amounts regarded by Starling as safe is placed by Pearl under the "heavy or steady" drinking category. According to these statistical results, the person who takes irregularly and at not too frequent intervals an occasional glass of beer or drink of whisky is a moderate drinker, and imbibing alcohol to this extent is shown not to shorten life. Thus, however startling Prof. Pearl's conclusions may appear at first sight, an examination of the real meaning of his groups "moderate" and "heavy and steady" drinkers dissipates our surprise so that we can resume our reading with a sense of comfort. In the meantime Prof. Pearl must settle with Prof. Starling about that pint and a half of ale with the evening meal. Possibly, also, the insurance companies specially interested in temperance may have something to say from the opposite point of view.

Sir Frederick Mott's contribution to this volume deals with the relation of alcohol to mental disorders. He analyses in particular the statistics of admission to the London asylums and the post-mortem records of hospitals and asylums, and concludes that alcohol plays a relatively unimportant part in the production of certified insanity. He points out that people with an inborn neuropathic or psychopathic tendency become anti-social after imbibing relatively small



quantities of alcohol, and that this brings about their segregation in asylums, mentally defective institutions, and prisons. Here we have the view that alcohol is a "weed segregator."

It is obvious that this book deals widely and comprehensively with the problem of alcohol both from a physiological and from a social point of view. Like the book on alcohol published by the Science Committee of the Liquor Control Board, it is evidence that the problem is being removed from the unenviable position of being the shuttlecock of ignorant people. It can only lead to good results when men of standing take a hand at the game and raise the discussion of the problem to the highest level of scientific effort. Many men—especially business men—would greatly reduce their consumption of alcohol if they knew the facts as described in this book, especially if they realised the effect of alcohol on their judgment. On the other hand, it is to be doubted whether complete knowledge of the action of alcohol as at present understood would ever induce normal men to imbibe more than they now drink while in a state of relative ignorance.

E. M.

### Chemical Engineering.

*Principles of Chemical Engineering.* By Prof. W. H. Walker, Prof. W. K. Lewis, and Prof. W. H. McAdams. Pp. ix+637. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 25s.

THE work under notice, by three professors in the department of chemical engineering at the Massachusetts Institute of Technology, Boston, is a welcome addition to the literature dealing with the scientific aspects of the subject. It induces serious reflection on the great strides made in America as contrasted with Great Britain in a matter of vital importance to industrial chemical development, and at the same time provides food for thought to a small minority who consider that there is little scope in industry for the trained chemical engineer.

Probably the authors would not claim that their volume constitutes a complete treatise on chemical engineering, or, indeed, that it is more than a special method of treatment of selected aspects of the subject. The method of treatment, quantitative measurement combined with sound mathematical analysis, is a most valuable one, and it will be some time before the whole field of chemical engineering can be covered in the same thorough manner. It is this method of attack that characterises the book as a serious scientific contribution in a field which has hitherto been inadequately served by publications resembling too often the plant-maker's catalogue.

The greater part of the text has been in use as students' notes at the Massachusetts Institute. The book opens with a chapter on industrial stoichiometry, dealing with simple applications of chemical arithmetic, with the object of familiarising the reader with the use of English units in chemical, physico-chemical, and thermo-chemical calculations. English units are used throughout the numerous problems which form a valuable feature of the book. In view of the slow progress which the metric system has made in industrial circles, this choice is perhaps a wise one, though the writer would have preferred to see the use of the centigrade heat unit advocated in place of the B.T.U. on account of its numerical identity with the calorie, in which unit the bulk of thermo-chemical data is expressed in the literature. The chapters on fluid and heat flow which follow are excellently written, and lay the foundation on which the solution of most problems in plant design ultimately rests. The most recent work on fluid friction and the effect of boundary films on heat transfer is well presented.

The next section of four chapters deals in more descriptive manner with fuel, power, the theory of combustion, and the main principles of operation of a few typical furnaces, ovens, and gas producers, and is followed by sections on crushing, grinding, and mechanical separation. There is little new in these chapters, and the latter sections are somewhat cursorily treated. For example, there is only passing mention of froth flotation as a means of separating solids, and no mention of such processes as extraction and lixiviation. Processes for the extraction of solids from gases are dismissed in three pages, of which electrostatic precipitation methods receive twelve lines. Crystallisation, precipitation, and transportation of solids are not mentioned, while centrifuging receives insignificant attention. More surprising is the lack of any appreciable reference to the recovery of condensable vapours from gases by any such process as refrigeration, compression, oil washing, or adsorption. Little attention is given to purely engineering or structural questions, and description of industrial plant, though lucid, is limited to that necessary to enable the reader to visualise the types of apparatus employed. Corrosion, lubrication, and compatibility of materials of construction are not dealt with; neither are such broader questions as the lay-out of plant, and the construction of material and energy-flow sheets—what might be called the strategy of chemical engineering as contrasted with unit plant operation. These lacunæ are mentioned here, not in a spirit of criticism, but to indicate what ground the authors have not attempted to cover.

The best part of the book is to be found in the last



seven chapters, dealing with the unit operations of filtration, evaporation, humidification and dehumidification, water cooling, drying, and distillation. Much of the matter in these chapters is collected from the original papers of members of the Massachusetts Institute. Mathematical equations based on the fundamental physical and physico-chemical characteristics of the particular operations are derived, and these equations are then tested either on small-scale plant or on actual industrial installations, working under carefully controlled conditions. In this connexion the authors do not mention what the writer was privileged to inspect on a recent visit to America—the invaluable “School of Chemical Engineering Practice,” set up in certain typical factories to complement (from the training point of view) the more theoretical work at the Institute, and to provide opportunity for the trying out of theoretical conclusions on a factory scale. If English manufacturers, whether of plant or products, see anything of potential value to themselves in the type of work described in this book, one would commend to their notice the mutual arrangement between factory and university which enabled the work to be carried out.

The theory of plant operation as developed by the authors should be of the greatest value to the industry, the only criticism being that possibly the publication is a little premature, as much of the theoretical work is supported at present by comparatively few researches on isolated products. The researches themselves are in several instances published as private theses not accessible to the ordinary reader. Some of the equations will possibly need modification when tried out over a wider range; for example, a recent paper by Fisher (Proc. Roy. Soc., 1923) tends to show, *inter alia*, that shrinkage of material during drying does not at all necessarily have the effect on rate of drying ascribed to it by Prof. Lewis. However, he would in any case be a rash man, who, equipped only with formulæ, essayed at the present stage to build a chemical plant. The great value of a mathematical analysis, as the authors point out, is in the design of plant from data obtained on plants handling the same material, and in the calculation for a particular plant of the effect of altering operation conditions. We are still not in a position to design chemical plants with the same certainty as, say, ships; but by work along the lines indicated by Profs. Walker, Lewis, and McAdams we can at least avoid the blunders of the “telescope fiend,” who spies a laboratory scale plant and draws what he sees—a practice not so rare as might be imagined.

The book is attractively written and printed, and is free from those “Americanisms” which sometimes

mar the pleasure of English readers. It can be recommended as one of the best works of its kind that has yet appeared.

E. C. W.

### The Mountains and Rivers of Chinese Tibet.

*To the Alps of Chinese Tibet: an Account of a Journey of Exploration up to and among the Snow-clad Mountains of the Tibetan Frontier.* By Prof. J. W. Gregory and C. J. Gregory. Pp. 321 + 16 plates. (London: Seeley, Service and Co., Ltd., 1923.) 25s. net.

THERE are certain regions of the earth which will always have a fascination for the geographer who has some knowledge of geology, or the geologist who is interested in geographical problems, by reason of the unexplained peculiarities which they present when he sees them depicted in an atlas. Of these, one of the most remarkable is that region, lying between India and China, where the scattered drainage of a large area in Tibet is collected in three great rivers, the Salween, the Mekong, and the Yangtse-kiang, which flow for more than 150 miles in channels straight, parallel, and separated by high mountains, but so close together that the distance between the two outermost is barely more than 50 miles. It was to this region that Prof. Gregory, accompanied by his son, made a rapid excursion in the summer of 1922, and the book before us is one result of this journey. It is the joint production of the two travellers, who are somewhat quaintly referred to as the Chief and the Assistant, or occasionally as “one of us”; and the bulk of the book is taken up with a narrative account of the journey, mainly the work of the junior, though the inspiration, if not the hand, of the senior can be recognised in places. Of this, all that need be said is that the Assistant has done his work well, and produced a very readable book of travel; for readers of NATURE the main interest lies in the first and last chapters, which must be solely the work of the Chief, for he alone could have written them.

The first chapter states the problems to be solved. The backbone of Asia is formed by a great mountain system extending from the Caucasus to the Himalayas, which is of the same age as the Alps of Europe; but there is also an older mountain system, the Hercynian, represented by the north and south ranges of Indo-Malaya. The problem is, what becomes of the Himalayan system of disturbance when its easterly extension reaches the region of these older mountain chains? According to one view, it is bent back on itself, turning south-westwards, to find its continuation in the mountains south of Assam and west of Burma; according to other views, these ranges must be regarded as mere



offshoots of the Himalayan system, which continues either to the north-eastwards into northern China and Manchuria, or else to the south-eastwards through Yunnan. Also there is the problem of the river valleys, which recent observations had indicated as possibly rifts of the same age and similar origin to those of eastern Africa.

In the last chapter the geographical results are summed up in what reads like a kind of triumphant pæan of victorious solution of these problems. In Chinese Tibet, in the region of those remarkable river valleys, Prof. Gregory found convincing evidence that the district "had been disturbed by mountain-forming movements of a date much later than the formation of the Indo-Malayan Mountains," and, being of later date than the Hercynian, they are assigned to the Himalayan system of disturbance. From observations made on a previous journey in northern China, and on this journey, he rejects all of the suggestions made by earlier writers, and regards the eastern extension of the Himalayan system as being through the district visited by him, to the Nan Shan mountains of southern China; which is not the range of that name in Tibet, but the mountains south of the Yangtse-kiang, generally named Nan Ling on English atlases. As a result of the rise of the mountain range, produced by these rock movements, the east and west valleys of the Sanpo and Brahmaputra were emphasised, but to a great extent the drainage of the interior was ponded up in vast lakes. Then, on the cessation of compression, rifts were opened transverse to the mountain range, and the rising waters of the lakes found outlets, to form the present main channels of drainage; but the southerly courses of the rivers were not as now. The Yangtse-kiang continued south-eastwards to form the head waters of the Red River; the Mekong flowed across Tonkin as it now does; the Salween probably continued south-eastwards and flowed to the sea by Bangkok; the Irawadi must have flowed down the Sittang valley; the Sanpo doubtless flowed across upper Assam to form the head waters of the Chindwin; and the Brahmaputra, then a comparatively insignificant river, flowed to the sea by the delta of the Ganges.

As unfolded by Prof. Gregory, this forms a fascinating tale, clear and convincing to the uninitiated; but to one who has some knowledge of the geology and geography of the region, so far as it can be known at present, there are many difficulties. Of these, not the least is the Himalayan system of disturbance. As used by the author, the term is clear enough; he accepts the view, once almost universally adopted, that in fold mountains, among which the Himalayas are classed, the compression and folding of the rocks is the direct cause of the elevation of the mountains. Yet there is a considerable

body of observation, growing slowly, it is true, but at an increasing rate, which indicates that the parallelism between geological structure and topographical relief is not so close as was once supposed; that the folding of the rocks preceded the uplift of the mountains; and that this uplift may have been due to a wholly independent cause. So, too, of the author's history of the river system it may be said that there is at present no evidence of the existence of the vast lakes which he postulates, and the statements regarding the changes in the river courses are in every case open to doubt, in some to almost insurmountable difficulties. Of all these doubts and difficulties the author cannot have been unaware, but they leave him unmoved, and perhaps, after all, he is right. Who knows? Who can know?

### Our Bookshelf.

*Elementary Mathematical Astronomy.* By C. W. C. Barlow and Dr. G. H. Bryan. Eighth impression (Third edition). Pp. xvi+445. (London: University Tutorial Press, Ltd., 1923.) 9s. 6d.

THE teaching of astronomy is attended by many difficulties, and competes against other studies under disadvantages which cannot be denied. When facilities exist for practical work the weather may be trusted to play havoc with any prearranged time-table. When practical instruction is not attempted, astronomy when taken seriously demands so much knowledge of the elements of mathematics and the fundamental principles of physics that it may easily appear that the time would be more profitably spent in gaining familiarity with those primary sciences. Perhaps examinations and the requirements of candidates have a salutary effect in saving the subject from complete neglect. But its difficulties are not small; and even the student who has a fair mathematical equipment rarely finds it easy at first to acquire the jargon and the essential ideas of astronomy.

For the purpose of explaining the traditional terminology and fundamental notions of the science for the benefit of elementary students Barlow and Bryan's work is admirably adapted. It has been in existence for thirty years, and it is not surprising that it is still in demand. It is lucid, concise, and sound. It can scarcely be described as a stimulating book, but it fulfils a definite aim efficiently, and it is too well known to need description. This third edition has been revised by Dr. Crommelin, and its general accuracy should be above suspicion.

In the circumstances it is strange to find the eye arrested by references to the Nautical Almanack. The publication in question is and always has been the Nautical Almanac. Curiously enough, if one consults the first issue in 1767, one finds on a left- and a right-hand page confronting one another the Act of Parliament ordering a Nautical Almanack to be prepared and the authority of the Commissioners (a galaxy of naval heroes!) to the printers to publish a Nautical Almanac. Whitaker's Almanack, of course, is a whole century younger.

H. C. P.



*British Mammals*. Pp. 127+2 plates. 3s. 6d. net.  
*British Birds*. Pp. xiii+186+4 plates. 5s. net.  
*British Reptiles, Amphibians, and Fresh-Water Fishes*.  
 Pp. ix+114+2 plates. 3s. 6d. net. *British Butterflies and Moths*. Pp. xv+106+2 plates. 3s. 6d. net. *British Insects (General)*. By W. Percival Westell. Pp. xii+112+2 plates. 3s. 6d. net. (The Abbey Nature Books.) (London: Chapman and Dodd, Ltd., n.d.)

IN this series of volumes Mr. Westell gives a rapid survey of the salient features of the commoner forms of British animal life. He recognises the enormity of the subject and, while he has been able to include all the mammals, reptiles, amphibia and fishes, he has had to be content with a selection from the birds and the barest mention of most of the insects.

The information has been culled admittedly from larger and more authoritative works, and the author makes no pretence to originality, but merely desires to direct and impart useful and interesting information in simple and non-technical language. If, however, the reader is to be stimulated to observe on his own account (and this is, ostensibly, the aim and purpose of the series), it is essential that he should know how to recognise his animals, and Mr. Westell would have been well advised to have included more details about the characters which serve for a ready recognition of the animals about which he writes. Unfortunately, the illustrations are of little or no help in this matter. They are mainly outline figures which, while giving a good impression of general habit and characteristic attitude, convey no idea of colour and markings, so important for identification. Miss Meyer's work receives less than justice because of the rough paper on which her drawings are reproduced. The few coloured plates published with these books show that she has an accurate eye for animal form and colour and bear witness to her skill as an artist of Nature.

Mr. Westell's enthusiasm in the cause of Nature-study is unbounded, his energy prodigious, and his aims unquestionably important, but in spite of these things this series of volumes scarcely justifies itself. The information is not sufficiently detailed to be of use to the serious naturalist, and the dilettante reader has read it all elsewhere.

*Paläontologische Methoden und ihre Anwendung auf die paläobiologischen Verhältnisse des Steinheimer Beckens*. Von Dr. Hans Klähn. Pp. v+127. (Berlin: Gebrüder Borntraeger, 1923.) 4s. 8d.

DURING the Tertiary Epoch various lake-basins in Central Europe were the home of fresh-water molluscs. Being isolated and at the same time exposed to a variety of influences, these molluscs underwent notable changes, as recorded in the shape of their shells preserved in the successive sediments. Many attempts have been made to interpret those changes in the light of evolutionary doctrines, but the interpreters have failed to agree. Perhaps the most famous of these basins is that of Steinheim in eastern Württemberg, where, during the latter half of the Miocene period, lived crowds of the pond-snail, *Planorbis*. Studied by Hilgendorf (1866), Sandberger (1873), Hyatt (1880), Gottschick (1920), and many others, these form the centre of interest in the present remarkable book.

That Dr. Klähn should differ from his numerous predecessors was inevitable, but the really important difference lies in his methods of work. First he has re-surveyed the basin, working out the relations of the somewhat disturbed beds and the physical conditions under which each was deposited. Then he has collected from each zone, not the *Planorbis* alone, but all forms of life. Next, so far as the *Planorbis* shells are concerned, he has studied them by several statistical methods of much ingenuity, which have enabled him (in conjunction with the field work) to separate and follow out the various lineages. Finally, he has correlated the changes with such external conditions as temperature, concentration of calcium carbonate, depth of water, influx of silicic acid from hot springs, food-supply, and associated fauna and flora.

From Dr. Klähn's many conclusions we select these: There are three main stems, unconnected with each other. Each shows gradual change of form, which, in two series at least, amounts to the evolution of a new species. The generally progressive evolution, with occasional set-backs, of each stem, and its eventual retrogression and extinction, are due to the external factors and not to an inner impulse. The book demands, and will repay, careful study.

F. A. BATHER.

*Darwinism and Catholic Thought*. By Canon Dorlodot. Translated by the Rev. Ernest Messenger. Vol. 1: *The Origin of Species*. Pp. viii+184. (London: Burns, Oates and Washbourne, Ltd., 1922.) 6s.

THE author of this lucid and interesting work is Director of the Geological Institute of the University of Louvain. He was deputed to convey the address from that University to the gathering that celebrated the fiftieth anniversary of the publication of "The Origin of Species" at Cambridge in 1919. The present volume leads us to look forward to one promised on "The Descent of Man," though the lines of the argument can be sufficiently traced from these two "conferences" on the general question of evolution. "Darwinism" is here used as synonymous with the theory that species of organisms have been continuously evolved. The author combats (pp. 26 and 31) the view of Father Brucker, S.J., who has held that a certain number of species were connected with the Creation recorded in the Bible, while others, linked by chains of descent, arose later.

Dr. Dorlodot deals calmly and fairly with such attempts to read the two Biblical versions of the "days" as chronological accounts of actual happenings. He believes that the compiler, Moses or another, acted under divine inspiration, but utilised earlier documents and traditions familiar to the untutored folk whose intelligence he hoped to reach. We may be surprised at the statement (p. 57) that the Deity was "obliged" to use certain phraseology; but this is not the place to dwell on subtleties that lie beyond the province of the layman. Dr. Dorlodot points out the real advance towards the appreciation of the results of scientific research that was made by the Commission for Biblical Studies under Leo XIII. in 1905. His knowledge of Hebrew adds charm and distinction to his comments on the text of Genesis, and his conclusions may be commended to thoughtful naturalists,



and also to those who attack "Darwinism" in educational circles in America.

*The Jubilee Book of the Girls' Public Day School Trust, 1873-1923.* By Laurie Magnus. Pp. x+204+4 plates. (Cambridge: At the University Press, 1923.) 5s. net.

THE Girls' Public Day School Trust is to be congratulated on the excellence of the book in which Mr. Laurie Magnus has commemorated the jubilee of its foundation. It recalls, as did the recent Cambridge Local Lectures jubilee celebrations, the lofty educational aims and the strenuous and efficient endeavours to embody them in practical measures that marked the early seventies of the nineteenth century. About the middle of the century began a revolt against the false ideals and incompetence of the girls' schools (the "select establishments for young ladies") of the period, and an insistent demand for a return to more robust and honest standards. This movement, under the guidance of Mrs. William Grey and others, led to the formation of the "Women's Educational Union," the G.P.D.S. Trust, and the Teachers' Training and Registration Society. The Trust stood for "the training of the individual girl, by the development of her mental and moral faculties, to understand her relation to the physical world around her, her fellow-beings, and God, and to know and perform the duties which arose out of those relations." "The chief object of education should be," they held, "while fitting boys and girls for the tasks and duties of practical life, to preserve intact for them . . . as much as may be of childlike faith, of intellectual reverence and homage, and of gaiety and truthfulness of mind." The story of the several schools is full of interest. Thirty-eight in all, each with its own special features, they became nurseries of genuine culture; and this was due alike to the well-directed initial impetus given by the founders, to the discrimination exercised in the choice of the heads, and to the large measure of freedom from interference and red-tape which they enjoyed.

*Dynamics.* By Prof. Horace Lamb. Second edition. Pp. xi+351. (Cambridge: At the University Press, 1923.) 12s. 6d. net.

THE first edition of Prof. Horace Lamb's "Dynamics" was issued in 1914, and reprinted with additional examples in 1920. The fact that a new edition is now called for can be well understood by all teachers and students who have had occasion to use the book. Little change has been made in this second edition, except for the substitution of different examples in the polar co-ordinate section of the chapter dealing with central forces, and for the introduction of more than forty additional "miscellaneous" examples at the end of the book.

Perhaps we may use this opportunity to remark that Prof. Lamb's order of treatment would be changed by some teachers. The interpolation of the chapters on rigid dynamics in the midst of the particle dynamics course does not seem to be advantageous. Further, while agreeing with the author's remarks on pp. 152-3, we nevertheless think that d'Alembert's principle possesses one great advantage: it makes clear that in the case of a rigid body there are just sufficient equations of motion to deal with the six degrees of

freedom. Prof. Lamb's book will remain a favourite text-book at British universities for many years to come.

S. B.

*Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie.* Von P. Pringsheim. Zweite verbesserte Auflage. Pp. viii+228. (Berlin: Julius Springer, 1923.) 7s. 1d.

THE first edition of this book appeared two years ago. It was written during the author's internment in Australia on account of the War, and its object was to collect together the known facts of fluorescence and phosphorescence and to show to what extent Lenard's theory agreed with and explained those facts. In this present edition, many new observations are cited which support that theory. According to it, when radiation of frequency  $n_1$  falls on a phosphorescent molecule, it is absorbed by a "resonator" having the same frequency, which in turn gives its energy up to a "photoelectron," and this is driven from its atom. It is immediately captured by another atom of the same molecule, with which it remains associated for a more or less lengthy period before the thermal oscillations of the molecules bring it into a configuration from which it can return to its original atom. In doing so it sets free radiation of frequency  $n_2$ , which is in turn absorbed by a resonator of that frequency and given out as phosphorescent light. It does not appear possible at this stage to specify what parts of the nuclear atom furnish the resonators and photoelectrons of Lenard's theory.

*Practical Control of Electrical Energy.* By A. G. Collis. (Oxford Technical Publications.) Pp. xii+160. (London: Henry Frowde and Hodder and Stoughton, 1923.) 10s. 6d. net.

THIS book contains technical data which will be useful in the design of electric machines and apparatus. The requisite mathematical reasoning has been simplified so far as possible. We have noticed, however, several misprints in the equations (p. 23). In discussing the measurement of potentials by instruments based on the hot-wire principle, it is stated that owing to their low inductance the current is in phase with the potential difference. In making this inference it is assumed that the resistance of the hot-wire instrument is practically constant over the half-period of the applied potential difference. It would be well to mention this. The chapter on protective gear is useful, but the notes on lightning arresters are too brief to be of much value.

*Practical Physical Chemistry.* By Prof. Alexander Findlay. Fourth edition, revised and enlarged. Pp. xvi+298. (London: Longmans, Green and Co., Ltd., 1923.) 7s. 6d. net.

THE principal features of the new edition of Prof. Findlay's "Practical Physical Chemistry" are the introduction of additional experiments on hydrogen-ion concentration and of a number of experiments on colloids. Although the figure of the Pulfrich refractometer by Zeiss is retained in the text, the improved instrument of English manufacture (which formed the subject of a recent article in the new *Journal of Scientific Instruments*) is referred to in a footnote.



### Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor 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 Gorilla's Foot.

I HAVE now examined Mr. Akeley's cast of the gorilla's foot kindly forwarded by Dr. Gregory to the British Museum (Natural History). I regret that I am, in consequence, unable to agree with Dr. Gregory's opinion that the photograph published by Mr. Akeley in the *World's Work* (reproduced here as Fig. 3) gives "a very fair representation" of this cast. I am, on the contrary, confirmed in my condemnation of the photograph, and endorse Mr. Pocock's statement (*NATURE*, December 8, p. 827) that it is "entirely misleading," since it suggests a resemblance between the hallux of the gorilla and that of man which does not exist. I here submit a photograph of



FIG. 1.—Plantar surface of adult gorilla's foot showing position of the toes when the leg is supporting the full weight of the body. Drawn by Mr. R. I. Pocock, F.R.S.



FIG. 2.—Photograph of plantar aspect of the right foot of a gorilla; the animal is lying on the ground, dead. From "In Brightest Africa."

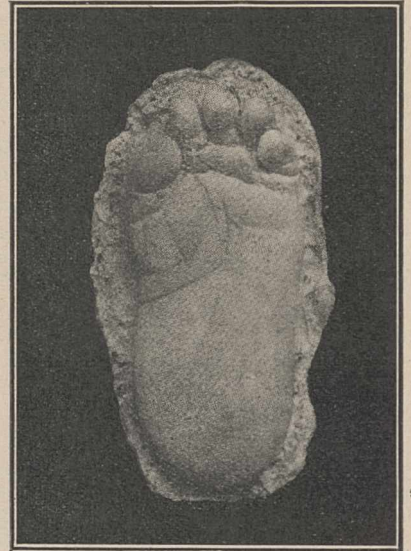


FIG. 3.—Photograph of the plantar aspect of the cast of an amputated gorilla's foot, published by Mr. Akeley in the *World's Work* (1922) and considered by Sir Ray Lankester to be "strangely distorted" and "made to present a false resemblance to the foot of man."

the same cast taken under the direction of Dr. Vevers at the Zoological Society's laboratory (Fig. 4). Proper care has, in this case, been given to the direction of the light falling upon the cast. The deceptive character of Mr. Akeley's photograph is obvious when it is compared with that now submitted.

At the same time I wish to record my opinion that the actual gorilla's foot from which Mr. Akeley's cast was taken was distorted by *post-mortem* changes and by pressure tending to bring the hallux alongside of and parallel with the other toes as in man, instead of allowing it to diverge widely from them as it does when not artificially constrained. Fig. 2, taken from a figure in Mr. Akeley's book "In Brightest Africa," shows the plantar surface of the foot of a recently killed gorilla. The great toe is in its natural position.

Misrepresentation and consequent misunderstanding of the mechanism of the gorilla's foot require attention and correction, when detected, because since the publication of Huxley's essay on "Man's Place in Nature," sixty years ago, the gorilla has occupied a special place in the literature of evolution. The suggestion made by Mr. Akeley that zoologists

have for sixty years overlooked important resemblances between the gorilla's foot and that of man seems to have been received in some quarters with unquestioning credulity. On the other hand, the evidence adduced in favour of Mr. Akeley's suggestion has proved on examination, by those acquainted with such matters, to be faulty—owing to the distorted condition of the gorilla's foot made use of by Mr. Akeley for casting, and the illusory nature of the illumination of the cast as photographed and published by him.

E. RAY LANKESTER.

December 9.

P.S., December 30.—I find that it is necessary to take up one or two factors in this discussion which are liable to be overlooked in consequence of the intervals caused by delay in postage to and from the United States. I must call to mind Mr. Akeley's share in this matter. He wrote in the *World's Work*, October 1922: "Not only has the gorilla

developed a heel, but his big toe is much more like man's than that of any other animal. This may seem a small matter, but a big toe that turns out from the foot, like a thumb does from the hand, can grasp branches and is useful in climbing. A big toe that is parallel with the other toes is useful for walking but not for climbing."

Mr. Akeley publishes his photograph of the cast of a gorilla's foot (reproduced here as Fig. 3) alongside of this statement. The figure is apparently intended to show that the gorilla's great toe is, when the muscles are relaxed, parallel with the other toes as in man. In the face of this astonishing assimilation of the gorilla's great toe to that of man and the implication that it is so articulated as to be used as is man's great toe—in walking—it becomes really necessary to remind readers of *NATURE* that European anatomists, more than sixty years ago, carefully studied and described the bones and muscles of the great anthropoid apes and compared them with those of man. Their conclusions are known throughout the zoological world, and a brief but still trustworthy exposition of these anatomical facts was given by Huxley in his book "Man's Place in Nature,"

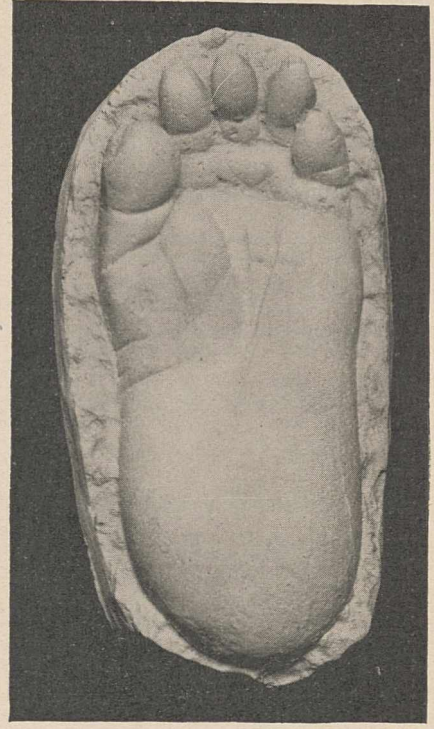


published in 1863. I was therefore startled by Mr. Akeley's assertions, and after careful examination of it came to the conclusion that his figure of the gorilla's foot was "entirely erroneous," and that the cast as shown in his photograph is made to present a false resemblance to the foot of man. I published this opinion in a note to my chapter on the gorilla of Sloane Street in my book "Great and Small Things," December 1922. It is, however, not only the figure of the cast of the gorilla's foot published by Mr. Akeley which is erroneous: his statements on the subject are even more plainly so. The presence of a heel is not (as Mr. Akeley suggests) a special man-like development in the gorilla. The other anthropoids have it—and so have monkeys in general. It is not the fact (as Mr. Akeley would have us believe) that the gorilla's big toe is much more like that of man than that of any other animal. The gorilla's great toe is far more like that of the chimpanzee and of many monkeys than it is like that of man.

made by lateral pressure to assume the unnatural parallelism with the other toes which it exhibits in



Photo] [F. W. Bond.  
FIG. 4.—Photograph by Dr. Vevers of the same cast as that used by Mr. Akeley (Fig. 3) but properly illuminated to give stereoscopic modelling.



Photo] [F. W. Bond.  
FIG. 5.—Photograph by Dr. Vevers of same cast with full illumination giving a deceptive "flattening" or "demodelling" effect as in Mr. Akeley's photograph (Fig. 3).

I have been able to account for the misleading nature of the photograph of the cast published by Mr. Akeley, as due to flattening by illumination, which obliterates the modelling of the surface (see Figs. 3, 4, 5, and 6, and the legends printed below each); but in the absence of any information as to the condition of the gorilla's foot when the cast was taken, I have had to suppose that it was in a soft, pliable condition so that a small amount of lateral pressure would suffice to push the great toe out of its natural position when free from muscular tension and diverging from the other toes, and to cause it to take up a pose with its axis more nearly parallel to that of the other toes.

the cast. There is no reason to suppose that the cast is itself "faulty" as a cast.

I cannot discuss, on the present occasion, the suppositions made by Dr. W. K. Gregory as to what I do or do not see in the history of the human foot. I can only assure him that he is entirely mistaken in assuming that there is to me anything either

I now learn from Dr. W. K. Gregory's letter dated December 7, in NATURE of December 29, p. 933, that the foot of the gorilla from which Mr. Akeley's cast was taken was cut from the animal's leg in Africa after *rigor mortis* had passed away, and that in order to receive the plaster for forming a mould it was placed in a hollow in the ground with the sole facing upwards. We are not informed as to when or where this operation was performed or whether the amputated foot has been preserved. It certainly is not surprising that in the course of this manipulation the great toe of the "flabby" detached foot was



Photo] [F. W. Bond.  
FIG. 6.—Photograph by Dr. Vevers of same cast viewed from the outer or fibular side of the foot (stereoscopic illumination). Note the deep fissure between the hallux and second digit.

novel or improbable in the notion that the human foot is "an anatomical palimpsest." E. R. L.



### The Transatlantic Migration of the Eel-larvæ.

I HAVE recently had occasion to draw up a statistical chart showing the distribution of the eel-larvæ according to size. This chart, which is here reproduced (Fig. 1.), I laid before the meeting of the International Council for the Exploration of the Sea, in Paris, last October. It makes a good supplement to the chart which accompanied my article in NATURE of January 13, 1923, but the material is, nevertheless, so differently treated here that it seems to me worth while to make it known in wider circles.

It will be seen that the area where eel-larvæ are found—here shaded on the chart—extends from America to Europe and the Mediterranean. We have ourselves, in the course of years, searched the whole of this area for eel-larvæ, and found them at all stages of development—from the youngest, less than 1 cm.

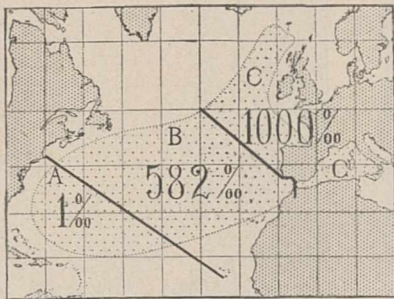


FIG. 1.—Distribution of the larvæ of the European fresh-water eel (*Anguilla vulgaris* Turt.) according to all existing records, showing the number of specimens more than 5 cm. long per mille.

Area A : 7018 specimens.  
 " B : 794 " (Atlantic, 869 + Mediterranean, 4002).  
 " C : 4871 "

long, to the largest, approaching 9 cm. in length. For the better understanding of the chart it should be noted that our implements are excellently suited to the capture of larvæ in all sizes, though their fishing capacity is, if anything, greater in the case of the small larvæ, which are less rapid in movement than the larger ones. This applies, by the way, not only to the eel, but also to the conger, and all other muræoids; indeed, to fishes generally.

A line drawn from Cape Cod to the Cape Verde Islands, and another from 50° N., 30° W. to Cape St. Vincent in Portugal, and diagonally across the Straits of Gibraltar, would divide the area of the eel-larvæ into three parts: a western (A), a central (B), and an eastern (C), the last-named including both an Atlantic and a Mediterranean section.

The chart is based on all available measurements of larvæ: between 12 and 13 thousand.<sup>1</sup> Of these, 7018 are from area A, 794 from area B, and 4871 from area C. The material is divided into two parts, according to size of the larvæ—those under and those over 5 cm. long—and we have worked out for each of the three areas the number per mille of larvæ over 5 cm. found in that area. This gave, for area A 1 per mille, for B 582 per mille, and for C 1000 per mille. In other words: in the western area there were practically no larvæ over 5 cm. long, in the central area there were about as many over as under, while in the eastern area all were over 5 cm.

This distribution speaks plainly enough, and admits of no misunderstanding. It shows that the larvæ

come from A and, as they grow, move via B to C, shaping their course roughly towards the N.E.

On the last expedition with the *Dana* (1921–22), extending from the Mediterranean to America, we used throughout the same nets and fished in the same way, by which it was easily seen that the eel-larvæ decreased in size from east to west. The results of the work in the Mediterranean (about October 1, 1921) were very clear, and entirely confirmed my previous results with the *Thor*. We captured about 2000 larvæ of eel-fishes in the Mediterranean, a full half being larvæ of the eel. As in 1908–10, we found small larvæ of all the other species (conger, etc.), but not of the eel. The size of the eel-larvæ varied from about 5½ to about 8 cm., i.e. precisely the same sizes already known from the Mediterranean.

There is only one possible conclusion to be drawn from these investigations—the same which I drew in 1912<sup>2</sup> after the investigations with the *Thor*—namely, that the Mediterranean has no indigenous stock of eels, but that the larvæ found there have immigrated from the Atlantic through the Straits of Gibraltar. I cannot go into details here, but must just mention that we had the good fortune, with the *Dana*, to encounter a huge invasion of eel larvæ passing through the Straits of Gibraltar. Finally, I must correct an erroneous idea which appears to be widely entertained, namely, that the eel-larvæ in the Mediterranean are found at greater depths than in the Atlantic. In both places we found the greatest quantities at depths of 100 metres or less.

JOHS. SCHMIDT.  
 Carlsberg Laboratory,  
 Copenhagen (Valby).

### Half-shade Polariser and Analysers.<sup>1</sup>

GLAZEBROOK'S "Dictionary of Applied Physics" (vol. iv. p. 482) gives what purports to be the essential features of a Brace polariser, but is in fact a confusion of three devices, namely, the Brace half-shadow polariser, the Brace half-shadow elliptic analyser, and Tool's adaptation of the latter to Stokes's method of elliptic analysis. The object of this note is to clear away the obscurity which obviously exists with some otherwise well-informed writers in regard to the design and use of these different instruments.

The Brace half-shadow polariser (Brace, *Phil. Mag.* (6), 5, p. 161, 1903) is not two plates of mica between crossed Nicols, but essentially a Lippich half-shadow system, in which is substituted in place of the common Nicol type of polarisers the Jamin type, which consists of a thin plate of Iceland spar immersed in a cell of carbon bisulphide at such a slant that it totally reflects the extraordinary ray. Brace used  $\alpha$ -monobromonaphthalene in place of carbon bisulphide. The advantages of this type are the fine dividing line between the half-shadow fields and the small lateral displacement which the thin strip of spar furnishes. Being fragile and inconvenient to maintain, it is to be recommended only where the highest precision is demanded. As noted in Glazebrook's "Dictionary," this system was used by Bates (in his attempt to detect anomalous magnetic rotation by an alcoholic solution of fuchsine).

The Brace elliptic analyser (Brace, *Phys. Rev.*, 18, p. 70, and 19, p. 218, 1904) is for measuring small ellipticities—ratio of minor to major axis of the elliptic vibration. It consists of a half-shadow strip and a variable azimuth "compensator," both of mica and both very thin. The half-shadow strip

<sup>1</sup> This includes measurements of 2283 larvæ from the Straits of Messina, published since 1912 by B. Grassi; not, however, the thousands of small *Anguilla* larvæ taken in area A by the *Dana* in the spring of 1922. When these are subsequently included, after separating them from the larvæ of the American eel, the figure for area A will fall below 1 per mille.

<sup>2</sup> "Danish Researches in the Atlantic and Mediterranean on the Life-history of the Fresh-water Eel (*Anguilla vulgaris* Turt.)" (*Internat. Revue der ges. Hydrobiologie und Hydrographie*, 1912).

<sup>3</sup> Published by permission of the Director of the Bureau of Standards of the U.S. Department of Commerce.



is of the order of about 0.01λ, showing Newton's colours before mounting. The order of the compensator commonly ranges between 0.02 and 0.04λ. The half-shadow strip mounted in Canada balsam between microscope cover slips is fixed to either the polarising or the analysing Nicol so as to cover half the field and at an azimuth giving maximum brightness when the Nicols are crossed—that is, at an azimuth of 45° to that of the Nicol to which it is fixed. The similarly mounted compensator is inserted on a rotating circle between polariser and analyser. The difference between circle readings for a "match" on plane polarised light and on the given elliptically polarised light serves to determine the ellipticity sought. The device is applicable to measuring ellipticities from zero to about 0.1 with high precision—the chief advantages being a vanishing half-shadow dividing line and relatively large compensator angles. It gives, however, but a crude indication of the azimuth of the elliptic vibration. The use of a thick compensator, e.g. 1/4λ, is precluded by the too small angular displacements which it entails. The instrument is found to be both practical and convenient by those who have used it.

Tool's adaptation of the Brace elliptic half-shadow strip and the Cornu-Jellett split Nicol to Stokes's method of elliptic analysis (Tool, *Phys. Rev.*, 31, p. 1, 1910) is used where the measurement of both azimuth and ellipticity with high precision is sought. It has the Brace elliptic half-shadow strip attached to a Cornu-Jellett half-shadow Nicol (at an azimuth therewith of 45°) giving a four-part field. This combination is carried by a rotating circle. Between it and the source to be measured is inserted a near 1/4λ variable azimuth compensator on a second rotating circle. By adjusting both circles a match of the four-part field is obtained. Following Stokes's method of making complementary settings for a "match," the compensator is effectually calibrated each time a pair of settings is made. It measures ellipticities of 0.02 with an accuracy better than 1 per cent. and circularly polarised light (ellipticity = 1), where the Stokes's instrument fails, with an accuracy of 0.05 per cent. Azimuths are measured with corresponding precision. C. A. SKINNER.

I AM indebted to Mr. Skinner for pointing out the oversight. The account given on p. 482 of the "Dictionary of Applied Physics," vol. iv., and called Brace's polariser, is really a description of his "Half-shadow elliptical polariser and analyser."

Brace devised probably the most sensitive instrument we have for measuring optical rotation in his half-shadow "sensitive strip" polariser (*Phil. Mag.* (6), 5, p. 161), and it is a description of this instrument which should properly have found a place in the article on polarimetry.

EDITOR "Dictionary of Applied Physics."

**A Formula for the Specific Heat of Ferromagnetic Substances and its Discontinuity at the Critical Temperature.**

THE loss of magnetism by ferromagnetic substances at their critical temperatures is accompanied by a striking change in the specific heat. Not only do ferromagnetic substances exhibit an abnormal rise in the specific heat up to the critical temperature, but also at this point there is a sudden diminution amounting to about one-half the increase. For example, the specific heat of iron is 0.119 at ordinary temperatures; it rises to 0.309 at the critical temperature, and at this point suddenly falls to about 0.189, so that there is an abrupt change of 0.120 in the true

specific heat—with nickel the discontinuity amounts to 0.0285, and with magnetite to about 0.079. Attempts have been made to obtain a quantitative relation between the loss of magnetic energy and the energy of this thermal discontinuity, and a formula has been given by H. A. Lorentz, based on the theories of Langevin and Weiss, which when reduced to its simplest form is

$$\Delta C = \frac{4.97}{m}$$

where ΔC is the discontinuity in the specific heat and m is the molecular mass of the ferromagnetic body. With this formula the calculated values of ΔC are 0.089 for iron, 0.0282 for nickel, and 0.0644 for magnetite, and the disagreement with observed values, except in the case of nickel, is very marked.

From considerations based on the application of Van der Waals' equation of state to ferromagnetism, I have arrived at a formula which allows not only the discontinuity but also the specific heat itself at the critical temperature to be calculated with an accuracy which leaves little doubt of its truth. The formula is

$$C_\theta = \frac{5 R I_0}{J \cdot a \theta}$$

which becomes, when the numerical values of R and J are inserted,

$$C_\theta = \frac{9.95 I_0}{a \theta}$$

C<sub>θ</sub> being the true specific heat, I<sub>0</sub> the maximum intensity, θ the critical temperature on the absolute scale, and a the atomic weight of the ferromagnetic substance. Calculated and observed results are as follows:—

	C <sub>θ</sub> (calculated).	C <sub>θ</sub> (observed).
Iron . . . . .	0.306	0.309
Nickel . . . . .	0.142	0.154
Cobalt . . . . .	0.187	0.193

These calculated and observed results agree within the accuracy with which C<sub>θ</sub>, θ, and I<sub>0</sub> are known.

The formula gives ΔC, the discontinuity in the specific heat at the critical temperature, if for the numeral 5 we write 2 for iron and 1 for nickel; thus

$$\Delta C = \frac{2 R I_0}{J \cdot a \theta}$$

for iron and half of this for nickel.

We then get

	ΔC (calc.).	ΔC (obs.).
Iron . . . . .	0.122	0.120 to 0.124
Nickel . . . . .	0.0284	0.0285
Magnetite . . . . .	0.0759	0.074 to 0.079

Cobalt is omitted, as ΔC has not been exactly determined for this metal. We obtain ΔC for magnetite when the numeral in the formula is 4, assuming R/a is that for iron.

In a letter to NATURE of July 1, 1922 (vol. 110, p. 10), the view was put forward that there was an addition of two degrees of freedom to the specific heat of ferromagnetic substances, corresponding to two degrees of freedom of rotational vibrations, as the substance increased in temperature up to the critical temperature. The specific heat at ordinary temperatures is calculable, on the assumption of three degrees of freedom, from 3 R, and we see that at the critical temperature it is calculable from 5 R, which is an increase of 2 R, corresponding to two degrees of freedom.

We may write the equation to ΔC thus,

$$\Delta C \theta \cdot J = K \cdot \frac{R}{a} I_0,$$

where K is a constant which has different but simple



numerical values for each of the ferromagnetics. The left side of the equation is thermal energy in mechanical units; and in order that the right side may also represent energy,  $R/a$  must play the part of a magnetic field. Now it is interesting to find that the expression for the maximum intrinsic magnetic field, as given by Van der Waals' equation, is  $2 R/a$  for iron and nickel,  $3 R/a$  for cobalt, and  $6 R/a$  for magnetite, and thus  $\Delta C$  may be easily expressed in terms of the intrinsic field if required.

J. R. ASHWORTH.

Rochdale, November 19.

### Magnetic Boreholes.

In practical oilfield work many phenomena are met with and investigated from time to time, but one of these, namely, the magnetic state of some boreholes, does not appear to have received the attention it merits, and it would be interesting to learn the experiences and conclusions arrived at by practical oilfield men who have encountered this occurrence.

No doubt many oil men know of instances where tools and casing are found to be highly magnetised upon withdrawal from the borehole, as well as the lifting tackle and headgear in the derrick being affected in a similar manner to a lesser or greater degree.

Some little time ago an instance of this kind came under my notice. A pole became unscrewed while drilling, and the drilling bit with several poles attached remained in the borehole. As the casing was not moving freely, it was decided to move it before fishing for the lost tools; this was done, that is, the casing was raised and lowered several times from four to five feet. A fishing socket was then lowered in, which should have taken hold of the lost tools at about 115 feet off bottom, instead of which it was found that the top of the lost tools was at 70 feet from bottom, at which depth a hold was taken. At the time this difference in depth could not be accounted for, as it was known that the tools and rods had not run away, but had simply become detached, and their maximum possible fall of one foot could not have accounted for the loss of measurement. When the lost tools were brought to the surface the above-mentioned difference was explained, the rods which had been left behind having become bent more or less in the form of a helical spring. This coiling of the rods could be attributed to several ordinary causes as follows:

1. That the tools had fallen a long distance; this, however, was not the case.

2. That the fishing socket had been carelessly lowered in and the rods forced down. As every care was exercised when lowering in the socket, this could not have happened, and was proved by the fact that the rods above the socket were not in any way distorted.

3. That poles had got below the casing shoe when it was lifted and had been forced down when the casing was lowered into position. As the rods stood about 100 feet inside the casing, this was obviously not possible.

4. It might be argued that one of the casing joints had caught the top of the poles or one of the pole joints when the casing was being let down. This is out of the question, because the casing was of the inserted joint type, perfectly flush on the inside, and careful examination showed no trace of catching.

This extraordinary occurrence of loss of distance and coiled rods could not be traced to any ordinary cause; and as it was known that the well was extremely magnetic, which was proved time after time by the condition of the tools whenever they were withdrawn from the borehole, as well as the magnetised state of the lifting tackle and derrick headgear, it would appear that the magnetic influence of the casing was the cause of the occurrence mentioned above.

One can assume that after the rods had become unscrewed they fell over to one side and rested for some considerable distance in contact with the casing, probably 100 feet or more. The casing as a magnet had not sufficient power to lift the poles plus the drilling tools, but upon the casing being lowered into place each time after lifting it partly held and dragged the poles down with it owing to its magnetised condition, and at each subsequent lowering in the poles became more and more deformed.

It may be that highly magnetic boreholes may considerably affect drilling as well as fishing operations, whether with pole tools or with cable, therefore it would certainly be of interest to learn whether experiences of a similar nature have been met with and recorded.

ALBERT MILLAR.

Boryslaw, Galicia, Poland.

### Experiments on *Ciona intestinalis*.

SINCE I had the pleasure of making copies, the only ones, I think, of Dr. Kammerer's photographs of *Ciona* during his visit to England, and believe that Prof. MacBride is not at the moment in possession of a complete set, I am taking the liberty of supplying the details requested by Mr. Cunningham in his letter to NATURE of December 15. I will, of course, forward prints to him at the earliest opportunity.

There are three photographs of *Ciona*. The first is of a single untreated specimen, the second of a group showing artificially produced *var. macrosiphonica*, and the third of two untreated offspring of the latter. In view of the various magnifications, both in the camera and from perspective, and since the whole of the animal is not visible in most cases, simple measurements would be meaningless. However, the increase of the siphon of *v. macrosiphonica* is chiefly in the direction of length, and therefore the ratios of length to breadth of the siphons provide a satisfactory method of comparing the specimens. The ratios are:

Photograph I. (Untreated, fully extended specimen.)  
Oral siphon 1.9, aboral 1.65.

Photograph II. (Group.) In a single fully extended specimen, doubtless that referred to by Prof. MacBride, the ratios are 2.0 oral and 1.65 aboral. In the remainder the ratios when expanded are 4.0 to 4.3 oral and 2.0 to 4.3 aboral, and when contracted 2.4 oral and 1.9 aboral.

Photograph III. One of these two young offspring of *v. macrosiphonica* is completely expanded or nearly so, the other is quite contracted; in the former the ratios are 4.1 oral and 2.05 aboral, in the latter they are 2.35 and 1.4.

The validity of the means of comparison suggested above is shown by the ratios of length to breadth for the main part of the body lying, in all the four or five specimens in which it can be measured, between 4.1 and 4.8; *i.e.* the error due to varying expansion, position, and focus cannot possibly be more than 20 per cent., yet *v. macrosiphonica* shows an increase in length of the siphons of as much as 125 per cent.

With regard to the possibility of *v. macrosiphonica* falling within the limits of normal variation, the most valuable contribution appears to have been made by Mr. Fox; the very extensive and apparently uniform scale on which, in his experiment, elongation of the siphons failed to result from an altered technique seems to show very clearly, especially in the light of Dr. Kammerer's controls, that the effect is to be correlated with the particular nature of the operation as cause, and not with any normal variation which may be possible from one time to another, or with the nature of the food supply.

B. STEWART.

Lovell House, Leeds,

December 18.



The Kinetic Atom.<sup>1</sup>

By Sir OLIVER LODGE, F.R.S.

EVIDENCE FOR THE NUCLEAR ATOM.

THE steps by which the nuclear atom was established are of such interest that it is worth while to remind ourselves of them. Rutherford was bombarding atoms by the alpha particles projected with known velocities from a deposit of radium C. He has carried out such bombardment many times since, sometimes with surprising and exciting results. But this time he was merely driving the particles through matter and catching them on a fluorescent screen, so as to see how many had been scattered or deflected from their original path, and by how much. If the atoms consisted of a nucleus surrounded by electrons, at planetary distances in proportion to their size, the atom would be as porous as a solar system, and the alpha particles could be trusted to go through it, for the most part, without perceptible perturbation. Some of the electrons might be knocked out, and so the atom become ionised; but the massive alpha particle would take scarcely any notice of minor obstructions, and would proceed untroubled on its way, until it encountered or came exceedingly close to a central nucleus, of mass greater than itself. Such an occurrence would be comparatively rare. Judging by the probable size of the nucleus on this theory, it would not occur more often than 1 in 10,000 times—probably not so often.

The circumstances of such an encounter, whenever it did occur, are amenable to ordinary and, so to speak, elementary dynamical considerations, if the law of inverse square holds good. Accordingly, it was possible to deduce beforehand what would happen in all the likely kinds of collisions—if they can be called collisions where there is no contact. The law of probability could be applied to determine the number of scatterings in each direction; and then, by the aid of Crookes's fluorescent zinc sulphide screen, on which the splashes or flashes caused by the impact of the deflected alpha particles could be seen, the number scattered in any direction by the atoms of a given substance could be counted and compared with theory. The result was triumphantly to uphold the theory. The central solid compact nucleus was established as a reality, and a proof was forthcoming that it exerted force, even in its immediate neighbourhood, as the inverse square of the distance;—the first time, so far as I know, that it was ever established that astronomical laws still hold good, even in the hopelessly ultra-microscopic region in the interior of atoms.

The quantum is there too, as Bohr afterwards showed. There are energy levels, surrounding the nucleus of atoms, which gravitation-like theory does not account for; though it must be admitted that in the solar system Bode's Law has not yet been accounted for either. But ordinary dynamical laws are there also. The quantum does not replace them, but supplements them, as Bohr found in his Correspondence Principle, and as Sommerfeld made use of in his brilliant prediction of the fine structure of spectrum

<sup>1</sup> An expository portion of a presidential address on "X-Rays and the Atom," of which other parts were delivered to the Röntgen Society on November 6.

lines. This fine structure, by the way, is too fine to be seen in ordinary visible spectra; but it can be seen well enough in X-ray spectra, where the theory clearly indicates that it ought to be much more pronounced and conspicuous. The treatment of that, however, must be postponed. I want to return to the simple dynamics of Rutherford's scattering experiment.

The problem may be stated thus. Take a massive particle with charge  $E$ —really equal to  $Ne$ , where  $N$  is Moseley's atomic number; and fire at it, with known velocity  $v$ , a much less massive particle with a charge  $E'$ —really  $ze$ . Consider what happens.

First let the line of fire be absolutely direct. The projectile will approach within a distance  $2a$  (Fig. 1), and at that distance (SJ) will rebound and return whence it came. The distance  $2a$ , which we may call "the stopping distance," is important; for it gives the major axis of all the hyperbolic paths which are the result of a less

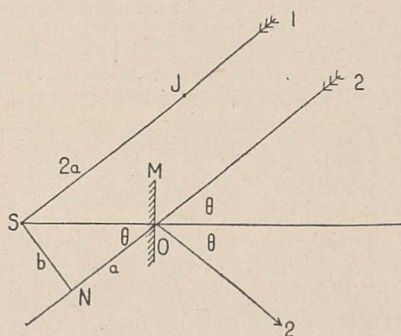


FIG. 1.—Let S be a massive nucleus fired at by an alpha particle, No. 1, correctly aimed. Let SJ be the stopping distance,  $EE'/mv^2$ , at which the particle will be stopped and driven back. Call this  $2a$ . Then let a second particle be aimed askew, at a perpendicular distance SN from the nucleus. Call this distance  $b$ . Then lay off a length NO =  $a$  along the line of fire, and join SO. If now a diagrammatic mirror M is set up perpendicular to SO, as shown, the particle No. 2 will appear to rebound from S exactly as if it had struck this mirror M. The angle of reflection is  $\theta$ , such that  $\tan \theta = b/a$ . The path is swung round through the angle  $\pi - 2\theta$ .

direct impact between the same particles. The bipolar equation of every one of these hyperbolæ will be

$$r_1 - r_2 = 2a.$$

The value of  $2a$  can be calculated at once as

$$2a = \frac{EE'}{\frac{1}{2}mv^2};$$

for that is the distance at which the kinetic energy of approach will be converted into the potential energy of recoil, and so the bombarding projectile will there be brought momentarily to rest before being driven back to its source.

In practice, absolute direct impact or accurate aim is infinitely unlikely. Let us take the case then of slightly oblique aim, so that the line of fire approaches the nucleus within a perpendicular distance  $b$ . The path will now be a hyperbola, with the above value of  $a$  for its semi-axis major, and with  $b$  for its semi-axis minor. The equation to the hyperbola being, as stated,  $r_1 - r_2 = 2a$ , its eccentricity is  $\sqrt{1 - b^2/a^2}$ , or what we may call  $\sec \theta$ . The asymptotic path of the particle will be swung round through an



angle  $\pi - 2\theta$ , where  $\tan \theta = b/a$ . In other words the particle will be reflected as if it had struck a mirror in a certain position and with a certain inclination (which can be best depicted in a diagram), and as if it had rebounded from it according to the usual law of reflection (Fig. 1).

Of course, it does not really strike anything: there is no clash or blow of any kind. The path is a perfectly regular curve, as shown in Fig. 2. But all the

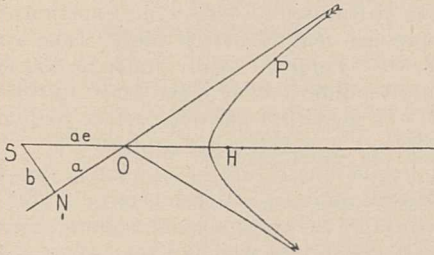


FIG. 2.—The particle in Fig. 1 does not really strike anything, and its path only appears to be straight and angular when seen from a distance. If we could approach close to, we should see the actual path curved, as in this Fig. The real path of the particle is one branch of a hyperbola with major axis  $2a$  and minor axis  $2b$ , with the two foci  $S$  and  $H$ , and with its centre  $O$  equidistant between them. The distance from  $O$  to the vertex of the hyperbola is  $a$ , while its eccentricity is  $e = SO/NO = \sec \theta$ . Also  $SH = 2ae$ . Taking any point  $P$  on the path of the particle, its equation is  $SP - HP = 2a$ . If the particle were attracted instead of repelled by the nucleus, the path would be the same, but the nucleus would be at  $H$  instead of at  $S$ .

appearance as seen from a distance, or as estimated from the result, will be as if it had been suddenly reflected, from the mirror  $M$ , according to the exact geometrical conditions of Fig. 1.

If we consider the projectile as having a sign of electric charge opposite to that of the central nucleus, so that it is attracted instead of repelled, then the circumstances will be very similar. There will still be the appearance of reflection, as in a mirror; the angle turned through will be just the same for the same line of aim; and the same hyperbolic path will be described; but the central attracting particle will be in the other focus.  $H$  instead of  $S$ .

The accompanying figures, 1 and 2, give a good idea of what a "collision" between charged particles is really like when the inverse square law is obeyed.

In these bombardment experiments, it would appear as if the quantum does not enter. One can scarcely suppose that the line of aim is regulated by quantum conditions, so that the perpendicular distance  $b$  for different shots is in arithmetical progression. If, however, we did make such a supposition, we should then have a series of quantised hyperbolic orbits, all with the same major axis  $2a$  and the different minor axes  $2b$ , which are quite analogous with the family of quantised elliptic orbits, in the recognised theory of Sommerfeld and others.

#### VARIETIES OF POSSIBLE ORBITS.

As every one knows, Kepler discovered that in a planetary orbit the rate of sweeping areas is constant, and that this gives the law of velocity of a planet at every part of its orbit. Newton showed that this was a necessary characteristic of all central orbits, no matter what the law of force was. The moment of momentum, or angular momentum, is constant, the moment of acceleration being zero. Bohr made the assumption—and justified it by results, after the

manner of Kepler—that this rate of sweeping areas, admittedly constant for any one orbit, must proceed by definite integer multiples from orbit to orbit, and that only those orbits were stable for which the rate of sweeping areas was characterised by an integer. These, therefore, represent Bohr's energy levels. The most natural kind of orbit to associate with an energy level is circular: and what we have just said means that  $v^2r$  proceeds by steps like the integer  $n$ . Ordinary mechanics show that  $v^2r$  is equal to a known constant independent of  $n$ ; and from these two very simple equations a great many things follow.

In general, we may expect that different orbits will correspond to different energy levels; and that is so in the main. But it is possible to have different orbits at one and the same energy level, in the form of a set of ellipses with all their major axes the same. Their periods of revolution will also be the same, since this depends on the major axis. The rate of sweeping areas will be the area of any orbit divided by its periodic time: and since the periods are all equal, the rate of sweeping areas (or the moment of momentum) will be proportional to the area of each orbit. If, then, this has to proceed by integers, in accordance with the quantum, the minor axes of the only possible elliptic orbits are certain definite fractions of the major axis. Thus, suppose the major axis is 4, the minor axis might be either 3, 2, or 1. If the major axis is 6, the minor axis can be 5, 4, 3, 2, or 1. If the major axis is 3, the minor

could be naturally 2 or 1. If the major axis is 2, there is only one alternative possible, namely, 1; and if the major axis is 1, no other orbit except a circular one is possible. The number applied to the major axis corresponds to the number of the stable circular orbits surrounding the nucleus in Bohr's theory;  $K$  being No. 1,  $L$ , No. 2, and so on; their radii being proportional to  $n^2$ . These represent

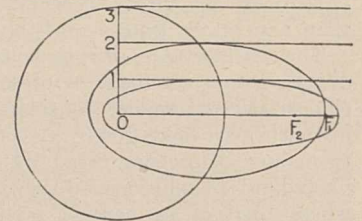


FIG. 3.—To draw the varieties of orbit possible at a given energy level. Let the energy levels  $K, L, M, N$ , etc., be called 1, 2, 3, 4, etc. Connect two pins by a single length of string: put the two pins together at  $O$ , and with the loop draw a circle. Subdivide its radius into sections equal to the particular number of the energy level to be represented—say 3, as in this Fig.; and draw parallel lines at these points perpendicular to the radius selected. Then, after replacing the string and pencil, separate the pins along the line through  $O$ , until the pencil in the loop of string is brought down first to one and then to another of these lines, and each time draw an ellipse. These will be the varieties of possible orbits at the  $M$  level; and they are in their right position, with  $O$  as common focus. Electrons describing any of these orbits have all the same period, and the same energy except for a cumulative perturbation due to fluctuating speed; but their angular momenta are, like the elliptic areas, as 3:2:1. A similar construction serves for any level.

the primary or fundamental energy levels; but at all the higher levels elliptic orbits are permissible too. The permissible orbits for main orbit No. 3 are shown in Fig. 3.

#### EFFECT OF ELLIPTICITY ON THE SPECTRUM.

These alternative elliptic orbits, being in the main at the same energy level as the circular one of which they are variations, will be responsible for the same spectral lines as the circular one, when electrons drop into them. If this were accurately so, they would not



be worthy of attention; but it is not accurately so. The electrical theory of matter, and the consequent variation of inertia at high speeds, necessitates further analysis. The speed in a circular orbit is constant; but is not so in an elliptic orbit. Hence the mass in an elliptic orbit is not constant either. The result can be shown, astronomically, to be a cumulative progression of the apses: that is to say, a revolution of the orbit in its own plane,—like that which has long been familiar in the planets, especially in the planet Mercury<sup>2</sup>—the particle describing a kind of rosette instead of a really closed curve. This progressive elliptic motion can be compounded of two opposite circular motions of nearly but not quite the same period, and nearly but not quite the same energy; accordingly it has the effect of doubling the line which would otherwise be emitted. That is its main effect.

<sup>2</sup> See, for example, *Phil. Mag.* for August 1917, *et seq.* If  $m = \beta m_0$  a revolution through  $2\pi\beta$  is needed for a journey from one perihelion to the next.

Other perturbations are possible too, which will give multiple lines—what is called the fine structure of the spectrum—all which has been worked out in detail by Sommerfeld, and found to agree with observation; though the observations in the visible part of the spectrum are very difficult and delicate, and some of them quite recent.

With X-ray frequencies, these effects are more marked; and it is in the X-ray spectrum that they were first discovered. The fact that they can be accounted for in accordance with astronomical laws, supplemented by the electrical theory of matter, is surely a remarkable testimony to the general validity of what may be called the astronomical theory of the atom.

They strengthen the position of the kinetic atom of the physicist, as against the static atom of the chemist, beyond any reasonable doubt: though for chemical purposes and molecule-building, the static atom is certainly attractive, and, I expect, useful.

### The Scientific Renaissance in China.

By Prof. J. W. GREGORY, F.R.S.

THE political changes in China during the last decade have had two opposite effects on the intellectual sides of Chinese life. The Revolution of 1911 gave a powerful stimulus which enabled the intellectual aristocracy to revolt successfully against the domination of tradition, and to advance a scheme of education free from the chains of classicism; but the concurrent political disorder has led to a reactionist triumph in administration. The reform in education which was regarded in 1911 as of primary importance was the replacement of the old written language by one based on an alphabet. The debt China owes to its written characters is incalculable. They have formed the real bond between the many provinces and races of the Empire, and long training in their use has given the Chinese their precision in observation, tenacious memories, and fine artistic perception. These great benefits have been attended by serious drawbacks. Learning the characters practically monopolises all school time. Each character has to be learnt by a distinct effort of memory. A child learns in the four years in the lower primary classes 700 or 1000 characters and a little arithmetic; and if it leaves school with a knowledge of only that number, it in time falls into the ranks of the illiterate. Knowledge of 4000 characters is required for general purposes, and a well-educated man is expected to know 8000 or 10,000. Hence the seven years spent at the lower and higher primary schools, and most of the subsequent four years at a secondary school, are occupied in learning to read and write.

There have accordingly been repeated attempts during the past 2200 years to replace the ideographic by an alphabetic system; but they have failed owing to the inherent advantages of the old system. The primary difficulty is that while the written characters are the same throughout China, the meaning of the words alters with the tone of expression, and the pronunciation varies from province to province. A phonetic rendering of a given character would mean different things in different localities. A uniform alphabetic system is possible only if the same pronunciation be adopted in all parts of China. The first step is therefore the establishment of a standard pro-

nunciation for the whole country. Such a system having been prepared and enacted, the second step is the invention of a set of phonetic alphabetic characters. A Commission for the Unification of the National Language adopted an alphabet of 39 letters, and the teaching of its system was begun experimentally in 1915. In 1918 the scheme was regarded as satisfactory, and it was introduced into the schools. The 39 letters having proved insufficient, another was added in 1920, and in addition to the established 40, others will be required for some dialects, such as Cantonese, which are exceptionally rich in sounds.

This system would give China a unified colloquial language which people could learn to read in a few months instead of requiring a decade of daily toil; it would enable the schools and colleges to give a liberal and scientific education, and would render possible the development of a living literature. The reformers hope that this system will be established throughout China in twenty years.

Concomitant with this reform, a new system of Chinese popular and higher education was promulgated in 1912 by a National Education Conference. This system consists of a universal compulsory course for four years; a higher primary course of three years; a secondary school course of four years; a preparatory course for the colleges of three years; and, finally, three years in colleges or professional institutions for pupils of the ages of 21-24. The scheme included four national universities—Pekin for the north-east, Nanking for the middle east, Wuchang for the north-west, and Canton for the south and south-west. Each of these universities was intended to have faculties in literature, science, medicine, law, commerce, agriculture, and industry.

These noble schemes have been to a large extent frustrated by the political disorders that followed the Revolution. After the collapse of the Manchu Government, the local military leaders seized the reins of power and the revenues. The old officials, who had been selected by severe competitive examination, were replaced by nominees of the military. A riot of corruption and inefficiency has ruined the provincial govern-



ments. In many provinces the educational funds have been seized by the soldiers, and the schools were compelled to close. Education has had a severe set-back instead of being greatly extended.

Nevertheless, the virtues of the individual Chinaman are once again enabling the country to conquer apparently insuperable difficulties. The provinces of Kiangsu and Chekiang have maintained their schools by securing the old grants; in some districts richly endowed temples have been converted into high schools, the lack of which long rendered impossible advanced educational institutions and universities.

The university problem in China is complicated by the existence of numerous foreign Christian universities established by the missionary societies. They are not universities according to British standards. There are two Christian universities in Shanghai—the Aurora University, Roman Catholic, and the St. John's University, Church of England. Others are at Pekin, Wuchang, Nanking, Shantung, Suchow, and Chengtu. The Pekin University was founded in 1888 by the American Methodist Episcopal Mission; and the National University at Pekin has been compelled to adopt the name of the Government University of Pekin.

There are two foreign institutions which promise to reach a high rank and do much for Chinese scientific education. The Union Medical College in Pekin has been richly endowed by the Rockefeller Foundation, and was opened in 1921. Its object is to train not medical practitioners, but medical teachers and investigators; it has at present to undertake some pre-medical classes, but this elementary work will be discontinued as soon as there is an adequate supply of students sufficiently well grounded to profit by the advanced teaching of the College. The College is on a great scale; its teaching staff numbers 67, and one branch of it has a service staff of more than 600. It has already achieved valuable medical research.

What the Rockefeller Institute may do for medical work in northern China, the Hongkong University may do for general education throughout China. It was established by Sir Frederick Lugard when Governor of Hongkong, and opened through the generosity of Mr. H. Mody in 1912.

This institution is planned on novel lines, which seem admirably adapted to the development of an Oriental university. Its original faculties were those of medicine and engineering. These technical departments require chairs in academic subjects; and the number of these chairs is being gradually increased until a wide range of teaching is provided in pure science. A faculty of pure science will thus be founded on those of applied science. A faculty of arts has been already instituted, with commerce as its strongest branch. The university hopes that its external examiners will maintain its degrees on the same standard as those of the University of London, like which it has an external as well as an internal side. Its external side should prove of high service to China as the standardising and coordinating agency for the scattered sectarian universities. Their students may enter for its degrees by examination, and Hongkong University may thus raise their standards of teaching and afford a public test of their educational efficiency.

Meanwhile, the Chinese have themselves established universities which promise well. The National University of Pekin has been re-established by its Chancellor, Tsai Yuan-Pei, and is managed by a Senate elected by the professors. The teaching staff numbers 250 in faculties of science, literature, philosophy, history, and economics. At Nanking the High School has been developed into a university for the south-east of China, with its faculty of commerce at Shanghai. A university has been established at Amoy owing to the munificence of Tien Kak Kee, who has endowed it with a million dollars and an annual grant for maintenance of 120 thousand dollars, which is guaranteed for 25 years.

Tsing Hua is a college in the suburbs of Pekin which is extending American influence in China. The United States in 1908 remitted about half the indemnity due to it after the Boxer Rebellion on the understanding that the money was spent in sending Chinese students to American universities and on a college for their preliminary training. The college was founded in the suburbs of Pekin. Its non-Chinese teachers are American, 18 in number.

Shansi University was also due indirectly to the Boxer Rebellion. The two missions in Shansi nobly refused to accept compensation for the murder of their members, and suggested that the provincial government should spend the money in educational work and thus lessen the chance of similar massacres. The provincial government acted on this suggestion and founded the Shansi University at Tai-yan, placing it under European direction for the first ten years. Attached to it is the Nystrom Institute for geological and biological research, from which Dr. Norin has made valuable additions to the geology of north-central China.

Advanced scientific research in China is being promoted by new institutions and societies. The institution which is regarded as most successful is the Geological Survey and Museum, which have been organised by the first director, Mr. V. K. Ting. He has now the help of Dr. Gunnar Andersson, the Mining Adviser to the Chinese Government and head of the Geological Survey Museum, and of Dr. Grabau, the well-known American palæontologist. This Museum is being arranged on lines which combine due attention to scientific research and an educational exhibition. The Geological Survey has been described as the best thing in science which China has done for itself. The Survey has published a series of four Bulletins, five Memoirs, and five volumes of its "Palæontologia Sinica," containing monographs on Chinese fossils. Mr. Ting has given the Geological Survey of China an excellent start, but his recent resignation of the directorship, in order to undertake the general managership of a great Chinese coal company, is a serious loss to Chinese geology. He has an able successor in Mr. W. H. Chang.

An Archæological Society has been founded under the presidency of Dr. Black, director of the Anatomical Department of the Pekin Union Medical College, and has begun publication of contributions to Chinese ethnology; also a Chinese Engineering Society. A Chemical Society has been established at Shanghai, and has adopted the *China Journal of Science and Arts* as



its official organ. That journal is published by the China Society of Science and Arts, which was planned as a Biological Society, but, as it was found that there was more need for a general society, its scope was extended to include the pure sciences and arts. The journal of this society has issued four numbers containing many valuable and interesting contributions. The articles are partly popular and partly technical. The combination of original memoirs with popular articles has obvious drawbacks which may lead to its subdivision into a general magazine and a technical journal.

The Geological Society of China has begun on more normal lines. Its regular meetings are held at Peking. It has issued the two first volumes of its Bulletin, which contain many important additions to Chinese geology. The Journal of the Chinese branch of the Royal Asiatic Society is available for the publication of technical articles both on science and arts; the volume for 1922 contained seven biological and two geological memoirs, showing the increasing attention paid by that society to natural science.

Much of the new scientific work of China is naturally centred at Peking, but Shanghai, in addition to being the headquarters of the Chemical Society and the Faculty of Commerce of the University of Nanking, is projecting a first-class science museum, which is being organised by the Shanghai Museum Association.

It may be felt that the outlook for these schemes is not promising and that the existing political chaos in China may bring them all to naught. But Chinese history encourages confidence as to their future. Its general story has been of the gradual decadence of a ruling dynasty until it has become incompetent and corrupt and has been swept away. Then follows a confused interregnum which may be passed through in a decade or may last for a couple of centuries; it ends when some strong man establishes a new dynasty. Though the present disorders may last for years, peace will assuredly be restored. In the meantime, the new Chinese Renaissance promises to make good progress in spite of political turmoil and military misgovernment.

### The Serum Diagnosis of Syphilis.

THE Wassermann test for syphilis was discovered by the logical pursuit of a coherent series of observations. From the first it has proved of the highest value for the diagnosis of an infection which is often obscure. But it soon turned out that it was simply an empirical trick and not an application of the general principle which it was originally supposed to illustrate. If the typhoid bacillus, typhoid antibody, and fresh blood serum are mixed together, the three will combine in such a way that the substance in (or property of) fresh serum known as "complement" will disappear. If typhoid antibody is not present, the complement remains and its presence or absence can be determined by a test mixture of red blood corpuscles and red blood corpuscle antibody, in which the red cells will be dissolved if complement is also present. Supposedly the same would apply to a mixture of the spirochæte of syphilis, syphilitic antibody, and complement; and just as typhoid antibody, and therefore typhoid infection, can be detected by this Bordet-Gengou reaction, so was it thought that syphilitic antibody could be found in a patient's serum and syphilitic infection thereby inferred. In practice the idea seemed to work excellently, until it was found that an alcoholic extract of, *e.g.*, normal heart muscle would do as well as spirochætes. The reaction is therefore not specific, and as a matter of fact it is given by the blood in a proportion of cases of many protozoal infections. But it is specially constant in syphilis, and, as other protozoal infections are rare in Great Britain, it comes to be a splendid empirical method of diagnosing that disease.

The widespread use of the method in practical medicine has led the curious to come across a further series of phenomena in which the serum of syphilitics is quantitatively different from that of normal people. Thus it more easily becomes opaque on dilution with water or by admixture with the suspension of lipoids made by adding an alcoholic extract of heart muscle to salt solution—facts which have formed the basis of a number of simplified methods of diagnosis, all of which indicate that the proteids in syphilitic serum aggregate

into masses more easily than do those of normal serum. It is doubtless in this formation of aggregates or precipitates—visible or invisible to the bare eye—that the serum loses its property of acting as complement. A number of observations on the opacity of these mixtures of serum and lipoids in the presence of various concentrations of electrolytes have recently been described by Holker,<sup>1</sup> and illustrate the complexity of phenomena which have at present no rational explanation. The whole theoretical basis of the original Wassermann test and its almost innumerable progeny badly needs investigation. The problem is beyond the interests of the practical empiricism which has raised it.

Of the practical modifications of the original procedure, that introduced by Sachs and Georgi has proved one of the best. In this a solution of the alcohol-soluble acetone-insoluble lipoids of heart muscle, to which a small amount of cholesterol has been added, is diluted with salt solution. This opaque suspension is then added to the serum under examination: syphilitic sera give a flocculent precipitate more easily (*i.e.* with less serum) than normal. Experience showed that this simplified procedure was almost or quite as useful in diagnosis as the original more elaborate method.

In 1921 Dreyer and Ward made an ingenious attempt to standardise what at first sight seems rather an uncontrollable reaction, and so reduce it to comparable quantitative terms. The Medical Research Council has lately published<sup>2</sup> an exhaustive account of the method, with an elaborate analysis of the results obtained in a long series of cases in comparison with the more classical procedure. The value of the new "sigma" method is fully confirmed. But the account of the procedure should be studied by others who are concerned with colloids rather than medicine; it evidently raises larger problems than the diagnosis of syphilis.

<sup>1</sup> *Journ. Path. Bact.* vol. xxv. pp. 291, 522; *Proc. Roy. Soc., A*, vol. cii. p. 710.

<sup>2</sup> *The Serum Diagnosis of Syphilis: the Wassermann and Sigma Reactions Compared.* Medical Research Council: Special Report Series, No. 78. (London: H.M. Stationery Office, 1923.) 5s. 6d.



## Electrode Reactions and Equilibria.

By Dr. ERIC K. RIDEAL.

THE conditions of reversibility at electrodes as well as the cause of the phenomena to be noted at irreversible electrodes were discussed at a meeting of the Faraday Society on November 26.

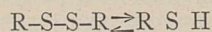
It has long been an accepted fact that the hypothesis of an electrolytic solution pressure as a characteristic property of a metal, originally suggested by Nernst, although convenient for purposes of arithmetical calculation, does not give any insight into the true mechanism of reversible electrodes. The alternative suggestion of a characteristic ionic solubility advanced by van Laar is certainly a more tenable hypothesis, although the enormous values to be attributed to the partition coefficients of the ions between electrode and solution when equilibrium is established somewhat strain the imagination. The hypothesis of Smits, based upon ionic and electronic solubility coefficients, does not appear to be an improvement on van Laar's view, and indeed the accuracy of Faraday's laws appears to offer a very direct proof of its untenability.

A cause for the difference in the electromotive behaviour of the elements is to be found in the nature of the atom itself. The work required to remove an electron from a metal, a value which may be determined from the investigations on thermionic emission by Richardson or from the data on photoelectric emission with the aid of Einstein's quantum relationship, varies from element to element in a manner very similar to the electrode potentials, and indeed it is possible to formulate an expression for the E.M.F. of a cell in reversible equilibrium with the aid of this conception. We are at present uncertain as to the nature of the ionic equilibrium at the surface of the electrode. Attempts have been made to investigate the conditions of a dynamic equilibrium between metal cations and anions being simultaneously discharged at a metal surface resulting in the formation of a definite potential difference and a definite ionic concentration in the solution; but the relationship (if any) of such potential differences to the electro-kinetic potentials due to adsorption and discharge at non-metallic surfaces is by no means clear.

A gap between "reversible" and "irreversible" electrode reactions is to be found in the so-called "inaccessible" electrode reactions. These are generally observed in oxidising or reducing solutions; thus, although a ferrous-ferric ion solution will affect a platinum electrode so as to create a definite reproducible potential difference between metal and solution, yet a solution of glucose or an arsenite-arsenate mixture will not. The inaccessibility of such a potential measurement is due apparently to the relative speeds at which equilibrium at the surface and within the electrode is attained. By suitable artifices, however, inaccessible electrode potentials may be accurately measured.

Certain oxidising and reducing agents, on the other hand, are completely and rapidly electromotively active; such is the quinhydrone electrode of Bijlman, which is now so widely employed for the accurate measurement of the  $P_H$  of solutions and the hydrolytic

constants of weak acids and bases. A number of similar organic oxidising and reducing agents are likewise electromotively active; the case of the system



which was investigated by Hopkins, appears to be transitional in that equilibrium potentials can only be obtained under very limited experimental conditions.

Truly irreversible electrode reactions embrace, *inter alia*, the phenomena of passivity and overpotential. Although passivity may be caused by films of multi-molecular thickness, yet in most cases a unimolecular film is sufficient for the purpose, and, in general, oxygen is the cause of passivity. In the case of the ordinary oxygen electrode consisting of platinum immersed in an electrolyte of definite oxygen pressure, there is little doubt that the oxygen penetrates into the interior of the solid metal. It is uncertain as yet whether definite oxides of platinum are formed, but it is more than probable that the oxygen atoms simply interpenetrate the space lattice of the metal and may take up positions of greatest stability when definite stoichiometric ratios obtain. The irreversible nature of this electrode, at least, must be attributed to the slow diffusion rate of the oxygen in the metal, a factor frequently complicated by a transfer resistance at the electrode boundary in those cases where the chemical reaction of oxidation or reduction is non-ionic and relatively slow.

The many and varied theories advanced to explain the phenomenon of hydrogen overpotential have not yet been reduced to a reasonable number, and it is still a matter of dispute whether the make-and-break or continuous-current method is not suitable for the determination of this value. The use of the positive ray oscillograph for the former and minute polarising currents for the latter appear to be the most promising methods for experimental comparison.

Supporters of the view that overpotential is caused by the formation of small bubbles at the electrode, a suggestion first advanced by Helmholtz, are apparently diminishing in numbers, and the consensus of opinion is gradually veering round in favour of the conception either of a hydrogen atom solid solution or adsorbed hydrogen film; there are, however, numerous difficulties associated with any conception hitherto advanced.

The simple capillary electrometer used almost universally in conjunction with zero potential determinations appears likewise to offer an interesting field for research. The existence of a Quincke electrostatic double layer at the surface of the mercury does not account for the parabolic form of curve obtained when the surface tension is plotted as a function of the applied electromotive force; there appears to be little doubt that the adsorption of ions producing an electro-kinetic potential difference at the interface and a concentration gradient in the electrolyte may give rise to a similar form of curve, and it remains a subject of further investigation whether any effect at all is to be attributed to an electrostatic action unaccompanied by a material or ionic transfer.



Obituary.

COL. C. SWINHÖE.

THE death of the distinguished entomologist, Col. Charles Swinhoe, who had for many years past been recognised as a leading authority on the Lepidoptera of the Indian region, took place on December 2 at his residence at West Kensington. Born on August 29, 1836, of a family which has produced more than one distinguished zoologist, Col. Swinhoe entered the army in his nineteenth year as an ensign of the 56th Regiment. Shortly after the end of the Mutiny, the young officer was dispatched to India, and was gazetted to the Bombay Staff Corps, in which he served for upwards of thirty years, and was with Lord Roberts in the historic march to Kandahar. The rich and varied Indian fauna soon engaged his attention, and he became an enthusiastic student of the Lepidoptera, of which order of insects he formed one of the largest and most comprehensive collections in existence; though his energies were by no means confined to entomology, as is shown by several able memoirs on Indian birds from his pen. In collaboration with Mr. E. C. Cotes, of the Indian Museum, he published the first great "Catalogue of the Moths of India" (Calcutta, 1887-89), and also gave much assistance in the compilation of the "Lepidoptera Indica," this work having been completed by him after the death of its principal author, Dr. Frederic Moore.

On his retirement from active service, Col. Swinhoe at first made his home at Oxford, where his time was largely devoted to the preparation of the "Catalogue of Eastern and Australian Lepidoptera-Heterocera in the Oxford University Museum." This important work appeared in two volumes in 1892 and 1900, and the honorary degree of M.A. was conferred on its author by the University of Oxford. Col. Swinhoe removed to London in 1902, and was for many years a familiar figure at the Natural History Museum. He contributed largely to the publications of the learned societies of which he was a member, and as recently as last spring his "Revision of the Genera of the Family Liparidæ" appeared in the "Annals and Magazine of Natural History." A paralytic seizure in August last, just as he was entering on his eighty-seventh year, brought his life-long work to a close. He had been since 1881 a fellow of the Linnean Society, and had served on its Council, as well as on that of the Entomological Society of London, of which in 1892 he was vice-president. J. J. W.

CANON THEODORE WOOD.

THE sudden death on December 13, at the age of sixty-one, of Canon Theodore Wood, vicar of St. Mary Magdalene, Wandsworth Common, has taken from us one who, both by his writings and by his lectures, did much to popularise natural history, and to awaken in the public mind a sympathetic interest in the birds, insects, and other common animals that come under the notice of dwellers in country places. Brought up under the influence of his father, the Rev. J. G. Wood, who was known even better to a former generation than the son is to the present as the author of excellent books on natural history, he early acquired the seeing eye of the expert naturalist, and a close, personal acquaintance with the ways and habits of many forms of animal life.

In manhood Canon Wood handed on to others the torch that he had thus received. His frequent articles in "Our Country Page" of the Saturday issues of the *Morning Post*, though adapted to the general rather than to the scientific reader, were accurate, showed a considerable knowledge of current scientific literature, and were always worth reading. The titles of his books, "Our Insect Allies," "Our Insect Enemies," "Our Bird Allies," "The Farmer's Friends and Foes," to name but a few of them, indicate his desire to instruct the public on the economic importance of many of the lower animals, and to prevent the ignorant slaughter of useful and beautiful creatures by fruit-growers, farmers, and gardeners; while many a boy naturalist has to thank him for "Butterflies and Moths," a useful introduction for the young collector. As a lecturer he was eminently successful, holding his audiences by his simple, clear language and enthusiasm for his subject, and not less by the skilful and rapidly executed black-board drawings with which he would illustrate his discourse.

M. GUSTAVE EIFFEL.

THE death is announced, at the age of ninety-one years, of M. Gustave Eiffel, whose name will always be associated with the gigantic tower named after him and built by him in Paris in 1889. Alexandre Gustave Eiffel was born on December 15, 1832, and was educated as an engineer. His earlier work was concerned mainly with bridge-building on the Continent, and in this, as in all his engineering work, he introduced novel means of construction.

In 1900, M. Eiffel took up meteorological research, and for some years published an annual "Atlas Météorologique." A laboratory with a small wind-tunnel was established at the Champ de Mars, and experiments on air resistance were also carried out at the Eiffel Tower. In 1907 he published "Recherches expérimentales sur la Résistance de l'Air exécutées à la Tour Eiffel," and in 1910 there appeared a volume describing the experimental work; this was translated into English and German (*v. NATURE*, November 20, 1913, p. 342). A better equipped laboratory was secured at Auteuil, some account of which was given in our issue of February 20, 1913, p. 677; it contained a wind tunnel in which velocities of 2 to 32 metres per second could be produced. The results obtained were embodied in a volume issued in 1914. Work on aeroplanes, propellers, and projectiles was carried on throughout the War, a report on the experiments being issued in 1919, and in 1920 M. Eiffel published "L'Hélice aérienne." His work was of primary importance in aeroplane design and construction.

M. Eiffel was an honorary member of the Institution of Mechanical Engineers and a former president of the French Society of Civil Engineers. In 1913 he received the third Langley medal of the Smithsonian Institution of Washington, "for advancing the science of aerodynamics by his researches relating to the resistance of the air in connexion with aviation."

WE much regret to announce the death of Dr. Otto Klotz, chief astronomer and director of the Dominion Observatory, Ottawa, aged seventy-one.



### Current Topics and Events.

THE list of New Year honours includes the following names of men known by their scientific work or associations: *Baronet*: Sir Donald Macalister, K.C.B., M.D., F.R.C.P., F.R.S.E., president of the General Medical Council. *Knights*: Dr. Byrom Bramwell, for services to medicine; Dr. H. L. Ferguson, Dean of the Faculty of Medicine, University of Otago, Dunedin, New Zealand; Mr. T. H. Mottram, H.M. Chief Inspector of Mines, Mines Department, Board of Trade; and Mr. H. Murray, Assistant Forestry Commissioner of England and Wales. *K.C.B. (Military Div.)*: Sir William B. Leishman, Director-General, Army Medical Service. *C.B. (Military Div.)*: Maj.-Gen. D. J. Collins, Deputy Director of Medical Services, Southern Command, East Indies. *K.C.M.G.*: Prof. W. R. Dunstan, for services as Director of the Imperial Institute.

ON November 6 Sir Oliver Lodge gave a presidential address to the Röntgen Society, entitled "X-rays and the Atom." In it he dealt first with the way in which X-rays had been employed by various experimenters in elucidating the structure of the atom. He also described the X-ray spectrometer, whereby the wave-length of any given set of X-rays can be quickly determined; thus furnishing a measure of their penetrating power, and the characteristics which make them serviceable for any particular kind of surgical or medical examination. These portions of the address will be published in the Journal of the Röntgen Society. On account of the length of the address, certain portions had to be omitted. Some of these portions were of an expository character, and two sections, appropriate to the pages of NATURE, are published elsewhere in this issue. The concluding portions were of a more speculative character, and endeavoured to suggest hydrodynamical inquiry into the exceptional or peculiar behaviour of electrons inside the atom, so as to reconcile it with dynamical or electromagnetic theory.

WE are very glad to learn that, through the generous intervention of a guarantor who prefers to remain anonymous, and an educational trust with which he is associated, the publication of the accurate and interesting monthly periodical of progressive knowledge, *Discovery*, is to be continued. The journal has maintained a high standard throughout its existence, and its contributors have included men of distinction in many departments of learning. The articles and illustrations have represented popular science—natural and humane—at its best, and have always been attractive without being tawdry and superficial. Every endeavour to enlighten the community in this way, and thereby to stimulate interest in human achievement in intellectual fields, merits all the encouragement that can be afforded it. We welcome, therefore, the announcement that the beacon of *Discovery* is to continue to shine for the pleasure and guidance of all who care to profit by its light.

IN an article in our issue of December 1, p. 781, reference was made to the future of the Industrial

Research Associations. In the September-October issue of the *Scientific Worker* the belief is expressed that further public funds will be available for their preservation if the industries themselves will show by their financial support that they believe them to be vital for progress in the distant as well as the near future. So far, the work of these associations has been wrapped in mystery and the public has known too little of their doings. An estimate carefully made of the increase in national wealth due directly or indirectly to research financed out of public funds would be most valuable at the present juncture. The United States estimates that the 400,000*l.* spent during the past ten years on the Forest Products Laboratory at Madison saves American industries 6 million pounds sterling annually. In order that the best methods of administration and control of Research Associations may be adequately discussed, the journal invites the business firms constituting, and the scientific staff employed by the Associations, to express their candid opinions on the subject.

As a result of the success of the "Scientific Novelties Exhibition" held a year ago in support of King Edward's Hospital Fund for London, King's College, Strand, is once more housing a similar exhibition open December 29–January 9. The exhibits are supplied by the colleges, hospitals, and associated institutions of the University of London. The college is lent by the Delegacy, and the gas and electricity are given by the respective supply companies. With this combination the organisers of the enterprise hope to raise funds for the hospitals. The exhibition is designed to bring before the man in the street (and his children) the wonder aspect of science, and to present interesting and amusing applications of scientific principles. Though most of the demonstrations and exhibits are scarcely novelties, they appear to delight the crowd of visitors which daily passes through the building between the hours of 2 and 9 P.M., and no doubt many of the devices will find a place in college and school conversaciones of the future. The exhibits include many old favourites, such as large Wimshurst machines with accessories, stroboscopes old and new, discharge through gases and X-rays, howling tubes and Chladni's figures, polarisation and ultra-violet light. In one very amusing exhibit a professor of engineering surpasses his previous efforts with high tension discharge by the production of thunder by the suitable use of students and stage properties. As an alternative to such a display, a room near by tempts those with a taste for anthropology, with skulls, casts of skulls, etc. But this is a mere outline of the contents of the rooms open to the public. Another feature of the exhibition is the very full lecture list. On most days four or six lectures are given, on a large variety of subjects, mostly by people whose names would normally draw crowds to a lecture. Without a doubt one may say that, if the public is made aware of the exhibition, by suitable advertisement, the organisers will not be



disappointed in the amount of money which they will hand over to the hospital fund at the end of the ten days.

PROFS. BOHR (Copenhagen), Einstein (Berlin), and von Kries (Freiburg) have been elected foreign members of the Göttingen Academy of Sciences.

DR. W. BOTTING HEMSLEY, Keeper of the Herbarium and Library, Royal Botanic Gardens, Kew, from 1899 to 1908, well known by his work on insular floras and on the floras of China and of Central America, attained his eightieth birthday on December 29. He was elected a fellow of the Royal Society in 1889.

THE following free public Gresham Lectures are announced for delivery at Gresham College, Basinghall Street, E.C.2, at 6 o'clock each day: Geometry, by W. H. Wagstaff, on January 15, 16, 17, and 18; Astronomy, by A. R. Hinks, on January 22, 23, 24, and 25; Phisic, by Sir Robert Armstrong-Jones, on January 29, 30, and 31, and February 1.

DR. PAUL VON GROTH, the distinguished professor of mineralogy in the University of Munich, is, according to the *Chemiker Zeitung*, to retire on April 1, 1924. It will be remembered that a special number of the *Zeitschrift für Kristallographie*, which was referred to in NATURE of October 6, p. 519, was issued to commemorate the eightieth birthday, on June 23, of its founder and first editor, Prof. von Groth, who has devoted his long life to the study of crystallography.

To mark the seventy-fifth anniversary of the American Association for the Advancement of Science, it is announced in *Science* that a member of the Association has given the sum of one thousand dollars to be awarded as a prize to the author of a paper containing a notable contribution to the advancement of science, presented at the Cincinnati meeting either before the Association or before one of the affiliated societies. The award will be made by a committee to be appointed by the council of the Association.

THE Council of the Institution of Automobile Engineers has established a medal to be awarded to a member of any grade for any paper or similar service which may be considered likely to have special influence on the advancement of automobile engineering. The medal, which is of bronze, bears on its obverse side a replica of the head of Dr. F. W. Lanchester as symbolical of progress in the industry. The Council has decided to award the first medal to Dr. Lanchester for his contributions to scientific knowledge.

THE Council of the Royal Anthropological Institute has resolved to offer medals, not more than two in number in any one year, as a reward for specially meritorious anthropological work in the field. All British subjects and anthropologists of other nationalities who may be fellows of the Institute will be eligible for the award. The medals will be known as the Rivers Memorial medals in memory of the late Dr. W. H. R. Rivers, who was president of the Institute at the time of his death.

REFERRING to the article "Science in Agriculture," based on the Rothamsted Experimental Station Report for 1921-22, in NATURE, December 15, p. 881, Dr. B. A. Keen, Assistant Director of the Station, informs us that the report is not an annual one, but covers the two years 1921 and 1922; its "somewhat belated" appearance is due to the extra work of dealing with a double set of figures. The arrears of work arising out of war and post-war conditions have now been dealt with, and it is hoped that it will be possible to recommence the issue of annual reports.

THERE has been issued from the British Museum (Natural History) a calendar for 1924, attractively decorated by a brilliant coloured representation of a Morpho butterfly. On the mount are stated the hours of admission to the Museum and of the official tours, the publications issued by the Trustees, a few of the more notable recent additions to the collections, a list of the Museum staff, and the postage rates. We should also like to direct attention to the list (N.H.M. Form 170) of picture cards issued by the Museum, many of which could be employed effectively by teachers.

IN connexion with the twelfth annual conference of Educational Associations now in progress, the Selborne Society has arranged a demonstration of the kinematograph in education at the Stoll Picture Theatre, Kingsway (which Sir Oswald Stoll has kindly lent for the purpose), on Thursday, January 10, 1924, at 10.30 A.M. Illustrations will be given of the teaching of physical geography, history, and natural history with the aid of films. Admission will be by tickets only, which will be sent on request by the honorary secretary of the Selborne Society, Mr. Wilfred Mark Webb, The Hermitage, Hanwell, W.7.

DR. F. M. BECKET, of the National Carbide and Carbon Co., N.Y., has been awarded the Perkin medal, and, according to *Chemistry and Industry* for Nov. 30, the presentation is to take place at the meeting of the American Section of the Society of Chemical Industry on January 11. Dr. Becket's most noteworthy achievement was probably the discovery and development of the process for reducing ores by silicon. In the case of the more valuable metals, this process made possible the economic production of a superior quality of alloy of low carbon content which is admirably suited to the manufacture of certain tool-steels. Dr. Becket has also carried out valuable work in electrochemical and chemical engineering fields.

THE programme of Friday evening discourses before Easter at the Royal Institution covers a wide range of subjects and includes the names of many distinguished scientific workers. The first discourse of the session, on January 18, by Prof. Henry E. Armstrong, will be on the scientific work of Sir James Dewar, Fullerial professor of chemistry (1877-1923). Among the other lecturers and their subjects are the following: Sir William Bragg (recent research on crystalline structure), Sir Arthur Evans (recent lights on the Minoan art of Crete), Dr. J. H. Jeans (origin of the solar system), Prof. G. Elliot Smith (the



human brain), Dr. Walter Rosenhain (inner structure of alloys), Sir Frederick Keeble (the plant commonwealth and its government), Prof. Hugh Maclean (insulin), Sir Ernest Rutherford (the nucleus of the atom), Prof. Jocelyn Thorpe (colours, stains, and dyes). The complete programme of discourses and lectures can be obtained from the assistant-secretary, Royal Institution of Great Britain, 21 Albemarle Street, W.1.

THE following awards have been made for papers read before or published by the Society of Engineers (Inc.) during 1923: President's gold medal to Mr. J. W. Gordon for his paper on "Railway Surveying by Photography"; Bessemer premium to Mr. Mauciere for his paper on "The Pneumatic Handling of Petrol and other Inflammable Liquids"; Nursey premium to Mr. A. Hiley for his paper on "The Impact of Imperfectly Elastic Bodies, with particular reference to the Effect of the Hammer Blow in Pile-driving"; Bernays premium to Mr. A. Ferguson for his paper on "A new entirely automatic Machine for the Mass Production of Glass Bottles"; Society premium to Mr. A. S. E. Ackermann for his paper on "The Physical Properties of Clay (fifth paper) and the Dynamics of Pile-driving"; Clarke premium to Mr. R. C. Hill for his paper on "Work Beneath the Waves" read before the Gloucestershire Engineering Society, associated with the Society of Engineers; and Geen premium to Mr. H. F. Jones for his paper on "Boilers" read before the Crystal Palace Engineering Society, associated with the Society of Engineers.

THE fourth report of the National Institute of Agricultural Botany, for 1922-23, shows steady

progress since the founding of the station. The first series of field trials has been completed and a new series begun with improved methods in the light of the experience gained. The volume and importance of the results of the scientific and practical work has justified the establishment of an Institute Journal, of which the first number has already appeared. A decision has had to be made as to the relative importance of trial and distribution of seed in the work of the station, and it is proposed to concentrate for the next few years on the elaboration and improvement of methods of trial, in order that eventually it may be possible to issue authoritative reports on the yield and quality of different forms of farm plants and their suitability for different climates and soils. The work of the Official Seed Testing Station goes on steadily, though there has been a decline in 1922-23 in the number of samples tested owing to seasonal and trade conditions. A second course of instruction in seed testing was given. The financial position of the Institute is such that at present sufficient funds are available for the fulfilment of the present programme. Any extension of this, however, is impossible unless adequate outside assistance is forthcoming from the general public, and an appeal is made by the Council to all who are interested to assist either by becoming fellows of the Institute or by making donations to the general funds.

WE are informed by Dr. N. A. F. Moos, late director of Bombay and Alibag Observatories, that the selection of disturbed Bombay magnetic curves mentioned in our issue of October 20, p. 603, was prepared by him, and that he had hoped it might have been possible to include introductory matter and a discussion in the publication.

### Our Astronomical Column.

COMETS.—D'Arrest's Comet was observed by M. P. Chofardet at Besançon on Dec. 6<sup>d</sup> 6<sup>h</sup> 27<sup>m</sup> 36<sup>s</sup> G.M.T., its apparent place being 22<sup>h</sup> 53<sup>m</sup> 56.30<sup>s</sup>, South Decl. 24° 8' 41.2". It was estimated to be of magnitude 12½ to 13; it appeared as a small, ill-defined nebulousity, at most 20" in diameter, without definite nucleus. The observation was difficult owing to low altitude and the presence of mist near the horizon; it is very creditable to have obtained an observation under these conditions.

Dr. Baade of Bergedorf Observatory is still keeping his comet of October 1922 under photographic observation. It is now well outside the orbit of Jupiter, and its magnitude is less than 15. The long arc of observation will enable the orbit to be calculated precisely and reveal any departure from a parabola that may be present.

STELLAR PHOTOMETRY AT YALE OBSERVATORY.—It was found that the stellar images on photographs obtained with the Loomis Memorial telescope at Yale were unsuitable for purposes of exact measurement of position, and it was accordingly decided to use the instrument for stellar photometry, measuring by means of a Hartmann wedge photometer the density of extra-focal star images. The calibration of the wedge to star-magnitude was determined from some Pleiades plates, using Hertzsprung's standard photographic magnitudes.

Vol. 3, Part II., of the Observatory Transactions contains an investigation of the light curves of the

Cepheid RR Ceti and the Algol-variable VV Orionis. The curve of the former differs in two respects from the visual curves of Ichinohe and Pračka: (1) the light range is 0.9 mag. visual, 1.2 mag. photographic, indicating that the star gets redder at minimum; (2) the pause midway in the descent is not shown in the photographic curve, which has, however, a slight hump just before the minimum.

VV Orionis has a curve with two minima, indicating that both stars are luminous, but the brighter star gives nine times the light of the fainter one, which it totally eclipses at secondary minimum. Only one spectrum is seen, so the mass ratio cannot be determined. Assuming that it is 2 to 1, the masses in terms of the sun are 6.9, 3.4, and the diameters 5.3, 2.5.

PARALLAX AND PROPER MOTION OF RR LYRÆ.—Many researches have lately been carried out on the parallaxes of variable stars. *Astr. Nachr.* No. 5260 contains a photographic investigation by H. Fuss of that of RR Lyræ, the period of which is 0.567 days, the spectral type varying from B9 at maximum to F2 at minimum.

A very small value for the parallax,  $0.0003'' \pm 0.0038''$ , is found; Van Maanen had found  $0.006'' \pm 0.006''$ , so there is no doubt that the star is very remote. In spite of this it has the considerable annual proper motion of  $-0.0098''$ , and  $-0.202''$  in R.A. and Decl. respectively, so that its linear velocity must be large.



## Research Items.

ANCIENT MAN IN NORTH AMERICA.—In the Bulletin of the American Museum of Natural History (December 4, 1923) Dr. William K. Gregory and Mr. Milo Hellman analyse in still greater detail the two molar teeth attributed by Prof. H. F. Osborn to "a new and independent type of Primate"—*Hesperopithecus*—which existed in North America during Pliocene times. They find that the "type" tooth is, as has been maintained, a second upper molar of the right side, but do not definitely reject the suggestion of Dr. Gerrit Miller, that it may prove to be a third molar. While Dr. Gregory sees in these recently found fossil teeth a resemblance to the molar type of the gorilla and chimpanzee, his partner leans towards their human resemblances. With only drawings to guide him, Dr. Smith Woodward (*NATURE*, June 10, 1922, p. 750) was disposed to regard the type tooth not as that of a primate but of a carnivore—possibly *Hyænarctos*—and he considered that the tooth had the characters of a lower rather than an upper molar. In their present paper the authors state that the tooth of *Hesperopithecus* differs profoundly from that of carnivores and that it has fundamental points of agreement with those of the ape-man group of the primates. They cite altogether ten opinions, all of them different, which experts have passed as to the nature of the two teeth ascribed to the enigmatical *Hesperopithecus*. Prof. Osborn was right when he wrote in *NATURE* (August 26, 1922, p. 283) "we must seek more material before we can determine its relationships"; and in truth the same may be said of the teeth.

THE IRON AGE.—Dr. J. Newton Friend, in a paper entitled "Iron in Antiquity" which has been published in the Carnegie Scholarship Memoirs, volume xii., has brought together a great deal of information relating to the early use of iron. He agrees with Sir Flinders Petrie in regarding the iron which occurs in Egypt between the find of the pre-dynastic beads at El Gerzeh and the 18th Dynasty as belonging to the "Sporadic Iron Age of Egypt," and inclines to the view that the earliest iron used there was meteoric in origin, notwithstanding the fact that the earliest known larger piece of iron—that found in the pyramid of Khufu—was telluric. In support of the likelihood of the use of meteoric iron by primitive man, he cites the cases of the Eskimo of the Coppermine River and Cape York quoted by Zimmer. Dr. Friend has some interesting notes on the use of iron in India. These include an account of the remarkable pillars of wrought iron at Delhi, dating from 300 A.D., and at Mandu near Dhār. Of these, the former is 23 ft. 8 in. in height, and the latter, now in three pieces, was originally 43 ft. 4 in. or possibly 50 ft. in length. Discussing the peculiar freedom from rust of early Indian iron, Dr. Friend states that he has found by experiment that after one year's exposure to the corrosive influence of alternating wet and dry, the relative corrodibility of modern mild steel is 100:0 as compared with iron from the Black Pagoda at Konarak, Madras, 89:3.

WITCHES AND VAMPIRES.—During the past year, Miss M. Edith Durham has contributed to *Man* a number of interesting articles dealing with the ethnography of the Balkans. In the December issue she writes of witches and vampires in Bosnia, Montenegro, and Albania. In Montenegro the Vilas, the female spirits, usually evil, live in the underground caverns frequent in limestone rocks, and sometimes swear sisterhood with a warrior and protect him from his foes. They also make love to male animals, and it is interesting to note that the tangled knots

in a horse's mane, which used to be known to the negroes of the United States as "witches' stirrups," are also said in the Balkans to be a sign left by the Vilas. In Albania, the population being more primitive, the belief is universal. The witch or *shtriga* is especially powerful in the first week in March. Weakness and pallor are commonly ascribed to the night attack of a witch in the form of a fly, bee, or moth. The witch here has evidently assimilated to the vampire. The belief in the vampire, which is a characteristic folk belief of the whole of eastern Europe, is very prevalent, and Miss Durham records a case in which it was believed that a woman's betrothed had returned to her as a vampire after his death and had become the father of her child.

CINCHONA PLANTATION IN BURMA.—In *NATURE* of April 21, p. 547, reference was made to the Report of the Botanical Survey of India for 1921-22 and the efforts therein described to introduce *Cinchona* cultivation in Burma. The original locality chosen had proved to be far too wet, the heavy rainfall being disastrous to the young plants, and in that Report the decision was recorded to make a new start in the neighbourhood of Tenasserim. The Report for 1922-23 of the Botanical Survey of India records interesting progress in spite of the necessity of retrenchment due to the limitation of funds; 250 acres only were planted instead of 500 acres, but the new situation so far seems admirably adapted to the plants. The plants are described as having made phenomenal growth, whilst, in the process of hardening the seedlings to the sun, "methods which have never been deemed possible in Bengal have been successfully employed this year in Burma." But one of the most interesting points is that the plants grown in unfavourable conditions at the earlier Burma experimental station at Tavoy provided sufficient bark to enable the alkaloid contents to be estimated. In spite of adverse climatic conditions under which these plants at Tavoy have been grown, at two years of age the bark showed an alkaloid content of 4 per cent., and at one year old of between 2 per cent. and 3 per cent., percentages obtained in Bengal only from trees of from four to seven years of age.

TIDE PREDICTION.—At a meeting of the Royal Geographical Society on December 10, Dr. A. T. Doodson gave a remarkably clear and interesting account of the past work and future plans of the Tidal Institute, Liverpool, of which he is secretary. Many phases of this work have previously been mentioned in this column in connexion with the annual reports of the Institute, issued by the honorary director, Prof. J. Proudman. Dr. Doodson's present article surveys the field of tidal investigation more generally, and with more reference to the work of others in the same field, than would be appropriate in the annual reports. He postulates, as the ideal to which tidal research must address itself, the power to explain the tides quantitatively without tidal observations; the tide generating forces of the sun and moon are known, and the problem is that of mathematical treatment of forced oscillations of water in various basins the geographical form and depth of which are known. Henri Poincaré indicated a sequence of direct mathematical operations, based on the dynamical equations of the tides, which would enable this problem to be solved; but he admitted that the amount of computation involved in applying his method to the actual oceanic basins would be prohibitive. A mathematical method of the same



general nature, though entirely different in detail, has been devised at the Institute, and will be tried; the computations are necessarily still very laborious, but perhaps not prohibitively so. Further details are given also of work on the effect of winds, and of friction, on tidal oscillations.

**WEATHER IN KOREA.**—A volume containing results of observations has recently been issued as the annual report of the Meteorological Observatory of the Governor-General of Chosen for the year 1920, compiled at the Meteorological Observatory at Zinsen. Hourly values of pressure, temperature, and wind are given from self-registering instruments, and other data commonly observed in European weather establishments. Monthly and annual results of the several elements are given, from four-hourly observations for the Observatory at Zinsen and 13 branch stations, together with earth temperatures, hours of sunshine, and various data. There are 205 auxiliary stations which supply observations of air temperature and precipitation for climatological investigation. Headmasters of the ordinary schools continue to supply observations of thunderstorms, and a report of past work has been issued for 1918. Weather telegrams are said to be much improved since the beginning of 1920 by the wireless communications between China and Korea. Storm warnings are exhibited at 43 stations round the Korean coast, and there are three typhoon signal stations at Chemulpo (Zinsen), Fusan, and Gensen. Seismic observations at Zinsen are given at the end of the report. Results of the meteorological observations in Korea for the lustrum 1916 to 1920 have also been recently published; these will add much to our knowledge of Korean weather. Rainfall at the several stations shows that there is an excess of rain in the summer months, and the precipitation is given for 8-hourly periods throughout the discussion; the totals for the several periods seem to vary considerably and somewhat irregularly, both position and height above sea level entering into the difference between day and night values.

**THE ROTARY SYSTEM OF OIL-WELL DRILLING.**—On December 11, Mr. L. R. McCollum presented to the Institution of Petroleum Technologists an account of the rotary system of drilling, now of increasing importance throughout the principal oilfields of the world. Broadly speaking, two systems of drilling are employed to-day—the cable-tool or percussion system, whereby the hole is literally pounded out by a cutting-bit alternately raised and lowered to produce a succession of “blows,” and the rotary system, in which a rigid pipe-stem rotates a special type of cutting-bit, a mud-flush being pumped down under hydraulic pressure through the drill-pipe. This flush serves to lubricate the process of drilling, drive the cuttings up out of the hole, and at the same time “mud up” the formations to prevent them caving; hence the special adaptability of the system to unconsolidated and caving sands or silts such as are commonly met with in the Gulf Coast fields of Texas and Louisiana, where the system was perfected in the first instance. The cable-tool system is better suited to harder rocks. The chief advantage of the rotary system is the rapidity with which a well can be drilled, 450 feet per day being made under exceptionally good conditions, a far greater depth than is possible with the cable-tool in normal circumstances. Further facts in favour of the system are that high gas and oil pressures are more easily controlled, less casing is required for the lining of the well, it is less costly to employ than cable-tools, and it is more universally adaptable to conditions of modern oilfield development. Two inherent disadvantages are the tendency through

“mudding” for the driller to miss oil shows, and the difficulty of obtaining uncontaminated samples for elucidating subsurface geological data. The first depends for its solution on the efficiency of the driller. The second has been lately successfully combated by the introduction and use of the core-barrel, a device by which adequate sampling can be carried out satisfactorily. The rotary system probably finds its greatest exploitation in California and the Mid-Continent fields to-day, a fact that has materially contributed to the development of petroleum production in North America during the last three or four years.

**ASPHALT AND RELATED BITUMENS.**—There has been a noteworthy increase both in production and utility of asphaltic material for commercial requirements during the last few years, especially in the United States, where domestic and Mexican petroleum and native bituminous rock constitute the chief sources of supply. In 1922, according to Mr. K. W. Cottrell's recent report (Mineral Resources of the United States, 1922, Part 2), the sales of asphalt and allied material represented increases amounting to 11 per cent. in quantity and 13 per cent. in value in the case of native products, and to 29 per cent. in quantity and 15 per cent. in value in the case of material manufactured from crude oil; asphalt obtained from Mexican petroleum showed an increase of 37 per cent. in quantity and 18 per cent. in value. Internally, California, Texas, and Illinois (in that order) were principally responsible for the sources of manufactured asphalt. Chief among the uses to which asphalt is put, either in its solid, semi-solid, or liquid forms, are those in connexion with paving and roofing. Refined asphalt and asphaltic cement are used in a fluxed or unfluxed condition for the construction of sheet asphalt, asphaltic concrete, asphaltic macadam, block and monolithic pavements; the saturation, coating, impregnation, or cementing of suitable fabric with asphaltic material is an equally important process in the production of waterproof roofing. Nowadays few motor-car tyres are manufactured which do not possess a certain amount of asphalt or asphaltic cement as a constituent, and this in itself has created an ever-growing market for this form of bitumen. With the popularisation of wireless telephony, insulating materials and acid-resisting compounds have been in increasing demand, both in the United States and in Great Britain, and here again asphalt has supplied the requisite raw material. Putty, mastic, asphaltic briquets, paint, varnish, or as a road-oil—all these are uses to which this valuable product is being applied. It is interesting to note that the two chief countries to which asphalt is exported from the United States are Canada and England in the case of unmanufactured products, and Canada and Spain in the case of manufactured products.

**PHOSPHORESCENCE AND CRYSTAL STRUCTURE.**—In the *Zeitschrift für Physik*, 18. 2. p. 109, 1923, Herr A. Scheelde states that the sulphide phosphores can be most simply considered as being built up in the following manner. Certain metal atoms of the ground substance are replaced by foreign metal atoms, and these, with the surrounding arrangement of atoms in the crystal lattice, are identical with Lenard's phosphorescent centres. Inorganic substances capable of luminescence show phosphorescence when prepared by melting, but not when prepared by roasting, or by slow crystallisation from solution. In the first case the crystallisation takes place suddenly, and lattice deformations may be expected; in the second case there will be no such disturbances, and it seems possible that the difference in phos-



phorescence is due to this cause. Zinc sulphide, in the wurtzite form, prepared by reduction of zinc sulphate, was found to be luminescent, but not phosphorescent; when this was compared by the X-ray method with a strongly phosphorescent zinc sulphide, the latter showed strong deviations in its lattice constants. Zinc silicate and calcium tungstate show a diminution of the period of phosphorescence, when they are maintained at a high temperature for a long time, without any flux; the intensity of the fluorescence is not diminished by this treatment. Certain organic substances give a similarly explained long period phosphorescence when frozen in alcohol, or mixed with molten boracic acid, which is then solidified. The electrons separated in consequence of these deformations probably return to their stable orbits only when, by chance, a heat vibration brings the atom again into its normal position with respect to its neighbours.

ELECTRIC CONDUCTIVITY OF THE VAPOUR OF CADMIUM IODIDE.—Although the easily vaporised halogen salts of metals are good conductors, the conductivity alters greatly with the time, and the irregularities are such that in most cases it is not possible to reproduce the results of a given measurement. The salts of zinc, cadmium, etc., easily decompose, and, except in the case of cadmium iodide, the vapour densities are very variable. In the *Annalen der Physik*, November 1923, Messrs. G. C. Schmidt and R. Walter describe an investigation of the last-named salt. They determined the density by passing a measured volume of dry nitrogen over the heated salt and finding the loss of weight due to evaporation; it vaporises normally, the density depending only on the temperature. This is not the case with other halogen salts. Conductivity determinations of the vapour show that the heated salt gives out only positive ions and no electrons, so that there is a surface ionisation, and not, as previously assumed, a volume ionisation; this takes place when the salt is heated on nickel, glass, or platinum. The conductivity is very dependent on the time during which the tube containing the salt and vapour is kept at a given temperature, generally rising to a maximum and then falling, at first rapidly and afterwards slowly. This is not due to any foreign substance being distilled out of the salt by degrees, and the explanation finally offered is that, the cadmium positive ions being given off, iodine is left behind in the solid. The distillate of cadmium iodide is always richer in cadmium than the original material, and this increases for each distillation. Complex salts,  $CdI_3$  or  $CdI_6$ , seem to be formed in the residual salt. The action seems to depend in some way on the catalyser (platinum, nickel, or glass); and the halogen produced by decomposition of  $CdI_3$  is supposed to "poison" the catalyser, reducing the reaction velocity and diminishing the conductivity of the vapour.

USE OF DESENSITISERS IN X-RAY PHOTOGRAPHY.—Dr. A. Bruce MacLean has tested the use of safranin (pheno-safranin) as a desensitiser in developing X-ray negatives. A pair of films were inserted in a film-holder and exposed for each part radiographed. One film of the pair was developed by the usual routine, in a Kodak developing tank, the other was treated to an aqueous bath of safranin (1 in 5000), well rinsed and then inserted in the developing tank. Development by a weak white light (such as a single candle) may then be carried out with safety. It was found that, with correctly exposed negatives, any advantage gained by the method is so slight as to be negligible. With under-exposed negatives the method is not to be recommended. With over-exposed films better results are obtainable than by the usual method of

development, as the dye acts as a powerful restrainer of development (*Archives of Radiology and Electrotherapy*, No. 280, November 1923, p. 184).

EARLY OPTICAL INSTRUMENTS.—The index part of volume 24 of the Transactions of the Optical Society contains two of the series of lectures intended to direct the attention of the Society to the early optical instruments in the Science Museum at South Kensington. The first, by Dr. L. C. Martin, deals with surveying and navigating instruments from the astrolabe and cross staff to the sextant and theodolite, and includes a valuable bibliography. The second, by Mr. D. Baxandall, is on early telescopes, and begins with the treatise on optics written about 1279 by the monk John Peckham of Oxford. It directs attention to the 12-inch "double convex perspective glass" of 15-foot focal length described by Bourne in his book on glasses written about 1585, and brings the history of the telescope down to the time of Herschel. By the co-operation of Col. Lyons, Director of the Science Museum, many of the instruments were exhibited at the lectures, and photographs of them are reproduced in the Transactions.

THE MICROSCOPIC STRUCTURE OF SOAP.—A paper on this subject by Kenneth MacLennan appears in *Chemistry and Industry* for October 5. The author found that the use of polarised light rendered magnifications of more than 100 diameters unnecessary. Fluid crystals and soap fibres were found to be very prominent in the specimens examined. The paper is illustrated by a series of microphotographs showing the structures of a variety of soaps. The bearing of the work described on manufacturing processes is considered.

INFLUENCE OF PROPELLER REVOLUTIONS UPON THE PROPULSIVE EFFICIENCY OF MERCHANT SHIPS.—A paper upon this complicated subject was read by Dr. Ing. Karl Schaffran before the North-East Coast Institution of Engineers and Shipbuilders on December 7. The author is superintendent of the Berlin ship experimental tank, and illustrates the research and design methods adopted in his department for estimating the power of a vessel from the results of ship models and model propeller experiments by reference to the high-speed passenger liner *Duilio*. A model of this ship was first of all run in the tank in the usual manner, without screws attached, and a second series of experiments was carried out under the same conditions and over the same speed range, but with a 4-bladed screw. The results of both sets are given in the paper, including a series of behind tests with a set of four 3-bladed screws. A discussion of these results substantiates the claim that the results of model experiments with screws attached, in addition to having an undeniable comparative value, can also make some claim to absolute value in the determination of the machinery horse-power and the propulsive efficiency of full-sized ships. The author proceeds to show how the results of systematic model experiments may be employed in the correct designing of the screws for a given case and the influence upon the propeller efficiency of a chosen number of revolutions. In order to use the results, a knowledge of the thrust deduction and wake fractions of the particular form of vessel under consideration is necessary; both of these factors are dealt with, and the results are used in the analysis which follows. A large number of diagrams is included, and the author illustrates their use by several numerical examples of practical design. In the appendices attached to the paper will be found descriptions of the model dynamometer used at the Berlin tank, as well as the propeller milling machine and the propeller dynamometer.



### The Pan-Pacific Science Congress, Australia, 1923.

THE relationships of the Australian flora were the subject of several communications at the recent Pan-Pacific Congress. Dr. J. McLuckie said there was a strong Antarctic element in the Australian flora, the main centre of which to-day was Tasmania; these Antarctic elements ranged northwards throughout Victoria and New South Wales, chiefly along the western slopes of the main range, and their northerly limit was determined by the climate. Mr. L. Rodway (Tasmania) stated that there were more endemic species in the wet west of Tasmania than in the drier east; thus the western pines were vestiges of a former flora which elsewhere had been overwhelmed by migrations from Australia. All the *Proteas* had dry country characters although they grew in wet areas; one of the two species of beech was very like a Northern Hemisphere tree. Dr. Rogers (South Australia) pleaded for the recording of the distribution of orchids as this might throw light on former land connexions. Dr. E. D. Merrill (Manila) stated that representatives of several families of plants, for the most part confined to Australia, occurred in the Philippines, but were scarce in other parts of Malaysia. His conclusion was that Australian plants, as well as those of New Caledonia and New Guinea, reached the Philippines through remote geological connexions, but were inhibited by constant arms of the sea from travelling the shorter distance to Borneo and Java. According to Mr. R. H. Cambage (Sydney), the original acacias belonged to the tropics, and there seemed no doubt that the wattles had entered Australia from the north; some of them suited themselves to dry conditions by dispensing with small leaflets, and by developing their leaf stalks into flat blades, or phyllodes, which served as leaves; in all cases the first leaf of a seedling was pinnate. One species in the Blue Mountains could revert to leaves after it had developed phyllodes.

Information was given of the experiments made by the Queensland Government with the view of combating the growth of the prickly pear which has ruined enormous areas and is increasing at an alarming rate; numerous kinds of insects have been imported from various parts of America, and it is hoped that some of these, combined with destructive fungi, may prove effective. The Sections of Agriculture, Entomology, and Forestry combined in recommending that the distribution of plant diseases and insect pests should be limited as much as possible by plant quarantines, and that plant diseases, insect pest surveys, and epidemiological studies, which are prerequisite to intelligent action, be undertaken in all countries bordering on the Pacific. The Section of Botany recommended that botanical surveys be made of Macquarie Island and the Aleutian Islands to obtain records of distribution and migration of the Antarctic and Arctic floras, and that the survey of Krakatau Island be continued. It was also recommended that there should be more interchange of information and specimens in the Pacific area.

It is generally recognised that reforestation has become a matter of urgency if the needs of the population in Australia fifty years hence are to be provided for, and resolutions were suggested by the Section on Forestry to the Commonwealth Government to establish and maintain an efficiently equipped Forest Products Laboratory and to reserve permanently for forestry all suitable timber-bearing areas in the Commonwealth. All Pan-Pacific countries were asked to give immediate attention to the planting of coniferous woods in regard to the approach-

ing world's shortage. Further investigation was required on the drying and seasoning of various kinds of wood, on the treatment of timber to preserve it from attacks of rot and insects, on the utilisation of waste timber, and on the mechanical testing of all commercial woods. The conversion of waste timber into alcohol was regarded by Mr. I. H. Boas as of the most fundamental importance for Australia, as alcohol must become the fuel of the future, and it was the only known fuel which did not draw on the stored energy in the earth.

The topics discussed by the Section of Zoology comprised marine biological investigations in the Pacific, the geographical distribution of certain animal groups in the Pacific, the phylogeny of the marsupials, and the problem of introduced pests and their natural enemies. The entomologists suggested that the Federal Government should provide funds for a Federal Bureau of Entomology for research to combat the danger to Australian industries from insect pests, and also that provision should be made for the training of economic entomologists in the Australian universities. One meeting was devoted to the discussion of certain parasitological problems, such as hookworm and beef nodule; the latter, which is caused by the Nematode worm, *Onchocerca* (the carrier of which is still undiscovered), has been the cause of enormous losses to the cattle industry in Northern Australia. Dr. R. J. Tillyard (New Zealand) said that the first insect fauna was received by Australia from Gondwana-land, and that remnants of it still persist, though all are absent from New Zealand. The insect fauna of New Zealand had resemblances with that of Tasmania through unions with Antarctica, and with Queensland through the northward union with New Caledonia, Australia, and New Guinea; it thus belonged to the Australian region, but it lacks the latest immigrant groups from the north into Australia, as it lacks the earliest. Prof. J. Cossar Ewart (Edinburgh) said there was a veritable gold mine for Australia in a study of the principles of genetics as applied to sheep. He also aroused great interest by his account of his researches into the ancestry of domesticated breeds of sheep, and of his crosses between certain primitive breeds quite unknown in Australia. Prof. A. F. Barker (Leeds) referred to the experiments at Cambridge on breeding a double-purpose sheep (wool and mutton) on Mendelian lines, and further dealt with genetics applied to wool production.

Australian biologists took advantage of the Congress to emphasise a matter which is very dear to their hearts, namely, the adequate protection of their native fauna from the extermination which is threatening many of their most interesting species. The mongoose in New Zealand and the fox in Australia were introduced to prey upon rabbits, but they have done serious damage to native birds; for example, the spotted pigeon, scrub turkey, and even the emu are threatened with extinction in Queensland. Dr. M. Oshima (Formosa) declared that the preservation intact of the Australian fauna was an international affair as the nation was trustee to the world of a unique possession. Of late years public interest has been thoroughly aroused in this matter, and in addition to the legal protection of many species throughout a part or whole of the year, extensive National Parks have been set aside as animal sanctuaries in various States. Prof. Harrison (Sydney) stated that reservations were required upon various types of country so that suitable environment might be available for all kinds of animals.

In the Section of Anthropology, as in other Sections,



there were papers of more or less local interest, as well as others that dealt with general problems. Sir Edgeworth David (Sydney) produced evidence to show that certain stone implements were contemporary with the last glacial age of Tasmania, which was then united to Australia. Mr. A. S. Kenyon (Melbourne) gave a classification of Australian stone implements; some of those from the south resemble Tasmanian types, but there is no evidence that these are older than other types; no chronological sequence has yet been established. The material culture of the Maori was illustrated by lantern slides and cinematograph films by Dr. P. H. Buck, and Mr. H. D. Skinner discussed the affinities of the Moa hunters of New Zealand. The linguistic problems of Oceania were discussed on several occasions. Dr. van H. Labberton gave the preliminary results of a research into the original relationship between the Japanese and Polynesian languages, in which he demonstrated that in the earliest form of the Japanese language there were numerous close affiliations with the Austronesian family of languages which have been overlaid by a later Asiatic language. He also showed that comparisons between various recent Oceanic languages and those of Indonesia and of mainland Asia are apt to be misleading, since changes have taken place in course of time, and comparison is valid only between the oldest forms of the words.

Capt. G. H. Pitt Rivers read an elaborate paper on variations in sex ratios in relation to racial decline, the main result of which was to show that more exhaustive and precise information was required before the causes of the decline in native populations could be established, this being a very complex problem; he adduced evidence which suggested that a preponderance of males over females was an indication of a declining population. The decline in native populations in the Pacific was also discussed in conjunction with the Section of Hygiene.

A discussion took place on the organisation of research in anthropology and ethnology, at which were read suggestions made by distinguished British anthropologists. It was agreed that the most urgent preliminary step to take was the establishment in Australia of a chair of social anthropology, and the suggestion was made that the professor should teach anthropology (*a*) in co-ordination with geographical, historical, psychological, anatomical, and other departments of the university to which he may be attached; (*b*) as a training for Government officials, missionaries, and others; (*c*) as a training for investigators in the field; and should himself undertake and direct field research. A report was drawn up indicating the need for research in Oceania and Australia and the objects of that research. This was desirable since the attention of the anthropologists at the first meeting of the Congress in Honolulu was largely confined to Polynesia. The suggestion was made that the various main regions of Oceania should severally be more particularly investigated by certain countries, so as to avoid undue overlapping and permit of more intensive study.

The problems of the relations of the various cultures and peoples in Oceania and Australia were discussed on several occasions. The latest conclusions of Mr. W. J. Perry (London) were submitted by him and led to interesting debates by Prof. J. Macmillan Brown, Mr. H. D. Skinner (both of New Zealand), and others. The final meeting consisted of a joint discussion with the Section of Geography in which Prof. T. Griffith Taylor (Sydney) explained his views on "zoning" and the geographic principles governing early migration—corridors, shatter-belts, etc. Dr.

Haddon gave a blackboard demonstration of his views concerning the early distribution and migrations of peoples, more particularly of the Indo-Pacific area, which differed fundamentally from that proposed by Dr. Griffith Taylor, though resembling it in some particulars.

Several papers were concerned with various aspects of hygiene, connected more especially with Australian and tropical conditions. There was a joint discussion of the Sections of Hygiene and Geography on tropical settlement, a subject which is engaging wide attention at the present time in view of the "White Australia" policy. If the tropical portions of Australia are to be settled solely by a white population, it is obvious that the settlers must adapt themselves and their mode of living to climatic conditions, and the respective State Governments should provide all the alleviations in their power, give instruction in hygiene, and supply a sufficient medical staff. A meeting in conjunction with the Sections of Entomology and Veterinary Science discussed the distribution of insects in relation to disease.

The subject that, not unnaturally, engaged the greatest attention was the hygiene of mining. Dr. W. Watkins-Pitchford (South Africa), from long and successful experience in the Transvaal, showed that silicosis (wrongly termed "miners' phthisis") could readily be almost eradicated if precautions were taken to prevent miners and others from inhaling minute particles of silica; these are conveyed into the areolar tissue of the lungs by means of wandering cells, and there give rise to fibrous tissue; this new tissue is eventually absorbed if the patient changes his occupation and escapes a tuberculous infection. As a disease, this simple silicosis might almost be ignored were it not that the patient becomes specially liable to tuberculosis. The arrangements for preventing the inhaling of silica dust and for the prevention of tuberculous infection are very imperfect in some Australian mines, and the inspection of the miners, clinically and by radiographs, is often inadequate. In certain mines, such as those at Broken Hill in N.S.W., the hygienic conditions are, however, fairly satisfactory. Apparently nowhere in Australia are radiographs taken periodically of all the miners, as they are in the Transvaal. Apart from the health of the miner and the risk of early death, the matter is of economic importance, as compensation has to be paid to those patients who have become seriously affected. Although no new method of prevention or treatment was presented, the Section of Hygiene as a whole, and individual members in their visits to various mines, performed a valuable service to Australian miners and mine managers.

The decline of population in the Pacific was discussed in conjunction with the Section of Anthropology, and the following resolution was passed: "That the scientific problem of the Pacific, which stands first in the order of urgency, is the preservation of the health and life of the native races by the application of the principles of the sciences of preventative medicine and anthropology."

A. C. HADDON.

In addition to the resolutions referred to above, and in the article which appeared in *NATURE* of October 27, p. 635, a number of further resolutions were discussed in the various sections.

A question which caused considerable discussion and on which there was wide difference of opinion was the proposal that in future the Pan-Pacific Congress should include all branches of physical and natural science, and that in particular chemistry, mining and metallurgy, and physics should be



included in the next meeting of the Congress. The inclusion of social science and economics was also suggested. Several members supported these proposals, and in particular favoured the inclusion of special sections for chemistry and physics. Others thought, however, that the introduction of new sections would merely mean the weakening of those already included, and they strongly urged the limitation of scope to subjects with direct bearing upon the natural history of Pacific regions. When these proposals were put to the meeting the voting for and against was practically equal. On the suggestion of the president (Sir David Masson), it was decided to recommend the governing body of the next Congress that it should give very serious consideration to the question of whether or not these further subjects should be included as specific sections.

Another matter of considerable interest was a proposal made by Dr. T. Wayland Vaughan (U.S.A. Geological Survey, Washington) that steps should be taken to create a permanent organisation for the Congress. This proposal was agreed to, and it was decided that the National Research Council (or similar institution) in each of the following countries, namely, Australia, Canada, Chile, France, Great Britain, Japan, the Netherlands, New Zealand, Philippine Islands, and the United States of America, should each be asked to appoint a member of an organisation committee to prepare a draft constitution for consideration at the next Congress.

On behalf of the Japanese Government and the National Research Council of Japan, Dr. J. Sakurai conveyed to the Congress an invitation to hold its next meeting at Tokyo in 1926. This invitation was gratefully accepted.

*Agriculture.*—On the proposal of Dr. T. H. Easterfield, Director, Cawthron Institute, Nelson, N.Z., the Congress approved the appointment of a special committee to collect information on all genetic research in progress in Pacific countries.

On the joint recommendation of the Agricultural, Entomological, and Forestry Sections, the Congress recommended that a survey of diseases of insect pests of sugar-cane and other natural means of control be undertaken in New Guinea by the Pacific countries interested in sugar-cane cultivation.

*Botany.*—It was resolved that a suggestion be made to the State Government of Victoria that it should reserve an area or areas of land on which the tallest Eucalypts now living have their stand.

*Geodesy and Geophysics.*—On the motion of Sir Gerald Lenox-Conyngham (University of Cambridge), resolutions were adopted by the Congress urging first the necessity for the preparation of maps of Australia on the International Scheme, and secondly the importance, on national, economic, and scientific grounds, of carrying out a geodetic survey of Australia. The Congress placed on record its appreciation both of the decision of the Commonwealth Government to proceed with the establishment of the Commonwealth Solar Physics Laboratory, and of the valuable work which has been carried out on the American non-magnetic survey yacht *Carnegie*.

*Pacific Radiotelegraphy.*—The Congress emphasised the importance of the speedy erection of wireless stations in all countries bordering the Pacific capable of communicating directly with each other. It recommended that arrangements be made for all wireless stations in the Pacific regions to keep daily records on an approved basis with regard to atmospheric conditions, their effect on wireless communication, and their relation to meteorological conditions. It was suggested that Governments of the different countries concerned should establish a daily mean time signal.

*Geography and Oceanography.*—On the motion of

Dr. N. Yamasaki, of the Imperial University, Tokyo, it was agreed to urge the increasing importance of accurate coastal surveys being carried out in accordance with the recommendations of the International Hydrographic Bureau, and that special attention should be given to the scientific and economic interest of the construction of detailed charts of the Great Barrier Reef of Australia. The Congress also invited attention to the need for an adequate wireless meteorological service in the more remote parts of the Pacific Ocean, and urged that the international exchange of meteorological information for the purposes of forecasting be extended to these regions.

It was also decided to recommend the Australian National Research Council to appoint a committee for the investigation of the temperature, salinity, currents, etc., of the Pacific Ocean.

*Geology.*—On the motion of Sir Edgeworth David, a number of resolutions were passed by the Congress arising out of the work of the Geology Section. It was recommended that geological maps of the Pacific countries on a scale of 1:1,000,000 be completed at as early a date as possible and that a committee consisting of representatives of the different countries concerned be appointed to expedite this work. In view of the many geological problems of the Commonwealth which called for investigation in areas transgressing the boundaries of the States, the Congress was of the opinion that a Federal Geological Survey Office should be established. It was pointed out, moreover, that the efficient administration of the Northern Territory can be effected only with geological assistance and that the work now being carried out in Papua, excellent though it is, requires considerable extension.

The Congress was impressed with the scientific and economic value of the results achieved in Papua by the Government Geologist, and it urged that these investigations should receive increased support. As regards the Fiji Islands, the Congress urged the desirability of a geological survey both on scientific grounds, particularly in throwing light on the origin of coral reefs and on earth movements in the Pacific regions, and also because it may procure valuable information of the mineral resources of the islands and cannot fail to be of great assistance in opening up the country for settlement.

In view of the importance of meteorological and seismological observations in the Pacific regions, the Congress urged that the staff and equipment of the Observatory at Samoa should be increased so that it may continue efficiently the good work already begun. The Congress strongly commended the proposal for the establishment of a seismological and volcanic observatory in the thermal region of New Zealand. It was urged that different agencies should co-operate in the study of coral reefs, and in this connexion it was suggested that, where practicable, aeroplane surveys should be made.

*Veterinary Science.*—The Congress recommended the creation of an International Bureau of Animal Health, to which all the countries represented at the Congress should forward a monthly notice of all outbreaks of contagious and infectious diseases of animals. The information thus obtained by the Bureau should be transmitted regularly to all the countries concerned. Another resolution was passed recommending that greater encouragement be given to the study of animal genetics so as to improve the breeds of productive animals in the various countries.

In conjunction with the Zoological Section a recommendation was approved that the Congress should express its appreciation of the work already done by the Commonwealth and State Governments of Australia in protecting the unique native fauna



of their territories. The Congress also decided to recommend that a veterinary survey of Papua and the Australian Mandated Territories should be carried out by the Commonwealth Government under the direction of a veterinary bacteriologist experienced in the tropical diseases of animals.

*Zoology.*—The Congress adopted resolutions recommending that the investigation and survey of terrestrial and marine fauna and flora of Pacific countries should be carried out. Attention was directed to the fact that many valuable species of marine mammals such as fur seals, sea otters, whales, elephant seals, and dugongs once occurred in various portions of the Pacific, but owing to extremely unwise and wasteful methods of prosecuting these industries, most of these animal resources have been reduced nearly to commercial extinction. There is a strong belief in the possibility of securing the

restoration and perpetuation of many of these useful animals. The Congress recommended that the Pacific nations concerned should make a thorough scientific investigation into the present condition, and should obtain such governmental measures as are necessary for the protection and restoration of the depleted herds and species. The Congress also urged the necessity for the establishment of marine biological stations in such parts of the Pacific coasts as do not already possess them.

As regards the resolutions submitted by the different sections, it was decided that approval of any of these resolutions by the whole Congress should mean approval only of the principle implied, and that the precise wording and the action to be taken in regard to the resolutions should be left to the executive committee of the Australian National Research Council.

### The French Physical Society's Exhibition.

INTENDED to commemorate the fiftieth anniversary of the Société Française de Physique, the "Exposition de Physique et de T.S.F." was held in the Grand Palais, Paris, on November 30–December 24. The title chosen for the Exhibition was perhaps a little too modest, a large part of the Exhibition being, in fact, devoted to industries, in the development of which applied physics has played an important rôle. In addition to the purely commercial exhibits, a well-organised experimental physics section enabled the visitor to become acquainted with some of the problems to which research is now directed. Every afternoon demonstrations were given by eminent physicists and a number of college graduates. Amongst a very large number of exhibits, spread over the entire floor and galleries of the Grand Palais, the following may be mentioned:

*Historical Section.*—An interesting collection of apparatus from various museums, including Fresnel mirror (1788–1827), Jamin circle (1818–1886), Van Marum's friction machine (1797), Ampère's table (1822), Masson's induction coil (1842), Branly's coherer (1890), Turpain's resonator for Morse reception of wireless signals (1894) and recorder (1911), Ferrié's electrolytic detector (1900), Lee de Forest's triodes (1907), Bellini's radiogoniometer (1909).

*Experimental Physics Section.*—Apparatus for counting  $\alpha$ -particles (Laboratoire Curie), Observation of Brownian movement in smoke (de Broglie), "Cellular tourbillons" (Bénard), piezo-electric apparatus for measuring the energy in sound waves in absolute units (Langevin et Ishimoto), apparatus for measuring speed of combustion of explosive powders (de Watterville), electrical deposition of dust, smoke, etc. (Société de Purification Industrielle des Gaz), apparatus showing dilatation and contraction of gelatinous substances due to the passage of an electric current and, inversely, the production of a current by mechanical deformation of the substance (Michaud), electrometer for measuring high potentials utilising the displacement of a liquid dielectric (Michaud), auto-excitation of a 3-phase squirrel-cage motor by the use of condensers (Soulier), remarkable insulating properties of "acroleine" (Moureu), high-power amplifying relay for continuous and low-frequency alternating currents, using stator and rotor windings of a high-speed dynamo (Monnier), differential manometric method for the dosage of carbon dioxide in flue gases (Picard and Laurent), cathode-ray oscillograph (Dufour), molecular vacuum pump (Holweck), dismountable triodes (Holweck), chronometric motor driven mechanically by electrically-maintained tuning fork (Lepaute).

The exhibits of the Bureau International des Poids

et Mesures and the Conservatoire des Arts et Métiers were somewhat disappointing. The former showed a number of standards, including a set of étalons for the absolute measurement of wave-lengths, the latter a small collection of testing appliances. Other state and private testing and research laboratories represented were: Section technique de l'Artillerie (a large and interesting display of instruments), Radiotélégraphie Militaire (wireless installations in tanks, etc.), Service Géographique de l'Armée (examples of map production, geodetic station, surveying instruments), Service de Santé (manufacture of clinical thermometers for army use), Ministère de la Marine (aerial photography for coastal surveys, navigational and signalling instruments), Postes et Télégraphes (Baudot apparatus, automatic wireless, etc.), Observatoire d'Astronomie Physique de Meudon (astronomical photographs), Office National des Inventions (high-frequency furnace, production of photographic portraits in relief, stereoscopic projection apparatus), Laboratoire Central d'Électricité (Blondel-pattern spherical lumen-meter, absolute electro-dynamometer, standard mercury ohm, cadmium cells), Office Central de Chauffage Rationnelle (examples of heat balances, statistics and information relating to heat-economy courses for engineers, works' foremen, etc.), Société Française de Photographie (various testing equipment), Société de Recherches et Perfectionnements Industriels (automatic weighing machines).

*Telegraphy and Telephony.*—As might be expected, the domestic wireless industry was strongly represented, and a very large choice of excellent receiving sets proved that a host of French manufacturers and amateurs are taking full advantage of their freedom from government restrictions. The Cie. "Radio-France" showed models of the high-power transcontinental stations at Sainte-Assise and Villecresnes. Other interesting exhibits were:—Établissement Éd. Belin: telegraphic transmission of photos, drawings, manuscripts, etc., a public service for which is being given a trial in France from January 1; "L'Infra-rouge" (Procédés Charbonneau): infra-red transmitters and receivers for secret signalling, landing of aircraft in fogs, etc.; Société de Condensation et d'Application Mécaniques: location of submarine objects by "ultra-sound" waves (Langevin-Chilowsky system); Cie. Générale d'Entreprises Électriques: system (full size) of 150,000-volt transmission system (as installed in connexion with the electrification of the Midi railway and in other parts of France)—the line insulators were supported by girder masts 72 feet high and the lines connected to a battery of distance-operated oil-tank switches, each capable of dealing



normally with 750,000 K.V.A.; Société Alsacienne de Constructions Mécaniques: high-frequency alternators for wireless transmission (32,400 periods/second, 6000 R.P.M.); Ateliers Carpentier: measuring instruments; Szilard: extra-sensitive electrometers for radio-activity and ultra-violet measurements; Étab. Gaiffe-Gallot and Pilon: Dauvillier's absolute dosimeter for X-ray therapy, etc.

*Optics.*—Jobin and Yvon: flint, quartz, and fluor-spar spectrographs, Fabry-Buisson microphotometer, Yvon spectrophotometer; Beaudouin: Féry spectrographs; Prin: automatically-controlled meridian instrument with 190 mm. telescope and circles 1 metre diameter; Optique et Précision de Levallois: stereoscopic range-finder for anti-aircraft use, range-finders for survey and military purposes, speed recorder for aircraft, photo "machine-gun"; Société d'Optique et de Mécanique: range-finders, surveying instruments, seismograph; interesting exhibits of different light-sources, optics and automatic appliances for lighthouses, searchlights, etc., were shown by the Service des Phares and by the manufacturers Barbier, Bénard, and Turenne, Sautter-Harlé, and the Cie. Générale d'Acétylène.

*Photography and Cinematography.*—In the section devoted to photography and cinematography, Messrs. Pathé-Cinéma, the Établissements Gaumont, and others, exhibited their latest models of cameras and projectors. Other exhibits were: apparatus for 3-colour cinematography and for vocal synchronisation, micro-photographs in colours of sections of wood for musical instruments, showing degree of ageing.

*Metallurgy.*—A fully-equipped metallurgical laboratory formed an interesting collective exhibit. Among the exhibitors were: S.A. de Commentry-Fourhambault: invar, elinvar, and other special alloys and their applications, Chevenard's recording dilatometer for the rapid determination of critical points. An instructive set of experiments illustrating the anomalous properties of certain alloys included a "thermo-elastic oscillator," showing the effect of temperature in increasing the elasticity of the alloy "modulvar," a "thermo-magnetic wheel" made of the alloy "N.M.H.G." which becomes a magnetic at 30° C.; Jacob Holtzer: special magnetic steels; Acieries et Forges de Firminy: electrolytic iron. Progress in electro-metallurgy and in the electro-chemical industries was illustrated by an historical display of furnaces and products by the Comité Électro-Métallurgique de France and other firms. Resistance and arc furnaces of industrial dimensions were shown in operation. Samples of electrically-welded apparatus in steel, aluminium, and other metals were also exhibited.

*Glass and Ceramic Industries.*—These industries were well represented. Parra Mantois and the Manufacture de St.-Gobain showed a large assortment of optical glass in various forms. Demonstrations of heat-resisting domestic glassware attracted large crowds. The firm of "Quartz et Silice" exhibited chemical apparatus, insulators, lamps, etc., in fused silica.

The Exhibition, which was visited by the President of the Republic and by many high officials, was a great success, and its educational value was appreciated by a large section of the general public. The authorities are to be congratulated on the artistic decorative effects, and especially on the pleasing uniformity of the name-signs. With a very few exceptions, the exhibits were of French manufacture, and one was struck by the vast progress made in recent years in the manufacture of many commodities which were previously imported from Great Britain and other countries. It would be interesting to know to what extent this industrial development has been assisted by the depreciation of the franc.

## University and Educational Intelligence.

BRISTOL.—Dr. J. A. Hanley has been appointed as Agricultural Information Officer. Dr. Hanley has been a member of the staff of the University of Leeds since 1915, and is lecturer in agricultural chemistry and advisory chemist in that University.

A Joint Extension Board for the University of Bristol and the University Colleges of Southampton and Exeter has recently been set up which will undertake the arrangement of Extension Lectures over the whole of the south-western counties. The first representatives of the University on the Board are the Vice-Chancellor and the Director of Extra-Mural Studies (Mr. Hubert Phillips).

CAMBRIDGE.—Dr. C. E. Tilley, Emmanuel College, has been appointed demonstrator in petrology. The John Bernard Seely prize has been awarded to A. E. W. Nutt, Gonville and Caius College, for an essay on "Aviation and Commerce."

EDINBURGH.—At the request of the London and North-Eastern Railway, the University has resolved to institute courses of lectures, for the managing and clerical staff of railways, in law, geography, and economics, with special reference to railway requirements, and in railway operating. A course of lectures will be delivered in each of four successive years. The first course of twenty lectures on railway law will begin on January 7.

LONDON.—Prof. G. B. Jeffery, at present professor of mathematics at King's College, has been appointed to the Astor chair of mathematics tenable at University College.

Miss Eleanor M. Scarborough has been appointed to the recently instituted readership in pharmacology tenable at the London School of Medicine for Women. Miss Scarborough was appointed demonstrator in pharmacology at the London School of Medicine for Women in 1919, and since 1921 has been assistant lecturer in that subject at the School.

The degree of D.Lit. has been conferred on Mr. Morris Ginsberg (University College) for a thesis entitled "The Psychology of Society."

Prof. Hugh MacLean has been awarded the William Julius Mickle fellowship (of the value of 200l.) for 1924 in respect of the work which he has carried out during the past five years in experimental medicine. This fellowship is awarded annually by the Senate, under the terms of the Mickle bequest, to the man or woman who, being resident in London and a graduate of the University, has done most to advance medical art or science within the preceding five years and has therein shown conspicuous merit.

Mr. Harold Cloughton has been appointed Financial Officer and Secretary to the Senate as from January 1, 1924. He was educated at Radley and at Trinity College, Oxford, graduating with honours in modern history.

DR. J. N. GREENWOOD, of Stocksbridge, near Sheffield, has been appointed to the chair of metallurgy in the University of Melbourne.

THE *Times* of December 28 reports that a fire on December 26 at the Imperial University at Fukuoka, South-Western Japan, destroyed the entire building and the Engineering College. The damage is estimated at 500,000l.



## Societies and Academies.

LONDON.

**British Mycological Society**, November 17.—Mr. F. T. Brooks, vice-president, in the chair.—A. A. Pearson: An account of the fungus foray of the Société Mycologique de France.—W. J. Dowson: A mould causing a disease of sweet-pea. The mould causes a white mealy growth, in some cases covering both sides of the leaf. No damage apparently is caused under ordinary climatic conditions, but in warm moist temperatures there is considerable effect: spots develop in ten days after infection, and produce spores in about a week. The fungus simulates a white form of *Homodendrum cladosporioides*.—J. Jackson Clarke: Some mycological chromidia. A comparison of nuclear phenomena observed in *Synchytrium* and its allies with those of *Molluscum contagium* and other human diseases.—R. Paulson: Field observations on mycorrhiza. Fungus-roots occur most frequently at a depth of one to three inches below the surface of masses of decaying leaves or under moss. In the birch, most of the roots become infected within the first few weeks. The seed while still on the tree frequently has fungal hyphæ between the persistent styles. These are carried down by hook-shaped processes on the hypocotyl. What part is played by this fungus (*Sporotrichum*) in mycorrhiza formation is as yet uncertain.—E. C. Stakman: The rust problem in America. An extempore account of the damage caused to cereals by rust, and the methods being used to overcome the disease.—A. S. Horne and G. N. Jones: A new species of *Eidamia*. The species differs from *E. acremonioides* morphologically in its tuberculate macrospores and physiologically in its ability to hydrolyse starch, invert sugar, etc. The authors prove the identity of *Monopodium uedopsis* and *E. acremonioides*.—R. Bracher: Notes on *Rhytisma acerinum* and *R. Pseudoplatani*. Infection takes place from an ascospore germ tube penetrating a stoma on the lower surface. The mycelium ramifies in the palisade layer, but finally concentrates in the upper epidermal cells, subsequent development occurring in these cells and killing them, the walls being ruptured and pushed apart. Black sclerotium formation is first apparent in the thickened outer walls of the upper epidermal cells, and is later increased by the formation of an inferior plectenchymatous layer. Splitting of the apothecia is accompanied by the development of a special mechanism whereby the sclerotium is broken down by hyphal secretion in the region of the split.

**Optical Society**, December 13.—T. Smith: The primary and secondary constant magnification surfaces of thin lenses. From theoretical considerations, the surfaces of constant magnification on which the primary and secondary focal lines for a thin lens are situated form families of similar surfaces, and lie between easily constructed surfaces (spheres for the secondary surfaces) determined by the power of the lens together with the Petzval sum for the one limit and the sum of the lens curvatures for the other.—W. Swaine: A suggested standard trial case and simplification in ophthalmic policy. Plano-form trial lenses were suggested in a previous paper to supersede the existing symmetrical form. A standard trial case is described with specified thicknesses, diameters, tolerances, etc., which would introduce minimum confusion—actually none—in practice, would materially help both refractionist and manufacturer, and would remove the uncertainty between them.—B. K. Johnson: Optical revolution counter. The instrument, which can be used without being in actual contact

with the object the speed of rotation of which is being measured, contains a reversing prism which when rotated through  $180^\circ$  rotates the image of the object through  $360^\circ$  in the same direction. If a rotating object be viewed through the prism when the latter is also revolving, the object appears stationary when the prism is rotating at half the speed of the object. When two such prisms are mounted on the same axis and made to rotate in opposite directions, the prisms need only rotate at one quarter of the speed of the object to make it appear stationary.

**Linnean Society**, December 13.—Dr. A. B. Rendle, president, in the chair.—R. D'O. Good: The germination of *Hippuris vulgaris*, Linn. Seedlings were raised from fruits taken from the gizzards of wild duck shot in Scotland. The lengthening of the hypocotyl pushes the hard plug out of the foramen of the endocarp. The hypocotyl then turns towards the mud, and produces a ring of root hairs near its tip. Beyond these hairs the radicle is developed and grows straight down into the mud. Meanwhile the hypocotyl has become erect. The ring of root hairs seems to provide a stable base from which the straightening of the hypocotyl can take place. Passage through the alimentary canal of a bird does not appear to be a necessary preliminary to germination.—H. G. Jackson: A new terrestrial Isopod from Zululand.—C. C. A. Monro: A new Polychæte worm, *Mercierella enigmatica* Fauvel. The worm is a brackish water Serpulid from the London Docks. Specimens have also been obtained by Prof. Fauvel from the brackish water of a canal near Caen. Their habit of growing upon floating timber makes it probable that they were imported into Great Britain on the hulls of ships. They now appear to be spreading on both sides of the English Channel.—S. Hirst: Arachnida from the Rhynie Chert. Among these arachnid remains is one species of mites (Acari), one species doubtfully referred to the spiders (Araneæ), and five species belonging to two genera of Anthracomarti. Of the Anthracomarti, which are ancestral to the Pedipalpi (whip-scorpions and their allies), and the Opiliones (harvest-spiders), several genera and species have been described from British Coal-Measures. Their Devonian representatives are much smaller and are distinguished by two small caudal segments, clearly the degenerate remains of a once larger tail. Mites were previously unknown before Tertiary times. The occurrence of Anthracomarti suggests that the evolution of Arachnida from the primitive Arthropod stock may have begun in Silurian times.—F. A. Bather: Binary and binominal nomenclature.

**Physical Society**, December 14.—Dr. Alexander Russell in the chair.—L. F. Richardson: The aerodynamic resistance of spheres shot upward to measure the wind. The resistance of the air to accurate steel spheres has been measured by two new methods: (1) by observing the tilt from the vertical at which the sphere must be projected in order that a measured wind-distribution may bring it back to the gun; and (2) by comparing the muzzle velocity with the time of flight of the sphere.—E. A. Owen and G. D. Preston: The X-ray analysis of zinc-copper alloys. The zinc-copper system crystallises on a rhombohedral hexagonal lattice from copper to  $\gamma$  brass, and on a close-packed hexagonal system from  $\epsilon$  (or possibly  $\delta$ ) brass to zinc. The observed parameter of the lattice of  $\epsilon$  brass suggests that the copper atom causes the zinc atom to rotate about an axis perpendicular to a 1120 plane, until the zinc atoms in successive 0001 planes are separated by a distance equal to the side



of the lattice of pure zinc. Fusion would then take place at about the same temperature in both cases. The hardness of the brasses attains a maximum in the region of  $\gamma$  brass, where the atomic volume curve shows the greatest departure from the straight line joining the atomic volumes of copper and zinc. The hardness of the  $\alpha$  phase is ascribed to local distortion and that of the  $\beta$  phase to the difference in type of lattice. The relatively very great hardness of  $\gamma$  brass is due to small atomic volume and loss of symmetry. The fact that the atomic volume curve consists of two straight lines suggests the existence of an allotrope of zinc with an atomic volume of  $13.92 \text{ \AA}^3$ . The  $\beta$  phase may be due to an allotropic modification of copper, with an atomic volume of  $12.79 \text{ \AA}^3$ .—K. R. Brain: Investigations of piezo-electric effects with dielectrics. The dielectrics examined were ebonite, glass, hornoid, sealing-wax, rubber, celluloid, and hard paraffin. With sensitive specimens the magnitude of the charge is of the same order as that found by Curie with crystals. Fatigue and hysteresis effects were established. Experiments on cubes showed a dissymmetry in results, suggesting an irregularity of structure. The general similarity of the behaviour of these dielectrics to that of crystals suggests that they possess a quasi-crystalline character, and the effects are explained on this assumption, which has been verified by X-ray photographs.

**The Faraday Society**, December 17.—Sir R. Robertson, president, in the chair.—W. H. Vernon: First Report to the Atmospheric Corrosion Research Committee of the British Non-Ferrous Metals Research Association. In the main, tarnishing as distinct from corrosion in the ordinary sense is dealt with. Specimens have been exposed to representative atmospheres, including open-air conditions (at South Kensington), together with several "indoor" types. Apart from visual (and microscopical) examination, the study of tarnish films has been conducted in two principal ways: (1) by measuring the loss in reflectivity of the metal surface; (2) by measurement of the increase in weight of the specimen. The former method gives quantitative expression to the relative behaviour of materials in the very early stages. Weight-increment and period of exposure give three types of curve, each corresponding with a definite function of the corrosion product: (1) a parabola about the time-axis (*e.g.* copper, within a wide range of humidity conditions); (2) a straight line (*e.g.* zinc, in an unsaturated atmosphere); (3) a parabola about the weight-axis (*e.g.* iron, in an atmosphere of relatively high humidity, intermittently reaching saturation). Thus, the rate of attack is, respectively, (1) retarded, (2) maintained constant, (3) accelerated, as the period of exposure increases. The tarnishing of copper in an ordinary (polluted) atmosphere appears to be due directly to the presence of gaseous sulphur compounds, the presence of solid or liquid particles having relatively little influence; with zinc, or iron, however, the converse obtains. With copper, the rate of tarnishing appears to be retarded slightly as saturation is approached; with zinc and iron it is accelerated considerably. The tarnishing of brightly-polished silver, under certain conditions (*e.g.* the atmosphere of a domestic kitchen), appears to be largely inhibited by alloying with copper (as in sterling silver); this effect is not observed upon emiered surfaces. The characteristic "filming" or "fogging" of nickel surfaces occurs when the temperature falls within the vicinity of, but still appreciably above, the dew-point; when once formed, the film is extremely persistent. At temperatures sufficiently far removed from the dew-

point to prevent "fogging" with nickel-copper alloys, ordinary tarnishing occurs approximately in proportion to the copper content.

**Aristotelian Society**, December 17.—Prof. T. P. Nunn, president, in the chair.—R. G. Collingwood: Sensation and thought. Sensation and thought are not two distinct cognitive activities each with a scientific object of its own—whether separable or inseparable—but correlative aspects of a single activity with a single object. This object cannot, either really or ideally, be divided into a *sensum* and an *intellectum*. The sense datum and the universal taken as real are philosophical errors. The activities of sensing and thinking, regarded as two modes of cognition by which we apprehend two kinds of objects, are as non-existent as the objects themselves. Of all knowledge we can say two things: that it is immediate and that it is mediate. There is a sense in which all knowledge is just a subject's immediate and intuitive apprehension of an object; but knowledge is never only this—it is always also mediated by reflection and reasoning. Philosophies of abstract change omit the immediacy; philosophies of static contemplation omit the mediation. The *what* and the *that* of knowledge are, both in reality and in thought, inseparable but distinct: opposites, like the convex and the concave of the curve, of which each determines the other and is determined by it.

**Royal Statistical Society**, December 18.—Harald Faber: Agricultural production in Denmark, 1909-13 and 1922. The comparison between British and German agriculture during the five years preceding the war, made by Sir T. H. Middleton and published by the Board of Agriculture in 1916, is extended to Danish agriculture. While the British farmer fed 45 to 50 persons on 100 acres, and the German farmer 70 to 75 persons, the Danish farmer fed 45 to 52. The reason for the low Danish figure was the large extent of animal produce, of which a large proportion is exported. Over 88 per cent. of Denmark's total exports, by value, were agricultural produce, and nearly 40 per cent. was exported. Converted into calories, the total agricultural production of Denmark yielded enough for the requirements of her own population, and of an additional population corresponding to 40 to 60 per cent. of her population. But this production consisted so largely of animal produce that by itself it would be unsuitable for human consumption. When corn, potatoes, milk, etc., are fed to live stock in order to produce food for man, there is a very large reduction in the number of calories, and the same applies to dairy produce. The number of persons fed per 100 acres is no measure of agricultural efficiency. Danish agriculture can, in times of enforced isolation, easily curtail the animal production and thereby produce food enough for a considerably greater number of persons. Denmark imported a quantity of corn and feeding stuffs corresponding to a little more than one-fifth of her own harvest. About 15 per cent. of the food of Danish cattle and about 27 per cent. of the food of pigs and poultry consisted of imported foodstuffs.

**Royal Meteorological Society**, December 19.—Dr. C. Chree, president, in the chair.—W. H. Pick and S. P. Peters: A note on the vertical visibility (estimated looking downwards) at Cranwell, Lincolnshire, during the period February 1922 to June 1923. The vertical visibilities as estimated by aeroplane pilots looking downwards from a height of 2000 feet are compared with other meteorological factors prevailing at the time. For at least seven of the fifteen types of Gold's classification, the vertical



visibility bears a definite relationship to the pressure type. The most outstanding feature resulting from an investigation of the distribution of vertical visibility with regard to wind direction is the predominance of "excellent or good" vertical visibility with surface winds blowing from between east by north and east-south-east. Surface wind velocity appears to be unrelated to the degree of vertical visibility. At 2000 feet the greater the wind velocity, the poorer the visibility. In general the vertical visibility appears to decrease progressively with increasing low cloud amount, and the presence of surface convection currents is accompanied by good vertical visibility. The relationship between vertical and ground horizontal visibility is slight.—H. Jeffreys: The cause of cyclones. The fixed cyclone of continental dimensions that produces the monsoons can be explained as a steady motion under the influence of a variation of temperature over horizontal surfaces. Instability convection may explain thunderstorms. A millpond eddy theory may explain tropical cyclones. Waves in the polar front are likely to have a wavelength comparable with that shown in cirro-cumulus clouds, but not that of cyclones. The mixing of air from the two sides of the polar front, however, must produce air with a tendency to rise, and it is possible that such air may provide the mechanism of the cyclones of temperate regions.—A. W. Lee: The relation of the circulation in the upper air to a circumpolar vortex. The circulation of the upper air in the region between 30° N. and 70° N., as determined from the isobars at 4, 6, and 8 km., is approximately the motion of a series of  $V/r$  vortices. It appears that each layer is an aerosphere which rotates around the polar axis as a solid, but on ascent there is relative motion between consecutive aerospheres; the velocity of the aerospheres in different latitudes is shown by a series of curves. The circulations which must be superimposed upon solid rotation at 4 km. in July in order to give the observed distribution of pressure are obtained.

## PARIS.

Academy of Sciences, December 3.—M. Albin Haller in the chair.—Paul Appell: Definite integrals connected with the constant  $C$  of Euler.—Louis Gentil: Overlapping strata of north-west Africa.—A. Blondel: The use of flywheels in electric generators and the dangers of resonance of the shafts of the internal combustion motors which drive them.—C. Guichard: Some properties of the traces of the asymptotic tangents to a surface in a fixed plane.—C. Camichel and L. Escande: Similitude. A study of various cases of similitude in hydraulics. Similitude, as expressed by Froude's law, was verified in the cases examined.—J. B. Senderens: The catalytic dehydration of the aromatic alcohols. A description of the hydrocarbons produced by the catalytic action of sulphuric acid ( $H_2SO_4 + 3H_2O$ ) upon cyclohexanol and the three cyclohexanediols.—Léon Pomey: The last theorem of Fermat.—Nikola Obrechhoff: The development in series of a system of analytical functions.—Miécislas Biernacki: A new algebraical theorem.—Mlle. Nina Bary: The unicity of trigonometrical development.—David Wolkowitsch: The infinitely small movements at a point of an elastic body in space.—R. Risser: The oscillations in the neighbourhood of the place of immersion of a solid in the case of waves by immersion in an indefinite medium.—M. Delanghe: A graphical method for the adaptation of helices to aeroplanes.—F. Baldet: Comparison of the various radiations emitted by the nuclei of comets, and of still unknown origin, with the spectrum of the Mecker burner. The wave

lengths of the lines in the spectrum of comets are tabulated side by side with those observed in the spectrum of the Mecker burner, and the close analogy between the two is pointed out.—E. M. Lémeray: The sidereal universe and the theory of relativity.—E. Brylinski: The precision of Michelson's experiment. It is shown that in this experiment the displacement of the fringes may vary with the geographical position of the observer, and with the date and time of the experiment.—Edmond Bauer, Pierre Auger, and Francis Perrin: The theory of the diffusion of X-rays. An alternative proof of the results of Compton.—H. Chipart: The theories of natural rotatory polarisation.—Mlle. St. Maracineanu: Researches on the penetration of radioactive substances in metals. An account of experiments on polonium and actinium supported on thin sheets of gold, lead, and glass. Variations in the constant for polonium might be attributed to phenomena of penetration of the metal: when discs of glass were used, no penetration was observed for polonium nor for actinium. Hence for the determinations of the constants of radioactive deposits, glass is preferable to metal.—M. Chavastelon: The diffusion of the vapour of sulphur in air at the ordinary temperature.—A. Vila: The estimation of small quantities of molybdenum. The application of ammonium phosphomolybdate for the indirect titration of phosphorus. The ammonium phosphomolybdate is reduced by hydrogen at 700° C., dissolved in a solution of molybdic acid in phosphoric acid, and the blue solution titrated with  $N/400$  potassium permanganate until colourless. Quantities of the order 0.01 milligram of phosphorus can be determined.—A. Gascard and G. Damoy: The acids of beeswax. Four acids have been isolated, neocerotic ( $C_{25}H_{50}O_2$ ), cerotic ( $C_{27}H_{54}O_2$ ), montaric ( $C_{29}H_{58}O_2$ ), and melissic ( $C_{31}H_{62}O_2$ ). The existence of these four acids with odd numbers of carbon atoms is in contradiction with the general view as regards the number of carbon atoms in the natural fatty acids.—Marcel Godchot: Some syntheses of dibasic acids of ether-oxide function. An account of the preparation of  $aa'$ -diphenyldiglycolic acid,  $C_6H_5 \cdot CH(CO_2H) \cdot O \cdot CH(CO_2H) \cdot C_6H_5$ ,  $\alpha$ -methyl- $\alpha'$ -phenyldiglycolic acid, and  $\alpha$ -phenyldiglycolic acid.—C. Gaudetroy: The variations in the dispersion of double refraction in the same crystal.—M. E. Denaeyer: The rocks of Aïr (Central Sahara).—P. Lasareff: The anomalies of terrestrial magnetism and of gravity in the province of Koursk (Russia). A study of the magnetic anomalies has led to the conclusion that immense deposits of magnetic oxide of iron ore must be present in this district. The magnetite deposit thus indicated has been found at a depth of about 150 metres: the outcrop is impure and contains only 40 per cent. of iron, but the purity increases with the depth.—René Souèges: The embryogeny of the Salicaceæ. The development of the embryo in *Salix triandra*.—L. Ravaz and G. Verge: The reddening of the vine. This disease can be caused by excess of stagnant water in the soil, and can be remedied by drainage and aeration.—Marcel Baudouin: A new method of prehistoric trepanning with circular or oval openings, cut with flint. A description of a method of making openings in the skull by means of flint with two cutting edges, used like a compass.—H. Cardot: The influence of the cooking of food on the development of *Agriolimax agrestis*. Both in the young and adult slug, at first the cooked food is more favourable, but the formation of the eggs in the adult and of the tissues in the young are hindered by the absence in the cooked food of a factor indispensable to growth.—Jacques Benoit: The histological structure of an organ of testicular nature developed spontaneously in



an ovariectomised hen.—Edouard Chatton: Parasitic peridinians of the Radiolaria.—L. Panisset and J. Verge: Bird diphtheria and contagious epithelioma.

## SYDNEY.

Linnean Society of New South Wales, October 31.—Mr. A. F. Basset Hull, president, in the chair.—P. Esben-Petersen: (1) Australian Neuroptera. Pt. iv. Four genera and eight species of Myrmeleonidae are described as new, and observations made on a number of described species; a list is also given of the species which have been described from Australia. (2) Australian Neuroptera. Pt. v. Observations are made on fourteen species of Mantispidae and a list of the described Australian species.—A. Théry: Note on the genus *Synechocera*, with description of a new species. Only two species of the genus are known—one from Amboina, described in 1801, and the other from Swan River. A third species is here described from Tasmania, larger than *S. elongata* and of different habitat.—John Mitchell: The Strophomenidae from the fossiliferous beds of Bowning, N.S.W. Fifteen species of Stropheodonta from the Bowning Beds (Silurian) are described as new.—R. J. Tillyard: Mesozoic insects of Queensland. No. 10. Summary of Upper Triassic insect fauna of Ipswich, Q. A summary and analysis of the insect fauna of the Ipswich Series, containing, as far as at present described, 122 species belonging to 63 genera. The composition of this fauna indicates that "the age of the Beds was not earlier than the lowest division of the Upper Triassic, and not later than the top of the Upper Triassic; it was most probably a little older than Rhaetic." In an appendix, one genus and one species of Neuroptera and two species of Hemiptera are described as new.—A. A. Lawson: The life-history of *Pherosphaera*. This investigation of the life-history of *Pherosphaera* affords the first knowledge we have of the gametophytes and embryo of this very rare and interesting Australian genus of Conifers. The structures of the male and female gametophytes and the embryo show no features that justify us in classing *Pherosphaera* among the Podocarpaceae.

## Official Publications Received.

- Astrographic Catalogue 1900'0. Sydney Section Dec.  $-51^{\circ}$  to  $-65^{\circ}$ . From Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 3: R.A.  $12^{\text{h}}$  to  $18^{\text{h}}$ , Dec.  $-51^{\circ}$  to  $-53^{\circ}$ . Plate Centres Dec.  $-52^{\circ}$ . Pp. vi+88. Vol. 4: R.A.  $18^{\text{h}}$  to  $24^{\text{h}}$ , Dec.  $-51^{\circ}$  to  $-53^{\circ}$ . Plate Centres Dec.  $-52^{\circ}$ . Pp. 37. (Sydney: Alfred J. Kent.)
- Total Eclipse of the Sun, 1922 September 21, Sydney Observatory. Pp. 13. (Sydney: Alfred J. Kent.)
- The Physical Society of London. Proceedings, Vol. 36, Part 1, December 15. Pp. 66. (London: The Fleetway Press, Ltd.) 6s. net.
- The University of Colorado Studies. Vol. 13, No. 1. Pp. ii+65. (Boulder, Colo.)
- Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1922. Pp. iv+46. (Trinidad.) 6d.
- Ministry of Public Works: Physical Department. The Rains of the Nile Basin and the Nile Flood of 1913. By Dr. H. E. Hurst. (Physical Department Paper No. 12.) Pp. iv+98+8 plates. (Cairo: Government Publications Office.) P.T. 10.
- Transactions of the Royal Society of Edinburgh. Vol. 53, Part 2. No. 22: Geology of the Outer Hebrides. Part 1: The Barra Isles. By Prof. T. J. Jehu and R. M. Craig. Pp. 419-441+4 plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 4s. 6d.
- Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1922. Pp. iii+60. (London: H.M. Stationery Office.) 1s. 6d. net.

## Diary of Societies.

SATURDAY, JANUARY 5.

- ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Crystals—Ice and Snow (Juvenile Lectures (5)).
- GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Sir David Prain: Gilbert White and Moral History.

NO. 2827, VOL. 113]

MONDAY, JANUARY 7.

- VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. M. G. Kyle: The Problem of the Pentateuch from the Standpoint of the Archaeologist.
- MATHEMATICAL ASSOCIATION (at London Day Training College), at 5.30.—Prof. H. H. Turner: Earthquakes.
- BRIISH PSYCHOLOGICAL SOCIETY (Education Section) (at University College), at 5.30.—Dr. J. Glover: Recent Advances in the Relations of Psycho-Analysis to Education.
- INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 6.—J. W. Beauchamp and others: Discussion on Troubles experienced with Domestic Electrical Appliances.
- SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. E. Fyfe: The Estimation of Butyric Acid in Presence of Acetic Acid.—C. E. Barts: The Estimation of Cadmium in Spelter and Zinc Ores.
- INSTITUTION OF RUBBER INDUSTRY (London Section) (at Engineers' Club), at 8.—Dr. S. S. Pickles: Consistency of Rubber and Rubber Compounds.

TUESDAY, JANUARY 8.

- MATHEMATICAL ASSOCIATION (at London Day Training College), at 10 A.M.—W. C. Fletcher: Mathematics and English.—W. Hope-Jones: A Plea for Teaching Probability in Schools.—A. W. Lucey: Exhibition of a Surveying Instrument, and explanation of its use in connexion with practical work in Trigonometry.—At 2.30.—Sir Thomas L. Heath: Presidential Address.—Discussion on the Report on the Teaching of Geometry.—G. Goodwill: Euclid and his Successors: Some Contusion and a Way out.—Prof. C. Godfrey: Construction in Geometry. What is legitimate?
- ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Crystals—Metals (Juvenile Lectures (6)).
- ROYAL SOCIETY OF MEDICINE (Medicine, Pathology, Therapeutics and Pharmacology Sections), at 4.30.—Sir Almoth Wright, Sir Thomas Horder, and others: Joint Discussion on The Uses and Limits of Vaccine Therapy.
- ASSOCIATION OF TEACHERS OF DOMESTIC SUBJECTS (at University College), at 5.30.—Sir Henry Gouvan: Light and Life.
- INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—J. Kewley: The Crude Oil of Sarawak.—Dr. A. E. Dunstan: The Crude Oil of Maidan-i-Naftun.
- INSTITUTION OF CIVIL ENGINEERS, at 6.—H. T. Tudsbery and A. R. Gibbs: An Account of an Examination of the Menai Suspension Bridge.
- INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—R. G. Reid: Modern Refrigerating Machines.
- ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—G. A. Clarke: A Note upon the Upper Cloud in Advance of the Depression of August 28-30, 1923.—H. M. Cartwright and others: Discussion on A Consideration of some Problems concerning the Measurement of Photographic Density.—W. J. G. Farrer: Exhibition of an apparatus for testing the Ultra-violet Transmission of Colour Filters.
- QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. Cuzner: The Respiration of Aquatic Organisms.
- ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Eoliths found *in situ* at South Ash.—De Barri Crawshaw: Azilian-Tardenoisian Flint Industry in Mesopotamia.
- RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—Dr. J. A. Crowthor: Studies in X-ray Production.—H. Moore: The Quality of the X-rays excited in hot cathode and in "gas" tubes by various types of generators of High-tension Current.

WEDNESDAY, JANUARY 9.

- ROYAL SOCIETY OF ARTS, at 3.—Prof. W. A. Bone: Fire and Explosions (Dr. Mann Juvenile Lectures (2)).
- GEOLOGICAL SOCIETY, at 5.30.—Prof. S. H. Reynolds and Dr. E. Greenly: The Geological Structure of the Clevedon-Portishead Area (Somerset).—Dr. F. S. Wallis: The Avonian of the Tytherington-Tortworth-Wickwar Ridge (Gloucestershire).—Miss Agnes E. Bamber: The Avonian of the Western Mendips, from the Cheddar-Valley Railway to the Sea, West of Brean Down.
- INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—J. M. Moncrieff: The Work of a Constructional Engineer's Office.
- INSTITUTION OF HEATING AND VENTILATING ENGINEERS, INC. (at Engineers' Club, Coventry Street), at 7.—T. Lindsay: A New Universal Regulator for the Control of Temperature, Pressure, Humidity, etc.

THURSDAY, JANUARY 10.

- LINNEAN SOCIETY, at 5.—A. J. Wilmott: Some further Additions to the British Flora.—Mrs. Henshaw: Plant Life in British Columbia.—R. H. Burne: Exhibition of Specimens of the Carotid Arteries of Lamna and other Sharks.
- ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Dr. Aitchison and Mr. North: Materials from the Aeronautical Point of View.
- INSTITUTION OF ELECTRICAL ENGINEERS AND THE SOCIÉTÉ DES INGENIEURS CIVILS DE FRANCE (British Section) (in the Lecture Theatre of the Institution), at 6.—Continuation of discussion on A. Bachelery's paper on the Electrification of the Midi Railway.
- INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers, Inc.), at 8.—W. T. Griffiths: X-rays and Metallurgy.

FRIDAY, JANUARY 11.

- ROYAL ASTRONOMICAL SOCIETY, at 5.
- MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.
- INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.
- JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. O. Mourant: Concrete Engineering.

PUBLIC LECTURE.

SATURDAY, JANUARY 12.

- BIRKBECK COLLEGE, at 5.30.—Dr. F. H. Hayward: Homage Celebration of Leonardo da Vinci.