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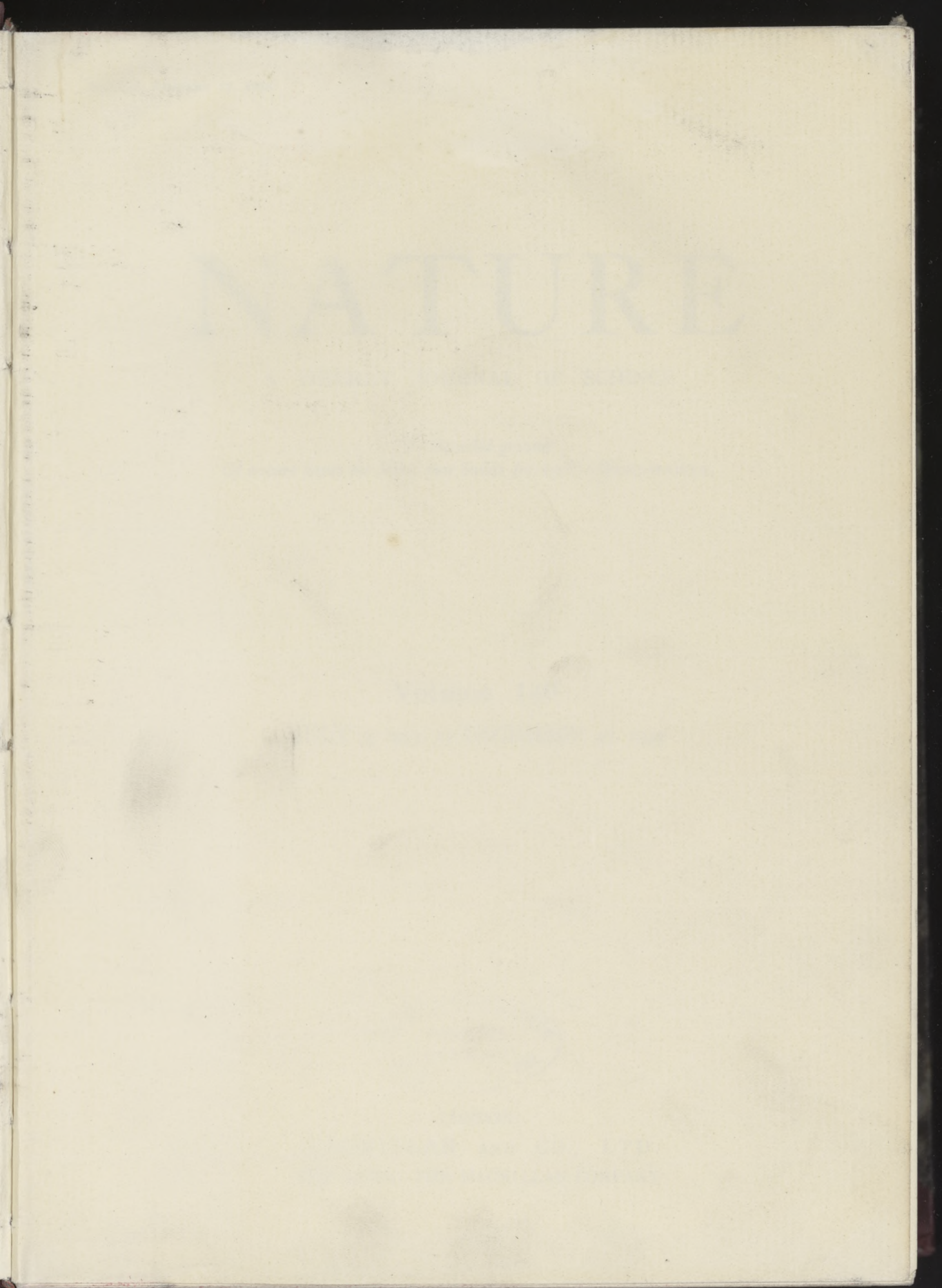
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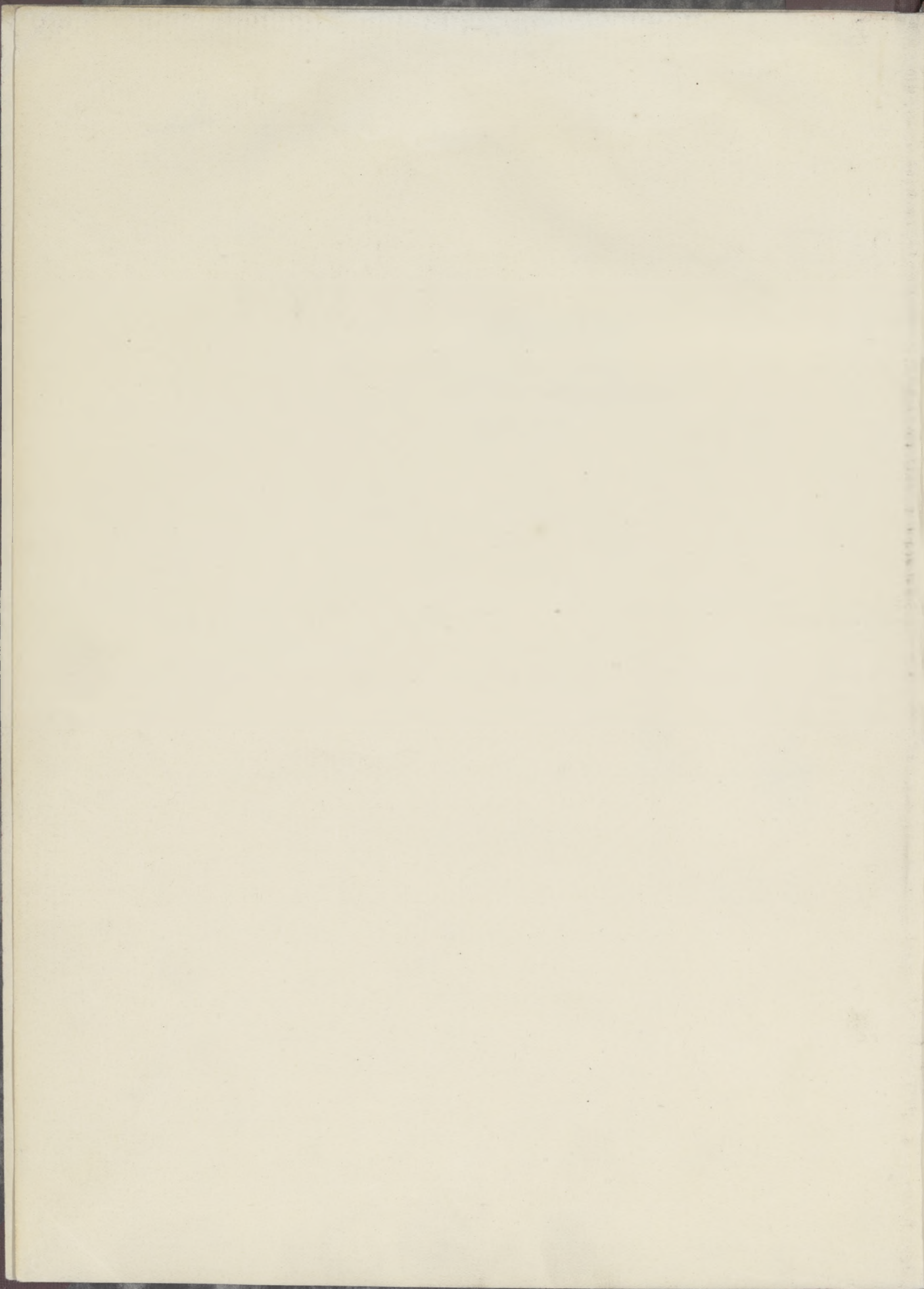
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*"To the solid ground
Of nature trusts the Mind that builds for aye."*—WORDSWORTH.

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INDEX

NAME INDEX

- Abelson (P.), [S. F. Cook, K. G. Scott and], Deposition of Radio-phosphorus in Tissues of Growing Chicks, 944
- Abercrombie (M.), elected a junior research fellow in zoology at Queen's College, Oxford University, 38
- Abraham (E. P.), elected to a taberdarship in chemistry at Queen's College, Oxford University, 38; and Prof. R. Robinson, Crystallization of Lysozyme, 24
- Abraham (W. E. V.), Geological Aspects of Deep Drilling Problems, 73
- Adam (Miss M. G.), appointed assistant tutor in science at St. Hugh's College, Oxford, 38
- Adam (Flight-Lieut. M. J.), World's Air Altitude Record, 56
- Adam (Prof. N. K.), Pollution of Sea and Shore by Oil, 100; Use of the Word Substrate, 158
- Adams (Dr. F. D.), awarded the Flavelle medal of the Royal Society of Canada, 287
- Adams (Dr. R.), Inter-racial Marriage in Hawaii (*Review*), 665
- Aebersold (P. C.), [G. N. Snell and], Production of Sterility in Male Mice by Irradiation with Neutrons, 779
- Agar (Prof. W. E.), Cytology of *Lepidosiren*, 931
- Ahier (G.), Christiansen Filters, 477
- Ainsworth (Dr. G. C.), The Plant Diseases of Great Britain: a Bibliography (*Review*), 91
- Airey (Dr. J. R.), [death], 536; [obituary article], 796
- Aitken (A. C.), Studies in Practical Mathematics (2), 124
- Aitken, Allott, Castleden and Walker, Potassium and Paralysis, 367
- Aldersloff (Prof. H.), [death], 455
- Alexander (W.), and J. Swaffield, Magnetostriction, 1068
- Algar (J.), and Isabella P. Carey, Synthesis of Flavonols: Oxidation of Flavindogenides, 292
- Alington (Very Rev. Dr. C. A.), elected president of the University of Durham Philosophical Society, 967
- Allen (Dr. C.), Modern Discoveries in Medical Psychology (*Review*), 343
- Allen (Dr. J. F.), Dr. R. Peierls and M. Zaki Uddin, Heat Conduction in Liquid Helium, 62
- Allibone (Dr. T. E.), and J. M. Meek, Development of the Spark Discharge, 804
- Allmand (Prof. A. J.), appointed Daniell professor of chemistry at King's College, London, 942
- Almqvist (H. J.), Crystals with Vitamin K Potency, 25
- Alty (T.), Sublimation and Condensation of Crystals, 814
- Amat (M.), [J. Duclaux and], Ultra-filters of Carborundum, 656
- Anderson (Dr. G. C.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
- Anderson (Dr. J.), appointed representative of the Scottish Beekeepers' Association on the Bee Research Committee, 274
- Anderson (Dr. J. S.), Structure of Organic Molecular Compounds, 583; Constitution of the Poly-acids, 850
- Anderssen (F. G.), Citrus Manuring, 976
- Andrade (Prof. E. N. da C.), The Mechanism of Nature, being a simple approach to Modern Views on the Structure of Matter and Radiation. Revised edition (*Review*), 260; Lord Rutherford, 753; Interpretations of Atomic Constitution, 894; and R. C. Parker, Absolute Measurements of Sound Intensity, 34
- Angell (J. R.), and others, A History of Psychology in Autobiography. Vol. 3. Edited by C. Murchison (*Review*), 830
- Angström (A.), A Coefficient of Humidity of General Applicability, 160
- Angus (Prof. R. W.), elected an honorary member of the Engineering Institute of Canada, 274
- Anthony (Dr. H.), 'Shiva's Temple', Arizona, 613
- Arakatsu (B.), K. Kimura and Y. Uemura, Expulsion of Neutrons from Lead by Cosmic Rays, 277
- Arbour-Stephens (Dr. G.), Clean Milk and Pasteurization, 614
- Arensberg (Dr. C. M.), The Irish Countryman: An Anthropological Study (*Review*), 299
- Armstrong (A. L.), Rev. N. Jones and H. B. Maufe, Antiquity of Man in Rhodesia, 469
- Armstrong (Dr. E. F.), Tendencies of World Power Development, 706; awarded an honorary associate-ship of the Birmingham Central Technical College, 929
- Armstrong (Prof. H. E.), [death], 97; [obituary article], 140; (late Prof. H. E.), Ammonolaty: the Life Element, 134
- Armstrong (J. M.), Cytology of the genus *Poa*, 368
- Arthur (J. C.), and G. B. Cummins, Rust Fungi of the Philippines, 648
- Ashby (Dr. E.), appointed professor of botany in Sydney University; work of, 883; resignation from Bristol University, 904
- Asmus (Dr. R.), Organische Synthesen (Organic Syntheses) (*Review*), 486
- Astbury (Dr. W. T.), Relation between 'Fibrous' and 'Globular' Proteins, 968; X-Rays and Wool Fibre, 1069
- Aste-Salazar (J. H.), [J. W. Thompson, W. Corwin and], Physiological Patterns and Mental Disturbances, 1062
- Aston (Dr. F. W.), Packing Fractions of Krypton and Xenon, 149; A Second-order Focusing Mass Spectrograph and Isotopic Weights by the Doublet Method, 905
- Atanasiu (M.), Natural Convection in Liquids, 985
- Atkinson (Dr. R. d'E.) appointed chief assistant at the Royal Observatory, Greenwich; work of, 457
- Attems (Dr. C.), Millipedes of India, 72
- Audubert (R.), Ultra-violet Emission Spectrum of the Slow Thermal Dissociation of Silver Nitride, 518
- Auerbach (Dr. C.), [Prof. F. A. E. Crew and], 'Spheroidal': A Mutant in *Drosophila funebris* affecting Egg Size and Shape, and Fecundity, 124; New Mutation in *Drosophila*, 898
- Aufrère (L.), Boucher de Perthes and the Foundations of Prehistoric Archaeology, 261
- Auger (P.), P. Ehrenfest, jun., A. Freon and Mme. Thérèse Grivet, Mechanism of the Production of Cosmic Bundles, 292
- Auger (V.), and Mlle. Nina Ivanoff, Molybdenum Blues, 293
- Augustus, Emperor, Bimillenary of the, 577
- Austin (Lord), conferment upon, of an honorary doctorate by Birmingham University, 80
- Aveling (Prof. F.), Science in Psychology (*Review*), 909
- Ayres (Prof. Q. C.), Soil Erosion and its Control (*Review*), 445
- d'Azambuja (L.), International Co-operation for the Continuous Observation of the Sun, and its First Results, 208

- Ba Thi (M.), T. G. Hunter and A. W. Nash and others, Solvent Dewaxing, 1105
- Baber (T. D. H.), appointed an assistant lecturer in mathematics in Sheffield University, 735
- Bacharach (A. L.), Adsorption Columns (*Review*), 48; Harris's Vitamins in Theory and Practice (*Review*), 302; and H. E. Glynn, Liver Extract and Haemoglobin in Rats, 896; [Dr. B. P. Wiesner and], Effect upon Sex Behaviour of a Diet Deficient in Vitamin E, 972
- Bachelery (A.), Electrification of the Paris-Orléans and Midi Railways, 1025
- Bacsich (Dr. P.), appointed lecturer in embryology in Glasgow University, 654
- Baddar (F. G.), and F. L. Warren, Synthesis of Benzanthrones, 321
- Badenhuizen, jun. (N. P.), [Prof. K. H. Meyer and], Transformation of Hydrate Cellulose into Native Cellulose, 281
- Baden-Powell (Major B. F. S.), [death], 611
- Bachni (C.), Male Inflorescence of *Scyphostegia borneensis*, 737
- Baekeland (Prof. L. H.), conferment upon, of an honorary doctorate by Edinburgh University, 80
- Baens (L.), and F. M. Yenks, Effect of Moulds upon Tanning Liquors, 687
- Baerts (F.), and R. Vandewijer, Alkalinity of the Ash and Loss of Chlorine on Incineration, 943
- Bailey (C. R.), Infra-red Absorption of Carbon Disulphide, 851
- Bailey (Prof. E. B.), Prof. A. Heim, 573
- Bailey (Prof. K. C.), The Retardation of Chemical Reactions (*Review*), 340; Behaviour of Cylinders of Inflammable Gas in a Fire: Extinguishing Flames by Coal Gas, 503; Tritium or Triterium?, 590; and G. T. Taylor, Retardation of Chemical Reactions, 327
- Baily (Prof. F. G.), and others, Universities and Education, 689
- Bake (Dr. A. A.), appointed a senior research fellow of Brasenose College, Oxford, 694
- Baker (Dr. J. R.), Nomenclature of the Seasons, 890
- Balavoine (P.), Variation of the Iodine Value of Drying Oils according to their Origin, 125
- Balchin (W. G. V.), Erosion Surfaces of Cornwall, 326
- Bald (J. G.), Ecology of Tomato 'Spotted Wilt' Virus, 1019; and G. E. Briggs, Aggregation of Virus Particles, 111
- Baldick (K. J.), and F. Lions, Derivatives of 6:7-Dimethoxybenzoparathiazine, 695
- Baltazard (M.), [G. Blanc and], Cross Immunity between the Pustular Fever and Purpura Fever of the Rocky Mountains, 905
- Baly (Prof. E. C. C.), Photosynthesis of Carbohydrates *in vitro*, 930
- Bamford (C. H.), elected a fellow of Trinity College, Cambridge, 735; [Prof. R. G. W. Norrish and], Photodecomposition of Aldehydes and Ketones, 195
- Bangham (Prof. D. H.), S. Mosallam and Z. Saweris, Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces, 237
- Banks (E.), Intoxicants in Sarawak, 936
- Banting (Sir Frederick), Early Work on Insulin, 901
- Barber (A.), [Dr. F. C. Champion and], Production of Positron and Electron Pairs by bombardment of Mercury with β -Particles of Low Energy, 105
- Barclay (A.), Chemistry: A Brief Outline of its History and Development, 232
- Barger (Prof. G.), appointed regius professor of chemistry in Glasgow University, 537, 556; work of, 537
- Barkworth (Capt. H.), and L. W. L. Cole, Acidosis and Off-Flavoured Milk, 324
- Barling (Sir Harry Gilbert), conferment upon, of an honorary doctorate by Birmingham University, 80
- Barnes (Dr. C.), Masses and Parallaxes of Binary Stars, 286
- Baron (J.), and P. Laffitte, Inflammation of Acetaldehyde, 477
- Barrer (R. M.), Nature of the Diffusion Process in Rubber, 106
- Barrett (Sir James), Central (Native) Medical School, Suva, Fiji, 472
- Barrett (Sir William), Personality Survives Death: Messages from. Edited by his wife (*Review*), 1078
- Barrie (H. J.), appointed demonstrator in pathology in Sheffield University, 904
- Barrie (Miss M. M. O.), Vitamin E Deficiency in the Suckling Rat, 426
- Barry (A. M.), appointed a Frank Edward Elmore student in Cambridge University, 123; awarded the E. G. Fearnside's scholarship of Cambridge University, 291
- Barry (D. R.), Changes of Colour by Injection of Pituitary Extracts in a Dogfish (*Scylliorhinus canicula*), 769
- Bartlett (Prof. F. C.), Native Science in Southern Sudan (*Review*), 338
- Bartley (Mary A.), [W. J. Robbins, A. G. Hogan, L. R. Richardson and], Pyrimidine and Thiazole Intermediates as substitutes for Vitamin B, 779; [W. J. Robbins and], Thiazole and the Growth of Excised Tomato Roots, 779
- Barton (H. J.), [H. W. Newton and], Bright Solar Eruptions and Radio Fadings in 1935-36, 688
- von Basch (Samuel Siegfried Karl) (1837-1905); work of, 393
- Bassière (M.), Structure of Cadmium Nitride (Hydrazoate), 125
- Bate (Dorothea M. A.), [Elinor W. Gardner and], The Bone-bearing Beds of Bethlehem: Their Fauna and Industry, 431
- Bateman (Dr. J. B.), International Congress for Short Waves in Physics, Biology and Medicine, Vienna, 372; Mitogenetic Radiation and the Theory of Nerve Excitation (*Review*), 565; Dr. H. Loewenthal and Dr. H. Rosenberg, Alleged Specific Effects of High Frequency Fields on Biological Substances, 1063
- Bates (R. G.), and W. C. Vosburgh, Potential of the Iodine Electrode, 776
- Batten (Miss Jean), awarded the gold medal of the Royal Aero Club, 844
- Bauer (D. J.), elected Michael Foster student in physiology in Cambridge University, 291
- Bauer (P. T.), awarded the Wrenbury scholarship of Cambridge University, 291
- Bauer (S. H.), Structure of Diborane, 552
- Bawden (F. C.), and N. W. Pirie, Crystalline Preparations of Viruses, 1018
- Baxt (L. M.), renewal to, of a Salters' Institute fellowship, 274
- Baxter (A. M.), awarded the Sir William White post-graduate scholarship of the Institution of Naval Architects, 422
- Bayley (D. S.), and H. R. Crane, The β -rays from Lithium and Boron Isotopes, 776
- Beadle (G. W.), and B. Ephrussi, Ovary Transplants in *Drosophila melanogaster*; Meiosis and Crossing-over in Super Females, 779
- Beadle (L. C.), and F. A. Booth, An Inexpensive Low-Temperature Thermostat, 279
- Beadnell (Surgeon Rear-Admiral C. M.), An Inquiry into "Marvels" (*Review*), 87
- Beal (J. M.), Bud Development in *Lilium Harrisii* following Treatment with Indoleacetic Acid, 519
- Beams (Prof. J. W.), [Dr. F. T. Holmes and], Frictional Torque of an Axial Magnetic Suspension, 30
- Beatty (A. Chester), gift to London University for a scholarship in radiology, 778; gift to the Royal Cancer Hospital, 844
- Beaumont (A.), [death], 309; and P. H. Gregory, A Leaf-spot Disease of *Gerbera Jamesoni*, 511
- Bedson (Prof. S. P.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
- Běhounek (Dr. F.), and F. V. Novák, Retention of Radioactive Substances in the body of Rats and the Lethal Dose, 106
- Behrens (Hon. Mrs.), endowment of a Clive Behrens lectureship in Leeds University, 166
- Beischer (D.), and A. Winkel, Size of Particles Responsible for Ferromagnetism, 202
- Belcher (D.), Effect of Viscosity on Ionic Mobilities, 810

- de Belin (G. A.), appointed assistant lecturer and research assistant in the department of metallurgy of Sheffield University, 207
- Bell (Prof. E. T.), Men of Mathematics (*Review*), 525
- Bell (Miss Florence O.), appointed research assistant in textile physics in Leeds University, 942
- Bellingham (L.), A Double Refraction Effect in Certain Fatty Materials, 70
- Beltrán (Prof. J. R.), appointed professor of the history of medicine at Buenos Aires University, 641
- Belz (M. H.), [J. H. Michell and], The Elements of Mathematical Analysis. 2 Vols. (*Review*), 631
- Benjamin (Dr. M.), and R. O. Jenkins, Surface migration of Barium, 152
- Benndorf (H.), and M. Mitlacher, Stationary Air Currents in Closed Vessels, 1112
- Bennett (Miss A.), Plant Ecology of Limestone Pavements, 731
- Benson (Dr. E.), Grammar Schools and Technical Education, 79
- Bentsáth (A.), and Prof. A. Szent-Györgyi, Vitamin P, 426
- Berg (Dr. W. F.), Mechanism of the Photographic Process, 997
- Bergel (Dr. F.), [Dr. A. R. Todd, H. Waldmann, T. S. Work and], Constituents of Vitamin E Concentrates from Rice- and Wheat-Germ Oils, 361
- Bergey (Prof. D. H.), [death], 576
- Bernal (J. D.), appointed professor of physics at Birkbeck College, 904
- Bernard (R.), Spectrum of Nitrogen and Atmospheric Pressure at High Altitudes, 930
- Bernstein (R. E.), Excretion of Vitamin C in Sweat, 684
- Berthelsen (H.), [A. Hjärre and], Method for Fixing Neutral-Red in Supra-Vital Stained Blood Smears, 155
- Bertrand (G.), Presence and Distribution of Boron in the Potash Salts of Alsace, 820
- Bertrand (P.), Comparative Ontogeny of Living and Fossil Phanerogams, 1111
- Best (R. J.), Artificially Prepared Visible Paracrystalline Fibres of Tobacco Mosaic Virus Nucleoprotein, 547
- Bevin (E.), Trades Union Congress and Science, 457
- Bewley (Dr. W. F.), Science in Relation to the Glasshouse Industry, 887
- Beyling (Dr. C.), awarded the medal of the Institution of Mining Engineers, 967
- Bhabha (Dr. H. J.), awarded an 1851 exhibition studentship, 38
- Bhagavantam (Prof. S.), and B. Sundara Rama Rao, Adiabatic and Isothermal Compressibilities of Heavy Water, 1099
- Bhatnagar (Prof. S. S.), Dr. H. Lersheim and Mohan Lal Khanna, The Ground State of the Se_2 Molecule, 152
- Bialinycki-Birula (Dr. A. A.), [death], 97
- Bieling (Prof. R.) and others, Die europäischen und mediterranen Ottern und ihre Gifte: Grundlagen zur Darstellung eines wirksamen Schlangenserums (*Review*), 744
- Bilger (G.), Potential of Polygons and Elementary Geometry, 376
- Bilham (E. G.), Effects of Obstacles on Sunshine Records, 648; Weather and Water Supplies, 964
- Biquard (Dr. P.), The Palace of Discovery at the Paris International Exhibition, 1937, 328
- Birch (A. J.), Detection and Estimation of α -Phellandrene in Essential Oils, 377
- Birch (Prof. de Burgh), [death], 536; [obituary article], 715
- Biswas (K. P.), Aquatic and Marsh Plants of India and Burma, 592
- Bizette (H.), and B. Tsai, Magnetic Rotatory Power of Compressed and of Liquefied Nitric Oxide, NO, 208
- Black (M.), appointed a demonstrator in geology in Cambridge University, 123
- Black (Prof. N. H.), New Laboratory Experiments in Practical Chemistry (*Review*), 173; and J. B. Conant, New Practical Chemistry: Fundamental Principles Applied to Modern Life (*Review*), 173
- Blackett (Prof. P. M. S.), appointed Langworthy professor of physics in Manchester University, 207; work of, 962
- Blackman (Dr. F. F.), presentation of a portrait of, to the Botany School, Cambridge, 845
- Blackman (Prof. V. H.), conferment upon, of the title of emeritus professor by London University, 778
- Blacktin (Dr. S. C.), Spontaneous Electrical Charge of Fine Coal Dust, 280; Electrotor Smoke and Dust Meter, 331, 582; New Inventions Exhibition, 982; awarded the Founder's silver medal and the Institute of Patentees' silver medal, 1058
- Blackwell (Miss Elizabeth), Germination of Resistant Spores of *Blastocladi* *Pringsheimii*, 933
- Blair (Dr. G. W. Scott), appointed head of the chemistry department of the National Institute for Research in Dairying, 61; 654
- Blanc (G.), and M. Baltazard, Crossed Immunity between the Pustular Fever and Purpura Fever of the Rocky Mountains, 905
- Blatter (late Rev. E.), and W. S. Millard, Some Beautiful Indian Trees (*Review*), 633
- Blau (Dr. Marietta), and Dr. Hertha Wambacher, Measurement of the Length of Proton Tracks by the Photographic Method, 252; awarded the Ignaz L. Lieben prize of the Vienna Academy of Sciences, 332; Disintegration Processes by Cosmic Rays with the Simultaneous Emission of Several Heavy Particles, 585
- Bless (A. A.), Effects of the Length of X-Ray Waves on Seeds, 83
- Blodgett (K. B.), and I. Langmuir, Built-up Molecular Films, 470
- Bodson (H.), [J. Timmermans and], Surface Tension of Water and that of Heavy Water, 293
- Bogert (Prof. L. J.), Dietetics Simplified: the Use of Foods in Health and Disease. With Laboratory Section by M. T. Porter (*Review*), 829
- Böhnecke (G.), Temperatur, Salzgehalt und Dichte an der Oberfläche des atlantischen Ozeans. Lief. 1; Atlas (*Review*), 704
- Bohr (Prof. Niels), Lord Rutherford, 752; 1048
- Bois (Prof. D.), Les plantes alimentaires chez tous les peuples et à travers les ages: histoire, utilisation, culture. Vol. 4. (*Review*), 787
- Bolland (J. L.), and Dr. H. W. Melville, Analysis of Ternary Gas Mixtures by Thermal Conductivity Measurements, 63
- Bolliger (A.), Compounds of Creatinine with Alkaline Hydroxides, 377; Red Compounds formed by Picric Acid and Creatinine in the Presence of Sodium Hydroxide, 519
- Bomke (Dr. H.), Vakuumspektroskopie (*Review*), 528
- Bond (C. J.), Biology and the New Physics: a Plea for a consistent Philosophy of Life (*Review*), 953
- Bond (Dr. G.), Excretion of Nitrogen by Leguminous Plants, 683
- Bond (Dr. W. N.), [obituary article], 716
- Bonét-Maury (P.), Utilization of Photo-Elements with Semi-Conducting Layer for Radioactive Measurements, 208; Optical Properties of Bacterial Suspensions, 985
- Bonhoeffer and Fredenhagen, Cannizzaro Reaction, 369
- Booth (F. A.), [L. C. Beadle and], An Inexpensive Low-Temperature Thermostat, 279
- Bordet (Prof. J.), awarded the Grand Cross of the Order of Leopold, 104
- Borocco (A.), [L. Hackspill and], Compounds of the Isotope 2 of Hydrogen with the Alkali Metals (Alkaline Deuterides), 82
- Bosch (Prof. C.), elected president of the Kaiser Wilhelm Society for the Advancement of Science, 274
- Bose (Prof. D. M.), Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd^{+++} Ion due to Crystalline Fields, 109
- Bose (Sir Jagadis Chandra), [death], 922; [obituary article], 1041

- Bose (Dr. S. R.), Polyporaceous Fungi, 592; and S. N. Sarkar, Enzymes of Wood-Rotting Polypores, 813
- Bosler (J.), and H. Roure, Disappearance of Biéla's Comet, 40
- Botha (Lt.-Col. C. G.), Science of Archives in South Africa, 374
- Bouchard (Charles), (1837-1915), work of, 457
- Bouckaert (Prof. J. J.), awarded the Gluge prize of physiology of the Belgian Royal Academy of Sciences, 274
- Boulenger (Dr. G. A.), [death], 960
- Bourdouil (Mme. C. Sosa), Composition of the Pollen of Some Ranunculaceæ and on their Systematic Position, 656
- Boutry (G. A.), and G. Tréherne, Commutable and Stable Electrical Contacts, 251
- Bowen (E. G.), [R. A. Watson-Watt, A. F. Wilkins and], Reflection of Radio Waves in the Atmosphere, 512
- Bowen (Prof. I. S.), Prof. R. A. Millikan and Dr. H. V. Neher, Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts, 23
- Bowen (Prof. N. L.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884
- Bowman (J.), awarded a Royal Asiatic Society's Universities Essay prize, 967
- Boyd (J. D.), appointed lecturer in anatomy in Cambridge University, 123
- Boyes (J. W.), and W. P. Thompson, Endosperm and Embryo in Reciprocal Cereal Crosses, 511
- Boys (Sir Charles Vernon), Weeds, Weeds, Weeds (*Review*), 994
- Bradley (A. J.), H. J. Goldschmidt, H. Lipson and A. Taylor, Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543; and A. Taylor, An X-Ray Investigation of the cause of High Coercivity in Iron-Nickel-Aluminium Alloys, 1012; and H. Lipson, Rapid Survey of Ternary Alloy Systems by X-Rays, 1069
- Bradley (Dr. O. C.), [death], 1043
- Bragg (Sir William), elected an honorary associate of the Royal Institute of British Architects, 21; conferment upon, of an honorary doctorate by Edinburgh University, 80; Lord Rutherford, 752; recommended for re-election as president of the Royal Society, 840; appointed a member of the advisory council to the Committee of the Privy Council for Scientific and Industrial Research, 888; The Grain-like Structure of Solids, 954; The Pilgrim Trust Lecture, 961
- Bragg (Prof. W. L.), Atomic Structure of Minerals (George Fisher Baker lecture) (*Review*), 783
- Braun (A.), Dr. P. Preiswerk and P. Scherrer, Detection of α -Particles in the Disintegration of Thorium, 682
- Braunstein (Prof. A. E.), Specificity of the Salicylic Aldehyde Reaction of Csonka-Straub, 427; and M. G. Kritzmann, Formation and Breakdown of Amino-Acids by Intermolecular Transfer of the Amino Group, 503
- Breen (J.), J. Keane and T. J. Nolan, Chemical Constituents of Lichens found in Ireland—*Pertusaria concreta*, 333
- Brenchley (Dr. Winifred E.), Pasture Problems, 918
- Brewster (A. B.), [obituary article], 881
- Brickwedde (F. G.), [R. B. Scott and], Liquid Parahydrogen, 1020
- Bridgman (Prof. P. W.), Polymorphic Transitions of Inorganic Compounds to 50,000 kgm./cm.², 83; Polymorphism under Pressure, 899
- Briegleb (Dr. G.), and W. Lauppe, Raman Spectra of Oxonium Compounds, 236
- Briggs (G. E.), [J. G. Bald and], Aggregation of Virus Particles, 111
- Briggs (L. J.), Standardization of Physical Units, 122
- Bright (Sir Charles), [death], 1002
- Brightman (R.), Reflections on Life (*Review*), 341; Social Theory and Discipline (*Review*), 481
- Brindley (Dr. G. W.), and P. Ridley, Asymmetry in Metals of Hexagonal Structure, 461
- Briner (E.), [D. Monnier, B. Susz and], Raman Spectra of Acrylic Acid and of Methyl Methacrylate, both Monomer and Polymerized, 737; and E. Perrotet, Complementary Results on the Catalytic Action of Ozone in the Oxidation of Aldehydes, 737
- Briscoe (Prof. H. V. A.), Dust Control in Industry, 773; Intermediate Chemistry (*Review*), 910
- Brockett (Lord), gift of Devil's Dyke, Wheathampstead, as an open space, 764
- Brockway (L. O.), [L. Pauling and], Carbon-Carbon Bond Distances, 688
- de Broglie (Duc), Lord Rutherford, 1050
- Brohult (S.), Splitting of the Hæmocyanin Molecule by Ultra-Sonic Waves, 805
- Broniewski (W.), S. Przedpelski and S. Sulowski, Some Physical and Chemical Properties of Very Pure Steels, 334
- Brooke (G. B.), and A. G. Waddington, Determination of Alumina in Metallic Aluminium, 858
- Brooks (C. F.), and A. H. Tiessen, Meteorology of Great Floods in the Eastern United States, 511
- Broom (Dr. R.), Discovery of a Lower Molar of *Australopithecus*, 681
- Brown (A. B.), and R. G. H. Cormack, Heteroauxin and Cambial Activity, 898
- Brown (A. G.), [M. B. Crane and], Incompatibility and Sterility in Sweet Cherries, 1019
- Brown (Dr. D.), Sound-Films as Diffraction Gratings for Visual Fourier Analysis of Sound-Waves, 1099
- Brown (J. M.), appointed lecturer in political science in the United College, St. Andrews University, 207
- Brown (L. W.), [Dr. F. W. G. White and], Annual Variation of the Absorption of Wireless Waves in the Ionosphere, 931
- Brown (Prof. P. E.), [death], 226
- Brown (R. S.), Anatomy of *Ophelia cluthensis* McGuire, 292
- Browne (E. T.), [death], 1043
- Bruce (E. L.), Gold Deposits of the Canadian Shield, 116
- Bruce (M. M.), Utilization of Leisure, 229
- Brück (Dr. H.), appointed first junior observer in the Cambridge Solar Physics Observatory, 819
- Brunner (Dr. O.), awarded the Rudolf Wegscheider prize of the Vienna Academy of Sciences, 332
- Brunovsky (B. K.), [Prof. W. I. Vernadsky, C. G. Kuna-sheva and], Concentration of Mesothorium-I by Duckweed (*Lemna*), 317
- Brunt (Prof. D.), and others, Investigation of the Upper Air, 876
- de Bruyne (Dr. N. A.), awarded the Simms gold medal of the Royal Aeronautical Society, 1094
- Budden (K. G.), and J. A. Ratcliffe, An Effect of Catastrophic Ionospheric Disturbances on Low-frequency Radio Waves, 1060
- Buffle (J. P.), Origin of the Calcium Bicarbonate in the Waters of the River Versoix (Canton of Geneva), 125
- Builder (Dr. G.), [Dr. A. L. Green and], Control of Wireless Signal Variations, 76
- Bull (Dr. H. B.), The Biochemistry of the Lipids (*Review*), 787
- Bull (L.), and P. Girard, Influence of Electric and Magnetic Fields on the Electric Spark in Air at Atmospheric Pressure, 1111
- Buller (Prof. A. H. R.), awarded a Royal medal of the Royal Society, 840; presented with a Royal medal of the Royal Society; work of, 980
- Bullock (W.), Gold Mining with the Aid of Aeroplanes, 100
- Bulman (Dr. O. M. B.), appointed lecturer in palæozoology in Cambridge University, 123
- Bunting (E. N.), [R. F. Geller and], Lead Borates, 34
- Burchell (J. P. T.), Pottery in the Palæolithic Period, 800
- Burg (A. B.), and H. I. Schlesinger, Borine Carbonyl, 74
- Burgess (A. H.), Drying of Plant Materials, 1104
- Burn (Prof. J. H.), appointed professor of pharmacology in Oxford University; work of, 227; elected a professorial fellow of Balliol College, Oxford, 694
- Burn (W. S.), Development of the Two-Stroke Cycle Oil Engine, 597

- Burnham (J.), [P. C. Cross, P. A. Leighton and], Structure of Water, 512
- Burnous (E. G.), Ethnology of Wallis Island, 812
- Burton (Prof. E. F.), Refractive Indexes of Helium I and II, 1015
- Bushnell, jun. (D. I.), Early Indian Sites in Virginia, U.S.A., 854
- Butenandt (Dr. A.), awarded the Scheele medal of the Chemical Society of Stockholm, 274
- Butler (Dr. N. Murray), conferment upon, of an honorary doctorate by Edinburgh University, 80
- Buzzard (Sir E. Farquhar), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
- Byerly (Prof.), Earthquakes off the Coast of Northern California, 937
- Byng (E. S.), and G. A. Robinson, Education in Industrial Management, 79
- Byron (R.), The Road to Oxiana (*Review*), 788
- Cadbury (Edward), conferment upon, of an honorary doctorate by Birmingham University, 80
- Cady (Prof. W. G.), awarded the Duddell medal of the Physical Society; work of, 55
- Caie (J. M.), State Intervention in Agriculture, 416
- Cajal (Santiago Ramón y), Translated by Prof. E. H. Craigie, with the assistance of Prof. J. Cano, Recollections of My Life (*Review*), 617
- Calman (Dr. W. T.), conferment upon, of an honorary doctorate by St. Andrews University, 694
- Cameron (Dr. G. R.), conferment upon, of the title of professor by London University, 207
- Cameron (T. W. M.), Life-History of *Apophallus venustus*, 510
- Camm (G. L.), awarded the senior mathematical scholarship of Oxford University, 38
- Campbell (D.), Electric Furnaces, 59
- Campbell (Sir Malcolm), Motor-boat Speed Record, 460
- Campbell (Dr. N. R.), Measurement of Radiant Energy (*Review*), 828
- Camsell (C.), Mining Industry of Canada, 542
- Candler (A. C.), Atomic Spectra and the Vector Model. 2 Vols. (*Review*), 626
- Cannon (D. A.), awarded a Medical Research Council junior research fellowship in tropical medicine, 274
- Capdecemme (L.), and P. Jacquet, Reflecting Power of Copper, 40
- Capstick (Dr. J. W.), [obituary article], 225
- Carey (Isabella P.), [J. Algar and], Synthesis of Flavonols: Oxidation of Flavindogenides, 292
- Carpenter (F. M.), Fossil Insects from Kansas Rocks, 116
- Carpenter (Prof. G. D. Hale), Attitude and Concealing Coloration, 684; Wild Birds and Butterflies, 974
- Carpenter (Sir Harold), awarded the Carl Lueg gold medal of the Verein deutscher Eisenhüttenleute; work of, 675
- Carr (Dr. Emma R.), awarded the Francis B. Garvan gold medal of the American Chemical Society, 888
- Carr (Dr. F. H.), elected president of the Association of British Chemical Manufacturers, 719
- Carrisson (G.), Rapid Counting of a Microbial Suspension, 376
- Carroll (Prof. J. A.), Method of Determining Stellar Rotation, 162
- Cartan (Prof. E.), Rédigées par Dr. P. Vincensini, Leçons sur la théorie des espaces à connexion projective (*Review*), 950; appointed Rouse Ball lecturer in Cambridge University for 1937-38, 1026
- Carter (Major B. C.), and A. G. Pugsley, awarded the Edward Busk memorial prize of the Royal Aeronautical Society, 1094
- Carter (Dr. G. S.), appointed a lecturer in zoology in Cambridge University, 904
- Cathcart (E. B.), [Dr. K. G. Emeléus, C. M. Minnis and], Electrical and Optical Properties of Iodine Vapour, 251
- Cave (Dr. A. J. E.), Human Skeletal Remains in London, 497
- Cavell (A. C.), [late Prof. T. M. Lowry and], Intermediate Chemistry (*Review*), 910
- Cawston (F. G.), Development of Teeth in the Radula of Fresh Water Mollusca; South African larval Trematodes with Forked Tails, 1028
- Cayeux (L.), New Data on the Existence of Bacteria in the Old Sedimentary Rocks, 124
- Čeřovská (Miss J.), Circular Ultra-Sonic Grating in Liquids, 425
- Chadwick (Sir David), elected an honorary fellow of Sidney Sussex College, Cambridge, 38, 80
- Chadwick (Prof. J.), Lord Rutherford, 749
- Champion (Dr. F. C.), and A. Barber, Production of Positron and Electron Pairs by Bombardment of Mercury with β -Particles of Low Energy, 105
- Chao (C. Y.), and T. H. Wang, Spacing of the Resonance Neutron Levels of Silver, Rhodium and Bromine Nuclei, 768
- Chaplin (H. O.), [Dr. L. Hunter and], Evidence of Restricted Rotation about the N-C Bond in 2: 6-Disubstituted Acetanilides, 896
- Chapman (F.), National Museums of Natural History, 272
- Chapman (Prof. S.), Cosmic Rays and Magnetic Storms, 423; appointed a member of the Cambridge University Committee for Geodesy and Geophysics, 1026
- Chapman (V. J.), A Dune Drainage System, 592
- Charlesworth (Prof. J. K.), Map of the Glacier Lakes and Local Glaciers of the Wicklow Hills, 251; 977
- Charpy (G.), Determination of Silicon in Steels, 820
- Chasen (F. N.), [late H. C. Robinson and], The Birds of the Malay Peninsula. Vol. 3: Sporting Birds; Birds of the Shore and Estuaries (*Review*), 1034
- Chatterjee (Prof. B. C.), The Hydro-electric Practice in India. 2 Vols. (*Review*), 442
- Chenery (E. M.), Colour of Hydrangea Flowers, 326
- Childs (Dr. E. C.), The Function of Experiment, 852
- Childs (S. W.), gift by, to Yale University for cancer research, 21
- China (W. E.), [I. W. Helmsing and], Hemipterous Insects of the Family Peloridiidae, 326
- v. Cholnsky (Dr. L.), [Prof. L. Zechmeister und], Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen (*Review*), 48
- Chrétien (A.), and J. Kraft, Uranyl Phosphites, 251
- Church (Dr. A. H.), [obituary article], 268
- Churcher (B. G.), and A. J. King, Performance of Noise Meters in Terms of the Primary Standard, 331
- Cimerman (C.), and P. Wenger, Micro-separation of Zinc by Means of *o*-Oxyquinoline in Acetic Solution; Volumetric Micro-estimation of Zinc in Alkaline Solution, 737
- Clark (A. J.), and J. Raventos, Pharmacology of Tetramethylammonium, 325
- Clark (E. Graham), appointed secretary to the Institution of Civil Engineers, 1058
- Clark (Frances N.), Interseasonal and Intra-seasonal Changes in the Size of the California Sardine; Fishing Localities for the California Sardine, 858
- Clark (G. L.), elected an Isaac Newton student of Cambridge University, 904
- Clarke (Dr. J. G. D.), Mesolithic Site in Surrey, 144
- Clarke (S. H.), Gurjun, Apitong, Kerning, Kapur and Allied Timbers, 326
- Claus (W. D.), [A. Hollaender and], Problem of Mitogenetic Radiation, 1007
- Clay (J.), and G. van Kleef, Conductivity of Pure Gases at High Pressures, 1111
- Clayton (Dr. A. E.), Validity of Laws of Electrodynamics, 246
- Clegg (Dr. H. A.), [Dr. C. Hill and], What is Osteopathy? (*Review*), 788
- Clifford (F. W.), A Census of Periodicals (*Review*), 786
- Clifton (Dr. C. E.), Prevention of Assimilation in Respiring Cells, 318
- Cline (J. K.), R. R. Williams and J. Finkelstein, Synthesis of Vitamin B₁₂, 856
- Clinton (Dr. G. P.), [death], 393
- Cloassen (Prof. P. W.), [death], 455

- Clouston (Flying Officer A. E.), and Mrs. Kirby-Green, New Flying Speed Records, 888, 929
- Cochrane (Flora), Histological Analysis of Eye Pigment Development in *Drosophila pseudo-obscura*, 292
- Cockerell (Prof. T. D. A.), Zoological Nomenclature, 27
- Cockerham (Dr. G.), Potato Flowers and Dissemination of Potato Viruses, 1100
- Cocking (W. T.), Wireless Servicing Manual. Third edition (*Review*), 914
- Codos (M.), and others, Flying Speed Record, 929
- Colas [Raymond Hamet and], Botanical Origin of the Chuchuhuasha, 334
- Cole (F. C.), Petrofabric Study of Moine Schists, 429
- Cole (H. A.), Breeding of Oysters in Tanks, 854
- Cole (L. W. L.), [Capt. H. Barkworth and], Acidosis and Off-flavoured Milk, 324
- Cole (Dr. R.), retirement of, from the directorship of the Hospital of the Rockefeller Institute for Medical Research, 104
- Collinge (Dr. W. E.), Wild Birds and Butterflies, 974
- Collins (Prof. H. H.), [death], 576
- Collins (Prof. H. J.), and C. A. Hart, Principles of Road Engineering (*Review*), 441
- Collins (Dr. Mary), Rabkin's Polychromatic Plates for Colour Sense Examination (*Review*), 49; Tests for Colour Defects, 414; 532; 569
- Comrie (Dr. L. J.), Dr. J. R. Airey, 796
- Conant (J. B.), [Prof. N. H. Black and], New Practical Chemistry; Fundamental Principles Applied to Modern Life (*Review*), 173
- Cone (W. H.), and H. V. Tartar, Passivity of Iron, 117
- Conn (G. K. T.), [Dr. G. B. B. M. Sutherland and], Infra-red Spectrum of Tetradeuteroethylene, 644
- Constable (Dr. J. E. R.), Science in Everyday Life, 457
- Conway (Prof. E. J.), Structural Laws of the Mammalian Kidney with Theoretical Derivations, 40; J. M. O'Connor and D. K. O'Donovan, Influence of Temperature on the Activity of the Kidney in Relation to its Influence on Oxygen Consumption, 40
- Cook (F. C.), and others, Road Design and Road Safety, 650
- Cook (S. F.), [K. G. Scott and], Effect of Radioactive Phosphorus upon the Blood of Growing Chicks, 293; K. G. Scott and P. Abelson, Deposition of Radio-phosphorus in Tissues of Growing Chicks, 944
- Cook (Dr. W. R. I.), [C. C. Hentschel and], Biology for Medical Students. Second edition (*Review*), 994
- Cooke (Mary Thacher), Speed of Flight of Birds, 325
- Cooper (C. Forster), Middle Devonian Fish Fauna of Achanarras, 292; appointed director of the British Museum (Natural History), 967
- Copenhagen (W. J.), Sulphur as a Factor in the Corrosion of Iron and Steel Structures in the Sea (2), 1028
- Corbet (R. E.), [H. N. Holmes and], Crystalline Vitamin A, 1020
- Cormack (R. G. H.), [A. B. Brown and], Heteroauxin and Cambial Activity, 898
- Cornes (J. J. S.), Attitude and Concealing Coloration, 684
- Cornish (Dr. Vaughan), Borderlands of Language in Europe: and their relation to the Historic Frontier of Christendom (*Review*), 994; Apparent Enlargement of the Sun at the time of Rising and Setting, 1082
- Cortis-Jones (B.), [Dr. R. Lemberg, M. Norrie and], An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin, 65
- Corwin (W.), [J. W. Thompson, J. H. Aste-Salazar and], Physiological Patterns and Mental Disturbances, 1062
- Costello (D. P.), awarded the Royal Asiatic Society's Universities Essay prize, 967
- Cosyns (M.), Belgian Stratosphere Balloon Experiment, 54; Abnormal Zenithal Distribution of Cosmic Rays, 931
- Cotter (J. L.), Extinct Mammals and Man in America, 243
- Cotton (R. T.), and N. E. Good, Insects and Mites in Stored Grain, 936
- Coursey (P. R.), Electrolytic Condensers: their Properties, Design and Practical Uses (*Review*), 636
- Cousty (C.), Diamagnetism of Solutions of Iodine and the Purity of the Alcohol, 518
- Cowles (W. H. H.), and J. E. Thompson, A Text Book of Trigonometry: for Colleges and Engineering Schools (*Review*), 344
- Cowley (E. G.), and Prof. J. R. Partington, Series Effect on the Dipole Moments of some Alkyl Halides, 1100
- Cowling (T. G.), appointed lecturer in mathematics in University College, Dundee, 38
- Cox (E. G.), [F. J. Llewellyn, T. H. Goodwin and], Crystalline Structure of Pentaerythritol, 430
- Cox (E. W.), The Evolution of the Australian Merino (*Review*), 870
- Crane (H. R.), [D. S. Bayley and], The β -Rays from Lithium and Boron Isotopes, 776; [J. J. Turin and], The β -Rays from Lithium and Boron Isotopes, 776
- Crane (M. B.), and A. G. Brown, Incompatibility and Sterility in Sweet Cherries, 1019
- Crawley (C. W. B.), [obituary article], 1002
- Crew (Prof. F. A. E.), Selective Action of Mortality, 410; The Sex Ratio, 449; Sex Ratio in the Domestic Fowl and its Bearing upon the Sex-linked Lethal Theory of Differential Mortality, 1027; and C. Auerbach, 'Spheroidal': a Mutant in *Drosophila funebris* affecting Egg Size and Shape, and Fecundity, 124; and Dr. C. Auerbach, New Mutation in *Drosophila*, 898; and others, The Sex-Ratio, 958; and S. S. Munro, Gynandromorphism and Lateral Asymmetry in Birds, 1027
- Croll (R. H.), Wide Horizons: Wanderings in Central Australia (*Review*), 1081
- Crommelin (Dr. A. C. D.), presented with the Walter Goodacre gold medal and gift of the British Astronomical Association, 800; [Mary Proctor and], Comets: their Nature, Origin and Place in the Science of Astronomy (*Review*), 566
- Crosland (L.), Higher School Revision Mathematics (*Review*), 7
- Cross (E. J.), and Prof. F. M. Rowe, Prof. A. G. Perkin, 13
- Cross (P. C.), J. Burnham and P. A. Leighton, Structure of Water, 512
- Crouzon (Dr.), appointed professor of social medicine in the Paris Faculty of Medicine, 929
- Crowfoot (Dr. D.), The Two Crystalline Modifications of Insulin, 149
- Crowther (H.), [death], 1002
- Crowther (Prof. J. A.), and H. Liebmann, An Effect of X-Radiation on the ξ Potential of Colloidal Graphite, 28; Biological Action of X-Rays: a Theoretical Review (Silvanus Thompson memorial lecture), 1069
- Crowther (J. G.), Famous American Men of Science (*Review*), 439; Congrès du Palais de la Découverte, International Meeting in Paris: Physics, 710
- Crozier (W. J.), [A. H. Holway and], Law of Minimal Discrimination of Intensities (2), 943; E. Wolf and Gertrud Zerrahn-Wolf, Specific Constants for Visual Excitation, 943
- Cullis (Prof. C. G.), retirement of; work of, 185
- Cumming (Dr. W. M.), [death], 309
- Cummins (G. B.), [J. C. Arthur and], Rust Fungi of the Philippines, 648
- Cunningham (Dr. B.), River Flow Around Bends, 728; Estuary Channels and Embankments (Vernon-Harcourt lecture), 1046; Inland Water Survey in Great Britain, 1106
- Curme, jun. (Dr. G. O.), Recent Progress in Synthetic Organic Chemistry, 901
- Curzon (H. H.), and R. W. Thornton, South African Native Cattle, 551
- Cushing (Prof. H.), [Prof. J. F. Fulton and], A Bibliographical Study of the Galvani and the Aldini Writings on Animal Electricity, 840
- Cuthbertson (Prof. A. C.), G. Gee and Prof. E. K. Rideal, The Kinetics of Polymerization, 889
- Cuthbertson (J. W.), Young's Modulus Apparatus, 511
- Cutler (D. Ward), and Miss Mabel Dunkley, Standardization of Potato Slopes for Bacteriological Tests, 1015
- Dale (Sir Henry), awarded the Copley medal of the Royal Society, 840; presented with the Copley medal of the Royal Society; work of, 979

- Dalén (Dr. N. G.), [death], 1087
- Dales (J. L.), awarded a Medical Research Council junior research fellowship in tropical medicine, 274
- Dalling (Prof. T.), conferment on, of a degree by Cambridge University, 778
- Dalzell (Dr. J. Moir), Practical Stereoscopic Photography (*Review*), 528
- Dandekar (S. B.), Lectures on College Algebra (*Review*), 831
- Dannatt (C. W.), appointed reader in metallurgy at the Imperial College—Royal School of Mines, 942
- Danzer (Dr.), Birth Policy and the Problem of Space, 678
- Darlington (Dr. C. D.), The Biology of Crossing-over, 759; Interaction between Cell Nucleus and Cytoplasm, 932; Recent Advances in Cytology. Second edition (*Review*), 1033
- Daunt (J. G.), awarded the Scott scholarship for research in physics of Oxford University, 819
- Dauvillier (A.), A Universal Counter, 477
- Davenport (H.), appointed an assistant lecturer in mathematics in Manchester University, 207
- Davenport (R. W.), The Ohio-Mississippi Floods of 1937, 666
- Davey (D. G.), Physiology of Nematodes, 645
- David (Prof. W. T.), and B. Pugh, Influence of Hydrogen and Water Vapour upon the Combustion of Carbon Monoxide Mixtures, 1098
- Davidson (Dr. J.), Bioclimatic Zones of Australia, 265
- Davidson (Rev. Dr. M.), Comets and Problems of Cosmogony, 799; Free Will or Determinism? (*Review*), 871
- Davies (Dr. A. Morley), Evolution and its Modern Critics (*Review*), 912
- Davies (E. R.), Action of Light on Photographic Materials, 997
- Davies (Dr. G. R.), [Sir Gilbert Morgan and], Preparation of Germanium and Gallium, 688
- Davies (J. D. G.), appointed assistant secretary of the Royal Society, 460
- Davies (Dr. R. D.), elected a research fellow of Christ's College, Cambridge, 38
- Davis (Dr. A. H.), Noise (*Review*), 637
- Davis (H. T.), The Theory of Linear Operators: from the Standpoint of Differential Equations of Infinite Order (*Review*), 174
- Davison (E. H.), Field Tests for Minerals (*Review*), 830
- Davison (Dr. C. J.), awarded, with Prof. G. P. Thomson, the Nobel prize for physics; work of, 882
- Davson, Bt. (Sir Edward), [death], 268
- Davy (M. J. B.), Interpretative History of Flight (*Review*), 637
- Dawson (Sir Philip), Co-ordination of Fuel Interests, 763
- Daymond (J. R.), Run-off after Rainstorms, 470
- Debierné (A.), A New Mode of Transformation, 518; and L. Goldstein, New Transformations Produced at Low Temperatures (*frigidreactions*), 656
- Debiesse (J.), Absorption Spectra of Microbial Broths, 985
- De Donder (Prof. T.), and Prof. P. Van Rysselberghe, Thermodynamic Theory of Affinity: a Book of Principles (*Review*), 344
- Degerbøl (M.), and others, Greenland Culture (2), The Eskimo, 177
- Delaplace (R.), Vapour Pressure of Gaseous Saturated Hydrocarbons at Low Temperatures in the Presence of Silica Gel, 435; Pressure of some Permanent Gases at Low Temperatures in the Presence of Silica Gel, 985
- Delépine (M.), and A. Horeau, Catalysis of the Cannizzaro Reaction by Active Nickel and Platinum, 208
- Delfosse (Dr. J.), [Prof. M. de Hemptinne, J. Jungers and], Raman Spectra of Deuteroethylenes, 323
- Dellinger (Dr. J. H.), Ionosphere Disturbances, 732
- Delorme (G.), [P. Riou, H. Gamelin and], Distribution of Manganese and Iron in the Conifers of Quebec Province, 1027
- Demassieux (Mme. Nathalie), and B. Federoff, Dehydration of the Double Sulphate of Copper and Potassium, 778
- Demerec (M.), [H. Fricke and], Influence of Wave-length on Genetic Effects of X-Rays, 519; [B. P. Kaufmann and], Frequency of Induced Breaks in Chromosomes of *Drosophila melanogaster*, 943
- Demmelmair (A.), [Prof. V. F. Hess and], World-wide Effect in Cosmic Ray Intensity, as Observed During a Recent Magnetic Storm, 316
- Dennell (R.), Feeding Mechanism of *Apseudes*, 469
- Dent (Prof. Alberta), [Mary T. Dowd and], Elements of Foods and Nutrition (*Review*), 829
- Deodhar (Dr. G. B.), Introduction to Optics (*Review*), 216
- Desnuelle (P.), [Prof. P. Kuhn and], Protein of Yellow Enzyme, 936
- Desveaux (R.), [M. Lemoigne, P. Monguillon and], Reduction of Nitric Acid to Hydroxylamine by the Higher Plants, 293
- Des Vœux (Dr. H. A.), Idealism, 691
- Dew (Dr. R. Elsdon), Races with a High Proportion of Blood Group AB, 1066; Bantu Blood Groups, 77; Blood Groups in Central Africa, 927
- Dewan (J. G.), and D. E. Green, A New Oxidation Catalyst, 1097
- Dewar (J.), appointed lecturer in chemistry in the United College, St. Andrews University, 38
- Dewey (H.), Lower Greensand and Water Supply, 963
- Dewrance (Sir John), [death], 716
- Dhar (Prof. N. R.), Chemical Stabilization (*Review*), 340; Light in the Service of Man (*Review*), 444
- Diamond (J.), appointed a demonstrator in engineering in Cambridge University, 476
- Dible (Prof. J. H.), appointed professor of pathology at the British Postgraduate Medical School, 166
- Dickinson (Dr. H. C.), Enforcement of the Rules of the Road, 580
- Dickson (H.), A Short Periodic Growth Cycle and a Secular Variation in *Lemna minor*, 112
- Diebold (R.), [A. Travers and], Isolation of Pure Cementite by Acid Attack of Ferrous Materials, etc., 1073
- Dietz [Fischer, Jübermann and], Separation of the Rare Earths, 74
- Dingle (Dr. H.), Judgment by Hypothesis, 589; Science and the Unobservable, 963
- Divers (Dr. Edward), centenary of the birth of; work of, 924
- Dixon (Prof. A. L.), Prof. E. B. Elliott, 267
- Dixon (J. K.), Cobalt Chloride Treatment of Sheep, 898
- Dixon (Prof. S. M.), G. Fitzgibbon and Dr. M. A. Hogan, Hydrography of the River Severn, 73
- Dixon (Dr. W. M.), Action of Iodoacetate on Dehydrogenases and Alcoholic Fermentation, 806
- Dixon-Scott (J.), England under Trust: the Principal Properties held by the National Trust in England and Wales (*Review*), 623
- Dobson (Dr. G. M. B.), appointed a member of the Advisory Council to the Privy Council for Scientific and Industrial Research, 680; elected an official fellow of Merton College, Oxford, 694; awarded the Symons gold medal of the Royal Meteorological Society, 929
- Dobzhansky (Prof. T.), Exposé de génétique, 2: L'Effet de position et la théorie de l'hérédité (*Review*), 788
- Dodd (Prof. E. L.), and Dr. J. Neyman, An International Conference on the Theory of Probability, 938
- Dodds (Prof. E. C.), Pituitary Extracts and Gastric Ulcers, 159; M. E. H. Fitzgerald and W. Lawson, Oestrogenic Activity of Some Hydrocarbon Derivatives of Ethylene, 772
- Dole (Prof. M.), Surface Tension of Strong Electrolytes, 464
- Doniach (Dr. I.), and Dr. J. C. Mottram, Sensitization of the Skin of Mice to Light by Carcinogenic Agents, 588; Photodynamic Action of Carcinogenic Agents, 933
- Donisthorpe (H.), Communal Life among Termites (*Review*), 622
- Donkin (Bryan), Progress of Engineering, 798
- Donnan (Prof. F. G.), conferment upon, of the title of emeritus professor of chemistry by London University, 1110

- Dorey (Dr. S. F.), Chemical Intercrystalline Fracture of Riveted Joints in Boilers, 597
- Doudoroff (P.), [F. B. Sumner and], Some Quantitative Relations between Visual Stimuli and the Production or Destruction of Melanin in Fishes, 83
- Douglas (Dr. A. V.), The Corona by Reflection from the Moon, 156
- Dowd (Prof. J.), Control in Human Societies (*Review*), 481
- Dowd (Mary T.), and Prof. Alberta Dent, Elements of Foods and Nutrition (*Review*), 829
- Dowson (W. J.), and W. A. R. D. Weston, A Disease of Hawthorn, 116
- Drioton (Dr.), Bull Cults of Ancient Egypt, 1067
- Drysdale (Dr. C. V.), Scientific Basis of Birth Control, 19
- Drumm (Dr. P. J.), [Dr. C. P. Stewart, H. Scarborough and], Isolation of Ascorbic Acid from Wine, 282
- Duckham (A. N.), Agricultural Marketing Policy, 887
- Duclaux (J. P. E.), Anodic Polarization of Tungsten, 208
- Duclaux (J.), and M. Amat, Ultra-filters of Carborundum, 656
- Dudley (Lord), work of the National Institute of Industrial Psychology, 1088
- Duerden (Prof. J. E.), [death], 455; [obituary article], 576
- Dufraisse (C.), and J. Le Bras, Combustible Substances, Regarded as Helping Incombustible Extinguishers, for the Practical Extinction of Flames, 905; and J. Houpillart, Dissociable Organic Oxides, 1027
- Duggan (Dr. G. H.), elected an honorary member of the Engineering Institute of Canada, 274
- Du Mez (Prof. A. G.), [Prof. G. L. Jenkins and], Quantitative Pharmaceutical Chemistry: Containing Theory and Practice of Quantitative Analysis Applied to Pharmacy. Second edition (*Review*), 634
- Dunkley (Miss Mabel), [D. Ward Cutler and], Standardization of Potato Slopes for Bacteriological Tests, 1015
- Dunlap, jun. (O. E.), Marconi: the Man and his Wireless (*Review*), 260
- Dunlop (Miss Margaret), Oolitic Limestone Escarpment in Bronze Age France, 243
- Dunlop (W. R.), A Psycho-Geometrical Representation of Personnel Organization, 152
- Dunnicliff (Dr. H. B.), Chemistry of Indian Opium, 92
- Dunton (W. F.), Validity of Laws of Electrodynamics, 245
- Dunworth (J. V.), awarded a Denman Baynes research studentship at Clare College, Cambridge, 435
- Durst (C. S.), A West Indian Hurricane, 117
- Duthie (Dr. E. S.), resignation from Sheffield University, 735
- Du Toit (Dr. P. J.), and Dr. A. I. Malan, Phosphorus and Calcium Deficiency Diseases as Two Etiologically Distinct Entities, 153
- Duval (C.), Cobalt Hydroxides, 985
- Du Val (P.), appointed an assistant lecturer in mathematics in Manchester University, 207
- Dwyer (Sister Cecilia Marie), [G. S. Sperti, Prof. J. R. Loofbourow and], Proliferation-promoting Substances from Cells Injured by Ultra-Violet Radiation, 643
- Dyson (Sir Frank), and Dr. R. v. d. R. Woolley, Eclipses of the Sun and Moon (*Review*), 991
- Earl (J. C.), and N. G. Hills, Action of Nitrous Acid on Amines, 1105
- Easterfield (T. E.), awarded a Denman Baynes research studentship at Clare College, Cambridge, 435
- Eastman (Prof. A. V.), Fundamentals of Vacuum Tubes (*Review*), 953
- Eaton (Dr. M. D.), [Prof. F. Urban and], Spectroscopic observations of Reactions between Lactoflavin, the Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*, 466
- Eckardt (A.), Production of Artificial Radioactive Elements, 649
- Eckersley (T. L.), Irregular Ionic Clouds in the *E* Layer of the Ionosphere, 846
- Eddington (Sir Arthur), Relativity Theory of Protons and Electrons (*Review*), 742
- Edisbury (Dr. J. R.), Dr. R. A. Morton and G. W. Simpkins, A Possible Vitamin A₂, 234; [Dr. J. A. Lovern, Dr. R. A. Morton and], A New Source of Vitamin A, 276
- Edwards (Dr. F. W.), appointed a deputy keeper in the department of entomology of the British Museum (Natural History), 61
- Ehrenberg (K.), Two New Remains of Primates from the Miocene of Lower Austria, 125
- Ehrenfest, jun. (P.), [P. Auger, A. Freon, Mme. Thérèse Grivet and], Mechanism of the Production of Cosmic Bundles, 292
- Einecke (Dr. E.), Das Gallium: Eine Kritische Würdigung der Erkenntnisse mit experimentellen Beiträgen (*Review*), 566
- Ellenby (C.), Relation between Body Size and Metabolism, 853
- Elias (G.), Deep Well Drilling, 1093
- Ellingham (Dr. H. J. T.), appointed reader in physical chemistry at the Imperial College of Science and Technology, 942
- Elliott (Prof. E. B.), [death], 184; [obituary article], 267
- Elliott (N.), Atomic Distances in Crystals, 978
- Ellis (Dr. O. C. de C.), Behaviour of Cylinders of Inflammable Gas in a Fire, 935
- Ellison (Capt. F. B.), History of the Hay Railway, 1810-1864, 964
- Ellison (M. A.), Observation of a Fireball Train, 244
- Ellsworth (J.), Rapid Changes in the Tail of the Finsler Comet, 1937f, 985
- Elton (A.), and R. Fairthorne, Why Aeroplanes Fly (*Review*), 1035
- Emeléus (Prof. K. G.), E. B. Cathcart and C. M. Minnis, Electrical and Optical Properties of Iodine Vapour, 251; and J. Sayers, Negative Ions in Discharge Tubes, 1111
- Emerson (Dr. P.), [death], 716
- Emmerson (H. C.), and others, Location of Industry, 515
- Emslie (S. G.), Gravitational Statics in Three Dimensions, 729; Diffraction of Slow Positive Ions, 463
- Endô (H.), and S. Morioka, Magnesium Alloys, 978
- England (H. W.), [obituary], 881
- Enthoven (R. E.), Indian Ethnography (*Review*), 213
- Ephrussi (B.), [G. W. Beadle and], Ovary Transplants in *Drosophila melanogaster*: Meiosis and Crossing-over in Super Females, 779
- Epstein (E.), Electrical Precipitation of the Disperse Phase of Organic and Inorganic Dispersoids by Radium Emanation, 1074
- Eriksson (H. A. S.), Ionization Energy of Li⁺ and He, 151
- Erman (Prof. A.), [death], 15; [obituary article], 309
- Ernle (Lord), [death], 97
- Esnault-Pelterie (R.), Coefficient of Self-inductance of a Solenoid, 1073
- Eurich (Dr. F. W.), awarded the medal of the Textile Institute on retirement from the Anthrax Investigation Board for Bradford and District; work of, 675
- Evans (D. G.), appointed assistant lecturer in chemistry in the department of bacteriology of Manchester University, 207
- Evans (D. S.), awarded a Martin Thackeray studentship at King's College, Cambridge, 435
- Evans (G.), and others, Herbage and Forage Seeds, 1018
- Evans (H. Muir), Feeding Habits of Pleuronectidæ, 116
- Evans (Dr. Joan), Index to the Palace of Minos. With Special Sections Classified in Detail and Chronologically Arranged by Sir Arthur Evans (*Review*), 486
- Evans (Dr. J. T.), Mud Fluid for Pressure Drilling Conditions, 202
- Evans (P.), Indian Oil Industry, 765; and A. Reid, Drilling Mud, 1025
- Evans (Dr. R. D.), presented with the Theobald Smith award in medical science, 460
- Evans (Dr. U. R.), Metallic Corrosion, Passivity and Protection (*Review*), 629
- Evans-Pritchard (Dr. E. E.), Witchcraft, Oracles and Magic Among the Azande (*Review*), 338
- Eve (Prof. A. S.), Lord Rutherford, 338; Interpretation of Atomic Constitution, 1061

- Evershed (S.), presentation of a portrait of, to the Institution of Electrical Engineers, 1094
- Evershed (W. L.), Quantity Surveying for Builders. Fourth edition (*Review*), 7
- Ewald (Dr. P. P.), Electron Diffraction in Crystals, 928
- Ewart (Prof. A. J.), [death], 496
- Eyston (Capt. G. E. T.), New World Land Speed Record, 929
- Fabry (Prof. C.), retirement of; work of, 883
- Fahie (W. C.), Galileo and Mathematical Demonstration, 646
- Fairbrother (Dr. J. A. V.), High Intensity Light Sources, 552
- Fairthorne (R.), [A. Elton and], Why Aeroplanes Fly (*Review*), 1035
- Fajans and Martin, Protective Spray Deposits, 511
- Falconer (Prof. A. W.), appointed principal and vice-chancellor of Cape Town University, 476
- Falconer (Dr. J. D.), Darwin in Uruguay, 138
- Fallot (M.), Magnetic Properties of Alloys of Iron and Iridium, 820; Magnetic Properties of Alloys of Iron and Rhodium, 905; [R. Hocart and], Identification of Various Phases by Magnetic Study and by the X-Rays in Alloys of Iron and Palladium, 81
- Fantham (Prof. H. B.), [death], 839; [obituary article], 1001
- Farineau (Dr. J.), L-Emission Bands of Zinc, Copper, Nickel and Cobalt, 508
- Faris (Prof. E.), The Nature of Human Nature: and other Essays in Social Psychology (*Review*), 566
- Farguharson (J. S.), Haboobs and Instability in the Sudan, 687
- Farrington (A.), [K. Jessen and], Bogs at Ballybetagh, with Remarks on the Development of Late-Glacial Deposits in Ireland, 376
- Fauteux (A.), awarded the Tyrrell medal of the Royal Society of Canada, 287
- Fawcett (Prof. C. B.), Changing Distribution of Population, 411
- Fawcett (Prof. H. S.), Citrus Diseases and their Control. Second edition (*Review*), 526
- Fawcett (W.), and Dr. A. B. Rendle, Flora of Jamaica. Vol. 7. Late S. Le Marchant Moore and Dr. A. B. Rendle (*Review*), 302
- Federoff (B.), [Mme. Nathalie Demassieux and], Dehydration of the Double Sulphate of Copper and Potassium, 778
- Feldenkrais (M.), [M. Pauthenier, L. Vigneron and], The Electrostatic Valve, 518
- Felix (Dr. A.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
- Fenner (C. N.), Magmatic Differentiation, 327
- Ferguson (W. B.), [death], 716; [obituary article], 797
- Fermi (Prof. E.), Lord Rutherford, 1052
- Ferraro (V. C. A.), Functions of Quaternions, 1111
- Ferris (Prof. G. F.), Atlas of the Scale Insects of North America (*Review*), 632
- Ffrench (Lt.-Gen. E. G.), [death], 226
- Field (Miss M. J.), Religion and Medicine of Gã People (*Review*), 869
- Field (Prof. R. M.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884
- Fieser (Prof. L. F.), The Chemistry of Natural Products Related to Phenanthrene. Second edition (*Review*), 704
- Finch (Prof. G. I.), Electron Diffraction and Surface Structure (Bedson Lecture), 800
- Findlay (Prof. A.), Use of the Name 'Racemic Acid', 22; Chemistry for Everyman (*Review*), 300; A Hundred Years of Chemistry (*Review*), 624
- Finkelstein (J.), [J. K. Cline, R. R. Williams and], Synthesis of Vitamin B₁, 856
- Fischer, Deitz and Jübermann, Separation of the Rare Earths, 74
- Fischer (Prof. H.), awarded the Davy medal of the Royal Society, 840; presented with the Davy medal of the Royal Society; work of, 980
- Fischer (W. H.), [Dr. K. Miescher, E. Tschopp and], The Effect of Enol-Esters of Testosterone, 726
- Fisher (Prof. Allan G. B.), appointed Price professor of international economics at Chatham House; work of, 143; 842
- Fisher (Dr. R. C.), Research on Wood-Destroying Insects, 368
- Fitzgerald (M. E. H.), [Prof. E. C. Dodds, W. Lawson and], Estrogenic Activity of Some Hydrocarbon Derivatives of Ethylene, 772
- Fitzgibbon (G.), [Prof. S. M. Dixon, Dr. M. A. Hogan and], Hydrography of the River Severn, 73
- Flaum-Fehér (G.), [L. Pollak and], Distribution of Sugar in the Body, and the Action of Insulin, 821
- Fleming (Sir Ambrose), Guglielmo Marconi and the Development of Radio Communication, 963
- Fletcher (Dr. H. Morley), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
- Flett (Sir John Smith), The First Hundred Years of the Geological Survey of Great Britain (*Review*), 915
- Fl eure (Prof. H. J.), Racial Evolution and Archæology (Huxley Memorial Lecture), 945, 981
- Flexner (Dr. S.), elected a supernumerary fellow of Balliol College, Oxford, 694
- Florence (Prof. P. S.), Economic Research and Industrial Policy, 411
- Flower (W. D.), Temperature and Relative Humidity in the Atmosphere over Lower Egypt, 813
- Fock (V.), The Neutrino Theory of Light, 113
- Folley (Dr. S. J.), and Dr. P. White, Response of the Pigeon Crop Gland to Prolactin: Inhibition by (Estradiol Monobenzoate), 505
- Forbes (A. C.), Some Climatic Theories in Connexion with Tree Remains in and under Peat, 81
- Forbes (G.), appointed lecturer in forensic medicine in Sheffield University, 207
- Ford (E.), The Nation's Sea-Fish Supply: being the Buckland Lectures for 1936 (*Review*), 952
- Forde (Prof. C. Daryll), A Compilation of Migrations (*Review*), 89
- Forster (Sir Martin), Chemical Changes and Chances Streatfeild memorial lecture), 1055
- Fosdick (R.), work of the Rockefeller Foundation during 1936, 500
- Foulkes (Major-Gen. C. H.), Offence and Defence in Gas Warfare (*Review*), 3
- Fourie (P. J.), and Dr. C. Rimington, Living Animal Cases of Congenital Porphyrinuria, 68
- Fowler (Prof. R. H.), Statistical Mechanics: the Theory of the Properties of Matter in Equilibrium. Second edition (*Review*), 382
- Fox (D. L.), Carotenoids and other Liquid-Soluble Pigments in the Sea and in Deep Marine Mud, 519
- Fox (F. W.), and W. Stone, Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products, 234
- Fox (Dr. J. J.), and Dr. A. E. Martin, Infra-Red Absorption of Hydroxy Compounds near 3μ , 937
- Fox (M.), [Prof. H. C. Urey, J. R. Huffman, H. G. Thode and], Concentration of Nitrogen Isotope, 512
- Fox (T. R. C.), appointed a demonstrator in engineering in Cambridge University, 476
- Fox-Wilson (G.), Insect and Allied Pests of Fruits (*Review*), 215
- Frame (J. W.), resignation from Sheffield University, 735
- Frame (W. M.), New Type of Threaded Connexion for Oil Well Casing, 117
- Francis (Dr. A. G.), appointed deputy Government chemist, 844
- Frankel (Prof. M.), and R. Maimin, Natural Activation of Papain, 1015
- Frankenburger (Dr. W.), Katalytische Umsetzungen in homogenen und enzymatischen Systemen (*Review*), 827
- Fraser (Dr. F. C.), [J. R. Norman and], Giant Fishes, Whales and Dolphins (*Review*), 911

- Fraser (Miss Lilian), Ecology of Sooty Mould Fungi, 1104
 Frazer (Sir James George), Aftermath: a Supplement to the Golden Bough (*Review*), 260
 Freak (R. H.), awarded a Salters' Institute fellowship, 274
 Fred (E. B.), [P. W. Wilson and], Mechanism of Symbiotic Nitrogen Fixation, 943
 Fredenhagen [Bonhoeffer and], Cannizzaro Reaction, 369
 French (Dr. J. Weir), Propagation of Optical Contact, 321
 French (Prof. S. J.), The Drama of Chemistry: How Man Deals with Atoms (*Review*), 634
 Freon (A.), [P. Auger, P. Ehrenfest, jun., Mme. Thérèse Grivet and], Mechanism of the Production of Cosmic Bundles, 292
 Fretter (Vera), Digestion in Polyplacophoran Molluscs, 976
 Fricke (H.), and M. Demerec, Influence of Wave-length on Genetic Effects of X-Rays, 519
 Friedrich (R.), [A. Maillard and], Products formed by the Incomplete Combustion of Light Liquid Hydrocarbons 985
 Friend (Dr. G. E.), Place of Vegetables and Fruit in the Well-balanced Diet, 615
 Friesen (Prof. H.), Artificial Release of Crossing-over in Meiosis and Mitosis, 362
 Frisch (Dr. O. R.), Dr. H. von Halban, jun. and Dr. J. Koch, The Magnetic Field Acting upon Neutrons inside Magnetized Iron, 360; Capture of Slow Neutrons in Light Elements, 895
 Fröhlich (Dr. H.), Elektronentheorie der Metalle (*Review*), 953
 Frolov (Prof. Y. P.), translated by C. P. Dutt, Pavlov and his School: the Theory of Conditioned Reflexes (*Review*), 700
 Frost (Miss Nancy), Newfoundland Amphipoda and Decapod Larvæ, 898
 Frost (Winifred E.), [C. F. Humphries and], Chironomid Fauna of the submerged Mosses, River Liffey, 976
 Frye (Royal M.), [Prof. N. A. Kent, W. H. Robinson and], Structure of H₂ of Hydrogen, 236
 Fryer (Dr. A. C.), [obituary article], 674
 Fukushima (I.), [Y. Ishida, T. Suetsugu and], Determination of Electronic Charge by the Oil Drop Method, 29
 Fulton (F.), awarded the Radcliffe scholarship in pharmacology of Oxford University, 166
 Fulton (Prof. J. F.), and Prof. H. Cushing, A Bibliographical Study of the Galvani and the Aldini Writings on Animal Electricity, 840
 Gaddum (Prof. J. H.), Conditioned Reflexes and Psychology (*Review*), 700; appointed professor of pharmacology at the College of the Pharmaceutical Society of Great Britain and director of the society's Pharmacological Laboratories; work of, 717
 Galpin (N.), Factors Affecting Hatching Weight of Chickens, 1027
 Galvani, Bicentenary of, 391; Celebration at Bologna, 836
 Gamelin (H.), [P. Riou, G. Delorme and], Distribution of Manganese and Iron in the Conifers of Quebec Province, 1027
 Gand (E.), [A. Tian and], Ionic Dissociation of the Alkyl Halides, 293
 Gardner (Dr. A. D.), appointed reader in bacteriology in Oxford University and conferment upon, of title of professor, 38
 Gardner (Elinor W.), and Dorothea M. A. Bate, The Bone-bearing Beds of Bethlehem: Their Fauna and Industry, 431
 Gardner (J. C. M.), Larvæ of Indian Coleoptera, 592
 Gardner (Prof. Percy), [death], 142; [obituary article], 267
 Garland (Dr. H. G.), appointed clinical lecturer in medicine and honorary demonstrator in medical pathology in Leeds University, 942
 Garnett (Miss A.), Insolation and Relief, 776
 Garrod (Miss D. A. E.), Flaked Flints from the Bone Beds of Bethlehem, 808
 Garrod (Dr. L. P.), appointed reader in bacteriology at St. Bartholomew's Hospital Medical College, 942
 Gask (Prof. G. E.), appointed a member of the Medical Research Council, 190
 Gatenby (Prof. J. B.), Biological Laboratory Technique: an Introduction to Research in Embryology, Cytology and Histology (*Review*), 1081
 Gates (Prof. R. R.), Double Structure of Chromosomes, 1013
 Gautheret (R.), New Researches on the Culture of Cambium Tissue, 905; [A. Guilliermond and], Conditions under which Neutral Red produces the Vital Coloration of the Vacuoles, 40
 Gaydon (A. G.), and Dr. R. W. B. Pearse, Band Spectrum of Chromium Hydride, CrH, 110
 Gayler (Dr. Marie L. V.), Constitution of the Alloys of Silver, Tin and Mercury; Dental Amalgams, 858
 Gee (G.), [Prof. A. C. Cuthbertson, Prof. E. K. Rideal and], The Kinetics of Polymerization, 889
 Geiringer (Martha), Influence of the Central Nervous System on the Adaptation of the Colour of the Frog (*Hyla arborea* L.), 41
 Geller (R. F.), and E. N. Bunting, Lead Borates, 34
 George (Dr. W. H.), Keeping Pace with Physics (*Review*), 443
 Germer (L. H.), and K. H. Storks, Structure of Langmuir-Blodgett Films of Stearic Acid, 779
 Gerö (Dr. L.), [Dr. R. Schmid and], Structure of a New System of CO Bands, 508
 Gibb (Sir Alexander), elected an honorary member of the Engineering Institute of Canada, 274; Research in Engineering, 412; Engineering in Transport, 719
 Gibb (Prof. A. W.), [death], 97; [obituary article], 611
 Gibberd (G. F.), and others, Prontosil in Puerperal Infections, 284
 Gibbons (Dr. S. G.), Scottish Copepods, 116; Variations in Copepod Development, 1064
 Gibbs (J. Willard), A Commentary on the Scientific Writings of Vol. I: Thermodynamics; dealing with the Contents of Volume One of the Collected Works. Edited by Prof. F. G. Donnan and Prof. A. Haas. Vol. 2: Theoretical Physics; dealing with the Contents of Volume Two of the Collected Works. Edited by Prof. A. Haas (*Review*), 298
 Gibson (Prof. C. S.), Elementary Chemistry and its Presentation (*Review*), 173; Production of Thin Gold Films, 279; Constitution of Aurous Compounds: Gold Mirrors, 583; A Survey of Organic Chemistry (*Review*), 868
 Gifford (E. W.), and Prof. A. L. Kroeber, Pomo Culture, 686
 Gilbert (Dr. W. M.), [death], 309
 Gill (E. W. B.), Effect of a Magnetic Field on the Electrodeless High-frequency Discharge, 1061
 Gillam (A. E.), Prof. I. M. Heilbron, Dr. E. Lederer and V. Rosanova, Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
 Gilson (H. C.), The Percy Sladen Expedition to Lake Titicaca, 877; appointed a demonstrator in zoology in Cambridge University, 1026
 Ginns (D. W.), awarded the John Winbolt prize of Cambridge University, 291; Tests for Stresses in Engineering Materials, 858
 Girard (Dr. A.), A. Ray and G. Richard, Antimicrobial Action of some Aromatic Compounds, 283
 Girard (P.), [L. Bull and], Influence of Electric and Magnetic Fields on the Electric Spark in Air at Atmospheric Pressure, 1111
 Glassel (S. A.), Porcellanids and Pinnotherids from Tropical North American Waters, 33
 Glasspoole (Dr. J.), The Wettest Place in the British Isles, 540
 Glick (D.), Choline Esterase Activity of Superior Cervical Ganglia, 426
 Glock (W. S.), Climatic Cycles and Tree Growth, 855
 Glocker (Prof. R.), Materialprüfung mit Röntgenstrahlen: unter besonderer Berücksichtigung der Röntgenmetallkunde. Zweite Auflage (*Review*), 914
 Glücksmann [Tansley, Spear and], Radiation and Cell Division, 686
 Glynn (H. E.), [A. L. Bacharach and], Liver Extract and Hæmoglobin in Rats, 896
 Goldenweiser (Prof. A.), Anthropology: an Introduction to Primitive Culture (*Review*), 632

- Goldschmidt (B.), Fractionation Coefficients of Salts possessing several Hydrates, 477
- Goldschmidt (H. J.), [A. J. Bradley, H. Lipson, A. Taylor and], Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543
- Goldschmidt (R.), A Remarkable Parallelism, 83
- Goldschmidt (Prof. R.), Spontaneous Chromatin Rearrangements in *Drosophila*, 767
- Goldstein (L.), [A. Debiegne and], New Transformations Produced at Low Temperatures (*frigidreactions*), 656
- Good (N. E.), [R. T. Cotton and], Insects and Mites in Stored Grain, 936
- Goodenough (W. M.), appointed a member of the Medical Research Council and treasurer of the Council, 21
- Goodeve (Dr. C. F.), The Cluster Theory of Imperfect Gases, 424; appointed reader in chemistry at London University College, 942; and F. D. Richardson, Existence of Chlorous Anhydride, 737
- Goodway (Dr. N. F.), and T. F. West, Conversion of β -Phellandrene into a Derivative of α -Phellandrene, 934
- Goodwin (A. J. H.), and others, Archæology of the Oakhurst Shelter, George, 167; (6), 334; (6 and 7), 656
- Goodwin (E. T.), appointed an assistant lecturer in mathematics in Sheffield University, 735
- Goodwin (T. H.), [F. J. Llewellyn, E. G. Cox and], Crystal-line Structure of Pentaerythritol, 430
- Goossens (A. P.), South African species of *Sporobolus* R.Br. with special reference to Leaf Anatomy, 905
- Gordon (Dr. J. E.), appointed professor of preventive medicine and epidemiology at Harvard University Medical School, 582
- Gordon (Prof. R. M.), awarded the Chalmers medal of the Royal Society of Tropical Medicine and Hygiene; work of, 98
- Gordon (Seton), Thirty Years of Nature Photography: a Personal Record of Two Observers (*Review*), 302
- Gordon (Prof. W. T.), The Seventeenth International Geological Congress, 789
- Gorman (M. J.), A Non-bulbing Derivative of Yellow-fleshed Swedish Turnip, 333
- Gormley (P. G.), Zeros of Legendre Functions, 81
- Gorski (F.), Polarimetric Titration of the Oxyacids, 167
- Goshawk (E. R.), Air-drag and the Equilibrium of Whirling Threads, 194
- Gosset (W. S.), [death], 716; [obituary article], 838
- Götzinger (G.), Geological Analysis of the Quaternary Deposits in the Traun Valley region above Gmunden, 41
- Gough (G. S.), elected a fellow of Trinity College, Cambridge, 735
- Gough (Dr. H. J.), and W. Wood, X-Ray Methods in the Investigation of Failure in Service, 1069
- Gould (Lt.-Comdr. R. T.), A Book of Marvels (*Review*), 87
- Gourlay (Dr. J. S.), Viscosity of Binary Mixtures, 157
- Graham (A.), Ciliary Currents on Lamellibranch Gills, 687
- Granit (Prof. R.), Absorption Curve for Visual Purple and the Electrical Response of the Frog's Eye, 972
- Graue (G.), and N. Riehl, Investigation of Porous Structure, 327
- Gravier (Prof. C.), [death], 922
- Gray (J. L.), The Nation's Intelligence (*Review*), 528
- Gray (Dr. J.), Mentality of Fish, 496
- Green (Dr. A. L.), Service Area of a Radio-telegraphic Transmitter, 900; and Dr. G. Builder, Control of Wireless Signal Variations, 76; and Dr. O. O. Pulley, Control of Phase Fading in Long-distance Radio Communication, 76
- Green (D. E.), Rust-resistant Antirrhinums, 73; A Downy Mildew of Snapdragons, 511; [J. G. Dewan and], A New Oxidation Catalyst, 1097
- Greene (Sir Wilfrid Arthur), conferment upon, of an honorary doctorate by Birmingham University, 80
- Greenly (Lt.-Col. J. H. M.), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 680
- Greenshields (F.), Cytology of Parthogenetic Reproduction of Hymenoptera Symphyta (1), 124
- Greenwood (Dr. T.), Logic and Empiricism (*Review*), 866
- Gregory (Prof. F. G.), and O. N. Purvis, Devernalization of Spring Rye by Anærobic Conditions and Revernalization by Low Temperature, 547
- Gregory (P. H.), [A. Beaumont and], A Leaf-spot Disease of *Gerbera Jamesoni*, 511
- Gregory, Bt. (Sir Richard), Science and Social Service, 1088
- Gresswell (R. K.), Rivers, 496
- Grey of Fallodon (late Viscount), Memorial to, 1092
- Grierson (Sir Herbert), conferment upon, of an honorary doctorate by Edinburgh University, 80
- Griffith (Mrs. F. L.), [obituary article], 881
- Griffiths (Prof. A.), [obituary article], 97
- Grinsell (L. V.), The Ancient Burial-Mounds of England (*Review*), 218
- Grist (D. H.), An Outline of Malayan Agriculture (*Review*), 7
- Grivet (Mme. Thérèse), [P. Auger, P. Ehrenfest, jun., A. Freon and], Mechanism of the Production of Cosmic Bundles, 292
- Gromoff (Col. M.), Long Distance Air Record, 143
- Grover (Prof. F. W.), Poetry and Astronomy, 146
- Groves (Prof. E. W. H.), conferment upon, of an honorary doctorate by Queen's University, Belfast, 166
- Grünberg (Prof. A. A.), Metal-Ammonia Ions, 422
- Grundström (Dr. B.), Band Spectrum of Thallium Hydride, 365
- Grüneberg (Dr. H.), Gene Doublets as Evidence for Adjacent Small Duplications in *Drosophila*, 932
- Gucker, jun. (F. T.), and R. H. Munch, Nature of Calomel Vapour, 648
- Guillet (Prof. L.), nominated an honorary vice-president of the Iron and Steel Institute, 104
- Guilliermond (A.), and R. Gautheret, Conditions under which Neutral Red produces the Vital Coloration of the Vacuoles, 40
- Gundel (Dr. W.), Dekane und Dekansterbilder: ein Beitrag zur Geschichte der Sternbilder der Kulturvölker (*Review*), 701
- Gunn (Dr. D. L.), J. S. Kennedy and D. P. Pielou, Classification of Taxes and Kinases, 1064
- Gunn (Dr. J. A.), elected a supernumerary fellow of Balliol College, Oxford, 694
- Gunther (Dr. R. T.), Early Science in Cambridge (*Review*), 130; Early Astronomical Instruments at Oxford, 1089
- Gupta (J.), Hexaco-ordination of Tellurium, Molybdenum and Tungsten, 685
- Gurney (Dr. R.), Larvæ of Decapod Crustacea, 692
- Gurney (R. W.), and Prof. N. F. Mott, Photolysis of Silver Bromide and the Photographic Latent Image, 1073
- Gurwitsch (Prof. A. G.), Mitogenetic Analysis of the Excitation of the Nervous System (*Review*), 565
- Haagen-Smit (A. J.), [K. V. Thimann and], Effects of Salts on Emergence from the Cyst in Protozoa, 645
- Hackspill (L.), and A. Borocco, Compounds of the Isotope 2 of Hydrogen with the Alkali Metals (Alkaline Deuterides), 82
- Hadorn (E.), An Accelerating Effect of Normal "Ring Glands" on Puparium Formation in Lethal Larvæ of *Drosophila melanogaster*, 943
- Hahn (L.), and Prof. G. Hevesy, Origin of Yolk Lecithin, 1059
- Hahn (Prof. O.), Lord Rutherford, 1051
- Haitinger (O. M.), awarded the Fritz Pregl prize of the Vienna Academy of Sciences, 332
- v. Halban, jun. (Dr. H.), A Method of obtaining Polarized Neutron Beams, 425; [Dr. O. R. Frisch, Dr. J. Koch and], The Magnetic Field acting upon Neutrons inside Magnetized Iron, 360; Capture of Slow Neutrons in Light Elements, 895
- Haldane (Prof. J. B. S.), The Position of Genetics, 428; first Weldon professor of biometry at University College, London, 612
- Hale (R. W.), Products formed during the Preparation of Ketene, 1017
- Hale (Dr. W. J.), Prosperity Beckons: Dawn of the Alcohol Era (*Review*), 637

- Hall (Sir Daniel), Soil Erosion: the Growth of the Desert in Africa and Elsewhere, 886
- Hall (K.), [Dr. V. Korenchevsky and], Effects on Ovariectomized Rats of Progesterone alone and in combination with the other Sexual Hormones, 154; Histological Changes produced by Castration and by Sex Hormones with Adrenals of Normal and of Castrated Male Rats, 318
- Hall (R. T.), [J. H. Yoe and], Isotopes of Potassium, 34
- Hallpike (C. S.), Prof. H. Hartridge and Dr. A. F. Rawdon-Smith, Response of the Ear to a Phase Reversal, 74
- Hamilton (J. G.), Rates of Absorption of Radio-sodium in Normal Human Subjects, 944
- Hamilton (J. W. O.), foundation of prizes for radio research, 641; 862
- Hamilton (W. J.), Embryology of the Ferret, 775
- v. Håmos (Dr. L.), The X-Ray Microscope, 30
- Hanson (A. J.), awarded a Pilcher memorial prize of the Royal Aeronautical Society, 1094
- Hanson (E. A.), [Dr. J. A. A. Ketelaar and], Elementary Cell and Space Group of Ethylchlorophyllide, 196
- Harbord (F. W.), Thomas-Gilchrist Basic Process, 1057
- Harington (Prof. C. R.), and others, Structure of Protein, 491
- Harkins (Prof. W. D.), and R. J. Myers, Viscosity of Monomolecular Films, 465
- Harkness (William), centenary of the birth of; work of, 1004
- Harland (Dr. S. C.), Homologous Loci in Wild and Cultivated American Cottons, 467
- Harris (Prof. H. A.), Richard Watson and the Constitution of Elements, 926
- Harris (Dr. L. H.), Vitamins in Theory and Practice. New edition (*Review*), 302; Nicotinic Acid and the Pellagra-preventing Vitamin, 1070
- Harrison (E.), appointed professor of agriculture at the Imperial College of Tropical Agriculture, Trinidad, 1009
- Harrison (G. O.), retirement from Birmingham University; work of, 1045
- Harrison (Dr. H. S.), Ethnological Museums: Methods and Limitations, 57; retirement of; work of, 227
- Harrison (Dr. J. V.), elected lecturer and demonstrator in geology in Oxford University, 1026
- Harrison (K. P.), awarded a Harold Fry studentship of King's College, Cambridge, 435
- Harrison (Reginald), (1837-1905), work of, 310
- Harrison (T.), [C. Madge and], Mass-Observation, 843
- Hart (C. A.), [Prof. H. J. Collins and], Principles of Road Engineering (*Review*), 441
- Hartley (G. S.), appointed to a Warren research fellowship, 232; The Cis-form of Azobenzene, 281
- Hartley (Sir Harold), Agricultural products as Raw Materials for Industry (Mather lecture), 221
- Hartley (J. J.), Dalradian Rocks of the Sperrin Mountains, 251
- Hartree (Dr. E. F.), Congrès du Palais de la Découverte, International meeting in Paris: Biological Chemistry, 714
- Hartridge (Prof. H.), [C. S. Hallpike, Dr. A. F. Rawdon-Smith and], Response of the Ear to a Phase Reversal, 74
- Hart-Mercer (J.), elected Gwynæth Pretty student and Nita King scholar in Cambridge University, 476
- Harvey (J.), A New Harmonic Analyser, 74
- Haugaard (G.), Mechanism of the Glass Electrode, 66
- Häuslmayer (W.), Chemical Development of the Markings of Butterflies, 41
- Huvas (L.), Colchicine, 'Phytocarcinomata' and Plant Hormones, 191
- Havinga (E.), and J. de Wael, Monomolecular Films, 160
- Hawkes (Prof. C. J.), Engineering Progress in the Navy, 1024
- Hawking (Dr. F.), awarded a Medical Research Council research fellowship in tropical medicine, 274
- Haworth (Prof. W. N.), awarded, with Prof. P. Karrer, the Nobel prize for chemistry; work of, 882
- Hayes (R. C.), Deep-focus Earthquakes in the South-West Pacific, 855
- Hazlewood (S. J.), and others, Pyrroles derived from Acetylacetone, 695
- Hazoumé (P.), Blood-brotherhood in Dahomey, 325
- Heathcoat (Dr. F.), appointed vice-principal and head of the chemistry department of the Swansea Technical College, 1058
- Hecht (S.), Instantaneous Visual Threshold after Light Adaptation, 83
- Heilbron (Prof. I. M.), [A. E. Gillam, Dr. E. Lederer, V. Rosanova and], Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
- Heim (Prof. A.), [death], 455; [obituary article], 573, 611
- Heiser (Dr. V. G.), awarded the medal for distinguished service of the Pennsylvania Society of New York, 274
- Heitler (Dr. W.), Absorption of the Soft Component of Cosmic Radiation, 235
- Helmsing (I. W.), and W. E. China, Hemipterous Insects of the family Peloridiidae, 326
- de Hemptinne (Prof. M.), J. Jungers and Dr. J. Delfosse, Raman Spectra of Deuteroethylenes, 323
- Hemsley (F. R. W.), appointed an honorary demonstrator in anatomy in Leeds University, 942
- Henderson (Prof. G. G.), A Retrospect of Chemical Science, 145
- Henderson (Prof. G. H.), Some New Types of Pleochroic Haloes, 191
- Henderson (H. D.), The Displacement of Labour by Machinery, 679
- Henderson (J.), elected an honorary member of the Verein deutscher Eisenhüttenleute; work of, 675
- Henderson (Prof. J.), [death], 1043
- Henderson (J. R.), Fatigue and Air Movement in Rooms, 976
- Henne (A. L.), Fluoroform, 593
- Hentschel (C. C.), and Dr. W. R. I. Cook, Biology for Medical Students. Second edition (*Review*), 994
- Heptner (Prof. V. G.), General Zoogeography (*Review*), 663
- Herchenroder (M.), Atmospheric Pressure at Mauritius, 855
- Herrmann (Dr. H.), and G. Perlmann, Reaction between Proteins and Metaphosphoric Acid, 807
- Herskovits (Dr. M. J.), Woman Marriage in Dahomey, 284
- Hertzler (Prof. Joyce O.), The Social Thought of the Ancient Civilizations (*Review*), 914
- Hertzog (Genl.), The South African Protectorates, 99
- Herzberg (Prof. G.), translated by Prof. J. W. T. Spinks, Atomic Spectra and Atomic Structure (*Review*), 626
- Hess (Prof. V. F.), and A. Demmelmair, World-wide Effect in Cosmic Ray Intensity, as observed during a recent Magnetic Storm, 316
- Hesse (Prof. R.), Ecological Animal Geography. Prepared by W. C. Allee and K. P. Schmidt (*Review*), 620
- Hetherington (A. L.), Chinese Ceramic Glazes (*Review*), 382
- Hevesy (Prof. G.), Lord Rutherford, 1049; and E. Lundsgaard, Lecithinæmia following the Administration of Fat, 275; Dr. K. Linderström-Lang and N. Nielsen, Phosphorus Exchange in Yeast, 725; [L. Hahn and], Origin of Yolk Lecithin, 1059
- Hewer (H. R.), conferment upon, of the title of reader in zoology by London University, 778
- Hewitt (E. R.), Natural Colour Eclipse Photography, 271
- Hewitt (J.), New Forms of the Genus *Acontias* Linn., 1028
- Hewlett (Prof. R. T.), Dr. Carl Spengler, 797
- Hey (Dr. D. H.), and Dr. W. A. Waters, Free Radicals in Solution, 934
- Heyrovský (Prof. J.), and Dr. J. Novák, Overvoltage in Light and Heavy Water, 1022
- Hickman (V. V.), Embryology of the Crustacean *Anaspides*, 1018
- Hicks (Prof. G. Dawes), The Philosophical Bases of Theism (Hibbert lectures) (*Review*), 485
- Higgins (Dr. A. L.), conferment upon, of the title of reader in civil engineering by London University, 1110
- Higgs (A. J.), and Dr. S. E. Williams, Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, 603

- Hill (Prof. A. V.), National Factors of Physical Fitness (*Review*), 561
- Hill (Dr. C.), and Dr. H. A. Clegg, What is Osteopathy? (*Review*), 788
- Hill (Prof. W. C. Osman), Longevity of Monkeys, 72; Embryonic Monkeys and Man, 115; Blood-groups of Veddahs, 548
- Hillebrand (K.), Evolution of Cosmic Dust Clouds, 125
- Hills (N. G.), [J. C. Earl and], Action of Nitrous Acid on Amines, 1105
- Hjarre (A.), and H. Berthelsen, Method for fixing Neutralized in Supra-vital Stained Blood Smears, 155
- Hoare (Sir Samuel), elected Chancellor of Reading University, 694; Air Raid Precautions, 1044
- Hocart (A. M.), Polynesia Through Many Eyes (*Review*), 1080
- Hocart (R.), and M. Fallot, Identification of Various Phases by Magnetic Study and by the X-Rays in Alloys of Iron and Palladium, 81
- Hodgkin (A. L.), appointed demonstrator in physiology in Cambridge University, 123
- Hodgkin (R. H.), elected provost of Queen's College, Oxford; work of, 676
- Hodsman (H. J.), Institution of Gas Engineers: Autumn Research Meeting, 903
- Hogan (A. G.), [W. J. Robbins, Mary A. Bartley, L. R. Richardson and], Pyrimidine and Thiazole Intermediates as Substitutes for Vitamin B₁, 779
- Hogan (Dr. M. A.), [Prof. S. M. Dixon, G. Fitzgibbon and], Hydrography of the River Severn, 73
- Högbom (Prof. I.), Distribution of Raw Materials, 801
- Hogentogler (C. A.), and others, Engineering Properties of Soil (*Review*), 635
- Hole (D. R.), [Prof. R. H. Stoughton and], Photoperiodic After-Effect, 808
- Hollaender (A.), and W. D. Claus, Problem of Mitogenetic Radiation, 1007
- Holland (J. H.), Overseas Plant Products (*Review*), 914
- Holland (Sir Thomas), elected president of the Geographical Association, 582
- Hollick (Dr. F. S. J.), appointed a demonstrator in zoology in Cambridge University, 1026
- Holmes (Prof. A.), Origin of Lead Ores, 937
- Holmes (Dr. E.), The Metabolism of Living Tissues (*Review*), 91
- Holmes (Dr. F. T.), Frictionless Torque-free Suspensions, 1105; and Prof. J. W. Beams, Frictional Torque of an Axial Magnetic Suspension, 30
- Holmes (H. N.), and R. E. Corbet, Crystalline Vitamin A, 1020
- Holtermann (C.), and P. Laffitte, A New Oxide of Lead, 293
- Holway (A. H.), and W. J. Crozier, Law of Minimal Discrimination of Intensities (2), 943
- Hönigschmid, Atomic Weight of Phosphorus, 856; Atomic Weight of Neodymium, 1104
- Hopf (Prof. L.), Materie und Strahlung (Korpuskel und Feld) (*Review*), 386
- Hopkins (Sir Frederick Gowland), address at opening of the new Chemistry Laboratories at Birmingham, 121; elected president of the Cambridge Philosophical Society, 888
- Hopkins (Prof. R. H.), and B. Krause, Biochemistry applied to Malting and Brewing (*Review*), 705
- Hopwood (Dr. A. T.), Prof. Hans Reck, 351
- Hora (Sunder Lal), Researches on Indian Fishes, 367
- Horler (Lord), Health and a Day (*Review*), 705
- Horeau (A.), [M. Delépine and], Catalysis of the Cannizzaro Reaction by Active Nickel and Platinum, 208
- Hornblower (G. D.), Marriage of Osiris, 854
- Hornell (J.), Canoes of Polynesia, Fiji and Micronesia, 510
- Horowitz (N. H.), [A. Tyler and], Action of Certain Substituted Phenols on Marine Eggs in relation to their Dissociation, 779
- Hoskins (Prof. L. M.), [death], 716
- Hosoi (T.), Movement Within *Paramecium* Fragments, 647
- Houpillart (J.), [C. Dufraisse and], Dissociable Organic Oxides, 1027
- House (Prof. F. N.), The Development of Sociology (*Review*), 481
- Howchin (Rev. W.), [death], 1043
- Howe (Hon. C. D.), elected an honorary member of the Engineering Institute of Canada, 274
- Hoyle (F.), Capture of Orbital Electrons, 235
- Hrabik (O.), Local Transformation of Solid and Hollow Bones of *Molge cristata* Laur, 1074
- Hrdlička (Dr. A.), Racial History in the Arctic, 577; 'Minnesota Man', 1103
- Hubble (Dr. E.), Red Shifts and the Distribution of the Nebulae, 649
- Hüchel (Prof. W.), Lehrbuch der Chemie. Teil 2: Organische Chemie (*Review*), 868
- Hudspeth (H. M.), and D. W. Phillips, Coal Measure Rocks. Part 1, 813
- von Huene (Prof. F.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884
- Huffman (J. R.), [Prof. H. C. Urey, M. Fox, H. G. Thode and], Concentration of Nitrogen Isotope, 512
- Hughes (G. K.), and F. Lions, Derivatives of Higher Catechol Ethers, 695
- Huizinga (Dr. D. S.), elected president of the fifth International Grassland Congress, 249
- Hulubei (H.), Element 87 (Ml), 1111
- Humbert (Prof. P.), Pierre Gassendi, 732
- Humphries (C. F.), and Winifred E. Frost, Chironomid Fauna of the Submerged Mosses, River Liffey, 976
- Hungerford (S. J.), elected an honorary member of the Engineering Institute of Canada, 274
- Hunter (H.), awarded the gold medal of the North-East Coast Institution of Engineers and Shipbuilders, 500
- Hunter (Dr. J. de Graaff), Development in International Geodesy, 75
- Hunter (Dr. L.), and H. O. Chaplin, Evidence of Restricted Rotation about the N—C Bond in 2:6-Disubstituted Acetanilides, 896
- Hunter (T. G.), [M. Ba Thi, A. W. Nash and], and others, Solvent Dewaxing, 1105
- Huntingford (G. W. B.), Boats of Victoria Nyanza, 812
- Huntress (E. H.), Daily Chemical Anniversaries as a Teaching Tool, 616
- Huntsman (Prof. A. G.), elected president of the Royal Society of Canada, 287
- Hurley (F. H.), [A. F. Scott and], Atomic Weight of Carbon, 1068
- Hutchinson (Prof. Arthur), [death], 1043; [obituary article], 1087
- Hutton (Dr. Charles), Bicentenary of; work of, 269
- Hutton (Dr. J. H.), Assam Origins in relation to Oceania, 413; 487
- Huxley (Mrs. E.), Soil Erosion in the United States, 687
- Huxley (Dr. J.), [H. G. Wells, G. P. Wells and], Science of Life Series. 9 Vols. (*Review*), 484
- Huzayyin (Dr. S. A.), Egyptian University Scientific Expedition to South-West Arabia, 513
- Hyde (Dr. H. M.), and G. R. F. Nuttall, Air Defence and the Civil Population (*Review*), 661
- Ijdo (J. B. H.), Vitamin C in the Potato, 977
- Iimori (T.), Electron Diffraction Studies of Oxides formed on Iron, 278
- Iitaka (Dr. I.), A New Equilibrium Diagram for the System Fe—C, 462
- Ikebe (T.), [H. Nagaoka and], Magnetic Variation during an Explosion of Asamayama, and its Mechanism, 695
- Ikeda (K.), Self-Fertilization in Japanese Slugs, 591
- Ilse (Dora), New Observations on Responses to Colours in Egg-laying Butterflies, 544
- Imai (S.), An Edible Mongolian Fungus, 'pai-mo-ku', 695
- Imai (T.), Temperature and the Growth of *Drosophila* and of *Lymnaea*, 1067
- Imms (Dr. A. D.), Prof. V. L. Kellogg, 610; Invertebrates of the Faroes, 733
- Ingold (Prof. C. K.), appointed director of the Chemistry Laboratories of London University College, 654
- Inwards (R.), [death], 611; [obituary article], 715
- Iredale (Dr. T.), and A. Maccoll, Thermal Decomposition of Ethylene Bromide, 24

- Irving (Dr. J. T.), [D. N. Mullick and], Nutritional Value of Some Indian Diets, 319
- Isaac (W. E.), Evolution of a Growth-Inhibiting Emanation from Ripening Peaches and Plums, 1027
- Isherwood, Bt. (Sir Joseph), [death], 881
- Ishida (Yoshio), Collision of Two Oil Drops and the Stability of a Non-spherical Oil Drop, 70; 158; I. Fukushima and T. Suetsugu, Determination of Electronic Charge by the Oil Drop Method, 29
- Ishii (C.), [Dr. Y. Nishini and], A Cosmic Ray Burst at a depth equivalent to 800 m. of Water, 774
- Israels (Dr. M. C. G.), appointed a Foulerton research fellow, 1058
- Ito (Y.), [T. Minohara and], Ionosphere Observations in Japan during a Solar Eclipse, 814
- van Isterbeck (Prof. A.), and P. Mariens, Determination of the Relaxation Time for the Vibrational Energy of Carbon Dioxide, 850
- Ivanoff (Mlle. Nina), [V. Auger and], Molybdenum Blues, 293
- Ivanoff (S. S.), Lomonosov and Early Science in Russia (*Review*), 784
- Jackson (A. A.), [L. G. G. Warne and], Skatole as a Root Forming Substance, 26
- Jackson (D. A.), and Dr. H. Kuhn, Nuclear Moments of Aluminium, 110; Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium, 276
- Jacobi (Prof. H.), [obituary article], 880
- Jacobj (Prof. K.), Eightieth birthday of, 641
- Jacquet (P.), [L. Capdecemme and], Reflecting Power of Copper, 40
- Jacyna (W.), Differences in the Indications of Gas Thermometers, 167; Thermodynamic Scale below 1° K., 863
- Jaeger (J. C.), On Bremsstrahlung, 108
- Jaffray (J.), Stratified Geissler Discharge in Different Gases at Atmospheric Pressure, 477
- Jameson (A. H.), An Introduction to Fluid Mechanics (*Review*), 635
- Jausseran (C.), Anomalies of the Dispersion of Light by Colloidal Solutions of Silver, 209
- Javet (P.), [G. Tiercy and], Pulsation of Variable Stars of the Cepheid Type, 125
- Jears (Sir James), to preside over the jubilee meeting of the Indian Science Congress Association, 803; Science and Music (*Review*), 947
- Jebsen-Marwedel (Dr. H.), Glastechnische Fabrikationsfehler (*Review*), 830
- Jeffcott (Dr. H. H.), [death], 15; [obituary article], 183
- Jeffreys (Dr. H.), Reliability of Pacific Seismological Stations, 237
- Jena (Prof. L. S.), Indiana. I: Leben, Glaube und Sprache der Quiché von Guatemala; II: Mythen in der Muttersprache der Pipil von Izalco in El Salvador (*Review*), 788
- Jenkins (Prof. G. L.), and Prof. A. G. Du Maz, Quantitative Pharmaceutical Chemistry: containing Theory and Practice of Quantitative Analysis applied to Pharmacy. Second edition (*Review*), 634
- Jenkins (J.), resignation from Sheffield University, 735
- Jenkins (Rhys), The Collected Papers of (*Review*), 301
- Jenkins (R. B. M.), appointed assistant lecturer in civil engineering in Sheffield University, 904
- Jenkins (R. O.), [Dr. M. Benjamin and], Surface Migration of Barium, 152
- Jenks (Prof. A. E.), "Minnesota Man", 578; Pleistocene Man in Minnesota: a Fossil *Homo sapiens*. With a chapter on the Pleistocene Geology of the Prairie Lake Region, by Dr. G. A. Thiel, 596
- Jensen (Prof. B.), translated and revised by G. S. Avery, jun., and P. R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer, Growth Hormones in Plants (*Review*), 257
- Jentschke (W.), and G. Stetter, Short-range Particles emitted when Polonium α -Particles are scattered by Heavy Nuclei, 821
- Jenyns (R. S.), Early Chinese Bronzes, 591
- Jessen (K.), and A. Farrington, Bogs at Ballybetagh, with remarks on the development of Late-Glacial Deposits in Ireland, 376
- Joerg (W. L. G.), and O. M. Millar, Map of Ellsworth Trans-Antarctic Flight, 648
- Johnson (Prof. T. B.), A New Purine in Tea, 814
- Johnston (J. E.), [Dr. H. W. B. Skinner and], *M*-emission Bands of Zinc, Copper and Nickel, 508; Absorption Edges in the Soft X-Ray Region, 732
- Johnstone (Prof. R. J.), Some Thoughts on Medical Education, 186
- Jones (Prof. Bradley), Elements of Practical Aerodynamics (*Review*), 175
- Jones (C. D. P.), appointed a demonstrator in anatomy in Cambridge University, 123
- Jones (Prof. F. Wood), appointed professor of anatomy in Manchester University; work of, 15
- Jones (G. Howard), The Earth Goddess: a Study of Native Farming on the West African Coast (*Review*), 698
- Jones (Rev. N.), [A. L. Armstrong, H. B. Maufe and], Antiquity of Man in Rhodesia, 469
- de Jong (W. F.), Two Spectrometers for X-Ray Analysis, 768
- Jongmans (Dr. W. J.), elected a foreign fellow of the Geological Society of London; work of, 883
- Jordan (Prof. H. E.), and Prof. J. E. Kindred, A Textbook of Embryology. Third edition (*Review*), 949
- Jordan (Dr. K.), Lord Rothschild, 574
- Jørgensen (A.), Practical Management of Pure Yeast: the Application and Examination of Brewery, Distillery and Wine Yeasts. Third edition, revised by A. Hansen (*Review*), 705
- Joyet-Lavergne (P.), Distinguishing the Zones of Oxidation in the Living Cell by the Method of Cobalt Salts, 125
- Jübermann (Fischer, Dietz and), Separation of the Rare Earths, 74
- Judge (A. W.), Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance. Third edition (*Review*), 704; Car Maintenance and Repair. Second edition (*Review*), 704
- Juilfs (J.), Ionization by Radioactive Gamma and Cosmic Rays in Different Gases, 767
- Julia (Prof. G.), Introduction mathématique aux théories quantiques: Éléments de géométrie infinitésimale (*Review*), 950; rédigés par Dr. G. Bourion, Exercices d'analyse. Tome 4 (*Review*), 445
- Jungers (J.), [Prof. M. de Hemptinne, Dr. J. Delfosse and], Raman Spectra of Deuteroethylene, 323
- Just (Dr. G.), appointed director of the Institute of Genetics of the Health Office of the Reich at Berlin-Dahlem, 766
- Juza (R.), and R. Langheim, Adsorption of Gases and Vapours on Activated Charcoal, 649
- Kadam (B. S.), and others, Genetics of Rice, 1068
- Kaempfert (W.), Science, Invention and Society, 803
- Kalekar (H.), Phosphorylation and Respiration, 1103
- Kamal (Prince Youssouf), Hallucinations scientifiques (les portulans) (*Review*), 662
- Kania (A.), Magnetic Declination at Cracow during the Period 1914-36, 335
- Kapitza (Dr. P.), Lord Rutherford, 1053
- Kaposi (Prof. Moriz), centenary of the birth of; work of, 717
- Karrer (Prof. P.), awarded, with Prof. W. N. Haworth, the Nobel prize for chemistry; work of, 882
- Kasner (E.), Trihornometry: a New Chapter of Conformal Geometry, 519
- Kasterin (N. P.), Aerodynamic and Electrodynamical Equations, 244
- Kaufmann (B. P.), and M. Demerec, Frequency of induced Breaks in Chromosomes of *Drosophila melanogaster*, 943
- Kavanagh (F.), [W. J. Robbins and], Intermediates of Vitamin B₁ and growth of Phycomyces, 943
- Kaye (Dr. G. W. C.), Noise and the Nation, 408; 446; 490

- Keane (J.), [J. Breen, T. J. Nolan and], Chemical Constituents of Lichens found in Ireland—*Pertusaria concreta*, 333; [Margaret Mohan, T. J. Nolan and], Chemical Constituents of Lichens found in Ireland—*Parmelia conspersa*, Ach., 376
- Kearns, Martin and Wilkins, Egg-Killing Washes, 469
- Keeble (Sir Frederick), Foundations of Terrestrial Life: The Soil and the Green Plant, 1107
- Keen (Dr. B. A.), African Agricultural Problems (*Review*), 698
- Keidan (I. J.), appointed an honorary demonstrator in anatomy in Leeds University, 942
- Keith (Sir Arthur), Bronze Bust of, 1094
- Kellner (Dr. L.), Infra-red Spectrum and Molecular Structure of Diketopiperazine and Tetramethyl-diketopiperazine, 193
- Kellogg (Prof. V. L.), [death], 309; [obituary article], 610
- Kemmer (Dr. N.), Interaction of Nuclear Particles, 192
- Kendal (Dr. L. P.), and Dr. L. H. Stickland, The Initial Stages of Glycolysis in Muscle Extracts, 360
- Kendrick (T. D.), Scandinavian Influence in Northumbrian Art, 1090
- Kennaway (Prof. E. L.), awarded the Baly medal of the Royal College of Physicians of London, 232; presented with the Baly medal of the Royal College of Physicians of London, 722
- Kennedy (J. M.), appointed lecturer in infectious diseases in Sheffield University, 207
- Kennedy (J. S.), Phase Transformation in Locusts in the Field, 889; [Dr. D. L. Gunn, D. P. Pielou and], Classification of Taxes and Kineses, 1064
- Kennelly (Dr. A. E.), Giorgi's System of Units, 20
- Kent (Duke of), conferment upon, of an honorary doctorate by Birmingham University, 735
- Kent (Prof. N. A.), Royal M. Frye and W. H. Robinson, Structure of Ha of Hydrogen, 236
- Kenworthy (L.), Methods of Testing Zinc Coatings of Iron and Steel, 858
- Kermack (W. O.), and A. G. McKendrick, Tests for Random Observations, 369
- Ketelaar (Dr. J. A. A.), and E. A. Hanson, Elementary Cell and Space Group of Ethyl-chlorophyllide, 196
- Keynes (J. M.), and others, Britain and the Beast (*Review*), 623
- Khanna (Mohan Lal), [Prof. S. S. Bhatnagar, Dr. N. Lessheim and], The Ground State of the Se_2 Molecule, 152
- Kidson (E.), Cyclone Series in the Caribbean Sea, October 17–24, 1935, 286
- Kilpatrick (M.), [K. A. Krieger and], Conductance of Mixtures of Strong Electrolytes, 1020
- Kimball (R. F.), Inheritance of Sex at Endomixis in *Paramecium aurelia*, 943
- Kimura (K.), [B. Arakatsu, Y. Uemura and], Expulsion of Neutrons from Lead by Cosmic Rays, 277
- Kimura (T.), An Improvement on Cyanin Synthesis (mixed solvent process) and the reaction of Orthothioformic Ester, 695
- Kindred (Prof. J. E.), [Prof. H. E. Jordan and], A Textbook of Embryology. Third edition (*Review*), 949
- King (A. J.), [B. G. Churcher and], Performance of Noise Meters in Terms of the Primary Standard, 331
- King (Dr. E. J.), Solubility of Silica Dusts, 320
- Kishinouye (F.), Earthquake Swarm of Itô, Japan, 977
- Kisser (J.), and K. Lohwag, Histochemical Study of Lignified Cell Walls, 335
- Kitson (A.), [death], 611
- van Kleef (G.), [J. Clay and], Conductivity of Pure Gases at High Pressures, 1111
- Kleinholz (Dr. L. H.), and Dr. J. H. Welsh, Colour Changes in *Hippolyte varians*, 851
- Knight (Dr. B. H.), Geology in Engineering (*Review*), 259 Science and the Modern Highway (*Review*), 441
- Knowles (F. G. W.), elected to the Naples Biological scholarship of Oxford University, 166
- Kobayashi (R.), [J. Obata and], A Direct-reading Pitch Recorder and its applications to Music and Speech, 695
- Kobjakova (Z. I.), Decapod Crustacea of Japan, 72
- Koch (Dr. J.), [Dr. O. R. Frisch, Dr. H. von Halban, jun., and], The Magnetic Field acting upon Neutrons inside Magnetized Iron, 360; Capture of Slow Neutrons in Light Elements, 895
- Kögl (Prof. F.), and others, Growth Factors, 161
- Kolkmeijer (Dr. N. H.), C. J. Krom and H. Kunst, X-Ray Intensifying Screens adapted to Structure Analysis, 67
- Koller (Dr. L. R.), The Physics of Electron Tubes. Second edition (*Review*), 133
- Koller, (Dr. P. C.), Human Sex Chromosomes, 429
- König (Dr. A.), Die Fernrohre und Entfernungsmesser. Zweite Auflage (*Review*), 831
- Konzett (H.), Promotion of Sleep and Narcosis by Dyes, 821
- Korenchevsky (Dr. V.), and K. Hall, Effects on Ovariectomized Rats of Progesterone Alone and in Combination with the other Sexual Hormones, 154; Histological Changes Produced by Castration and by Sex Hormones in the Adrenals of Normal and of Castrated Male Rats, 318
- de Körösy (Prof. K.), Transitive Interference in Gene Linkages, 322
- Kothari (Dr. D. S.), and B. N. Srivasava, Joule-Thomson Effect and Quantum Statistics, 970
- Kraft (J.), [A. Chrétien and], Uranyl Phosphites, 251
- Kramer (M. M.), [C. H. Whitnah, B. L. Kunerth and], Determination of Lactoflavin in Milk, 430
- Krause (B.), [Prof. R. H. Hopkins and], Biochemistry Applied to Malting and Brewing (*Review*), 705
- Kremann (Prof. R.); Mitbearbeitet von Dr. M. Pestemer, Zusammenhänge zwischen physikalischen Eigenschaften und chemischer Konstitution (*Review*), 831
- Krieger (K. A.), and M. Kilpatrick, Conductance of Mixtures of Strong Electrolytes, 1021
- Krishnan (Prof. K. S.), and A. Mookherji, Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields, 549; Crystal Structure and the Magnetic Anisotropy of $CuSO_4 \cdot 5H_2O$, 896
- Kritzmann (M. G.), [Prof. A. E. Braunstein and], Formation and Breakdown of Amino-acids by Intermolecular Transfer of the Amino Group, 503
- Kroeber (Prof. A. L.), [E. W. Gifford and], Pomo Culture, 686
- Krom (C. J.), [Dr. N. H. Kolkmeijer, H. Kunst and], X-Ray Intensifying Screens Adapted to Structure Analysis, 67
- Krug (Dr. C. A.), Chromosomes of Coffee Plants, 429
- Krzemieniewska (Mme. H.), and S. Krzemieniewski, The Myxobacteria-Cellulose-Degrading Agents, 167
- Krzemieniewski (S.), [Mme. H. Krzemieniewska and], The Myxobacteria-Cellulose-Degrading Agents, 167
- Kuczynski (Dr. R. R.), Registration and Population Trends, 966
- Kuenen (P. H.), Formation of Submarine Canyons, 117
- Kuhlmann (Prof. A. G.), The Individuality of Gliadin, 119
- Kuhn (Dr. H.), [D. A. Jackson and], Nuclear Moments of Aluminium, 110; Intensity Ratios of the Hyperfine Structure Components of the Resonance Lines of Potassium, 276
- Kuhn (Prof. R.), and P. Desnuelle, Protein of Yellow Enzyme, 936
- Kuhn (Dr. W.), appointed professor of physical chemistry in Kiel University, 358
- Kunashava (C. G.), [Prof. W. I. Vernadsky, B. K. Brunowsky and], Concentration of Mesothorium-I by Duckweed (*Lemna*), 317
- Kunerth (B. L.), [C. H. Whitnah, M. M. Kramer and], Determination of Lactoflavin in Milk, 430
- Kunst (H.), [Dr. N. H. Kolkmeijer, C. J. Krom and], X-Ray Intensifying Screens Adapted to Structural Analysis, 67
- Kunz (Prof. J.), and R. G. La Baw, Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
- Kynch (G. J.), [Dr. W. G. Penney and], Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd^{+++} Ion Due to Crystalline Fields, 109

- La Baw (R. G.), [Prof. J. Kunz and], Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
- Lachman (Dr. G. V.), awarded the Wakefield gold medal of the Royal Aeronautical Society, 1094
- Lacroix (A.), Reality of an Eruption of the Soufrière of Saint-Vincent in 1718, 656
- Łada (Dr. P.), [obituary], 1087
- Laffitte (P.), [C. Holtermann and], A New Oxide of Lead, 293; [J. Baron and], Inflammation of Acetaldehyde, 477
- Laidler (P. W.), Pipes and Smoking in South Africa, 656
- Laissus (J.), Cementation of Nickel by Beryllium, 251
- Lambert (Dr. R. H.), [Dr. S. E. Sheppard, R. D. Walker and], Mechanism of Optical Sensitizing of Silver Halides by Dyes, 1096
- Landau (Prof. E.), Übereinige neuere Fortschritte der additiven Zahlentheorie (*Review*), 950
- Landau (Dr. L.), and G. Rumer, Production of Showers by Heavy Particles, 682
- Langdon (Prof. S. H.), [obituary article], 14
- Langheim (R.), [R. Juza and], Adsorption of Gases and Vapours on Activated Charcoal, 649
- Langley (Miss E. A.), appointed by the Board of Education inspector of meals for school children, 641
- Langmuir (Dr. I.), Chemical Research, 901; [K. B. Blodgett and], Built-up Molecular Films, 470
- Lapage (Dr. G.), Nematodes Parasitic in Animals (*Review*), 526
- Larsen (Dr. K.), Invertebrates of Dybø Fjörd, 1018
- Larsen (M. J.), [D. Lewis and], Cancellation, Reinforcement and Measurement of Subjective Tones, 779
- Lauppe (W.), [Dr. G. Briegleb and], Raman Spectra of Oxonium Compounds, 236
- Laurie (A. H.), Age and Stock of Blue Whales, 201
- Laustsen (Winge and), Diploid and Haploid Colonies of a Yeast, 1104
- Law (Dr. R. R.), [Dr. V. K. Zworykin, W. H. Painter and], Projection Television, 286
- Lawrence (Prof. E. O.), awarded the Hughes medal of the Royal Society, 840; presented with the Hughes medal of the Royal Society; work of, 981
- Lawrence (R. F.), Odoriferous Glands of South African Harvest Spiders, 209
- Lawson (W.), [Prof. E. C. Dodds, M. E. H. Fitzgerald and], Estrogenic Activity of Some Hydrocarbon Derivatives of Ethylene, 772
- Lea (Dr. F. C.), Hardness of Metals (*Review*), 260
- Lea (Dr. F. M.), Hydraulic Cements, 899
- Leach (E. H.), appointed William Hulme lecturer in physiology at Brasenose College, Oxford, 166
- Leacock (Prof. S.), awarded the Lorne Pierce medal of the Royal Society of Canada, 287
- Le Bras (J.), [C. Dufraisse and], Combustible Substances, Regarded as Helping Incombustible Extinguishers, for the Practical Extinction of Flames, 905
- Leclainche (Prof. E.), seventy-fifth birthday of, 21
- Lecoq (R.), Influence of Iodine and of Some Inorganic and Organic Iodine Compounds on the Bone Lesions of Experimental Rickets, 334
- Lederer (Dr. E.), [A. E. Gillam, Prof. I. M. Heilbron, V. Rosanova and], Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
- Lee, (Dr. A. W.), Baffin's Bay Earthquake of 1933, 369
- Lee (Sir George), elected president of the Institution of Electrical Engineers, 104; Co-operation between the Engineering Professions, 799
- Leggett (D. M. A.), elected a fellow of Trinity College, Cambridge, 735
- Lehmann (Prof. A. L. F.), [death], 576; [obituary article], 960
- Lehmann (H.), [Dr. J. Needham and], Glyceraldehyde and Embryonic Glucolysis, 198
- Leighton (P. A.), [P. C. Cross, J. Burnham and], Structure of Water, 512
- Leitch (J. D.), and L. B. Leppard, Dust Control in Industry, 772
- Lejay (P.), General Characters of the Acceleration of Gravity in the Levant, 694; Absorption of Solar Radiation by the Atmosphere in Band A, 943
- Lemaître (Prof. G.), Longitude Effect and the Asymmetry of Cosmic Radiation, 23
- Lemberg (Dr. R.), B. Cortis-Jones and M. Norrie, An Oxyprophyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin, 65
- Lemoigne (M.), P. Monguillon and R. Desveaux, Reduction of Nitric Acid to Hydroxylamine by the Higher Plants, 293
- Leppard (L. B.), [J. D. Leitch and], Dust Control in Industry, 772
- Lescher (T. E.), Pharmacy To-day—Its Responsibilities, 228
- Lessheim (Dr. H.), [Prof. S. S. Bhatnagar, Mohan Lal Khanna and], The Ground State of the Se₂ Molecule, 152
- Leverhulme (Lord), Necessities of Scientific Training, 144
- Levi (Dr. F.), Diffraction of Light by Ultrasonics at Oblique Incidence, 969
- Levi-Civita (Prof. T.), Double Stars and Relativity, 470
- Levi-Strauss (C.), Clan Reciprocity among the Bororo, 429
- Levine (Dr. I.), Faithful Rebels: A Study in Jewish Speculative Thought (*Review*), 218
- Levy (Prof. H.), Application of Scientific Methods to Problems involving Social Relationships, 1055
- Levyns (M. R.), Geographical Distribution of Plants in the Western Portion of the Little Karroo, 657
- Lewis (A. D.), Roaring Sands of the Kalahari Desert, 285; Fulgurites from Witsands, Kalahari, 368
- Lewis (D.), and M. J. Larsen, Cancellation, Reinforcement and Measurement of Subjective Tones, 779
- Lewis (Prof. D. M.), [death], 226; [obituary article], 392
- Lewis (Miss L. F.), Secular Trends of Temperature, 899
- Lewis (M. M.), Infant Speech: a Study of the Beginnings of Language (*Review*), 172
- Lewis (T.), and E. E. Pochin, Pain Nerves, 325
- Lexer (Prof. E.), awarded the Goethe medal for art and science, 148
- Liebmann (H.), [Prof. J. A. Crowther and], An Effect of X-Radiation on the ζ Potential of Colloidal Graphite, 28
- Liepmann (H.), translated by Eden and Cedar Paul, Death from the Skies: a Story of Gas and Microbial Warfare (*Review*), 176
- Lignell (A.), Practical Difficulties in International Telephony, 312
- Linderstrøm-Lang (Dr. K.), Principle of the Cartesian Diver applied to Gasometric Technique, 108; [Prof. G. Hevesy, N. Nielsen and], Phosphorus Exchange in Yeast, 725
- Lindsay (Sir Harry), Interrelation between Science, Agriculture and Industry, 652
- Link (Prof. G. K. K.), Role of Heteroauxones in Legume Nodule Formation, Beneficial Host Effects of Nodules, and Soil Fertility, 507
- Linnett (J. W.), [Dr. H. W. Thompson and], Force Constants and Molecular Structure, 1065
- Lions (F.), [K. J. Baldick and], Derivatives of 6:7-Dimethoxybenzoparathiazine, 695; [G. K. Hughes and], Derivatives of Higher Catechol Ethers, 695
- Lipmann (F.), Pyruvic Acid Dehydrogenation, Vitamin B₁ and Cocarboxylase, 25; A Coloured Intermediate on Reduction of Vitamin B₁, 849
- Lips (Prof. J. E.), translated by V. Benson, The Savage Hits Back: or The White Man through Native Eyes (*Review*), 619
- Lipschütz (Prof. A.), Androgenic Endocrine Activity in the Female Mammal, 892
- Lipson (H.), [A. J. Bradley, H. J. Goldschmidt, A. Taylor and], Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543; [Dr. A. J. Bradley and], Rapid Survey of Ternary Alloy Systems by X-Rays, 1069
- Lissimore (N.), appointed honorary demonstrator in pathology in Leeds University, 942
- Ljungström (O.), Philosophical Overhaul, 615

- Llewellyn (F. J.), E. G. Cox and T. H. Goodwin, Crystalline Structure of Pentaerythritol, 430
- Lloyd (L. S.), Music and Sound (*Review*), 947
- Locher (G. L.), [Mary Nagai and], Production of Mutations by Neutrons, 111
- Lockhart (Dr. L. P.), Wider Issues of Health Legislation in Industry, 1090
- Lodge (Prof. Alfred), [death], 1002
- Loewe (Dr. F.), Meteorological Connexions between Greenland and Europe, 593
- Loewenthal (Dr. H.), [Dr. J. B. Bateman, Dr. H. Rosenberg and], Alleged Specific Effects of High-frequency Fields on Biological Substances, 1063
- Lohwag (K.), [J. Kisser and], Histochemical Study of Lignified Cell Walls, 335
- London (F.), A New Conception of Supraconductivity, 793; 834
- Longworth (L. G.), Densities of Mixtures of Light and Heavy Water, 900
- Loofbourow (Prof. J. R.), [G. S. Sperti, Sister Cecilia Marie Dwyer and], Proliferation-Promoting Substances from Cells Injured by Ultra-Violet Radiation, 643
- Loomis (Prof. F. B.), [death], 393
- Lord (Dr. R. C.), and Dr. A. Wright, Structure of Carbon Suboxide, 856
- Lorimer (J. H.), bequest to the Edinburgh Astronomical Association, 886
- Louderback (G. D.), Fault-Movements and the Safety of Reservoir Dams, 160
- Love (Prof. A. E. H.), awarded the Sylvester medal of the Royal Society, 840; presented with the Sylvester medal of the Royal Society; work of, 980
- Lovern (Dr. J. A.), Dr. J. R. Edisbury and Dr. R. A. Morton, A New Source of Vitamin A, 276
- Lowery (Dr. H.), appointed principal of the South-West Essex Technical College, 803
- Lowndes (A. G.), The Term "Gnathobase Lankester", 33; Body Orientation in Crustacea, 241
- Lowry (late Prof. T. M.), and A. C. Cavell, Intermediate Chemistry (*Review*), 910
- Lub (Mlle. Willy A.), Optical Spectrum of Actinium, 40
- Ludlam (Dr. E. B.), A. W. Pryde and H. Gordon Rule, Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
- Ludovici (A. M.), The Future of Woman (*Review*), 486
- Lundsgaard (E.), [Prof. G. Hevesy and], Lecithinæmia following the Administration of Fat 275
- Lunz (G. R.), Stomatopoda of the Bingham Oceanographic Collection, 551
- Lustig (Senator A.), [death], 576
- Lutenberg (A.), [Prof. M. Ushakov and], Oxidation of Cholesterol and Dehydroandrosterone by Means of Osmic Acid, 466
- Lyll (R. A.), awarded the scholarship of the North-East Coast Institution of Engineers and Shipbuilders, 500
- Lynch (Father J.), Effect of Occluded Hydrogen on the Rigidity of Metals, 363
- Lythgoe (Dr. R. J.), Structure of the Retina and the Role of its Visual Purple (Thomas Young oration), 1045
- Lyttelton (Dame Edith), Some Cases of Prediction: a Study (*Review*), 1078
- Lyttleton (Dr. R. A.), appointed a faculty assistant lecturer in mathematics in Cambridge University, 476
- Maby (C.), Sunspot Photography with a Small Visual Refractor, 552
- Macara (T.), Science and the Conservation of Food, 203
- Macarthur (Anne R.), Training in Domestic Science, 421
- MacBride (Prof. E. W.), Miss Dorothy Sladden, 184; Mendel, Morgan and Genetics, 348; Cytology of *Lepidosiren*, 932
- McCallien (W. J.), Structure of the Rathmullen District, Co. Donegal, 167
- McCarrison (Sir Robert), Nutritional Requirements of Pregnancy, 186
- Macht (Dr. D. I.), Absorption of Tri-brom Ethanol through the Skin, 849
- McCleary (Dr. G. F.), The Menace of British Depopulation (*Review*), 528
- Maccoll (A.), [Dr. T. Iredale and], Thermal Decomposition of Ethylene Bromide, 24
- McDermott (L. H.), Daylight Illumination Necessary for Clerical Work, 201
- MacDonald (J. Ramsay), Science and the Community (Radford Mather Lecture), 756; [obituary article], 839
- MacDonald (Malcolm), The South African Protectorates, 99
- McDougall (Prof. W.), *Journal of Parapsychology*, 272
- MacDowell (Dr. E. C.), Inheritance of Leukæmia in Mice, 368
- Macfarlane (Miss Eileen W. E.), Eastern Himalayan Blood-Groups, 591
- McGowan (Lord), Commercial Production of Oil from Coal, 143
- McGregor (A. G.), The Economic Reforms required for Lasting Prosperity and Peace, 354
- Mache (H.), and O. Moszkowicz, Ionization of Air at Low Pressures by γ -Rays, 1074
- Mellroy (Dame Louise), Nutritional Requirements of Pregnancy, 186
- McKendrick (A. G.), [W. O. Kermack and], Tests for Random Observations, 369
- Mackenzie (Sir Morell), centenary of the birth of; work of, 16
- MacKichan (I. W.), awarded a Medical Research Council junior research fellowship in tropical medicine, 274
- McKie (Dr. D.), [Prof. J. R. Partington and], Levity of Phlogiston, 1089
- McKinney (Dr. H. H.), Mutation in Tobacco Virus, 33
- Mackintosh (Sir Ashley), [death], 716
- MacLachlan (Dr. W. G.), Problem of Chemotherapy in Pneumonia, 901
- McLaughlin (D. B.), Spectrum of Nova Herculis, 593
- Maclean (Prof. M.), [death], 455; [obituary article], 673, MacMichael (Sir Harold A.), appointed High Commissioner and Commander-in-Chief for Palestine and Commissioner for Transjordan; work of, 1003
- Macnair (Dr. D. S.), [death], 1002
- MacNalty (Sir Arthur), Public Health in Great Britain, 927
- McVittie (Dr. G. C.), Hyperbolic Space, 773; Hyperbolic or Spherical Space, 1105
- Madelung (Prof. E.), unter mitarbeit von Dr. K. Boehle und Dr. S. Flüge, Die mathematischen Hilfsmittel des Physikers. Dritte Auflage (*Review*), 218
- Madge (C.), Mass-Observation, 229; and T. Harrison, 843
- Madigan (Dr. C. T.), Natural History and Science in South Australia, 419; Discovery of a Meteoric Crater and a Meteorite in Australia, 801
- Madsen (Dr. T.), re-elected president of the Health Committee of the League of Nations, 315
- Magat (M.), [H. Moureu, G. Wetroff and], Raman Spectra of the Two Forms of Phosphorus Pentachloride, 598; Stereochemical Structure of Phosphorus Pentachloride, 863
- Maillard (A.), and R. Friedrich, Products formed by the Incomplete Combustion of Light Liquid Hydrocarbons, 985
- Maillet (L.), Emission of X-Rays by Vacuum Tubes of Very Small Dimensions, Submitted to a High-frequency Current, 557
- Maimin (R.), [Prof. M. Frankel and], Natural Activation of Papain, 1015
- Maitra (A. T.), [Prof. K. Prosad and], Intensity and Structure Changes of the *La* Emission Lines of Cu and Fe on Intense Cooling of their Anticathodes, 464
- Makinson (R. E. B.), awarded a Strathcona exhibition for physics at St. John's College, Cambridge, 476
- Malan (Dr. A. I.), [Dr. P. J. Du Toit and], Phosphorus and Calcium Deficiency Diseases as Two Etiologically Distinct Entities, 153

- Malcolm (Dr. L. W. G.), appointed curator of the Horniman Museum, 228
- Malinowski (Prof. B.), The Dilemma of Contemporary Linguistics (*Review*), 172
- Maman (A.), The Octanes, 656
- Manlove (C. W.), Coloured Roads, 1091
- Mann (Dr. F. G.), and Dr. A. F. Wells, Phosphine and Arsine Derivatives of the Group I (b) Metals: Volatile Derivatives of Gold, 502
- Mann (Dr.), Arctic and Antarctic Diatom Floras, 1019
- Mannheim (Prof. K.), Ideology and Utopia: an Introduction to the Sociology of Knowledge (*Review*), 481
- Marais (E. N.), with a biographical note by his son, and translated by Winifred de Kok, The Soul of the White Ant (*Review*), 622
- Marconi (Marchese), [death], 142; [obituary article], 182
- Marett (Dr. R. R.), conferment upon, of an honorary doctorate by Oxford University; work of, 923
- Mariens (P.), [Prof. A. van Itterbeck and], Determination of the Relaxation Time for the Vibrational Energy of Carbon Dioxide, 850
- Mark (Prof. H.), The Synthesis of Large Molecules, 8
- Marr (J. W. S.), Antarctic Surveys: Work of the *Discovery* Investigations, 863
- Marshak (A.), Effect of X-Rays on Chromosomes in Mitosis, 779
- Marshall (Dr. F. H. A.), Sexual Periodicity, 284; Human Embryology (*Review*), 949
- Marshall (Dr. P. G.), *Para*-Cresol from the Urine of Pregnant Mares, 362
- Martin [Fajans and], Protective Spray Deposits, 511; [Kearns, Wilkins and], Egg-killing Washes, 469
- Martin (Dr. A. E.), [Dr. J. J. Fox and], Infra-red Absorption of Hydroxy Compounds near 3μ , 937
- Martin (Dr. H.), The Scientific Principles of Plant Protection: with Special Reference to Chemical Control (*Review*), 384
- Martin (H. E. L.), awarded the M. C. James medal of the North-East Coast Institution of Engineers and Ship-builders, 500
- Martin (P.), awarded the Denny marine engineering scholarship of the Institution of Naval Architects, 722
- Martyn (Dr. D. F.), and G. H. Munro; A. J. Higgs and Dr. S. E. Williams, Ionospheric Disturbances, Fade-outs, and Bright Hydrogen Solar Eruptions, 603
- Martynov (A.), Fossil Insects from Kansas Rocks, 116
- Masaryk (Prof. T. G.), [obituary article], 575
- Maseré (M.) and R. Paris, Constitution of Scoparoside (Scoparine) of *Sarothamnus scoparius*, 125
- Masiyama (Dr. Y.), Magnetostriction, 552
- Mason (Dr. T. G.), [Dr. E. Phillis and], Concentration of Solutes in Vacuolar and Cytoplasmic Saps, 370
- Massee (Dr. A. M.), The Pests of Fruits and Hops (*Review*), 215
- Massey (H. S. W.), Creation of Electron Pairs by Nuclear Capture of Neutrons, 292
- Masson (Sir David Orme), [death], 268; [obituary article], 534
- Masson (Prof. Irvine), Iodine, 1005
- Mather (G. Radford), founder of the Radford Mather Lecture; work of, 762
- Mather (Prof. T.), [death], 15; [obituary article], 96; 226
- Mather (Prof. W. T.), [death], 184
- Matherson (C.), Fisheries of Wales, 721
- Matsumoto (N.), Oriented Crystallization, 978
- Matthew (late Dr. W. D.), Paleocene Faunas of the San Juan Basin, New Mexico (*Review*), 46
- Maufe (H. B.), [A. L. Armstrong, Rev. N. Jones and], Antiquity of Man in Rhodesia, 469
- Maurice (Major-Genl. Sir Frederick), Haldane, 1856-1915: The Life of Viscount Haldane of Cloan, K.T., O.M. (*Review*), 989
- Maurice (H. G.), awarded the Johannes Schmidt medal, 104
- Maxwell, Bt. (Sir Herbert), [death], 797; [obituary article], 959
- Mayer (A.), Encyclopédie française. Tome 4: La vie (*Review*), 664
- Mayer (Dr. J.), Lag of Social Sciences, 1021
- Mayne (J. E. O.), Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes, 818
- Mazères (R.), Palaeolithic Man in Brittany, 352
- Mead (G.), awarded the Taylor gold medal of the Royal Aeronautical Society, 1094
- Meddlcott (Col. H. E.), Oil Transport in the Middle East, 312
- Mee (A. J.), Practical Organic Chemistry (*Review*), 634; Volumetric Analysis (*Review*), 831
- Meek (Dr. C. K.), Law and Authority in a Nigerian Tribe: a Study in Indirect Rule (*Review*), 826
- Meek (J. M.), [Dr. T. E. Allibone and], Development of the Spark Discharge, 804
- Mees (Dr. C. E. K.), Photography (*Review*), 566
- Meggy (A. B.), and Prof. R. Robinson, A Diene Synthesis Applicable to the Sterol Group, 282
- Megson (N. J. L.), and W. A. Wood, Examination of Synthetic Resins by X-Rays, 642
- De Meillon (B.), A Cage Colony of *Anopheles gambiae* Giles, 428
- Mellanby (Dr. Helen), appointed part-time demonstrator for medical and dental students in Sheffield University, 735
- Mellon (A.), [death], 393
- Melville (Dr. H. W.), Catalytic Reactions (*Review*), 827; [J. L. Bolland and], Analysis of Ternary Gas Mixtures by Thermal Conductivity Measurements, 63
- Mendel (Dr. B.), and Miss F. Strelitz, Specific Action of Ferricyanide on Aerobic Glycolysis of Tumour Cells, 771
- Menshutkin (Prof. B. N.), Trudy M. V. Lemonosova po Fisiķe i Chimii (*Review*), 784
- Menzies (W. J. M.), Migrations of Salmon, 326
- Metcalfe (G.), appointed Frank Smart student in botany of Cambridge University, 735
- Meusel (Prof. A.), Man and the Machine Age (*Review*), 45
- Meyer (E. A.), A Managed Gold Standard, 354
- Meyer (Prof. K. H.), and N. P. Badenhuizen, jun., Transformation of Hydrate Cellulose into Native Cellulose, 281
- Meyer (Prof. S.), Lord Rutherford, 1047
- Miall (L. M.), [Dr. S. Miall and], Chemistry, Matter and Life (*Review*), 300
- Miall (Dr. S.), and L. M. Miall, Chemistry, Matter and Life (*Review*), 300
- Michaelson (Prof. J. W.), [death], 226; [obituary article], 308
- Michell (Prof. J. H.), and M. H. Belz, The Elements of Mathematical Analysis. 2 Vols. (*Review*), 631
- Miescher (Dr. K.), W. H. Fischer and E. Tschopp, The Effect of Enol-Esters of Testosterone, 726
- Mihul (Constantin), [Mme. Irène Mihul and], Ionization of the Lower Part of the Ionosphere, 694
- Mihul (Mme. Irène), and Constantin Mihul, Ionization of the Lower Part of the Ionosphere, 694
- Miles (A. A.), appointed professor of bacteriology at University College Hospital Medical School, 166
- Milhoud (A.), Inflammation of Dirigible Balloons, 518
- Millar (O. M.), [W. L. G. Joerg and], Map of Ellsworth Trans-Antarctic Flight, 648
- Millard (W. S.), [late Rev. E. Blatter and], Some Beautiful Indian Trees (*Review*), 633
- Miller (N. C. E.), Lac in Malaya, 510
- Millikan (Prof. R. A.), [Prof. I. S. Bowen, Dr. H. V. Neher and], Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts, 23
- Mills (J. P.), The Rengma Nagas (*Review*), 564
- Milne (Prof. E. A.), elected president of the London Mathematical Society, 1094
- Milnthorpe (Miss W.), [Dr. B. P. Uvarov and], Locust Outbreak in Africa and Western Asia, Fifth Survey of the, 33
- Minakami (T.), [R. Takahasi and], Precursors of a Volcanic Eruption, 470

- Minnis (C. M.), [Prof. K. G. Emelús, E. B. Cathcart and], Electrical and Optical Properties of Iodine Vapour, 251
- Minohara (T.), and Y. Ito, Ionosphere Observations in Japan During a Solar Eclipse, 814
- Misch (L.), and van der Wyk, Structure of Crystallized Azulene, 737
- Mitlacher (M.), [H. Benndorf and], Stationary Air Currents in Closed Vessels, 1112
- Mitra (A.), Some Plant Diseases and Pests of India and their Control, 272
- Mitra (Prof. S. K.), and K. K. Roy, Anomalous Dielectric Constant of Artificial Ionosphere, 586; Anomalous Dielectric Constant of Artificial Ionosphere, 1066
- Miyabe (Naomi), Results of Re-levelling in Kyúsyú, Japan, 695
- Miyabe (Prof. N.), Crust Displacements in Japan, 776; Sanriku Earthquake Seawaves of 1936, 1020
- Moffat (C. B.), Mammals of Ireland, 292
- Mohan (Margaret), J. Keane and T. J. Nolan, Chemical Constituents of Lichens found in Ireland: *Parmelia conspersa* Ach., 376
- Moir (Reid), and Mr. and Mrs. MacAlpine Woods, Ancient Man in Devon, 367
- Mokhtar (M.), and Dr. A. M. Mosharrafa, Modes in Modern Egyptian Music, 548
- Molisch (Prof. H.), [death], 1043
- Molisch (H.), Influence of One Plant on Another which is Remote from It, 125
- Monguillon (P.), [M. Lemoigne, R. Desveaux and], Reduction of Nitric Acid to Hydroxylamine by the Higher Plants, 293
- Monnier (D.), B. Susz and E. Briner, Raman Spectra of Acrylic Acid and of Methyl Methacrylate, both Monomer and Polymerized, 737
- Mönnig (H. O.), A New Blow-fly Repellent, 812
- Montandon (Prof. G.), La civilisation Ainou et les cultures arctiques (Review), 386
- Montel (Prof. P.), elected a member of the section of geography of the Paris Academy of Sciences, 104
- de Montessus de Ballore (Count Robert), [obituary article], 226
- Mookherji (A.), [Prof. K. S. Krishnan and], Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields, 549; Crystal Structure and the Magnetic Anisotropy of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 896
- Moon (A. E.), Bright Meteor of November 9, 1102
- Moore (Dr. A. R.), Structure of Protoplasm, 367
- Moore (E. J.), Biology for Students of Pharmacy (Review), 633
- Moore (Sir John), [death], 716
- Moore-Brabazon (Lt.-Col. J. T. C.), Interpretations of Atomic Constitution, 893; 971
- Morgan (Dr. A.), conferment upon, of an honorary doctorate by Edinburgh University, 80
- Morgan (Sir Gilbert), Scientific Aspect of Chinese Glazes (Review), 382; and Dr. G. R. Davies, Preparation of Germanium and Gallium, 688
- Morgan (W. W.), Classification of Stellar Spectra, 430
- Morioka (S.), [H. Endó and], Magnesium Alloys, 978
- Moritz (Dr. A.), Population Policy in Germany, 678
- Morley (Prof. F.), [death], 716; [obituary article], 880
- Morris (L. E.), and R. H. Richharia, Crosses between Radish and Turnip, 285
- Morris (Dr. N.), appointed professor of materia medica and therapeutics in Glasgow University, 556
- Morrison (W. M.), Aluminium Manufacture in Great Britain, 163
- Morton (Dr. R. A.), [Dr. J. R. Edisbury, G. W. Simpkins and], A Possible Vitamin A₂, 234; [Dr. J. A. Lovern, Dr. J. R. Edisbury and], A New Source of Vitamin A, 276
- Mosallam (S.), [Prof. D. H. Bangham, Z. Saweris and], Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces, 237
- Mosharrafa (Dr. A. M.), [M. Mokhtar and], Modes in Modern Egyptian Music, 548
- Moszkowicz (O.), [H. Mache and], Ionization of Air at Low Pressures by γ -Rays, 1074
- Mott (Prof. N. F.), A Theory of Light Action and Latent Image Formation, 997; [R. W. Gurney and], Photolysis of Silver Bromide and the Photographic Latent Image, 1073
- Mottram (Dr. J. C.), [Dr. I. Doniach and], Sensitization of the Skin of Mice to Light by Carcinogenic Agents, 588; Photodynamic Action of Carcinogenic Agents, 933
- Moureu (H.), M. Magat and G. Wétroff, Raman Spectra of the Two Forms of Phosphorus Pentachloride, 598; Stereochemical Structure of Phosphorus Pentachloride, 863
- Moy-Thomas (J. A.), re-elected lecturer in zoology at Christ Church, Oxford University, 38
- Mukerjee (Prof. R.), Theory and Art of Mysticism (Review), 636
- Müller (Dr. A.), Structure of Metals, 1011
- Mullick (D. N.), and Dr. J. T. Irving, Nutritional Value of some Indian Diets, 319
- Munch (R. H.), [F. T. Gucker, jun. and], Nature of Calomel Vapour, 648
- Munro (G. H.), [Dr. D. F. Martyn and], Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, 603
- Munro (S. S.), [Prof. F. A. E. Crew and], Gynandromorphism and Lateral Asymmetry in Birds, 1027
- Murati (K.), [Prof. M. Nakaidzumi, Y. Yamamura and], Biological Effects of the Rays Produced by a Cyclotron, 359
- Murphy (Major P.), [death], 184
- Murphy (Dr. W. P.), A Weakness of Medical Research, 901
- Murray (Dr. M. M.), Fluorine Poisoning (Review), 483
- Myers (Dr. C. S.), In the Realm of Mind: Nine Chapters on the Applications and Implications of Psychology (Review), 705
- Myers (Dr. G. N.), appointed demonstrator in pharmacology in Cambridge University, 123
- Myers (R. J.), [Prof. W. D. Harkins and], Viscosity of Monomolecular Films, 465
- Nachmansohn (D.), Choline Esterase in the Central Nervous System, 427
- Nagai (Mary), and G. L. Locher, Production of Mutations by Neutrons, 111
- Nagaoka (H.), and T. Ikebe, Magnetic Variation during an Explosion of Asamayama, and its Mechanism, 695
- Nakaidzumi (Prof. M.), K. Murati and Y. Yamamura, Biological Effects of the Rays Produced by a Cyclotron, 359
- Nakaya (Prof. U.), and others, Snow Crystals, 345
- Nandi (Dr. H. K.), Trisomic Mutations in Jute, 973
- Nash (Prof. A. W.), Education and Training for the Oil Industry, 459; [M. Ba Thi, T. G. Hunter and], and others, Solvent Dewaxing, 1105
- Natanson (S.), Position of Maximum Optical Sensitivity of Sensitized Photographic Plates, 198
- Nath (N. S. Nagendra), β -Decay as Due to a Neutrino Shower, 278
- Naylor (G. F. K.), Occurrence of Palaeozoic Strata near Taralga, N.S.W., 377
- Nebel (B. R.), Mechanism of Polyploidy through Colchicine, 1101
- Needham (Dr. Dorothy M.), and R. K. Pillai, Coupling of Dismutations with Esterification of Phosphate in Muscle, 64
- Needham (Dr. J.), Latin Clarity and the Sciences of Life (Review), 664; Integrative Levels: a Reevaluation of the Idea of Progress (Herbert Spencer lecture), 679; and H. Lehmann, Glyceraldehyde and Embryonic Glucolysis, 198
- Neher (Dr. H. V.), [Prof. I. S. Bowen, Prof. R. A. Millikan and], Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts, 23
- Němec (Prof. B.), Duše Rostlin (The Soul of Plants) (Review), 1081

- Němec (Prof. B.), and others, Gold in Plant Ash, 73
 Neuberger (Prof. K.), sixtieth birthday of, 21; work of, 923
 Neugebauer (T.), A Theory of Ball Lightning, 814
 Neumann (M.), and P. Toutakin, Dissociation of Peroxides and the Cold Flame of Hydrocarbons, 598
 Neuss (Dr. J. D.), [Prof. W. Rieman, III and], Quantitative Analysis: a Theoretical Approach (*Review*), 914
 Nevin (T. E.), Rotational Analysis of the Visible O_2^+ Bands, 1101
 Newman (W. A. C.), [Sir Thomas Kirke Rose and], The Metallurgy of Gold. Seventh edition (*Review*), 258
 Newsham (J. C.), The Horticultural Note Book. Fifth impression (*Review*), 527
 Newton (H. W.), and H. J. Barton, Bright Solar Eruptions and Radio Fadings in 1935-36, 688
 Neyman (Dr. J.), [Prof. E. L. Dodd and], An International Conference on the Theory of Probability, 938
 Nice (Margaret N.), Population Study of the Song Sparrow, 159
 Nichols (Prof. E. L.), [death], 960
 Nicolau (A.), Thermomagnetic Study of Two Paramagnetic Solutions, 905; Thermomagnetic Properties and Constant Paramagnetism of the Ion UO_2^{++} in some Uranyl Salts in Aqueous Solution, 985
 Nielsen (N.), [Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and], Phosphorus Exchange in Yeast, 725
 Nigghi (Prof. P.), Mineral Chemistry and Crystal Structure (*Review*), 783; Das Magma und seine Produkte. Teil 1: Physikalisch-chemische Grundlagen (*Review*), 913
 Nikitin (B. A.), Chemical Properties of the Rare Gases, 643
 Nilakantan (P.), Temperature Variation of Magnetic Anisotropy of Organic Crystals, 29
 Nishini (Dr. Y.), and C. Ishii, A Cosmic Ray Burst at a Depth Equivalent to 800 m. of Water, 774
 Nitta (I.), and T. Watanabe, Hydrogen Bridges in Solid Pentaerythritol, 365
 Nobbs (P. E.), Design: a Treatise on the Discovery of Form (*Review*), 873
 Nocht (Prof. B.), eightieth birthday of, 845; award of Bernhard Nocht medals to Prof. J. Rodhain, Prof. E. Brumt, Dr. W. Fournau, Prof. E. Martini, Prof. E. Reichenow, Dr. P. Manson-Bahr, Prof. G. H. F. Nuttall, Prof. E. P. Snijders, Prof. N. H. Swellengrebel, Prof. G. Bastianelli and Sir Aldo Castellani, 1009
 Nolan (T. J.), [J. Breen, J. Keane and], Chemical Constituents of Lichens Found in Ireland—*Pertusaria concreta*, 333; [Margaret Mohan, J. Keane and], Chemical Constituents of Lichens found in Ireland: *Parmelia conspersa* Ach., 376
 Nolf (P.), awarded the Grand Cross of the Order of Leopold, 104
 Norman (J. R.), and Dr. F. C. Fraser, Giant Fishes, Whales and Dolphins (*Review*), 911
 Norman (Dr. V.), Essentials of Modern Medical Treatment (*Review*), 486
 Norrie (M.), [Dr. R. Lemberg, B. Cortis-Jones and], An Oxyporphyrin Hæmatin Compound as Intermediate between Protohæmatin and Verdohæmatin, 65
 Norrish (Prof. R. G. W.), and C. H. Bamford, Photodecomposition of Aldehydes and Ketones, 195
 North (Dr. F. J.), Humphrey Lhuys's Maps of England and of Wales, 813
 Northrup (Dr. E. F.) (Akkad Pseudoman), Zero to Eighty: being My Lifetime Doings, Reflections and Inventions, also My Journey Around the Moon (*Review*), 872
 Novak (F. V.), [Dr. F. Běhounek and], Retention of Radioactive Substances in the Body of Rats and the Lethal Dose, 106
 Novák (Dr. J.), [Prof. J. Heyrovský], Overvoltage in Light and Heavy Water, 1022
 Nuffield (Lord), gift to Oxford University for a new college; other gifts by him, 679, 697; conferment upon, of a degree by Oxford University, 819
 Numelin (Dr. R.), The Wandering Spirit: a Study of Human Migration (*Review*), 89
 Nurnberger (C. E.), Ionization Theory and Radio-biological Phenomena, 83
 Nuttall (Prof. G. H. F.), [death], 1087
 Nuttall (G. R. F.), [Dr. H. M. Hyde and], Air Defence and the Civil Population (*Review*), 661
 Nyrop (Dr. J. E.), The Catalytic Action of Surfaces. Second edition (*Review*), 827
 Obata (J.), and R. Kobayashi, A Direct-Reading Pitch Recorder and its Applications to Music and Speech, 695
 Ochoa (Dr. S.), appointed Ray Lankester investigator for 1937, 190; and C. G. Ochoa, Cozymase in Invertebrate Muscle, 1097
 O'Connor (J. M.), [Prof. E. J. Conway, D. K. O'Donovan and], Influence of Temperature on the Activity of the Kidney in Relation to its Influence on Oxygen Consumption, 40
 Odell (N. E.), Fjord Formation, 855
 O'Donovan (D. K.), [Prof. E. J. Conway, J. M. O'Connor and], Influence of Temperature on the Activity of the Kidney in Relation to its Influence on Oxygen Consumption, 40
 Oeser (Dr.), Factors of Vocational Guidance, 284
 O'Gorman (Dr. M.), Designation of "The Time-Space Continuum", 773
 Omer-Cooper (J.), Zoological Expedition to the Oasis of Siwa, Egyptian Libya, 919
 O'Neale (Dr. Lila M.), Early Peruvian Textiles, 32
 van Orde-de Lint (G. M.), and J. H. Shuurmans Stekhoven, jun., Parasitic Copepods of the North Sea and Baltic, 686
 Oppenheimer (Prof. C.), Die Fermente und ihre Wirkungen. Suppl. Lief. 6 (*Review*), 873
 Orde-Powlett (Hon. Nigel), Present and Future of Estate Woodlands, 817
 Orr (Dr. J. W.), elected reader in experimental pathology in Leeds University, 942
 Ortmann (H.), [N. Riehl and], Effect of Pressure on Phosphors, 593
 Orton (Prof. J. H.), Sex Biology of the Oyster and the Salmon, 68; Some Interrelations between Bivalve Spatfalls, Hydrography and Fisheries, 505; Oyster Biology and Oyster Culture: being the Buckland Lectures for 1935 (*Review*), 952
 Ortvay (Prof. R.), Problem of Reality in Physics, 313
 Osborn (A. W.), The Superphysical: a Review of the Evidence for Continued Existence, Reincarnation, and Mystical States of Consciousness (*Review*), 1078
 Osborn (R.), Freud and Marx: a Dialectical Study (*Review*), 344
 Osborne (Prof. W. A.), conferment upon, of an honorary doctorate of Queen's University, Belfast, 123; Why do Stranded Whales Die?, 1017
 Osgood (Dr. C.), Ethnography of the Tanaina, 898
 van Overbeek (J.), Effect of the Roots on the Production of Auxin by the Coleoptile, 293
 Owen (Dr. D.), Alternating Current Measurements at Audio and Radio Frequencies (*Review*), 637
 Owens (Dr. J. S.), The Electrorotor Smoke and Dust Meter, 331
 Painter (W. H.), [Dr. V. K. Zworykin, Dr. R. R. Law and], Projection Television, 286
 Palmer (W. G.), conferment upon, of a doctorate by Cambridge University, 1110
 Paneth (Prof. F. A.), Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures", 504; 809
 Pantin (Dr. C. F. A.), recommended for appointment as reader in invertebrate zoology in Cambridge University, 38; appointed reader in invertebrate zoology in Cambridge University, 904; and others, Transmission of Excitation in Living Material, 118
 Paramasivan (S.), Technique of the Painting Process in the Temple of Vijayalaya Cholivarvan in Pudukkottah State, 198

- Paris (R.), [M. Maseré and], Constitution of Scoparoside (Scoparine) of *Sarothamnus scoparius*, 125
- Parker (A.), Economic Position and Outlook in Germany, 541
- Parker (G. H.), Colour Changes Due to Erythrophones in the Squirrel Fish, *Holocentrus*, 83; Colour Changes in Elasmobranch Fishes, 469
- Parker (R. C.), [Prof. E. N. da C. Andrade and], Absolute Measurements of Sound Intensity, 34
- Parkin (M.), Jøbsen-Marwedel's Glastechnische Fabrikationsfehler (*Review*), 830
- Parnell (I. W.), Control of Nematodes of Horses and Sheep, 686
- Parodi (M.), Transmission of some Oxides in the Extreme Infra-Red, 208; Characteristic Frequencies of Chlorates, Bromates and Iodates, 943
- Parr (G.), The Low Voltage Cathode Ray Tube: and its Applications (*Review*), 1032
- Parrington (F. R.), appointed a lecturer in zoology in Cambridge University, 904
- Partington (Prof. J. R.), Work of Prof. Richard Watson, 803; Chemistry in the Ancient World (Bedson lecture), 1006; and R. P. Towndrow, Heterogeneous Equilibria with Deuterium, 156; and Dr. D. McKie, Levity of Phlogiston, 1089; [E. G. Cowley and], Series Effect on the Dipole Moments of some Alkyl Halides, 1100
- Paterson (C. C.), conferment upon, of an honorary doctorate by Birmingham University, 80; work of, 351; 717; Appraisal of Lighting (Guthrie lecture), 763
- Paterson (T. T.), Palæolithic Succession in England, 775; appointed curator of the Cambridge Museum of Archaeology and of Ethnology, 904
- Patterson (E. L.), appointed assistant lecturer in anatomy in Manchester University, 207
- Patterson (J. B. E.), Cobalt, and Sheep Diseases, 363
- Patwardhan (Dr. S. S.), Palæmon, the Indian River Prawn, 580
- Pauling (L.), and L. O. Brockway, Carbon-Carbon Bond Distances, 688
- Pauthenier (M.), M. Feldenkrais and L. Vigneron, The Electrostatic Valve, 518
- Peacock (Prof. A. D.), and Dr. Ann R. Sanderson, Maturation in the Thelytokously Partheno-Genetic Tenthredinidae, 240
- Peak (D. A.), Stereochemistry of the Sterols and the Bile Acids, 280
- Peake (H. J. E.), Problems of the New Stone Age, 551
- Pearce (R. R.), [Prof. W. Sucksmith and], The Paramagnetic Magnetron Numbers of the Ferromagnetic Metals, 970
- Pearl (Prof. R.), Problems of Population Density, 32; Need for the Study of Human Biology, 145
- Pearse (Dr. H. L.), Effect of Hetero-auxine on the Growth of Broad Bean Plants in Water Culture, 26
- Pearse (Dr. R. W. B.), [A. G. Gaydon and], Band Spectrum of Chromium Hydride, CrH, 110
- Pearson (G. E.), conferment upon, of the Croix de Chevalier de la Légion d'Honneur, 315
- Pearson (Prof. N. E.), Fishes of Paraguay, 510
- Peczenik (O.), and L. Popper, Posterior Lobe of the Hypophysis and the Thyroid Gland, 821
- Pedersen (K. O.), [A. Tiselius, Prof. The Svedberg and], Analytical Measurements of Ultracentrifugal Sedimentation, 848
- Peek (B. M.), Physical State of Jupiter's Atmosphere, 776
- Peierls (Dr. R.), [Dr. J. F. Allen, M. Zaki Uddin and], Heat Conduction in Liquid Helium, 62
- Penney (Dr. W. G.), and G. J. Kynch, Absorption Spectra Evidence of the Decomposition of the Ground Term of Nd⁺⁺⁺ Ion due to Crystalline Fields, 109
- Pennington (Prof. S. C. B.), [death], 184; [obituary article], 225
- Péquart (Marthe et Saint-Just), M. Boule et H. Vallois, évieç: Station-nécropole mésolithique du Morbihan, 329
- Perier (A.), The Torus Mandibularis and its Ultimate Phylogenic Signification, 737
- Perkin (Prof. A. G.), [obituary article], 13
- Perlmann (G.), [Dr. H. Herrmann and], Reaction between Proteins and Metaphosphoric Acid, 807
- Pernier (Prof. L.), [death], 393; [obituary article], 495
- Perren (J.), Equation of Solubility of a Pure Substance Forming a Solid Compound with the Solvent, 477
- Perrier (C.), and Prof. E. Segrè, Radioactive Isotopes of Element 43, 193
- Perrottet (E.), [E. Briner and], Complementary Results on the Catalytic Action of Ozone in the Oxidation of Aldehydes, 737
- Perry (Sir Percival), conferment upon, of an honorary doctorate by Birmingham University, 80
- Pessler (Dr. W.), Volkstumsatlas von Niedersachsen. Lief. 1 u. 2 (*Review*), 785
- Peters (J. L.), Check-List of Birds of the World. Vol. 3 (*Review*), 1034
- Petrović (Dr. A.), Serbian Gypsy Feast-Days, 115
- Pétrý (P.), Interpretation of Observations and Measurements Relating to Breakers, 820
- Pettersson (H.), Abundance Ratio of Thorium to Uranium in Rocks and in the Sea, 821
- Pfeiffer (Dr. H. H.), Self-arrangement in the Mitotic Spindle under Mechanical Influence, 770
- Philby (H. St. John), Archæological Exploration in Arabia, 885
- Philip (G.), [death], 1043
- Philip (Prof. J. C.), appointed deputy vice-chancellor of London University, 207
- Phillips (D. W.), [H. M. Hudspeth and], Coal Measure Rocks. Part I, 813
- Phillis (Dr. E.), and Dr. T. G. Mason, Concentration of Solutes in Vacuolar and Cytoplasmic Saps, 370
- Phillips (Dr. P.), [obituary], 393
- Philpot (J. St. L.), elected a senior research fellow of Balliol College, Oxford, 694
- Picard (Prof. L.), Fauna and Climate in Early Palestine, 497
- Pickard (Sir Robert), elected vice-chancellor of London University, 207
- Pielou (D. P.), [Dr. D. L. Gunn, J. S. Kennedy and], Classification of Taxes and Kineses, 1064
- Pierce (E. L.), A Plankton Collector for Fast Towing, 1014
- Piercy (Dr. N. A. V.), Aerodynamics (*Review*), 635
- Piggott (S.), Origin of the Long Barrow, 1103
- Pigott (S. J.), Progress of Marine Engineering, 539
- Pillai (R. K.), [Dr. Dorothy M. Needham and], Coupling of Dismutations with Esterification of Phosphate in Muscle, 64
- Pirotta (Prof. P. R.), [death], 455
- Pittard (Prof. E.), Origins of Civilization and the Hittites, 677; and H. A. Seylan, Prognathism, Cranial Capacity and Area of the Occipital Perforation in the Anthropoids, 737
- Plate (Prof. L.), [death], 922
- Platonov (G. P.), [P. J. Schmidt and], Anabiosis and Fish Transport without Water, 557
- Plomley (N. J. B.), and G. B. Thompson, Distribution of the Biting-Louse, 199
- Plotnikow (Prof. J.), Allgemeine Photochemie. Zweite auflage (*Review*), 444
- Pochin (E. E.), [T. Lewis and], Pain Nerves, 325
- Pohl (R. W.), and others, Conduction of Electricity in Solids, 204
- Polanyi (Prof. M.), Congrès du Palais de la Découverte International Meeting in Paris, 710
- Pollak (L.), and G. Flaum-Fehér, Distribution of Sugar in the Body and the Action of Insulin, 821
- Polunin (Dr. N.), The Birch 'Forests' of Greenland, 939
- Ponsonby (Arthur), (Lord Ponsonby of Shulbrede), Life Here and Now: Conclusions Derived from an Examination of the Sense of Duration (*Review*), 341
- Poole (Dr. H. H.), Measurement of Submarine Daylight, 50; A Convenient Form of Galvanometer Shunt for Use with Rectifier Photo-cells, 376
- Poole (J. H. J.), A Synchronous Clock Time-marker, 376
- Popper (L.), [O. Peczenik and], Posterior Lobe of the Hypophysis and the Thyroid Gland, 821
- Porret (D.), and Dr. E. Rabinowitch, Reversible Bleaching of Chlorophyll, 321

- Potts (F. A.), [death], 536; [obituary article], 575
- Poulton (Sir Edward B.), *The History of Evolutionary Thought as Recorded in Meetings of the British Association*, 395
- Poulton (Dr. E. P.), *Heat Production, Nutrition and Growth in Man*, 413
- Praeger (Dr. R. L.), *The Way I Went; an Irishman in Ireland (Review)*, 870
- Prain (Sir David), eightieth birthday of; work of, 98
- Preiswerk (Dr. P.), [A. Braun, P. Scherrer and], *Detection of α -Particles in the Disintegration of Thorium*, 682
- Prentiss (Dr. A. M.), *Chemicals in War: a Treatise on Chemical Warfare. With chapters on the Protection of Civil Populations and International Situation*, by Major G. J. B. Fisher (*Review*), 3
- Prettre (M.), *Heterogeneous Combustion of Mixtures of Carbon Monoxide, Hydrogen and Oxygen on a Vitreous Surface*, 251
- Price (H. L.), appointed a faculty assistant lecturer in mathematics in Cambridge University, 476
- Price (Dr. J. A.), appointed honorary demonstrator in medicine in Leeds University, 942
- Price (W. C.), *Rapports sur la photoluminescence présentés à la réunion internationale de photoluminescence, Varsovie, 20-25 Mai 1936 (Review)*, 787
- Priestley (Prof. J. H.), *Mechanism of Growth in Plants (Review)*, 257
- Priestley (Dr. R. E.), appointed vice-chancellor of Birmingham University, 923, 942; work of, 923; the University and the National Life, 1007
- Pringle (J. W. S.), appointed a demonstrator in zoology in Cambridge University, 1026
- Pritchard (Capt. J. L.), *Flight in the Stratosphere*, 165
- Proctor (Mary), and Dr. A. C. D. Crommelin, *Comets: their Nature, Origin, and Place in the Science of Astronomy (Review)*, 566
- Prosad (Prof. K.), and A. T. Maitra, *Intensity and Structure Changes of the La Emission Lines of Cu and Fe on Intense Cooling of their Anticathodes*, 464
- Pruvot (M.), *Antarctic Polychaetes*, 647
- Pryde (A. W.), [Dr. E. B. Ludlam, H. Gordon Rule and], *Optical Rotatory Power of Turbid Solutions in an Electric Field*, 194
- Pryor (M. G. M.), awarded a Frank Smart prize of Cambridge University, 123
- Przedpelski (S.), [W. Broniewski, S. Sulowski and], *Some Physical and Chemical Properties of Very Pure Steels*, 334
- Pseudoman (Akkad), (Dr. E. F. Northrup), *Zero to Eighty: being My Lifetime Doings, Reflections and Inventions*, also *My Journey Around the Moon (Review)*, 872
- Puddle (F. C.), *Hybrids of the Rhododendron*, 813
- Pugh (B.), [Prof. W. T. David and], *Influence of Hydrogen and Water Vapour upon the Combustion of Carbon Monoxide Mixtures*, 1098
- Pugh (W.), *Mercurous Perchlorate as a Volumetric Reagent for Chlorides and Bromides*, 656; [F. Serba and], *Gallium* (4), 656
- Pugsley (A. G.), [Major B. C. Carter and], awarded the Edward Busk memorial prize of the Royal Aeronautical Society, 1094
- Pullen-Burry (Miss B.), [obituary], 922
- Pulley (Dr. O. O.), [Dr. A. L. Green and], *Control of Phase Fading in Long-distance Radio Communication*, 76
- Pulling (Grace E.), *The World from a Window Garden*, 722
- Purser (G. L.), *Succession of Broods of *Lebistes**, 155
- Purvis (O. N.), [Prof. F. G. Gregory and], *Devernization of Spring Rye by Anaerobic Conditions and Revernization by Low Temperature*, 547
- Pye (Dr. D. R.), *Metallurgy and the Aero Engine* (autumn lecture of the Institute of Metals), 516
- Pyman (Dr. F. L.), *Researches in Chemotherapy*, 409; *Chemotherapy of Amœbicides*, 832
- Quick (H. E.), [A. R. Waterson and], *Gronemertes dendyi Dakin, a Land Nemertean in Wales*, 292
- Quilliam (J. P.), awarded the university studentship in physiology in London University, 38
- Quinet (Mlle. Marie Louise), *Classification into Two Groups of the Complex Compounds of Magnesium Chloride with Oxygenated Organic Compounds, etc.*, 985
- Rabinowitch (Dr. E.), [D. Porret and], *Reversible Bleaching of Chlorophyll*, 321
- Rabkin (Dr. E. B.), *Polychromatic Plates for Color Sense Examination (Review)*, 49
- Radoitchitch (Mlle. Milka), *Influence of the Solvent on the Absorption Spectra of Neodymium Acetylacetonate*, 81
- Ragozina (M. N.), *Neural Induction by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus**, 199
- Rainey (R. C.), *Absolute Configuration of the Naturally Occurring α Amino-Acids*, 150
- Raman (Sir C. V.), appointed professor of physics at the Indian Institute of Science, Bangalore, 232
- Ramanathan (Dr. K. R.), *Effect of Near Lightning Discharges on a Magnetometer*, 587
- Ramsay (Dr. J. A.), appointed Harding lecturer in experimental zoology in Cambridge University, 904
- Ramsey (A. S.), *Dynamics. Part 2 (Review)*, 217
- Randall (J. T.), appointed to a Warren research fellowship, 232
- Rao (B. Sundara Rama), [Prof. S. Bhagavantam and], *Adiabatic and Isothermal Compressibilities of Heavy Water*, 1099
- Rao (N. K. A.), [Prof. B. N. Singh and], *Changes in Chloroplast Pigments in Leaves during Senescence*, 728
- Rapson (Prof. E. J.), [obituary article], 839
- Ratcliffe (J. A.), [K. G. Budden and], *An Effect of Catastrophic Ionospheric Disturbances on Low-frequency Radio Waves*, 1060
- Rattray (Dr. R. S.), *Indirect Rule in Nigeria (Review)*, 826; *Religion and Medicine of a West African People (Review)*, 869
- Raunkiaer (Prof. C.), translated by H. Gilbert-Carter, *Plant Life Forms (Review)*, 1035
- Raventos (J.), [A. J. Clark and], *Pharmacology of Tetramethylammonium*, 325
- Rawdon-Smith (Dr. A. F.), [C. S. Hallpike, Prof. H. Hartridge and], *Response of the Ear to a Phase Reversal*, 74
- Rawling (Dr. S. O.), *Action and Theory of Photographic Development*, 997
- Rawlins (F. I. G.), *The Natural Philosophy of Paintings*, 219; *Kremann's Zusammenhänge zwischen physikalischen Eigenschaften und chemischer Konstitution (Review)*, 831
- Ray (A.), [Dr. A. Girard, G. Richard and], *Antimicrobial Action of some Aromatic Compounds*, 283
- Rây (Sir P. C.), retirement from Palit professorship of chemistry at the Calcutta University College of Science and election as professor emeritus; work of, 762
- Rayleigh (Lord), *The Light thought to have been seen in the neighbourhood of Alternate Current Magnets*, 423; elected president of the British Association; work of, 456; *Surface Layers on Glass and Silica*, 470
- Raymond (Prof. A.), elected president of the International Congress of the History of Science and Technology, 1022
- Raymond-Hamet and Colas, *Botanical Origin of Chuchuaasha*, 334
- Read (Prof. H. H.), *Metamorphic Rocks of Unst, Shetland Island*, 731
- Read (Prof. J.), *Sir David Orme Masson*, 534; *The Growth of Modern Chemistry (Review)*, 624
- Reboul (G. and J.), *Ionizing Radiations of Low Quantum emitted spontaneously by the Ordinary Metals*, 1073
- Reck (Prof. H.), [death], 309; [obituary article], 351
- Reddi (K. R.), and Dr. V. Subrahmanyam, *'Sonti' Fermentation*, 33
- Redlich (Prof. O.), elected president of the Vienna Academy of Sciences, 332

- Reeds (Dr. C. A.), Catalogue of the Meteorites in the American Museum of Natural History, 542
- Reid (A.), [P. Evans and], Drilling Mud, 1025
- Reimann (Dr. A. L.), Photo-conductivity and Phosphorescence of Zinc-blende, 501; Temperature Variation of the work functions of Clean and of Thoriated Tungsten, 1073
- Reinig (W. F.), Die Holarktis (*Review*), 129
- Reissner (M. E.), Theory of Beams Resting on a Yielding Foundation, 519
- Renaud (Prof. E. B.), Prehistoric Archæology of North-Eastern New Mexico, 72
- Rendle (Dr. A. B.), [W. Fawcett and], Flora of Jamaica. Vol. 7, late S. Le Marchant Moore and Dr. A. B. Rendle (*Review*), 302
- Renier (Dr. A.), elected a foreign fellow of the Geological Society of London; work of, 883
- Reynolds (J. H.), Observational Evidence for the Distribution of Matter in Space, 387
- Reynolds (S. J. R.), appointed a demonstrator in anatomy in Cambridge University, 123
- Reynolds (Dr. S. R. M.), Hæmodynamic Factors in the Uterus during the latter part of Gestation, 546
- Rice (S. F.), awarded the Parsons scholarship in marine engineering of the Institution of Naval Architects, 722
- Rich (T.), Devices for Fighting Fires, 271
- Richard (G.), [Dr. A. Girard, A. Ray and], Antimicrobial Action of some Aromatic Compounds, 283
- Richardson (F. D.), [Dr. C. F. Goodeve and], Existence of Chlorous Anhydride, 737
- Richardson (L. J. D.), Axial Spin and Weapons of the Ancients, 1016
- Richardson (L. R.), [W. J. Robbins, Mary A. Bartley, A. G. Hogan and], Pyrimidine and Thiazole Intermediates as Substitutes for Vitamin B₁, 779
- Richharia (R. H.), [L. E. Morris and], Crosses between Radish and Turnip, 285
- Richmond (Dr. H. W.), Prof. Frank Morley, 880
- Rideal (Prof. E. K.), Surface Action in Biology, 671; [Prof. A. C. Cuthbertson, G. Gee and], The Kinetics of Polymerization, 889
- Ridley (P.), [Dr. G. W. Brindley and], Asymmetry in Metals of Hexagonal Structure, 461
- Ried (O.), Influence of Irradiated Metal Compounds on the growth and development of *Phaseolus vulgaris*, 335
- Riehl (N.), [G. Graue and], Investigation of Porous Structure, 327; and H. Ortmann, Effect of Pressure on Phosphors, 593
- Rieman, III (Prof. W.), and Dr. J. D. Neuss, Quantitative Analysis: a Theoretical Approach (*Review*), 914
- Ries (Prof. H.), and Dr. T. L. Watson, Engineering Geology. Fifth edition (*Review*), 259
- Rimington (Dr. C.), Porphyrins of the I₁ and III Series in Congenital Porphyria, 105; and G. C. S. Roets, Duality of the Coproporphyrins in Bovine Congenital Porphyria, 584; [P. J. Fourie and], Living Animal Cases of Congenital Porphyria, 68
- Rinck (E.), Diagram of Solidification and Electrical Conductivity of the Rubidium-Cæsium Alloys, 518
- Riou (P.), G. Delorme and H. Gamelin, Distribution of Manganese and Iron in the Conifers of Quebec Province, 1027
- Ritchie (A. D.), appointed Sir Samuel Hall professor of philosophy and public administration in Manchester University, 207
- Ritchie (Prof. J.), Natural History Outlook, 417; The Distribution of Animals (*Review*), 620
- Riverdale (Lord), appointed chairman of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 888
- Rivers (Dr. T. M.), appointed director of the Hospital of the Rockefeller Institute for Medical Research, 104
- Robb-Smith (Dr. A. H. T.), appointed assistant director of pathology at the Nuffield Institute, Oxford University, 38
- Robbins (W. J.), and Mary A. Bartley, Thiazole and the Growth of Excised Tomato Roots, 779; A. G. Hogan and L. R. Richardson, Pyrimidine and Thiazole Intermediates as substitutes for Vitamin B₁, 779; and F. Kavanagh, Intermediates of Vitamin B₁, and growth of *Phycomyces*, 943
- Roberts (Dr. A. L.), National Smoke Abatement Society: Annual Conference at Leeds, 691
- Roberts (E. J.), Grass Drying, 243
- Robertson (Sir Charles Grant), resignation from Birmingham University, 694
- Robertson (B. S.), appointed lecturer in regional anatomy in University College, Dundee, 207
- Robertson (Dr. J. M.), [A. R. Ubbelohde and], A New Form of Resorcinol, 239
- Robertson (Sir Robert), appointed director of the Salters' Institute of Industrial Chemistry, 722
- Robinson (G. A.), [E. S. Byng and], Education in Industrial Management, 79
- Robinson (late H. C.), and F. N. Chasen, The Birds of the Malay Peninsula. Vol. 3: Sporting Birds; Birds of the Shore and Estuaries (*Review*), 1034
- Robinson (Prof. R.), [E. P. Abraham and], Crystallization Lysozyme, 24; [A. B. Meggy and], A Diene Synthesis applicable to the Sterol Group, 282
- Robinson (W. H.), [Prof. N. A. Kent, Royal M. Frye and], Structure of H₂ of Hydrogen, 236
- Robson (J. M.), and Dr. A. Schonberg, Œstrogen Reactions, including Mating, produced by Triphenyl Ethylene, 196
- Rochester (G. D.), appointed assistant lecturer in physics in Manchester University, 207
- Roets (G. C. S.), [Dr. C. Rimington and], Duality of the Coproporphyrins in Bovine Congenital Porphyria, 584
- Rogers (C. G.), [death], 960
- Roholm (K.), Fluorine Intoxication (*Review*), 483
- Rolleston (Sir Humphry), Historical Relations of Pharmacy and Physic, 676
- Rolleston (Dr. J. D.), The Tobacco Habit, 615
- Roos (S. E.), Antarctic Structure, 813
- Rosanov (V.), [A. E. Gillam, Prof. I. M. Heilbron, Dr. E. Lederer and], Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils, 233
- Rose (Sir Thomas Kirke), and W. A. C. Newman, The Metallurgy of Gold. Seventh edition (*Review*), 258
- Rosen (A.), The Television Cable, 355
- Rosenberg (Dr. H.), [Dr. J. B. Bateman, Dr. H. Loewenthal and], Alleged Specific Effects of High-frequency Fields on Biological Substances, 1063
- Ross (Sir E. Denison), retirement of; work of, 185
- Rossier (P.), Definition of Stellar Colour Indexes; the Wien-Planck Correction in the Calculation of the Magnitude of a Star, 125
- Roths (Earl of), appointed chairman of the governors of Faraday House Electrical Engineering College, 190
- Rothschild (Lord), [death], 393; [obituary article], 574
- Rotter (Dr. H.), Protective Effect against Experimental Rickets of Rats of a single massive dose of Vitamin D, 973
- Roupell (Marion G.), Union Catalogue of the Periodical Publications in the University Libraries of the British Isles, with their respective holdings, excluding titles in the World List of Scientific Periodicals, 1934 (*Review*), 786
- Roure (H.), [J. Bosler and], Disappearance of Brélas Comet, 40
- Roussel (Dr. A.), and others, Researches into Norse Culture in Greenland, 52
- Roussot (A.), New Measurements of the Factor of Depolarization of Light diffused by Argon, 251
- Roussy (Dr.), elected rector of Paris University, 888
- Rowe (Prof. F. M.), [E. J. Cross and], Prof. A. G. Perkin, 13
- Roxby (Prof. P. M.), Geographical and Cultural Regions, 605
- Roy (K. K.), [Prof. S. K. Mitra and], Anomalous Dielectric Constant of Artificial Ionosphere, 586; 1066
- Roy (Ramesh Chandra), [Sarat Chandra Roy and], The Khâriās, 2 Vols. (*Review*), 213
- Roy (Sarat Chandra), and Ramesh Chandra Roy, The Khâriās, 2 Vols. (*Review*), 213

- Rule (H. Gordon), [Dr. E. B. Ludlam, A. W. Pryde and], Optical Rotatory Power of Turbid Solutions in an Electric Field, 194
- Rumer (G.), [Dr. L. Landau and], Production of Showers by Heavy Particles, 682
- Rushton (Dr. W.), Blindness in Freshwater Fish, 1014
- Rushton (Dr. W. A. H.), Transmission of Excitation in Living Material, 118; appointed lecturer in physiology in Cambridge University, 123
- Russell (Gen. F. F.), awarded the Buchanan medal of the Royal Society, 840; presented with the Buchanan medal of the Royal Society; work of, 980
- Rutherford (Lord), The Search for the Isotopes of Hydrogen and Helium of Mass 3, 303; [death], 717; Prof. A. S. Eve, 746; Prof. J. Chadwick, 749; Sir J. J. Thomson, 751; Sir William Bragg, 752; Prof. Niels Bohr, 752; Prof. F. Soddy, 753; Prof. E. N. da C. Andrade, 753; Sir Frank Smith, 754; Funeral of, 754; further tributes to the late, Prof. S. Meyer, 1047; Prof. A. Norman Shaw; Prof. Niels Bohr, 1048; Prof. G. Hevesy, 1049; Duc de Broglie, 1050; Prof. J. Stark; Prof. O. Hahn, 1051; Prof. E. Fermi; Prof. L. Wertenstein, 1052; Dr. P. Kapitza, 1053
- Van Rysselberghe (Prof. P.), [Prof. T. De Donder and], Thermodynamic Theory of Affinity (*Review*), 344
- St. Joseph (Dr. J. K. S.), appointed a demonstrator in geology in Cambridge University, 123
- Sainty (J. E.), Palaeolithic Man in Norfolk, 731
- Sakurai (Prof. J.), Beginnings of Western Science in Japan, 205; elected vice-president of the International Council of Scientific Unions, 641
- Salaman (Dr. R. N.), The Potato in its Early Home and its Introduction into Europe (Masters lectures), 159
- Salisbury (Prof. E. J.), Education and the Modern Study of Plants, 415; 669; 707
- Salmon (Sir Isidore), Metric System and British Export Trade, 1089
- Salt (Dr. G.), appointed a lecturer in zoology in Cambridge University, 904
- Sampson (Prof. R. A.), retirement of; work of, 227
- Sand (Dr. H. J. S.), The Sign and Symbol of Heat of Reaction, 809
- Sanderson (Dr. Ann R.), [Prof. A. D. Peacock and], Maturation in the Thelytokously Parthenogenetic Tenthredinidæ, 240
- Sang (J. H.), awarded a Hutchinson studentship for zoology at St. John's College, Cambridge, 476
- Sansome (Dr. F. W.), The New Cytology (*Review*), 1033
- Sarkar (S. N.), [Dr. S. R. Bose and], Enzymes of Wood-Rotting Polypores, 813
- Sarnoff (D.), Science and Society, 459
- Sato (M.), Barbels of Japanese Fish, 429
- Saunders (Sir Charles E.), [death], 184
- Saunders (Miss E. R.), Floral Morphology: a New Outlook, with special reference to the Interpretation of the Gynæceum. Vol. 1 (*Review*), 132
- Saunders (Dr. K. J.), [obituary article], 1043
- Saunders (O. A.), appointed Clothworkers' reader in applied thermodynamics at the Imperial College—City and Guilds College, London, 38
- Savory (T. H.), Mechanistic Biology and Animal Behaviour (*Review*), 49
- Saweris (Z.), [Prof. D. H. Bangham, S. Mosallam and], Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces, 237
- Sawyer (W. W.), appointed an assistant lecturer in mathematics in Manchester University, 207
- Sayers (J.), [Prof. K. G. Emeléus and], Negative Ions in Discharge Tubes, 1111
- Scarborough (H.), [Dr. C. P. Stewart, Dr. P. J. Drumm and], Isolation of Ascorbic Acid from Urine, 282
- Schapera (Prof. I.), Contributions of Western Civilization to Modern Kxatla Culture, 16
- Schebesta (Dr. P.), translated by G. Griffin, Revisiting My Pygmy Hosts (*Review*), 445
- Scherrer (P.), [A. Braun, Dr. P. Preiswerk and], Detection of α -Particles in the Disintegration of Thorium, 682
- Schiller (Prof. F. C. S.), [death], 268; [obituary article], 454
- Schintlmeister (J.), Redetermination of the Range of α -Particles from Thorium, 519; Shortening of the range of Polonium α -Particles by Oblique Emission from the Source, 821
- Schlesinger (Dr. F.), An Annual Change in Longitudes, 1068
- Schlesinger (H. I.), [A. B. Burg and], Borine Carbonyl, 74
- Schmid (Dr. R.), and Dr. L. Gerö, Structure of a New System of CO Bands, 508
- Schmidt (Prof. G. A.), Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula, 199
- Schmidt (Prof. H.), Einführung in der Vektor- und Tensorrechnung (*Review*), 302
- Schmidt (P. J.), and G. P. Platonov, Anabiosis and Fish Transport without Water, 557
- Schmitz (H.), Irish Species of the dipterous family, *Phoridae*, 1111
- Schönberg (Dr. A.), [J. M. Robson and], Œstrous Reactions, including Mating, produced by Triphenyl Ethylene, 196
- Schott (Prof. G. A.), [obituary article], 922
- Schouten (J. F.), Role of Electric, Photo-chemical and Diffusion Phenomena in Vision, 41
- Schramm (Prof. P. E.), translated by L. G. W. Legg, A History of the English Coronation (*Review*), 5
- Schrödinger (Prof. E.), awarded the Planck medal of the German Physical Society, 722; World Structure (*Review*), 742
- Schulman (Dr. J. H.), appointed assistant director of research in colloid science in Cambridge University, 291
- Schwab (H.), Changes in the Hyperglycæmic Action of Adrenalin by the addition of Zinc Salts, 943
- Scott (A. F.), and F. H. Hurley, Atomic Weight of Carbon, 1068
- Scott (C. M.), Some Quantitative Aspects of the Biological Action of X- and γ -Rays, 936
- Scott (K. G.), and S. F. Cook, Effect of Radioactive Phosphorus upon the Blood of Growing Chicks, 293; [S. F. Cook, P. Abelson and], Deposition of Radio-phosphorus in Tissues of Growing Chicks, 944
- Scott (R. B.), and F. G. Brickwedde, Liquid Parahydrogen, 1020
- Scrase (F. J.), [Sir George Simpson and], Distribution of Electricity in Thunderclouds, 732
- Sealy (J. R.), Classification in the Amaryllidaceæ, 73
- Seaman (Prof. A. E.), [death], 309
- Sebba (F.), and W. Pugh, Gallium (4), 656
- Secrett (F. A.), Production of Early Vegetables and Salads under Glass, 887
- Segrè (Prof. E.), [C. Perrier and], Radioactive Isotopes of Element 43, 193
- Seiwell (H. R.), Consumption of Oxygen in Sea Water under Controlled Laboratory Conditions, 506
- Sekiguti (Prof. R.), Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936, 724
- Seligman (G.), Physical Investigations on Falling Snow, 345; Snow Crystal or Snowflake? 730
- Sellar (W.), Geometry of Conical Pipes, Bends and Joints, 900
- Sen (B. K.), Volume-Rectification of Crystals, 1102
- Sen (P.), Researches on Indian Fishes, 367
- Senderens (Prof. J. B.), [death], 881
- Servigne (M.), and E. Vassy, An application of Luminescence to Quantitative Analysis: the Micro-estimation of the Element Samarium, 124
- Sesmat (Prof. A.), Systèmes de référence et mouvements (Physique classique). Parts 5, 6, 7 (*Review*), 994
- Seward (Sir Albert), presentation of a portrait of, to the Botany School, Cambridge, 845
- Seylan (H. A.), [E. Pittard and], Prognathism, Cranial Capacity and area of the Occipital Perforation in the Anthropoids, 737
- Shapiro (B.), and Prof. E. Wertheimer, Action of Pancreatic Extract on Fatty Liver, 771

- Shapter (R. E.), [H. C. Trumble and], Associated Growth of Herbage Plants, 1067
- Sharples (A.), [death], 309; [obituary article], 494
- Shaw (Prof. A. Norman), Lord Rutherford, 1048
- Shaw (Sir Napier), conferment upon, of an honorary doctorate by Athens University, 104
- Shaw (late Dr. Vernon), The Bournemouth Outbreak of Typhoid Fever, 145
- Shearer (Dr. G.), X-Rays in Industrial Research, 1069
- Shelford (V. E.), Animal Communities in Temperate America: as Illustrated in the Chicago Region—a Study in Animal Ecology (*Review*), 620
- Shennan (Prof. T.), conferment upon, of an honorary doctorate by Aberdeen University, 123
- Sheppard (Dr. G.), The Geology of South-Western Ecuador. With a chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. T. W. Vaughan (*Review*), 1035
- Sheppard (Dr. S. E.), Dr. R. H. Lambert and R. D. Walker, Mechanism of Optical Sensitizing of Silver Halides by Dyes, 1096
- Sherlock (Dr. R. L.), and others, Origin of the Red Rocks, 554
- Shimadzu (S.), Oriental Crystallization, 978
- Shimwell (J. L.), conferment upon, of a doctorate by Birmingham University, 1110
- Shipton (E.), Problems of Conquering Everest, 394
- Shorland (F. B.), New Zealand Fish Oils, 223
- Shorter (A. W.), Prof. A. Erman, 309
- Shryock (Prof. R. H.), The Development of Modern Medicine: an Interpretation of the Social and Scientific Factors Involved (*Review*), 386
- Sidgwick (Prof. N. V.), The Organic Chemistry of Nitrogen. New edition, revised and rewritten by T. W. J. Taylor and Dr. W. Baker (*Review*), 4; awarded a Royal medal of the Royal Society, 840; presented with a Royal medal of the Royal Society; work of, 980
- Siegbahn (Prof. M.), appointed Scott lecturer in Cambridge University for 1938-39, 1026
- Silberblatt (A.), awarded the Denny naval architecture scholarship of the Institution of Naval Architects, 722
- Sillifant (R. R.), Metal Spraying, 1105
- Silsbee (Dr. F. B.), Supraconductivity, 420
- Simonnet (H.), G. Guittoneau, G. Mocquot and A. Eyraud, Influence of Pasteurization in the Absence of Air on the Nutritive Value of Milk, 209
- Simpkins (G. W.), [Dr. J. R. Edisbury, Dr. R. A. Morton and], A Possible Vitamin A₂, 234
- Simpson (Sir George), Snow Crystal or Snowflake? 729; and F. J. Scrase, Distribution of Electricity in Thunderclouds, 732
- Simpson (Dr. J. C. E.), Structure of β -Boswellinic Acid, 467
- Simpson (J. F. Hope), elected a senior scholar in botany at Christ Church, Oxford University, 38
- Sinclair (Dr. H. M.), elected an official fellow and tutor in physiology at Magdalen College, Oxford University, 38; Growth Factors for *Phycomyces*, 361
- Singer (Prof. C.), Spirit of Science in History, 1021
- Singh (Prof. B. N.), and N. K. A. Rao, Changes in Chloroplast Pigments in Leaves during Senescence, 728
- Sinnott (E. W.), Relation of Gene to Character in Quantitative Inheritance, 83
- Skinner (Dr. H. W. B.), and J. E. Johnston, *M*-Emission Bands of Zinc, Copper and Nickel, 508; Absorption Edges in the Soft X-Ray Region, 732
- Sladden (Miss Dorothy), [obituary article], 184
- Slade (F. H.), Electricity and Marketing, 311
- Slade (Dr. R. E.), Grass and the Nation's Food Supply, 456; Grass Drying, 1089
- Sloley (Sir Herbert), [obituary article], 674
- Small (Dr. J. K.), The Proposed Everglades National Park, U.S.A., 263
- Smallman (Lt.-Col.), Cancer: Memorandum on Provision of Radio-Therapeutic Departments in General Hospitals, 356
- Smiles (Dr. Samuel), Memorial to, 537; 1004
- Smith (Miss A. Lorrain), [death], 496
- Smith (Dr. Edith Philip), Dr. A. H. Church, 268
- Smith (Ernest A.), The Standard of Anglo-Saxon Silver Pennies, 1085
- Smith (Eng.-Capt. E. C.), elected president of the Newcomen Society, 964
- Smith (Sir Frank), Lord Rutherford, 754
- Smith (J. L. B.), South African Fishes of the Families Sparidae and Denticidae, 334
- Smith (Sydney), Early Sculpture from Iraq, 647
- Smith (Dr. S.), appointed a demonstrator in zoology in Cambridge University, 1026
- Smith (Prof. S. Parker), The Electrical Equipment and Automobiles: a Book of Principles for Motor Mechanics and Motorists. Third edition (*Review*), 704
- Smithells (Dr. C. J.), Gases and Metals: an Introduction to the Study of Gas-Metal Equilibria (*Review*), 385
- Smith-Rose (Dr. R. L.), Detection of Destructive Larvae in Timber, 512
- Smythies (E. A.), The Hailey National Park, 651
- Snell (G. N.), and P. C. Aebersold, Production of Sterility in Male Mice by Irradiation with Neutrons, 779
- Soddy (Prof. F.), Lord Rutherford, 753
- Sokolow (A.), Neutrino Theory of Light in Three Dimensions, 810
- Sonneborn (T. M.), Sex, Sex Inheritance and Sex Determination in *Paramecium aurelia*, 779
- Spärck (R.), Benthonic Animal Communities of the Coastal Waters, 420
- Spear [Tansley, Glücksmann and], Radiation and Cell Division, 686
- Spearman (Prof. C.), Psychology Down the Ages. 2 Vols. (*Review*), 909
- Speck (F. G.), Delaware Ceremonies and Dances, 32
- Spencer (Dr. L. J.), elected a corresponding member of the Société Géologique de Belgique, 190; Tenham Meteoric Shower of 1879, 369; Meteorites: The number of Pultusk Stones and the spelling of "Widmanstätten Figures", 589; elected president of the Mineralogical Society, 888
- Spengler (Dr. Carl), [obituary article], 797
- Sperti (G. S.), Prof. J. R. Loofbourow and Sister Cecilia Marie Dwyer, Proliferation-promoting Substances from Cells Injured by Ultra-violet Radiation, 643
- Spilhaus (Prof. A. S.), elected a foreign member of the Royal Meteorological Society; work of, 1058
- Squire (Alderman C.), presidential address to the Museums Association, 164
- Squire (F. A.), Nocturnal Habits of *Platyedra gossypiella* Saunders, 69
- Srivastava (B. N.), [Dr. D. S. Kothari and], Joule-Thomson Effect and Quantum Statistics, 970
- Stamp (Dr. L. Dudley), and others, Planning the Land of Britain, 791
- Stamp (T. C.), appointed reader in bacteriology at the British Postgraduate Medical School, 778
- Stanley (Dr. W. M.), Tobacco Mosaic Protein, 648
- Stapledon (Prof. R. G.), Grassland Management in Great Britain, 99; The Hill Lands of Britain: Development or Decay? (*Review*), 1031
- Stark (Prof. J.), Lord Rutherford, 1051
- Staudinger (Prof. H.), Cellulose, Starch and Glycogen, 1071
- Stebbing (Prof. E. P.), The Threat of the Sahara, 460
- Stedman (R. E.), appointed lecturer in philosophy in University College, Dundee, 38
- Stein (Sir Aurel), Archaeological Reconnaissances in North-Western India and South-Eastern Iran (*Review*), 523
- Archaeological Reconnaissance in Southern Persia, 885; 925
- Stekhoven, jun. (J. H. Schuurmans), [G. M. van Oorde-de Lint and], Parasitic Copepods of the North Sea and Baltic, 686
- Stenz (Dr. E.), Number of Fragments of the Pultusk Meteorite, 113
- Stepanow (A. W.), Artificial Slip Formation in Crystals, 64
- Stern (Prof. C.), Interaction between Cell Nucleus and Cytoplasm, 770
- Stern (F. C.), Garden Plants from China, 1093
- Stetter (G.), [W. Jentschke and], Short-range Particles emitted when Polonium α -Particles are scattered by Heavy Nuclei, 821
- Stewart (Dr. C. P.), H. Scarborough and Dr. P. J. Drumm, Isolation of Ascorbic Acid from Urine, 282

- Stewart (Prof. J. Q.), and T. Stokley, Observation of the Longest Eclipse, 143
- Stewart (Sir Thomas Grainger), (1837-1900); work of, 393
- Stickland (Dr. L. H.), [Dr. L. P. Kendal and], The Initial Stages of Glycolysis in Muscle Extracts, 360
- Stieda (Ludwig), centenary of the birth of; work of, 840
- Stille (Prof. H.), elected a foreign correspondent of the Geological Society of London, 883; work of, 884
- Stirling (Hon. G.), elected an honorary member of the Engineering Institute of Canada, 274
- Stokley (T.), [Prof. J. Q. Stewart and], Observations of the Longest Eclipse, 143
- Stone (Dr. Abraham), [Dr. Hannah M. Stone and], A Marriage Manual: a Practical Guide-book to Sex and Marriage. English edition, edited by M. Fielding (*Review*), 445
- Stone (Dr. Hannah M.), and Dr. Abraham Stone, A Marriage Manual: a Practical Guide-book to Sex and Marriage. English edition edited by M. Fielding (*Review*), 445
- Stone (W.), [F. W. Fox and], Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products, 234
- Storks (K. H.), [L. H. Germer and], Structure of Langmuir-Blodgett Films of Stearic Acid, 779
- Störmer (Prof. C.), Variations of Cosmic Ray Intensity during Magnetic Storms, 549; Divided Aurora Rays with one part in the Sunlit and another in the Dark Atmosphere, 1095
- Stoughton (Prof. R. H.), and D. R. Hole, Photoperiodic After-Effect, 808
- Stradling (Dr. R. E.), and others, Chemistry of Building Materials, 607
- Stratton (Prof. F. J. M.), The Zodiacal Light at a Total Solar Eclipse, 682; Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936, 725; elected president of the Committee on Science and its Social Relations (C.S.S.R.), 983; and others, The Solar Eclipse of June 19, 1936, 11
- Streeter (Canon B. H.), [obituary article], 736
- Strelitz (Miss F.), [Dr. B. Mendel and], Specific Action of Ferricyanide on Aerobic Glycolysis of Tumour Cells, 771
- Strong (T. H.), [H. C. Trumble and], Associated Growth of Herbage Plants, 1067
- Stuart (N.), Spiriform Morphology of some Lead Crystal Growths in Silica Gel, 589
- Stubbings (G. W.), Commercial A.C. Measurements. Second edition (*Review*), 91
- Stubbs (Rev. A. J.), Metric System and British Export Trade, 1089
- Studebaker (Dr. J. W.), Adult Education in the United States, 816
- Sturtevant (Dr. A. H.), and Dr. C. C. Tan, Linkage Relations of Parallel Mutations in *Drosophila*, 812
- Subrahmanyam (Dr. V.), [K. R. Reddi and], 'Sonti' Fermentation, 33
- Sucksmith (Prof. W.), and R. R. Pearce, The Paramagnetic Magnetron Numbers of the Ferromagnetic Metals, 970
- Suetsugu (T.), [Y. Ishida, I. Fukushima and], Determination of Electronic Charge by the Oil Drop Method, 29
- Sugden (Prof. S.), appointed professor of chemistry at University College, London, 654
- Sullivan (J. W. N.), [death], 309
- Sulowski (S.), [W. Broniewski, S. Przedpelski and], Some Physical and Chemical Properties of very Pure Steels, 334
- Sumner (F. B.), and P. Doudoroff, Some Quantitative Relations between Visual Stimuli and the Production or Destruction of Melanin in Fishes, 83
- Sure (Prof. B.), The Little Things in Life: the Vitamins, Hormones and other Minute Essentials for Health (*Review*), 829
- Susz (B.), [D. Monnier, E. Briner and], Raman Spectra of Acrylic Acid and of Methyl Methacrylate, both Monomer and Polymerized, 737
- Sutherland (Dr. G. B. B. M.), Carbon-Halogen Distance in the Methyl Halides, 239; and G. K. Conn, Infra-red Spectrum of Tetradeuteroethylene, 644
- Svedberg (Prof. The), [A. Tiselius, K. O. Pedersen and], Analytical Measurements of Ultracentrifugal Sedimentation, 848
- Swaffield (J.), [W. Alexander and], Magnetostriction, 1068
- Swann (H. W.), Electrical Accidents and their Causes, 887
- Sweeney (Miss Beatrice M.), [Prof. K. V. Thimann and], Action of Auxin on Protoplasmic Streaming, 807
- Swinton (Dr. W. E.), Improvement of Museum Collections, 734
- Sykes (C.), and H. Wilkinson, Transformation in the β -brass, 857
- Symmers (Prof. W. St. Clair), [death], 611
- Symms (L. S. T.), [Dr. R. v. d. R. Woolley and], Two Visual Binary Orbits, 160
- Symonds (H. H.), Afforestation in the Lake District: a Reply to the Forestry Commission's White Paper of 26th August, 1936 (*Review*), 214
- Syms (L. T. S.), The Orbit of $O\epsilon$ 79, 688
- Synge (P. M.), Mountains of the Moon: an Expedition to the Equatorial Mountains of Africa (*Review*), 951
- Synge (R. L. M.), appointed Benn W. Levy student in biochemistry in Cambridge University, 778
- Szent-Györgyi (Prof. A.), awarded the Nobel prize for medicine; work of, 798; [A. Bentsáth and], Vitamin P, 426
- Takahasi (R.), and T. Minakami, Precursors of a Volcanic Eruption, 470
- Tan (Dr. C. C.), [Dr. A. H. Sturtevant and], Linkage Relations of Parallel Mutations in *Drosophila*, 812
- Tansley, Spear and Glückmann, Radiation and Cell Division, 686
- Tansley (Miss Katherine), conferment upon, of a doctorate by London University, 1110
- Tarr (Dr.), Brood Diseases of Bees Investigations, 578
- Tartar (H. V.), [W. H. Cone and], Passivity of Iron, 117
- Tattersall (Prof. W. M.), New Species of Mysidacid Crustaceans, 775
- Tauber (Dr. H.), Enzyme Chemistry (*Review*), 948
- Tawde (Dr. N. R.), and S. A. Trivedi, Vibration Temperature in relation to Rotation Temperature in Band Spectra, 463
- Taylor (A.), [A. J. Bradley, H. J. Goldschmidt, H. Lipson and], Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays, 543; [Dr. A. J. Bradley and], An X-Ray investigation of the cause of High Coercivity in Iron-Nickel-Aluminium Alloys, 1012
- Taylor (G. T.), [K. C. Bailey and], Retardation of Chemical Reactions, 327
- Taylor (H. S.), Heavy Hydrogen in Scientific Research (Bruce-Preller lecture), 124
- Terrey (H.), conferment upon, of the title of reader by London University, 207
- Thackeray (Dr. A. D.), appointed assistant director of the Solar Physics Observatory, Cambridge University, 80
- Théodoresco (Mme. Marie), Study of the Raman Effect of Two Molybdo-tartaric Complex Compounds in Water, 209
- Thimann (Prof. K. V.), and A. J. Haagensmit, Effects of Salts on Emergence from the Cyst in Protozoa, 645; and Miss Beatrice M. Sweeney, Action of Auxin on Protoplasmic Streaming, 807
- Thiselton-Dyer (G. H.), Water Supplies and Town Planning, 963
- Thode (H. G.), [Prof. H. C. Urey, M. Fox, J. R. Huffman and], Concentration of Nitrogen Isotope, 512
- Thomas (Prof. F. W.), elected president of the ninth All-India Oriental Conference and a corresponding fellow of the Philosophical and Historical Section of the Prussian Academy of Sciences; work of, 55
- Thomas (Prof. J. M.), Differential Systems (*Review*), 950
- Thompson (Sir D'Arcy Wentworth), elected president of the Royal Society of Edinburgh, 766
- Thompson (F. C.), [death], 455; [obituary article], 610
- Thompson (G. B.), [N. J. B. Plomley and], Distribution of the Biting Louse, 199
- Thompson (Dr. H. W.), and J. W. Linnett, Force Constants and Molecular Structure, 1065

- Thompson (J. E.), [W. H. H. Cowles and], A Text Book of Trigonometry: for Colleges and Engineering Schools (*Review*), 344
- Thompson (J. W.), W. Corwin and J. H. Aste-Salazar, Physiological Patterns and Mental Disturbances, 1062
- Thompson (Prof. R. Campbell), elected Shillito reader in Assyriology in Oxford University, 38; elected a professorial fellow of Merton College, Oxford, 694
- Thompson (W. P.), [J. W. Boyes and], Endosperm and Embryo in Reciprocal Cereal Crosses, 511
- Thompson (W. R.), Moisture and Farming in South Africa (*Review*), 698; Science and Common Sense: an Aristotelian Excursion (*Review*), 872
- Thomson (Prof. G. H.), Intelligence and Civilization (Ludwig Mond lecture), 59; Selection and Mental Factors, 934
- Thomson (Prof. G. P.), awarded, with Dr. C. J. Davison, the Nobel prize for physics; work of, 882
- Thomson (Prof. J. G.), [death], 309; [obituary article], 495
- Thomson (Sir J. J.), Lord Rutherford, 751
- Thornley (S. K.), appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 680
- Thornton (R. W.), [H. H. Curzon and], South African Native Cattle, 551
- Thornton (Prof. W. M.), conferment upon, of the title of emeritus professor by Durham University, 435
- Thornycroft (Sir J. E.), Evolution of Torpedo Craft, 763
- Thorpe (Prof. J. F.), and Dr. M. A. Whiteley, Thorpe's Dictionary of Applied Chemistry. Fourth edition. Vol. 1 (*Review*), 1076
- Tian (A.), and E. Gand, Ionic Dissociation of the Alkyl Halides, 293
- Tiercy (G.), and P. Javet, Pulsation of Variable Stars of the Cepheid Type, 125
- Tiessen (A. H.), [C. F. Brooks and], Meteorology of Great Floods in the Eastern United States, 511
- Tilley (Prof. C. E.), Rock Magmas and Their Products (*Review*), 913
- Tillyard (late Dr. R. J.), Fossil Insects from Kansas Rocks, 116; 1018; 1104
- Timmermans (J.), and H. Bodson, Surface Tension of Water and that of Heavy Water, 293
- Timoshenko (Dr. G.), Controlled Cathode Sputtering, 67
- Tincker (Dr. M. A. H.), Relation of Growth Substances to Horticultural Practice, 594
- Tiselius (A.), K. O. Pedersen and Prof. The Svedberg, Analytical Measurements of Ultracentrifugal Sedimentation, 848
- Tissot (Prof. J.), Origin of Tuberculosis and Nature of the Tubercle Bacillus, 775
- Todd (Dr. A. R.), appointed reader in biochemistry at the Lister Institute of Preventive Medicine, 778; Dr. F. Bergel, H. Waldmann and T. S. Work, Constituents of Vitamin E Concentrates from Rice- and Wheat-germ Oils, 361
- Tolansky (Dr. S.), Atomic Spectra and Atomic Structure (*Review*), 626
- Tomlinson (Miss M. L.), appointed a staff fellow of Girton College, Cambridge, 819
- van Tongeren (W.), Gravimetric Analysis: a Laboratory Manual with special reference to the Analysis of Natural Minerals and Rocks (*Review*), 665
- Toutakin (P.), [M. Neumann and], Dissociation of Peroxides and the Cold Flame of Hydrocarbons, 598
- Towndrow (R. P.), [Prof. J. R. Partington and], Heterogeneous Equilibria with Deuterium, 156
- Trask (Dr. P. D.), Origin of Oil, 857
- Travers (A.), and R. Diebold, Isolation of Pure Cementite by Acid Attack of Ferrous Materials, etc., 1073
- Travers (Prof. M. W.), Nitric Oxide and Alkyl Ethers, 107
- Tréherne (G.), [G. A. Boutry and], Commutable and Stable Electrical Contacts, 251
- van Tress (R.), Plants and the Dwelling- House, 420
- Tritton (Sir Seymour), [death], 960
- Trivedi (S. A.), [Dr. N. R. Tawde and], Vibration Temperature in relation to Rotation Temperature in Band Spectra, 463
- Tropfke (Dr. J.), Geschichte der Elementar-Mathematik in systematischer Darstellung: mit besonderer Berücksichtigung der Fachwörter. Band 3. Dritte Auflage (*Review*), 255
- Trumble (H. C.), and T. H. Strong; H. C. Trumble and R. E. Shapter, Associated Growth of Herbage Plants, 1067
- Tsai (B.), [H. Bizette and], Magnetic Rotatory Power of Compressed and of Liquefied Nitric Oxide, NO, 208
- Tschopp (E.), [Dr. K. Miescher, W. H. Fischer and], The Effect of Enol-Esters of Testosterone, 726
- Tuck (J. L.), awarded a Salters' Institute fellowship, 274
- Turin (J. J.), and H. R. Crane, The β -Rays from Lithium and Boron Isotopes, 776
- Turnbull (C.), Kelvin and the Atomic Theory, 888
- Turner (Eng.-Rear-Admiral A.), A Law of Hydrostatics and its Influence on the Shapes of Sailing Yachts, 597
- Turner (Prof. W. E. S.), Twenty-one Years: a Professor Looks out on the Glass Industry, 1071
- Turrill (Dr. W. B.), A New Species of *Sempervivum*, 1057; and others, Genetics and Toxonomy, 572
- Tyler (A.), and N. H. Horowitz, Action of certain substituted Phenols on Marine Eggs in relation to their Dissociation, 779
- Ubbelohde (R. R.), and Dr. J. M. Robertson, A New Form of Resorcinol, 239
- Uddin (M. Zaki), [Dr. J. F. Allen, Dr. R. Peierls and], Heat Conduction in Liquid Helium, 62
- Uemura (Y.), [B. Arakatsu, K. Kimura and], Expulsion of Neutrons from Lead by Cosmic Rays, 277
- Unckel (H.), Deformation of the Macrostructure of some Two-phase Alloys by Cold-rolling, 857
- Urban (Prof. F.), and Dr. M. D. Eaton, Spectroscopic Observations of Reactions between Lactoflavin, the Coulter Compound, 'Cytochrome b', and Cytochrome c, 466
- Urey (Prof. H. C.), Heavy Nitrogen, 496; Recent Technical Processes, 901; M. Fox, J. R. Huffman and H. G. Thode, Concentration of Nitrogen Isotope, 512
- Ushakov (Prof. M.), and A. Lutenberg, Oxidation of Cholesterol and Dehydroandrosterone by means of Osmic Acid, 466
- Ushenko (Prof. A. P.), The Philosophy of Relativity (*Review*), 636
- Uvarov (Dr. B. P.), and Miss W. Milnthorpe, Locust Outbreak in Africa and Western Asia, Fifth Survey of the, 33; Evolution of the Holarctic Fauna and Flora (*Review*), 129; Fundamentals of Zoogeography (*Review*), 663
- Vahlen (Dr. T.), made an honorary professor in Greifswald University, 21
- Valette (de La), Museum Study of Man and his Work, 1108
- Van der Pijl (W. L.), Asiatic Flower-Birds and American Bird-Flowers, 775
- Vassy (E.), [M. Servigne and], An application of Luminescence to Quantitative Analysis: the Micro-estimation of the element Samarium, 124
- Vaughan (Dr. T. W.), Tertiary Larger Foraminifera of Ecuador (Geology of South-Western Ecuador) (*Review*), 1035
- Vaultrin (R.), Utilization of Wood as Fuel for Motive Power, 59
- Veit (O.), Die Tragik des technischen Zeitalters: Mensch und Maschine im 19 Jahrhundert (*Review*), 54
- Venkateswaran (Dr. C. S.), The O-H Raman Frequency in Inorganic Acids, 151
- Venkateswaran (Dr. S.), The Law of Trade and Merchandise Marks in India (*Review*), 342
- Vernadsky (Prof. W. I.), B. K. Brunowsky and C. G. Kunasheva, Concentration of Mesothorium-I by Duckweed (*Lemna*), 317
- Vernon (C. O.), awarded a Pilcher memorial prize of the Royal Aeronautical Society, 1094
- Vernon (Dr. W. H. J.), and Dr. F. Wormwell, Corrosion of Water Mains and Services, 964

- Viehfefer (F.), Loss of Charge of α -Particles in Helium, 125
 Vigneron (L.), [M. Pauthenier, M. Feldenkrais and], The Electrostatic Valve, 518
 Villat (Prof. H.), Count Robert de Montessus de Ballore, 226
 Virchow (Prof. H.), eighty-fifth birthday of, 641
 Virtanen (Prof. A. I.), Associated Growth of Legumes and Non-Legumes, 248; Excretion of Nitrogen Leguminous Plants, 683
 Voelcker (Dr. J. A.), [death], 839; [obituary article], 1001
 Voitkevič (A. A.), Morphogenetic Activity of Different Parts of the Hypophysis (3 and 4), 599; (5), 821
 Vosburgh (W. C.), [R. G. Bates and], Potential of the Iodine Electrode, 776
- Waddington (A. G.), [G. B. Brooke and], Determination of Alumina in Metallic Aluminium, 858
 Wade (S. H.), awarded a Salters' Institute fellowship, 274
 de Wael (J.), [E. Havinga and], Monomolecular Films, 160
 Wager (Elizabeth M.), [H. G. Wager and], Annual Changes in the Osmotic Value of some Arctic and Temperate Plants, 376
 Wager (H. G.), and Elizabeth M. Wager, Annual Changes in the Osmotic Value of some Arctic and Temperate Plants, 376
 Wald (Dr. G.), Photo-labile Pigments of the Chicken Retina, 545; and H. Zussman, Carotenoids of the Chicken Retina, 197
 Waldie (J. S. L.), Prof. S. Pennington, 225
 Waldmann (H.), [Dr. A. R. Todd, Dr. F. Bergel, T. S. Work and], Constituents of Vitamin E Concentrates from Rice- and Wheat-germ Oils, 361
 Walker (Sir Gilbert), Mechanics of Sport, 567
 Walker (R. D.), [Dr. S. E. Sheppard, Dr. R. H. Lambert and], Mechanism of Optical Sensitizing of Silver Halides by Dyes, 1096
 Wall (Dr. T. F.), Magnetic Quality of Nickel Wire as influenced by the Surface, 238; Effect of Surface Treatment on Magnetic Permeability, 856
 Wallace (E.), Activities of the Association of British Chemical Manufacturers, 719
 Wallace (Dr. R. C.), The Higher Learning, 541
 Walther (Prof. J.), [death], 184
 Wambacher (Dr. Hertha), [Dr. Marietta Blau and], Measurement of the length of Proton Tracks by the Photographic Method, 252; awarded the Ignaz L. Lieben prize of the Vienna Academy of Sciences, 332; Disintegration Processes by Cosmic Rays with the Simultaneous Emission of several Heavy Particles, 585
 Wang (T. H.), [C. Y. Chao and], Spacing of the Resonance Neutron Levels of Silver, Rhodium and Bromine Nuclei, 768
 Ward (A. G.), awarded an external research studentship at Emmanuel College, Cambridge, 435
 Ward (Dr. A. J.), Theory and Practice of the Calculus (Review), 631
 Ward (Prof. H. B.), Migrations of Salmon, 355
 Wardlaw (Dr. W.), appointed professor of physical chemistry at Birkbeck College, 207
 Warrington (Miss Katherine), Boron in Agriculture, 1016; conferment upon, of a doctorate by London University, 1110
 Warne (L. G. G.), Effect of Spraying Solutions of Growth Substances on the Inflorescences of the Florists' Chrysanthemum, 1065; and A. A. Jackson, Skatole as a Root-forming Substance, 26
 Warren (F. L.), [F. G. Baddar and], Synthesis of Benzanthrones, 321
 Warwick (Countess of), gift of Easton Park, Dunmow, as a Nature Reserve, 800
 Watanabé (T.), [I. Nitta and], Hydrogen Bridges in Solid Pentaerythritol, 365
 Waters (Dr. W. A.), Decomposition of Benzene-Diazonium Chloride, 466; (Dr. D. H. Hey and), Free Radicals in Solution, 934
 van Waterschoot van der Gracht (Dr. W. A. J. M.), elected a foreign fellow of the Geological Society of London; work of, 883
- Waterson (A. R.), and H. E. Quick, *Geonemertes dendyi* Dakin, a Land Nemertean in Wales, 292
 Watson (D. M.), West Middlesex Main Drainage, 733
 Watson (Dr. G. W.), conferment on, of the title of emeritus professor by Leeds University, 778
 Watson (J. W.), appointed assistant lecturer in geography in Sheffield University, 207
 Watson (Prof. Richard), work of, 803
 Watson (Dr. T. L.), [Prof. H. Ries and], Engineering Geology. Fifth edition (Review), 259
 Watson, W., & Sons, Ltd., Centenary of, 844
 Watson-Watt (R. A.), A. F. Wilkins and E. G. Bowen, Reflection of Radio Waves in the Atmosphere, 512
 Watts (Prof. W. W.), A Century of Geological Investigation (Review), 915
 Waud (Prof. R. A.), Production of Artificial Respiration by Rhythmic Stimulation of the Phrenic Nerves, 849
 de Wavrin (Marquis), Mœurs et coutumes des indiens sauvages de l'Amérique de sud (Review), 344
 Wayland (E. J.), Dry Crossing of the Nile, 811
 Webster (H. C.), The γ -Rays of Polonium, 852
 Weeks (Dr. C. C.), Prohibition and Cirrhosis of the Liver, 20
 Weems (Lt.-Comdr. P. V. H.), Air Navigation: British Empire edition. Edited by A. J. Hughes and P. F. Everitt (Review), 630
 Weidenreich (Prof. F.), Reconstruction of the entire Skull of an Adult Female Individual of *Sinanthropus pekinensis*, 1010; *Sinanthropus* VI, 1067
 Weil-Malherbe (Dr. H.), Glycerophosphoric Dehydrogenase, 725
 Weiss (Dr. E.), centenary of; work of, 310
 Welch (Dr. G. B.), The number of Discriminable Colours, 28
 Wells (Dr. A. F.), [Dr. F. G. Mann and], Phosphine and Arsine Derivatives of the Group I(b) Metals: Volatile Derivatives of Gold, 502
 Wells (G. P.), [H. G. Wells, Dr. J. Huxley and], Science of Life Series. 9 Vols. (Review), 484
 Wells (H. G.), Star-Begotten: a Biological Fantasia (Review), 171; The Informative Content of Education, 415; Dr. J. Huxley and G. P. Wells, Science of Life Series. 9 Vols. (Review), 484
 Wells (R. C.), Chemical Analyses of Rocks and Minerals, 202
 Welsh (Dr. J. H.), [Dr. L. H. Kleinholz and], Colour Changes in *Hippolyte varians*, 851
 Wenger (P.), [C. Cimerman and], Micro-separation of Zinc by means of *o*-Oxyquinoline in Acetic Solution; Volumetric Micro-estimation of Zinc in Alkaline Solution, 737
 Wertenstein (Prof. L.), Lord Rutherford, 1052
 Wertheimer (Prof. E.), [B. Shapiro and], Action of Pancreatic Extract on Fatty Liver, 771
 Wesenberg-Lund (Prof. C.), Ferskvandsfaunaen biologisk belyst: Invertebrata. Bind 1 and 2 (Review), 992
 Wesenberg-Lund (E.), Gephyrea, 420
 West (T. F.), [Dr. N. F. Goodway and], Conversion of β -Phellandrene into a derivative of α -Phellandrene, 934
 Westblad (E.), A New Hydroid from Norway, 1104
 Westenhofer (Prof. M.), elected an honorary member of the Medical Association of Kinesiologists, Buenos Aires, 358
 Westergård (Dr. M.), Cytology of *Gagea spathacea*, 551
 Westoll (T. S.), Cheek Bones of Teleostomes, 72
 Weston (W. A. R. D.), [W. J. Dowson and], A Disease of Hawthorn, 116
 Wétroff (G.), [H. Moureu, M. Magat and], Raman Spectra of the Two forms of Phosphorus Pentachloride, 598; Stereochemical Structure of Phosphorus Pentachloride, 863
 Wetzler-Ligeti (C.), and Dr. B. P. Wiesner, Restropic Effects of Anterior Pituitary Extracts, 892
 Wheeler (Dr. R. E. Mortimer), Town Life in Early Britain (Norman Lockyer lecture), 924
 Wheeler (Prof. R. V.), awarded the medal of the Institution of Mining Engineers, 967

- White (Dr. F. W. G.), and L. W. Brown, Annual Variation of the Absorption of Wireless Waves in the Ionosphere, 931
- White (Miss Kathleen M.), *Mytilus* (Review), 633
- White (Dr. P.), [Dr. S. J. Folley and], Response of the Pigeon Crop Gland to Prolactin: Inhibition by Estradiol Monobenzoate, 505
- Whiteley (A. L.), Photo-electric Control in Industry, 927
- Whiteley (Dr. M. A.), [Prof. J. F. Thorpe and], Thorpe's Dictionary of Applied Chemistry. Fourth edition. Vol. 1 (Review), 1076
- Whitlock (H. P.), The Story of the Gems: a Popular Handbook (Review), 703
- Whitnah (C. H.), B. L. Kunerth and M. M. Kramer, Determination of Lactoflavin in Milk, 430
- Whitrow (G. J.), Galileo and Mathematical Demonstration, 646
- Whytlaw-Gray (Prof. R. W.), and others, Town Planning and Smoke Abatement, 691
- Wiesner (Dr. B. P.), [C. Wetzler-Ligeti and], Restropic Effects of Anterior Pituitary Extracts, 892; and A. L. Bacharach, Effect upon Sex Behaviour of a Diet Deficient in Vitamin E, 972
- Wiggers (Prof. C. J.), Physiology in Health and Disease. Second edition (Review), 133
- Wildman (Dr. A. B.), Non-specificity of the Trio Follicles in the Merino, 891
- Wilkins (A. F.), [R. A. Watson-Watt, E. G. Bowen and], Reflection of Radio Waves in the Atmosphere, 512
- Wilkins [Kearns, Martin and], Egg-Killing Washes, 469
- Wilkinson (B. G.), awarded a Frank Smart prize of Cambridge University, 123
- Wilkinson (H.), [C. Sykes and], Transformation in the β -brass, 857
- Willey (Prof. A.), Graded Mutations in Wings of a Stonefly, 112
- Williams (Dr. E.), appointed lecturer in electrical engineering in Durham University, 435
- Williams (F. E.), Natives of Mount Hagen, Papua, 115
- Williams (Dr. G.), Kinetics of Catalysed Polymerization of Styrene, 363
- Williams (G. Bransby), Storage Reservoirs (Review), 635
- Williams (Miss Margaret I.), appointed assistant lecturer in applied physiology in Manchester University, 207
- Williams (R. F.), Drift of Net Assimilation Rate in Plants, 1099
- Williams (R. R.), [J. K. Cline, J. Finkelstein and], Synthesis of Vitamin B, 856
- Williams (Dr. S. E.), [A. J. Higgs and], Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, 603
- Williamson (R. W.), edited by Dr. R. Piddington, Religion and Social Organization in Central Polynesia (Review), 1080
- Williamson (W. O.), Darkening of some Commercial Titanium Dioxide in Daylight, 238
- Wills (Capt. D. M.), Value of the Substations of the National Institute of Agricultural Botany, 843
- Wills (Prof. L. J.), Glaciation of the Midlands, 409; The Pleistocene History of the West Midlands, 995; 1036
- Wills (M. S.), awarded the Scott scholarship in physics of Oxford University, 166
- Wills (Cadet Ralph), awarded the Howard prize of the Royal Meteorological Society, 21
- Wilson (A. H.), The Theory of Metals: Based on an Essay awarded the Adams prize in the University of Cambridge, 1931-1932 (Review), 702
- Wilson, jun. (Dr. E. B.), presented with the one thousand dollar award of the American Chemical Society, 888
- Wilson (G. Fox), A Pest of the Rhododendron, 202; Root-Knot Eelworm, 898; Drilling of a Deep Pressure Test in India, 430
- Wilson (Dr. H. E. C.), appointed lecturer in Pathological Biochemistry at the Royal Hospital for Sick Children, Glasgow, 654
- Wilson (Miss Janet M.), A New Fungus Gall, 1019
- Wilson (Prof. P. W.), Excretion of Nitrogen by Leguminous Plants, 154; and E. B. Fred, Mechanism of Symbiotic Nitrogen Fixation, 943
- Wilson (W. C.), bequest to Cambridge University, 735
- Wimpenny (R. S.), Biology of Plankton Animals, 284
- Wimperis (H. E.), advising on Aeronautical Research in Australia, 722
- Winbolt (S. E.), With a Spade on Stane Street (Review), 486; Archaeological Evidence and 'Development', 764
- Winge (Dr. O.), Succession of Broods in *Lebistes*, 467
- Winge and Laustsen, Diploid and Haploid Colonies of a Yeast, 1104
- Wingfield (C. A.), Function of the Gills of the Mayfly Nymph, *Cloeon dipterum*, 27
- Winkel (A.), [D. Beischer and], Size of Particles Responsible for Ferromagnetism, 202
- Winterbottom (A. B.), Polarimetric Studies of Oxide Film Formation on Metals, 364
- Wiseman (Dr. J. D. H.), Basalts from the Carlsberg Ridge, 855
- Witherby (H. F.), "The Handbook of British Birds", 199
- Withers (T. H.), British Museum (Natural History). Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2: Cretaceous (Review), 873
- Witts (A. T.), Television Cyclopædia (Review), 1032
- Witts (Prof. L. J.), appointed a member of the Medical Research Council, 190; appointed Nuffield professor of clinical medicine in Oxford University, 819; and others, The Hæmorrhagic States, 243
- Woldrich (Prof. J.), [obituary], 309
- Wolf (E.), [W. J. Crozier, Gertrud Zerrahn-Wolf and], Specific Constants for Visual Excitation, 943
- Woltjer, jun. (Dr. J.), Maintenance of the Pulsation in Cepheid Variables, 195
- Wood (Sir Kingsley), Care and After-care of the Tuberculous, 101
- Wood (Prof. R. W.), Recent Improvements in Diffraction Gratings and Replicas, 723
- Wood (W.), [Dr. H. J. Gough and], X-Ray Methods in the Investigation of Failure in Service, 1069
- Wood (W. A.), [N. J. L. Megson and], Examination of Synthetic Resins by X-Rays, 642
- Woods (Mr. and Mrs. MacAlpine), [J. Reid Moir and], Ancient Man in Devon, 367
- Woolley (Dr. R. v. d. R.), and L. S. T. Symms, Two Visual Binary Orbits, 160; [Sir Frank Dyson and], Eclipses of the Sun and Moon (Review), 991
- Work (T. S.), [Dr. A. R. Todd, Dr. F. Bergel, H. Waldmann and], Constituents of Vitamin E Concentrates from Rice- and Wheat-germ Oils, 361
- Wormald (H.), Bacteriosis of Cherry Trees, 285
- Wormwell (Dr. F.), [Dr. W. H. J. Vernon and], Corrosion of Water Mains and Services, 964
- Wright (Dr. A.), [Dr. R. C. Lord and], Structure of Carbon Suboxide, 856
- Wright (D. A.), Structure and Resistance of Thin Metal Films, 107
- Wright (Dr. F. E.), elected a foreign fellow of the Geological Society of London, 883; work of, 884
- Wright (J.), British Grid System, 394
- Wrinch (Dr. Dorothy M.), Patterns of Proteins, 244; Cyclol Theory of the Structure of Insulin, 286; Cyclol Hypothesis and the 'Globular' Proteins, 940
- Wyckoff (Dr. R. W. G.), Virus Proteins, 648
- van der Wyk [L. Misch and], Structure of Crystallized Azulene, 737
- Wymer (F. J.), Transport in France, 1056
- Yadoff (O.), Electrical and Mechanical Ageing of Copper Conductors under the Prolonged Action of the Electric Current, 251
- Yamamoto (Prof. I.), Observations of the Solar Eclipse of June 8, 1937, 501
- Yamamura (Y.), [Prof. M. Nakaidzumi, K. Murati and], Biological Effects of the Rays produced by a Cyclotron, 359
- Yeates (Prof. T.), conferment upon, of the title of emeritu professor by London University, 1026
- Yenko (F. M.), [L. Baens and], Effect of Moulds upon Tanning Liquors, 687

- Yoe (Prof. J. H.), Chemical Principles with particular application to Quantitative Analysis (*Review*), 634; and R. T. Hall, Isotopes of Potassium, 34
- Zakharin (K. G.), Polarization of the Solar Corona, 586
- Zalessky (Prof. G.), Ancestors of some Groups of the Present-day Insects, 847
- Zangwill (O. L.), awarded a Harold Fry studentship at King's College, Cambridge, 435
- Zechmeister (Prof. L.), und Dr. L. v. Cholnoky, Die Chromatographische Adsorptionsmethode: Grundlagen, Methodik, Anwendungen (*Review*), 48
- von Zeerleder (Prof. A.), translated by A. J. Field, The Technology of Aluminium and its Light Alloys (*Review*), 176
- Zener (Dr. C.), Internal Friction of Wires, 895
- Zerrahn-Wolf (Gertrud), [W. J. Crozier, E. Wolf and], Specific Constants for Visual Excitation, 943
- Zeuner (Dr. F. E.), Pleistocene Relations in East Anglia and Germany, 647
- Ziemecki (Dr. S.), Use of Krypton-filled Ionization Chambers for Cosmic Ray Measurements, 150
- Zilva (Dr. S. S.), Vitamin P, 588
- Zimens (K. E.), Polymorphic Changes of the Alkaline-Earth Carbonates, 202
- Zondek (Prof. B.), Oestrogenic Substances in the Dead Sea, 240
- Zussman (H.), [G. Wald and], Carotenoids of the Chicken Retina, 197
- Zwarenstein (Dr. H.), Gonadotropic Activity of Amphibian Anterior Pituitary, 588; 656
- Zwicky (F.), A New Cluster of Nebulae in Pisces, 293
- Zworykin (Dr. V. K.), W. H. Painter and Dr. R. R. Law, Projection Television, 286

TITLE INDEX

- α -Amino-Acids, Naturally Occurring, Absolute Configuration of the, R. C. Rainey, 150
- α -Phellandrene in Essential Oils, Detection and estimation of, A. J. Birch, 377
- α -Phellandrene, derivative of, Conversion of β -Phellandrene into α , Dr. N. F. Goodway and T. F. West, 934
- Aberdeen University, conferment of an honorary doctorate on Prof. T. Shennan, 123
- Abyssinia, Naturalists in, [1837], 1072
- A.C. Measurements, Commercial, G. W. Stubbings. Second edition (*Review*), 91
- Academic Assistance Council, Third Report of the, 169
- Acetaldehyde, Inflammation of, J. Baron and P. Laffitte, 477
- Acetanilides, 2 : 6-Disubstituted, Evidence of restricted rotation about the N—C Bond in, Dr. L. Hunter and H. O. Chaplin, 896
- Achanarras, Middle Devonian Fish Fauna of, C. Forster Cooper, 292
- Acidosis and Off-flavoured Milk, Capt. H. Barkworth and L. W. L. Cole, 324
- Acontias* Linn., New Forms of the Genus, J. Hewitt, 1028
- Acoustical Conference, First International, 370
- Actinium, Optical Spectrum of, Mlle. Willy A. Lub, 40
- Adrenalin, Changes in the Hyperglycaemic Action of, by the addition of Zinc Salts, H. Schwab, 943
- Adsorption Columns, A. L. Bacharach (*Review*), 48
- Aerial Protection in Belgium, 1008
- Aerodynamic and Electrodynamic Equations, N. P. Kasterin, 244
- Aerodynamics : A Text-book of (*Review*), 175 ; Practical, Elements of, Prof. B. Jones (*Review*), 175 ; Dr. N. A. V. Piercy (*Review*), 635
- Aero Engine, Metallurgy and the, Dr. D. R. Pye, 516
- Aeronautical Research Committee, Report for 1935-36, 289
- Aeroplanes Fly, Why, A. Elton and R. Fairthorne (*Review*), 1035
- Affinity, Thermodynamic Theory of, Prof. T. De Donder and Prof. P. Van Rysselberghe (*Review*), 344
- Afforestation in the Lake District : a reply to the Forestry Commission's White Paper of 26th August, 1936, H. H. Symonds (*Review*), 214
- Africa : East, Higher Education in, 781 ; (*Review*), 951 ; Central, Blood Groups in, R. Elsdon Dew, 927
- African : Pleistocene Mammals (*Review*), 6 ; Agricultural Problems, Dr. B. A. Keen (*Review*), 698 ; Natives, Higher Education for, 781
- Aftermath : a Supplement to the Golden Bough, Sir James George Frazer (*Review*), 260
- Agricultural : Products as Raw Materials for Industry, Sir Harold Hartley (Mather lecture), 221 ; Research Council, awards made to P. J. Faulks, R. S. Russell, F. H. Malpress, J. Wilson, G. H. L. Dicker, J. W. Whittick, F. D. Asplin and Miss K. M. Massey, 274 ; Research in Great Britain, 421 ; Marketing Policy, A. N. Duckham, 887
- Agriculture : Seventeenth International Congress of, at The Hague, 35 ; British, The Rehabilitation of, 76 ; State Intervention in, J. M. Caie, 416 ; State Intervention and, 601 ; Boron in, Miss Katherine Warington, 1016
- Ainou, La civilisation et les cultures arctiques, Prof. G. Montandon (*Review*), 386
- Air : Altitude Record, World's, Flight-Lieut. M. J. Adam, 56 ; -Conditioning Unit, An, 101 ; Record, Long Distance, Col. M. Gromoff, 143 ; -Conditioning, Future of, 579 ; Navigation : British Empire edition, Lt.-Comdr. P. V. H. Weems. Edited by A. J. Hughes and P. F. Everitt (*Review*), 630 ; Defence and the Civil Population, Dr. H. M. Hyde and G. R. F. Nuttall (*Review*), 661 ; Raid Precautions (*Review*), 661 ; Memorandum No. 5, 967 ; Sir Samuel Hoare, 1044 ; Ionization of, at Low Pressures by γ -Rays, H. Mache and O. Maszkowicz, 1074 ; Currents, Stationary, in Closed Vessels, H. Benndorf and M. Miltacher, 1112
- Aldehydes and Ketones, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
- Alexander's Electric Telegraph, [1837], 984
- Algebra, College, Lectures on, S. B. Dandekar (*Review*), 831
- Alibert, Baron [1837], 777
- Alkaline-Earth Carbonates, Polymorphic Changes of the, K. E. Zimens, 202
- Alkyl : Ethers, Nitric Oxide and, Prof. M. W. Travers, 107 ; Halides, Ionic Dissociation of the, A. Tian and E. Gand, 293 ; Series Effect on the Dipole Moments of Some, E. G. Cowley and Prof. J. R. Partington, 1100
- All-India Oriental Conference, Ninth, Prof. F. W. Thomas elected president of the, 55
- Alloys : of Iron and Palladium, Identification of various phases by Magnetic Study and by the X-Rays in, R. Hocart and M. Fallot, 81 ; of Iron and Iridium, Magnetic properties of, M. Fallot, 820 ; Deformation of the Macrostructure of some Two-phase, by Cold-rolling, H. Unckel, 857 ; Metals and, Studies of, 857 ; of Silver, Tin and Mercury, Constitution of the, Dr. Marie L. V. Gayler, 858 ; of Iron and Rhodium, Magnetic Properties of, M. Follot, 905 ; Iron-Nickel-Aluminium, High Coercivity in, An X-Ray Investigation of the Cause of, Dr. A. J. Bradley and A. Taylor, 1012
- Alternating Current Measurements at Audio and Radio Frequencies, Dr. D. Owen (*Review*), 637
- Aluminium : Nuclear Moments of, D. A. Jackson and Dr. H. Kuhn, 110 ; Manufacture in Great Britain, W. M. Morrison, 163 ; and its Light Alloys, The Technology of, Prof. A. von Zeerleder. Translated by A. J. Field (*Review*), 176
- Amarylhidaceæ, Classification of the, J. R. Sealy, 73
- Amarylids, Culture of, 861
- Ambix*, No. 1, 188
- American : Documentation Institute, 273 ; Men of Science, Famous, J. G. Crowther (*Review*), 439 ; Museum of Natural History, Catalogue of Meteorites in the, Dr. C. A. Reeds, 542 ; Philosophical Society, Library of the, 615 ; Chemical Society, award of the Francis B. Garvan gold medal to Dr. Emma R. Carr ; presentation of the society's one thousand dollar award to Dr. E. B. Wilson, jun., 888 ; Earthquakes, Recent, 899 ; Academy of Arts and Sciences, Research Grants of the, 1106
- Amino-Acids : α , naturally occurring, Absolute Configuration of the, R. C. Rainey, 150 ; Formation and Breakdown of, by Intermolecular Transfer of the Amino Group, Prof. A. E. Braunstein and M. G. Kritzman, 503
- Amines, Action of Nitrous Acid on, J. C. Earl and N. G. Hills, 1105
- Ammonolatory : The Life Element, late Prof. H. E. Armstrong, 134
- Amœbicides, Chemotherapy of, Dr. F. L. Pyman, 832
- Amphibian Anterior Pituitary, Gonadotropic activity of, Dr. H. Zwarenstein, 588
- Anabiosis and Fish Transport without Water, P. J. Schmidt and G. P. Platonov, 557
- d'analyse, Exercices, Prof. G. Julia. Rédigés par Dr. G. Bourion. Tome 4 (*Review*), 445
- Anaspides*, Embryology of the Crustacean, V. V. Hickman, 1018
- Ancient : Man in Devon, J. Reid Moir and Mr. and Mrs. MacAlpine Woods, 367 ; Monuments in France, 613 ; Civilizations, The Social Thought of the, Prof. Joyce O. Hertzler (*Review*), 914

- Androgenic Endocrine Activity in the Female Mammal, Prof. A. Lipschütz, 892
- Anglo-Egyptian Treaty Honours List, 310; -Saxon Silver Pennies, The Standard of, Ernest A. Smith, 1085
- Angmering Roman Villa, Appeal for funds for the Excavation of, 228
- Animal: Magnetism [1837], 476; Communities in Temperate America: as illustrated in the Chicago Region—a Study in Animal Ecology, V. E. Shelford (*Review*), 620; Geography, Ecological, Prof. R. Hesse. Prepared by W. C. Allee and K. P. Schmidt (*Review*), 620; Life, Wild, Conservation of, [*Review*], 1079; Year Book, The, Vol. 4. Edited by Dr. H. E. Bargmann (*Review*), 1079
- Animals, The Distribution of, Prof. J. Ritchie (*Review*), 620
- Anopheles gambiae* Giles, A Cage Colony of, B. de Meillon, 428
- Antarctic: Polychaetes, M. Pruvot, 647; Structure, S. E. Roos, 813; Surveys: Work of the "Discovery" investigations (Bruce memorial prize lecture), J. W. S. Marr, 863; vegetation, 936
- Anthropology: Applied, appointment of a standing committee on, 145; an Introduction to Primitive Culture, Prof. A. Goldenweiser (*Review*), 632
- Antirrhinums, Rust-resistant, D. E. Green, 73
- Anuran Gastrula, Ectoderm of the, Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the, Prof. G. A. Schmidt, 199
- Apophallus venustus*, Life-history of, T. W. M. Cameron, 510
- Apeudes*, Feeding Mechanism of, R. Dennell, 469
- Arabia, Archaeological Exploration in, H. St. John Philby, 885
- Archaeological: Excavations in Great Britain, Recent, 352; Reconnaissances in North-Western India and South-Eastern Iran, Sir Aural Stein (*Review*), 523; Evidence and 'Development', S. E. Winbolt, 764
- Archæology, Racial Evolution and, Prof. H. J. Fleure (Huxley memorial lecture), 945, 981
- Archives, The Science of, in South Africa, Lt.-Col. C. G. Botha, 374
- Arctic: Weather Reports, 394; Racial History in the, Dr. A. Hrdlička, 577
- η Argus, Outburst of, Observed by Herschel, [1837], 1026
- Armstrong College, Research at, 273
- Aromatic Compounds, Antimicrobial Action of some, Dr. A. Girard, A. Ray and G. Richard, 283
- Arsine, Phosphine and, Derivatives of the Group I(b) Metals: Volatile Derivatives of Gold, Dr. F. G. Mann and A. F. Wells, 502
- Art and Artists, Primitive (*Review*), 619
- Asamayama, Magnetic Variation during an Explosion of, and its Mechanism, H. Nagaoka and T. Ikebe, 695
- Ascorbic Acid: Specificity of Indophenol in the estimation of, in Fermented Products, F. W. Fox and W. Stone, 234; from Urine, Isolation of, Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm, 282
- Ash, Alkalinity of the, and loss of Chlorine on Incineration, F. Baerts and R. Vandewijer, 943
- Asiatic Flower-Birds and American Bird-Flowers, W. L. Van der Pijl, 775
- ASLIB List, New, 147
- Assam Origins in relation to Oceania, Dr. J. H. Hutton, 413; 487
- Astrology, The Science of (*Review*), 701
- Athenæum*, The, and Meteorology [1837], 208
- Athens University, conferment of an honorary doctorate on Sir Napier Shaw, 104
- Atlantic: Air Mail Service, 56; Crossing, Fast, by Air, 581
- Atlantischen Ozeans, Temperatur, Salzgehalt und Dichte an der Oberfläche des, G. Böhnecke. Lief 1; Atlas (*Review*), 704
- Atmospheric: Pollution, Twenty-second report on, 101; Pressure at High Altitudes, Spectrum of Nitrogen and, R. Bernard, 930; Pollution, Conference on, 966
- Atomic: Spectra: and Atomic Structure, Prof. G. Herzberg. Translated by Prof. J. W. T. Spinks; Dr. S. Tolansky (*Review*), 626; and the Vector Model, A. C. Candler. 2 Vols. (*Review*), 626; Theory, Kelvin and the, C. Turnbull, 888; Constitution, Interpretations of, Lt.-Col. J. T. C. Moore-Brabazon, 893; Prof. E. N. da C. Andrade, 894; Constitution, Interpretations of, Lt.-Col. J. T. C. Moore-Brabazon, 971; Distances in Crystals, N. Elliott, 978; Constitution, Interpretation of, Prof. A. S. Eve, 1061
- Augustus, Emperor, Bimillenary of the, 577
- Aurora Borealis [1837], 736; Rays, Divided, with One Part in the Sunlit and another in the Dark Atmosphere, Prof. C. Störmer, 1095
- Aurous Compounds: Constitution of, Gold Mirrors, Prof. C. S. Gibson, 583
- Australia: Scientific and Industrial Research, Council for, tenth annual report, 18; and New Zealand, Science in, 231; Bioclimatic Zones of, Dr. J. Davidson, 265; Aeronautical Research in, H. E. Wimperis Advising on, 722; Horticultural Research in, 843; Aborigines of, 1004; Administration and the, 1044
- Australian Aborigines, Representation of the, 798
- Australia's Burden, 1029
- Australopithecus*, Discovery of a Lower Molar of, Dr. R. Broom, 681
- Autobahnen*, The German, 926
- Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance, A. W. Judge. Third edition (*Review*), 704
- Auxin: Effect of the Roots on the Production of, by the Coleoptile, J. van Overbeek, 293; Action of, on Protoplasmic Streaming, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807
- Avebury, Scheme for the Preservation of, 144
- Axial Magnetic Suspension, Frictional Torque of an, Dr. J. T. Holmes and Prof. J. W. Beams, 30; Spin and Weapons of the Ancients, L. J. D. Richardson, 1016
- Azande, Witchcraft, Oracles and Magic Among the, Dr. E. E. Evans-Pritchard (*Review*), 338
- Azobenzene, The *Cis*-form of, G. S. Hartley, 281
- Azulene, Crystallized, Structure of, L. Misch and van der Wyk, 737
- β -Decay as Due to a Neutrino Shower, N. S. Nagendra Nath, 278
- β -Boswellinic Acid, Structure of, Dr. J. C. E. Simpson, 467
- β -Rays from Lithium and Boron Isotopes, D. S. Bayley and H. R. Crane; J. J. Turin and H. R. Crane, 776
- β -Brass, Transformation in, C. Sykes and H. Wilkinson, 857
- β -Phellandrene, Conversion of, into a Derivative of α -Phellandrene, Dr. N. F. Goodway and T. F. West, 934
- Babbage's "Bridgewater Treatise", [1837], 434
- Bacon Factory, Hygiene in the, 60
- Bacteria in the Old Sedimentary Rocks, New Data on the Existence of, L. Cayeux, 124
- Bacterial Suspensions, Optical Properties of, P. Bonét-Maury, 985
- Baffin Bay, Expedition to, 1937, 1083
- Ball Bearings, Miniature, 539
- Band Spectra, Vibration Temperature in Relation to Rotation Temperature in, Dr. N. R. Tawde and S. A. Trivedi, 463
- Bantu Blood Groups, Dr. R. Elsdon Dew, 77
- Barium, Surface Migration of, Dr. M. Benjamin and R. O. Jenkins, 152
- Battersea Power Station, 720
- B.D.H. Laboratory Chemicals, Catalogue of the, 803
- Beams Resting on a Yielding Foundation, Theory of, M. E. Reissner, 519
- Bee Research Committee, Dr. J. Anderson appointed representative of the Scottish Beekeeper's Association on the, 274
- Bees: Investigations, Brood Diseases of, Dr. Tarr, 578; Management of, [1837], 984
- Beit: Memorial Fellowships, elections to, 102; Fellowships for Scientific Research, award of, 148

- Belfast : Queen's University : conferment of an honorary doctorate on Prof. W. A. Osborne, 123 ; conferment of honorary doctorates on Dr. G. C. Anderson, Sir E. Farquhar Buzzard, Dr. H. Morley Fletcher, Prof. E. W. H. Groves, Prof. S. P. Bedson, and Dr. A. Felix, 166
- Belgian : Stratosphere Balloon Experiment, Dr. M. Cosyns, 54 ; Royal Academy of Sciences, award of the Gluge prize of physiology to Prof. J. J. Bouckaert, 274
- Belgique, Société Géologique de, Dr. L. J. Spencer elected a corresponding member of the, 190
- Bonding Wood by Hand, Methods of, 977
- Benzanthrones, Synthesis of, F. G. Baddar and F. L. Warren, 321
- Benzene-Diazonium Chloride, Decomposition of, Dr. W. A. Waters, 466
- Bethlehem : Early Man at, Evidence of, 186 ; Ancient Fauna and Early Man at, 381 ; The Bone-bearing Beds of, their Fauna and Industry, Miss Elinor W. Gardner and Miss Dorothea M. A. Bate, 431 ; Flaked Flints from the Bone Beds of, Miss D. A. E. Garrod, 808
- Bialowieza National Park, Poland, Census of Game Animals in the, 358
- Biélas Comet, Disappearance of, J. Bosler and H. Roure, 40
- Binary : Mixtures, Viscosity of, Dr. J. S. Gourlay, 157 ; Orbits, Two Visual, Dr. R. v. d. R. Woolley and L. S. T. Symms, 160
- Biochemistry : Applied to Malting and Brewing, Prof. R. H. Hopkins and B. Krause (*Review*), 705 ; Annual Review of, Edited by Dr. J. M. Luck. Vol. 6 (*Review*), 745 ; Progress of (*Review*), 745
- Bioclimatic Zones of Australia, Dr. J. Davidson, 265
- Biological : Standards, 555 ; Laboratory Technique : An Introduction to Research in Embryology, Cytology and Histology, Prof. J. B. Gatenby (*Review*), 1081
- Biologischen Arbeitsmethoden, Handbuch der, Herausgegeben von Prof. E. Aberdalden. Lief. 460. Abt. V : Teil 10, Heft 6 (*Review*), 218
- Biology : General, Systematics in Relation to, 211 ; for Students of Pharmacy, E. J. Moore (*Review*), 633 ; Surface Action in, Prof. E. K. Rideal, 716 ; and the New Physics : a Plea for a Consistent Philosophy of Life, C. J. Bond (*Review*), 953 ; for Medical Students, C. C. Hentschel and Dr. W. R. I. Cook. Second edition (*Review*), 994
- Birch 'Forests' of Greenland, The, Dr. N. Polunin, 939
- Bird Life (*Review*), 1034 ; Protection in Britain, 1094
- Birds : British, "The Handbook of, H. F. Witherby, 199 ; Speed of Flight of, May Thacher Cocka, 325 ; Wild, and Butterflies, Dr. W. E. Collinge ; Prof. G. D. Hale Carpenter, 974 ; of the Malay Peninsula, late H. C. Robinson and F. N. Chasen. Vol. 3 : Sporting Birds ; Birds of the Shore and Estuaries (*Review*), 1034 ; of the World, Check-List of, J. L. Peters. Vol. 3 (*Review*), 1034 ; The Book of, Edited by Dr. G. Grosvenor and Dr. A. Wetmore. 2 Vols. (*Review*), 1034
- Birmingham : Central Technical College, Dr. E. F. Armstrong awarded an honorary associateship of the, 929 ; University : conferment of honorary doctorates on Lord Austin, Sir Harry Gilbert Barling, E. Cadbury, Sir Wilfrid Arthur Greene, Sir Percival Perry, and C. C. Paterson, 80 ; New Chemistry Laboratories, opening address by Sir Frederick Gowland Hopkins, 121 ; conferment of an honorary doctorate on C. C. Paterson, 351 ; Development of, 538 ; resignation of Sir Charles Grant Robertson, 694 ; conferment of an honorary doctorate on the Duke of Kent, 735 ; appointment of Dr. R. E. Priestley as vice-chancellor, 932, 942 ; retirement of G. O. Harrison, 1045 ; conferment of a doctorate on J. L. Shimwell, 1110
- Birth Control, Scientific Basis of, Dr. C. V. Drysdale, 19
- Bivalve Spatfalls, Hydrography and Fisheries, Some Interrelations between, Prof. J. H. Orton, 505
- Blastocladia Pringsheimii*, Germination of Resistant Spores of, Miss Elizabeth Blackwell, 933
- Blood : -Brotherhood in Dahomey, P. Hazomoné, 325 ; Smears, Supra-vital Stained, Method for Fixing Neutral-red in, A. Hjärre and H. Berthelsen, 155 ; Group A B, Races with a High Proportion of, Dr. R. Elsdon Dew, 1066
- Blow-fly Repellent, A New, H. O. Mönning, 812
- Bodies for Dissection, Preservation of, [1837], 434
- Body Size and Metabolism, Relation between, C. Ellenby, 853
- Bogs at Ballybetagh, with Remarks on the Development of Late-Glacial Deposits in Ireland, J. Kissen and A. Farrington, 376
- Boissons, Les plantes à, Prof. D. Bois (Les plantes alimentaires chez tous les peuples et à travers les ages) (*Review*), 787
- Borine Carbonyl, A. B. Burg and H. I. Schlesinger, 74
- Boron : in the Potash Salts of Alsace, Presence and Distribution of, G. Bertrand, 820 ; in Agriculture, Miss Katherine Warrington, 1016
- Bororo, Clan Reciprocity Among the, C. Levi-Strauss, 429
- Botanical : Society : of Edinburgh, *Transactions and Proceedings* of the, 32, Part 1, 20 ; [1837], 208
- Botany, Medical, Advantages of, [1837], 904
- Bovine Congenital Porphyrinuria, Duality of the Coproporphyrins in, Dr. C. Rimington and G. C. S. Roets, 584
- Bradley's Zenith Sector Sent to the Cape [1837], 250
- Brazil, Caverns in, [1837], 655
- Breakers, Interpretation of Observations and Measurements Relating to, P. Pétry, 820
- Bremsstrahlung, On, J. C. Jaeger, 108
- Brisbane Seismological Station, 231
- Bristol University, resignation of Dr. E. Ashby, 904
- Britain : and the Beast, J. M. Keynes and others (*Review*), 623 ; Land of, Planning the, Dr. L. D. Stamp and others, 791 ; Early, Town Life in, Dr. R. E. Mortimer Wheeler (Norman Lockyer lecture), 924 ; The Hill Lands of, Development or Decay ? Prof. R. G. Stapledon (*Review*), 1031
- British : Association : Nottingham meeting of the, 95 ; at Liverpool, [1837], 375 ; 434 ; at Nottingham ; Lord Rayleigh elected president for 1938, 453 ; and the Indian Science Congress : a Scientific Delegation to India, 609 ; Seismological Committee, Report of the, 721 ; and the Indian Science Congress, 921 ; Astronomical Association, presentation of the Walter Goodacre gold medal and gift to Dr. A. C. D. Crommelin, 800 ; Chemical Manufacturers, Activities of the Association of, E. Wallace ; Dr. F. H. Carr elected president, 719 ; Depopulation, The Menace of, Dr. G. F. McCleary (*Review*), 528 ; Empire Cancer Campaign, grants, etc. of the, 103 ; Medical Association, Belfast meeting of the, 186 ; Museum : (Natural History) : Acquisitions at the, 18 ; Dr. F. W. Edwards appointed a deputy keeper in the department of entomology, 61 ; Acquisitions at the, 187 ; Acquisitions, 764 ; (Bloomsbury), Recent Acquisitions, 801 ; (Natural History), Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2 : Cretaceous, T. H. Withers (*Review*), 873 ; Polar Year Expedition, Fort Rae, N.W. Canada, 1932-33. 2 Vols. (*Review*), 825 ; Rainfall, 1936 (*Review*), 873 ; School of Archaeology at Athens, 1935-36, 58 ; Museum : (Natural History), Acquisitions of the, 966 ; (Bloomsbury), Acquisitions at the, 1046 ; (Natural History), C. Forster Cooper appointed director, 967 ; Colonies, Introduction of Plants into, 1055 ; Institute of Radiology : Annual Congress and Exhibition, 1069 ; Archaeology, Cultural Successions in, 1109
- Brittany, A Mesolithic Site in, 329
- Broad Bean Plants in Water Culture, Effect of Heteroauxin on the Growth of, Dr. H. L. Pearse, 26
- Broadcasting in India, 614
- Bronze Age France, The Oolitic Limestone Escarpment in, Miss Margaret Dunlop, 243
- Brown-Firth Research Laboratories, Equipment and Work of the, 60
- Buenos Aires, Medical Association of Kinesiology, Prof. M. Westenhofer elected an honorary member of the, 358

- Building Materials, Chemistry of, Dr. R. E. Stradling, 607
 Burial-Mounds of England, The Ancient, L. V. Grinsell
 (*Review*), 218
 Business: Man's Library, A, 615; Administration,
 Training in, 1092
 Butterflies: Markings of, Chemical Development of the,
 W. Hauslmayer, 41; Egg-laying, New Observations
 on Responses to Colours in, Dora Ilse, 544; Wild
 Birds and, Dr. W. E. Collinge; Prof. G. D. Hale
 Carpenter, 974
- CO Bands, Structure of a New System of, Dr. R. Schmid
 and Dr. L. Gerö, 508
 Cables for 200,000 Volt Pressures, 927
 Cadmium Nitride (Hydrozoate), Structure of, M. Bassière,
 125
 Calcium: Bicarbonate in the Waters of the River Versoix
 (Canton of Geneva), Origin of the, J. P. Buffle, 125;
 Phosphorus and, Deficiency Diseases as Two Etiolo-
 gically Distinct Entities, Dr. P. J. Du Toit and
 Dr. A. I. Malan, 153
 Calculus, Theory and Practice of the, Dr. A. J. Ward
 (*Review*), 631
 Calcutta: University College of Science, retirement of
 Sir P. C. Rây; election of Sir P. C. Rây as professor
 emeritus, 762
 California: Sardine and its Fishery, Frances N. Clark,
 858; Northern, Earthquakes off the Coast of, Prof.
 Byerly, 937
 Calomel Vapour, Nature of, F. T. Gucker, jun., and R. H.
 Munch, 648
 Cambridge: Philosophical Society, election of officers,
 888; University: Dr. H. J. Bhabha awarded an
 1851 exhibition studentship; Dr. C. F. A. Pantin
 to be appointed reader in invertebrate zoology;
 Dr. R. D. Davies elected a research fellow of Christ's
 College; Sir David Chadwick elected an honorary
 fellow of Sidney Sussex College, 38, 80; Dr. A. D.
 Thackeray appointed assistant director of the Solar
 Physics Observatory, 80; Dr. O. M. B. Bulman
 appointed lecturer in palæozoology, Dr. J. K. S. St.
 Joseph demonstrator in geology, M. Black demon-
 strator in geology, J. D. Boyd lecturer in anatomy,
 Dr. W. A. H. Rushton lecturer in physiology, S. J. R.
 Reynolds and C. D. P. Jones demonstrators in
 anatomy, A. L. Hodgkin demonstrator in physiology,
 and Dr. G. N. Myers demonstrator in pharmacology,
 123; A. M. Barry appointed a Frank Edward Elmore
 student, and B. G. Wilkinson and M. G. M. Pryor
 awarded Frank Smart prizes, 123; Early Science in,
 Dr. R. T. Gunther (*Review*), 130; Dr. J. H. Schul-
 man appointed assistant director of research in
 colloid science; D. J. Bauer elected Michael Foster
 student in physiology; award of the E. G. Fearnside
 scholarship to A. M. Barry, the Wrenbury scholar-
 ship to P. T. Bauer, and the John Winbolt prize to D. W.
 Ginns, 291; K. P. Harrison and O. L. Kangwill
 awarded Harold Fry studentships at King's College;
 J. V. Dunworth and T. E. Easterfield awarded
 Denman Baynes research studentships at Clare
 College; A. G. Ward awarded an external research
 studentship at Emmanuel College, 435; T. R. C. Fox
 and J. Diamond appointed demonstrators in engi-
 neering; Dr. R. A. Lyttleton and M. H. L. Price
 appointed faculty assistant lecturer in mathematics;
 J. Hart-Mercer elected Gwynaeht Pretty student and
 Nita King scholar; R. E. B. Makinson awarded a
 Strathcona exhibition for physics at St. John's
 College, and J. H. Sang a Hutchinson studentship for
 zoology, 476; G. Metcalfe appointed Frank Smart
 student in botany; G. S. Gough, C. H. Bamford and
 D. M. A. Leggett elected fellows of Trinity College;
 bequest by W. C. Wilson, 735; R. L. M. Synge
 appointed Benn W. Levy student in biochemistry;
 grants from the Balfour Fund; conferment of a
 degree on Prof. T. Dalling, 778; Dr. H. Brück
 appointed first junior observer in the Solar Physics
 Observatory; Miss M. L. Tomlinson elected a staff
 fellow of Girton College, 819; gifts from J. W. O.
 Hamilton for radio research, 862; portraits of Sir
 Albert Seward and Dr. F. F. Blackman presented to
 the Botany School, 845; G. L. Clark elected an
 Isaac Newton student; Dr. C. F. A. Pantin appointed
 reader in invertebrate zoology, T. T. Paterson curator
 of the Museum of Archaeology and of Ethnology,
 Dr. J. A. Ramsay, Harding lecturer in experimental
 zoology, Dr. G. S. Carter, F. R. Parington and Dr. G.
 Salt lecturers in zoology, 904; Prof. E. Cartan
 appointed Rouse Ball lecturer for 1937-38; Prof. M.
 Siegbahn appointed Scott lecturer for 1938-39; gift
 for the Experimental Zoology Fund; H. C. Gilson
 and Dr. S. Smith appointed demonstrators in zoology
 and Prof. S. Chapman a member of the Committee
 for Geodesy and Geophysics, 1026; conferment of a
 doctorate on W. G. Palmer, 1110
- Cambium Tissue, Culture of, R. Gautheret, 905
 Canada: Engineering Institute of, election as honorary
 members of Sir Alexander Gibb, Hon. C. D. Howe,
 Hon. G. Stirling, Prof. R. W. Angus, Dr. G. H.
 Duggan, and S. J. Hungerford, 274; Royal Society
 of, Annual Meeting; award of the Flavelle medal to
 Dr. F. D. Adams, the Lorne Pierce medal to Prof. S.
 Leacock, and the Tyrrell medal to A. Fauteux;
 Prof. A. G. Huntsman elected president for 1937-38,
 287; Mining Industry of, C. Camsell, 542; Petroleum
 Fuels in, 978
 Canadian Shield, Gold Deposits of the, E. L. Bruce, 116
 Cancer: Memorandum on Provision of Radio-Therapeutic
 Departments in General Hospitals, Lt.-Col. Smallman,
 356
 Candle, Death in the, [1837], 39
 Cannizzaro Reaction: Catalysis of the, by Active Nickel
 and Platinum, M. Delépine and A. Horeau, 208;
 Bonhoeffer and Fredenhagen, 369
 Canoes of Polynesia, Fiji and Micronesia, J. Hornell, 510
 Cape Town University, Prof. A. W. Falconer appointed
 principal and vice-chancellor, 476
 Car Maintenance and Repair, A. W. Judge. Second
 edition (*Review*), 704
 Carbohydrates *in vitro*, Photosynthesis of, Prof. E. C. C.
 Baly, 930
 Carbon: Monoxide, Hydrogen and Oxygen, Hetero-
 geneous Combustion of Mixtures of, on a Vitreous
 Surface, M. Prettre, 251; -Carbon Bond Distances,
 L. Pauling and L. O. Brockway, 688; Dioxide,
 Vibrational Energy of, Determination of the Relaxa-
 tion Time for the, Prof. A. van Isterbeek and P.
 Mariens, 850; Disulphide, Infra-red Absorption of,
 C. R. Bailey, 851; Suboxide, Structure of, Dr. R. C.
 Lord and Dr. A. Wright, 856; Atomic Weight of,
 A. F. Scott and F. H. Hurley, 1068; Monoxide
 Mixtures, Influence of Hydrogen and Water Vapour
 upon the Combustion of, Prof. W. T. David and B.
 Pugh, 1098
 Carborundum, Ultra-filters of, J. Duclaux and M. Amat,
 658
 Carcinogenic Agents, Photodynamic Action of, Dr. J. C.
 Mottram and Dr. I. Doniach, 933
 Caribbean Sea, Cyclone Series in the, October 17-24, 1935,
 E. Kidson, 286
 Carlsberg Ridge, Basalts from the, Dr. J. D. H. Wiseman,
 855
 Carnegie: Institution of Washington, Report for year
 ending October 31, 1936, 247; United Kingdom
 Trust, Report for 1936, 541; Catalogue of Publica-
 tions of the, 1094
 Carotenoids and other Lipoid-soluble Pigments in the
 Sea and in Deep Marine Mud, D. L. Fox, 519
 Cartesian Diver, Principle of the, Applied to Gasometric
 Technique, Dr. K. Linderström-Lang, 108
 Cartography, 460
 Caspian Sea, Level of the, [1837], 942
 Catalytic: Action of Surfaces, The, Dr. J. E. Nyrop.
 Second edition (*Review*), 827; Reactions, Dr. H. W.
 Melville (*Review*), 827
 Catechol Ethers, Derivatives of Higher, G. K. Hughes and
 F. Lions, 695

- Caterpillar Plagues in Great Britain, Recent, 94
 Catgut for Surgical Use, Safe, 1094
 Cathode : Sputtering, Controlled, Dr. G. Timoshenko, 67 ;
 Ray Tube : The Low Voltage, and its Applications,
 G. Parr (*Review*), 1032
Caves and Caving, No. 1, 186
 Cell : Walls, Lignified, Histochemical Study of, J. Kissler
 and K. Lohweg, 335 ; Division, Radiation and,
 Tansley, Spear and Glücksmann, 686 ; Nucleus and
 Cytoplasm, Interaction between, Prof. C. Stern, 770 ;
 Dr. C. D. Darlington, 932
 Cells, Respiring, Prevention of Assimilation in, Dr. C. E.
 Clifton, 318
 Cellulose : Hydrate, Transformation of, into Native
 Cellulose, Prof. K. H. Meyer and N. P. Badenhuizen,
 jun., 281 ; Starch and Glycogen, Prof. H. Staudinger,
 1071
 Cementite, Pure, Isolation of, by Acid Attack of Ferrous
 Materials and on Some Physical Properties of this
 Body, A. Travers and R. Diebold, 1073
 Cements, Hydraulic, Dr. F. M. Lea, 899
 Central : Nervous System, Choline Esterase in the, D.
 Nachmansohn, 427 ; (Native) Medical School, Suva,
 Fiji, The, Sir James Barrett, 472
 Cepheid Variables, Maintenance of the Pulsation in, Dr. J.
 Woltjer, jun., 195
 Cereal Crosses, Reciprocal, Endosperm and Embryo in,
 J. W. Boyes and W. P. Thompson, 511
 Charcoal, Activated, Adsorption of Gases and Vapours on,
 R. Juza and Langheim, 649
 Chatham House, Prof. A. G. B. Fisher appointed Price
 professor of international economics at, 143
 Chemical : Industry : Society of, Food Group, 20 ;
 Science, A Retrospect of, Prof. G. G. Henderson,
 145 ; Society of Stockholm, award of the Scheele
 medal to Dr. A. Butenandt, 274 ; Reactions : Re-
 tardation of, Prof. K. C. Bailey and G. T. Taylor, 327 ;
 The Retardation of, Prof. K. C. Bailey (*Review*),
 340 ; Stabilization, Prof. N. R. Dhar (*Review*), 340 ;
 Anniversaries, Daily, As a Teaching Tool, E. H.
 Huntress, 616 ; Engineering Congress of the World
 Power Conference, Transactions of the, 5 Vols.
 (*Review*), 627 ; Engineering : Position and Prospects
 (*Review*), 627 ; Principles, with Particular Applica-
 tion to Qualitative Analysis, Prof. J. H. Yoe (*Review*),
 634 ; Industry : French Society of, Seventeenth
 Congress in Paris, 672 ; Research, Dr. I. Langmuir,
 901 ; Changes and Chances, Sir Martin Forster
 (Streathfield memorial lecture), 1055 ; Encyclopædia,
 A (*Review*), 1076
 Chemicals in War : a Treatise on Chemical Warfare,
 Dr. A. M. Prentiss. With chapters on the protection
 of Civil Populations and International Situation, by
 Major G. J. B. Fisher (*Review*), 3
 Chemie : Lehrbuch der, Prof. W. Hüchel. Teil 2. Organische
 Chemie (*Review*), 868 ; Anorganischen, Handbuch der,
 Herausgegeben von Prof. R. Abegg, Dr. F. Auerbach
 und Dr. I. Koppel. Band 4. Abt. 3. Teil 4, Lief 1,
 Herausgegeben von Dr. I. Koppel (*Review*), 1081
 Chemistry : Progress of, Annual Reports on the, for
 1936. Vol. 33 (*Review*), 7 ; Applied, Reports of the
 Progress of, Vol. 21. 1936 (*Review*), 49 ; of Indian
 Opium, Dr. H. B. Dunncliff, 92 ; Elementary, and
 its Presentation, Prof. C. S. Gibson (*Review*), 173 ;
 New Practical, Fundamental Principles Applied to
 Modern Life, Prof. N. H. Black and J. B. Conant
 (*Review*), 173 ; Practical, New Laboratory Experi-
 ments in, Prof. N. H. Black (*Review*), 173 ; A Brief
 Outline of its History and Development, A. Barclay,
 232 ; for Everyman, Prof. A. Findlay (*Review*), 300 ;
 Matter and Life, Dr. S. Miall and L. M. Miall (*Review*),
 300 ; Inorganic, A Text-book of, Edited by Dr. J.
 Newton Friend. Vol. XI, Part 4, by A. E. Goddard
 (*Review*), 528 ; of Building Materials, Dr. R. E.
 Stradling and others, 607 ; A Hundred Years of,
 Prof. A. Findlay (*Review*), 624 ; Modern, The Growth
 of, Prof. J. Read (*Review*), 624 ; Organic, Practical,
 A. J. Mee (*Review*), 634 ; Quantitative Pharma-
 ceutical, Prof. G. L. Jenkins and Prof. A. G. Du Mez.
 Second edition (*Review*), 634 ; The Drama of, How
 Man Deals with Atoms, Prof. S. J. French (*Review*),
 634 ; of Natural Products Related to Phenanthrene,
 The, Prof. L. F. Fieser. Second edition (*Review*),
 704 ; Mineral, and Crystal Structure, Prof. P. Niggli
 (*Review*), 783 ; Organic : A Survey of, Prof. C. S.
 Gibson (*Review*), 868 ; Synthetic, Recent Progress
 in, Dr. G. O. Curme, jun., 901 ; Intermediate, late
 Prof. T. M. Lowry and A. C. Cavell ; Prof. H. V. A.
 Briscoe (*Review*), 910 ; Enzyme, Dr. H. Tauber
 (*Review*), 948 ; in the Ancient World, Prof. J. R.
 Partington (Bedson lecture), 1006 ; Applied, Thorpe's
 Dictionary of, Prof. J. F. Thorpe and Dr. M. A.
 Whiteley. Fourth edition. Vol I (*Review*), 1076
 Chemotherapy, Researches in, Dr. F. L. Pyman, 409
 Cherries, Sweet, Incompatibility and Sterility in, M. B.
 Crane and A. G. Brown, 1019
 Cherry Trees, Bacteriosis of, H. Wormald, 285
 Cheshunt Research Station, Annual Report for 1936,
 860
 Chicken Retina : Carotenoids of the, G. Wald and H.
 Zussman, 197 ; Photo-labile Pigments of the, Dr. G.
 Wald, 545
 Chickens, Hatching Weight of, Factors Affecting, N.
 Galpin, 1027
 Chile, Ancient Man in, 538
 China : Medical Mission to, [1837], 598 ; European
 Botanical Discoveries in, History of, F. C. Stern,
 1093
 Chinese : Ceramic Glazes, A. L. Hetherington (*Review*),
 382 ; Bronzes, Early, R. S. Jenyns, 591 ; Centres of
 Learning, Destruction of, 925
Chirocephalus (The Term "Gnathobase" Lankester), A. G.
 Lowndes, 33
 Chlorates, Bromates and Iodates, Characteristic Fre-
 quencies of, M. Parodi, 943
 Chlorophyll, Reversible Bleaching of, D. Porret and
 Dr. E. Rabinowitch, 321
 Chloroplast Pigments in Leaves during Senescence,
 Changes in, Prof. B. N. Singh and N. K. A. Rao, 728
 Chlorous Anhydride, Existence of, Dr. C. F. Goodeve and
 F. D. Richardson, 737
 Cholera : in Europe, [1837], 477 ; in Africa, [1837], 862
 Cholesterol and Dehydroandrosterone, Oxidation of, by
 Means of Osmic Acid, Prof. M. Ushakov and A.
 Lutenberg, 466
 Choline Esterase : Activity of Superior Cervical Ganglia,
 D. Glick, 426 ; in the Central Nervous System, D.
 Nachmansohn, 427
 Christiansen Filters, G. Ahier, 477
 Chromatographic Adsorption-methode : Die, Grund-
 lagen, Methodik, Anwendungen, Prof. L. Zechmeister
 und Dr. L. v. Cholnoky (*Review*), 48
 Chromium Hydride, CrH₃, Band Spectrum of, A. G.
 Gaydon and Dr. R. W. B. Pearse, 110
 Chromosomes : in Mitosis, Effect of X-Rays on, A.
 Marshak, 779 ; Double Structure of, Prof. R. R.
 Gates, 1013
Chronica Botanica, Changes in, 967
 Chrysanthemum, Florist's Effect of Spraying Solutions
 of Growth Substances on the Inflorescences of the,
 L. G. G. Warne, 1065
 Chuchuhuasha, Botanical Origin of the, Raymond-Hamet
 and Colas, 334
 Cist Burial at Blaydon-on-Tyne, 272
 Citizenship, 43
 Citrus : Diseases and their Control, Prof. H. S. Fawcett.
 Second edition (*Review*), 526 ; Manuring, F. G.
 Anderssen, 976
 Civil : List Pensions, Grants of, 104 ; Engineers, Institu-
 tion of, awards of the, 722 ; *Engineer and Architect's*
Journal, [1837], 777 ; Engineering at the University
 of Durham, [1837], 904 ; Engineers, Institution of,
 E. Graham Clark appointed secretary of the, 1058 ;
 List Pensions, Debate on, [1837], 1072
 Civilization and the Hittites, Origins of, Prof. E. Pittard,
 677
 Climatic Cycles and Tree Growth, W. S. Glock, 855
 Clock Time-marker, A Synchronous, J. H. J. Poole, 376

- Cloeon dipterum*, Function of the Gills of the Mayfly Nymph, C. A. Wingfield, 27
- Coal: Dust, Fine, Spontaneous Electrical Charge of, Dr. S. C. Blacktin, 280; Gas, Extinguishing Flames by, Behaviour of Cylinders of Inflammable Gas in a Fire: Prof. K. C. Bailey, 503; Measure Rocks, Part 1, H. M. Hudspeth and D. W. Phillips, 813; Carbonization of, at Low Temperatures, 937
- Cobalt: and Sheep Diseases, J. B. E. Patterson, 363; Hydroxides, C. Duval, 985
- Coffee Plants, Chromosomes of, Dr. C. A. Krug, 429
- Colchicine: 'Phytocarcinomata' and Plant Hormones, L. Havas, 191; Mechanism of Polyploidy through, B. R. Nebel, 1101
- Colliery Winding Ropes, Internal Corrosion in, Effect of Fibre Cores on, J. E. O. Mayne, 818
- Colonial: Office appointments, 104; 315; 460; 680; 845; 1058; Problem, A Scientific Approach to the, 739
- Color Sense Examination, Polychromatic Plates for, Dr. E. B. Rabkin (*Review*), 49
- Coloration, Attitude and Concealing, J. J. S. Cornes; Prof. G. D. Hale Carpenter, 684
- Colour: Defects, Tests for, Dr. Mary Collins, 414; 532; 569
- Colours, Discriminable, The Number of, Dr. G. B. Welch, 28
- Combustible Substances, Regarded as Helping Incombustible Extinguishers, for the Practical Extinction of Flames, C. Dufraisse and J. Le Bras, 905
- Comet: A New (1937 *f*), 103; Finsler, 273; 1937 *g* (Hubble), New, 315
- Comets: Preliminary General Catalogue of, 357; their Nature, Origin and Place in the Science of Astronomy, Mary Proctor and Dr. A. C. D. Crommelin (*Review*), 566; and Problems of Cosmogony, Rev. Dr. M. Davidson, 799
- Common Sense: Science and, an Aristotelian Excursion, Dr. W. R. Thompson (*Review*), 872
- Community, Science and the, J. Ramsay MacDonald (Radford Mather lecture), 756
- Compton Manor Estate as a Veterinary Field Station, 718
- Conditioned Reflexes and Psychology, Prof. J. H. Gaddum (*Review*), 700
- Conifers of Quebec Province, Distribution of Manganese and Iron in the, P. Riou, G. Delorme and H. Gamelin, 1027
- Connecticut, Amphibia of, 686
- Connexion Projective, Leçons sur la théorie des espaces à, Prof. E. Cartan (*Review*), 950
- Co-operation, International, in Science, 337
- Copepod Development, Variations in, Dr. S. G. Gibbons, 1064
- Copepods, Scottish, Dr. S. G. Gibbons, 116
- Copley medals, award of two, [1837], 941
- Copper: Reflecting Power of, L. Capdecemme and P. Jacquet, 40; Conductors, Electrical and Mechanical Ageing of, under the Prolonged Action of the Electric Current, O. Yadoff, 251; Potassium, Double Sulphate of, Dehydration of the, Mme. Nathalie Demassieux and B. Federoff, 778
- Cornwall, Erosion Surfaces of, W. G. V. Balchin, 326
- Corona: The, by Reflection from the Moon, Dr. A. V. Douglas, 156; The Globular, 577
- Coronal Emission Lines Observed at the Total Solar Eclipse of June 19, 1936, Prof. R. Sekiguti, 724; Prof. F. J. M. Stratton, 725
- Coronation: Ceremonial (*Review*), 5; English, A History of the, Prof. P. E. Schramm. Translated by L. G. W. Legg (*Review*), 5
- Acetanilides, 2: 6-Disubstituted, Evidence of Restricted Rotation about the N—C Bond in, Dr. L. Hunter and H. O. Chaplin, 896
- Acidosis and Off-flavoured Milk, Capt. H. Barkworth and L. W. L. Cole, 324
- Agriculture, Boron in, Miss Katherine Warrington, 1016
- Aldehydes and Ketones, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
- Alkyl Ethers, Nitric Oxide and, Prof. M. W. Travers, 107; Halides, Series Effect on the Dipole Moments of Some, E. G. Cowley and Prof. J. R. Partington, 1100
- Alloys, Iron-Nickel-Aluminium, High Coercivity in, an X-Ray Investigation of the Cause of, Dr. A. J. Bradley and A. Taylor, 1012
- Aluminium, Nuclear Moments of, D. A. Jackson and Dr. H. Kuhn, 110
- Amino-Acids: α , Absolute Configuration of the Naturally Occurring, R. C. Rainey, 150; Formation and Break-down of, by Intermolecular Transfer of the Amino Group, Prof. A. E. Braunstein and M. G. Kritzman, 503
- Amphibian Anterior Pituitary, Gonadotropic Activity of, Dr. H. Zwarenstein, 588
- Androgenic Endocrine Activity in the Female Mammal, Prof. A. Lipschütz, 892
- Anopheles gambiae* Giles, A Cage Colony of, B. De Meillon, 428
- Anuran Gastrula, Ectoderm of the, Neural Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the, Prof. G. A. Schmidt, 199
- Aromatic Compounds, Antimicrobial Action of Some, Dr. A. Girard, A. Ray and G. Richard, 283
- Arsine, Phosphine and, Derivatives of the Group I (*b*) Metals: Volatile Derivatives of Gold, Dr. F. G. Mann and A. F. Wells, 502
- Ascorbic Acid: in Fermented Products, Estimation of, Specificity of Indophenol in the, F. W. Fox and W. Stone, 234; from Urine, Isolation of, Dr. C. P. Stewart, H. Scarborough and Dr. P. J. Drumm, 282
- Atmospheric Pressure at High Altitudes, Spectrum of Nitrogen and, R. Bernard, 930
- Atomic Constitution, Interpretations of, Lt.-Col. J. T. C. Moore-Brabazon, 893; 971; Prof. E. N. da C. Andrade, 894; Prof. A. S. Eve, 1061
- Aurora Rays, Divided, with One Part in the Sunlit and another in the Dark Atmosphere, Prof. C. Störmer, 1095
- Aurous Compounds: Constitution of, Gold Mirrors, Prof. C. S. Gibson, 583
- Australopithecus*, Discovery of a Lower Molar of, Dr. R. Broom, 681
- Auxin, Action of, on Protoplasmic Streaming, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807
- Axial: Magnetic Suspension, Frictional Torque of an, Dr. F. T. Holmes and Prof. J. W. Beams, 30; Spin and Weapons of the Ancients, L. J. D. Richardson, 1016
- Azobenzene, The *Cis*-form of, G. S. Hartley, 281
- β -Boswellinic Acid, Structure of, Dr. J. C. E. Simpson, 467
- β -Decay as Due to a Neutrino Shower, N. S. Nagendra Nath, 278
- β -Phellandrene, Conversion of, into a Derivative of α -Phellandrene, Dr. N. F. Goodway and T. F. West, 934
- Band Spectra, Vibration Temperature in Relation to Rotation Temperature in, Dr. N. R. Tawde and S. A. Trivedi, 463
- Barium, Surface Migration of, Dr. M. Benjamin and R. O. Jenkins, 152
- Benzanthrones, Synthesis of, F. G. Baddar and F. L. Warren, 321
- Benzene-Diazonium Chloride, Decomposition of, Dr. W. A. Waters, 466
- Bethlehem, Bone Beds of, Flaked Flints from the, Miss D. A. E. Garrod, 808
- Binary Mixtures, Viscosity of, Dr. J. S. Gourlay, 157
- Birds: British, "The Handbook of, H. F. Witherby, 199; Wild, and Butterflies, Dr. W. E. Collinge; Prof. G. D. Hale Carpenter, 974
- Bivalve Spatfalls, Hydrography and Fisheries, Some Interrelations between, Prof. J. H. Orton, 505

CORRESPONDENCE

- α -Amino-Acids, Absolute Configuration of the Naturally Occurring, R. C. Rainey, 150
- α -Phellandrene, Conversion of β -Phellandrene into a Derivative of, Dr. N. F. Goodway and T. F. West, 934

- Blastocladia Pringsheimii*, Germination of Resistant Spores of, Miss Elizabeth Blackwell, 933
- Blood : Smears, Stained, Method for Fixing Neutral-red in Supra-vital, A. Hjarre and H. Barthelsen, 155 ; Group *A B*, Races with a High Proportion of, Dr. R. E. Dew, 1066
- Body Size and Metabolism, Relation between, E. Ellenby, 853
- Boron in Agriculture, Miss Katherine Warington, 1016
- Bovine Congenital Porphyrinuria, Duality of the Coproporphyrins in, Dr. C. Rimington and G. C. S. Roets, 584
- Bremsstrahlung, On, J. C. Jaeger, 108
- Broad Bean Plants, Effect of Hetero-auxin on the Growth of, in Water Culture, Dr. H. L. Pearse, 26
- Butterflies : Egg-laying, New Observations on Responses to Colours in, Dora Ilse, 544 ; Wild Birds and, Dr. W. E. Collinge ; Prof. G. D. Hale Carpenter, 974
- CO Bands, Structure of a New System of, Dr. R. Schmid and Dr. L. Gerö, 508
- Calcium, Phosphorus and, Deficiency Diseases as Two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. I. Malan, 153
- Carbohydrates *in vitro*, Photosynthesis of, Prof. E. C. C. Baly, 930
- Carbon : Dioxide, Vibrational Energy of, Determination of the Relaxation Time for the, Prof. A. van Itterbeek and P. Mariens, 850 ; Disulphide, Infra-red Absorption of, C. R. Bailey, 851 ; Monoxide Mixtures, Influence of Hydrogen and Water Vapour upon the Combustion of, Prof. W. T. David and B. Pugh, 1098
- Carcinogenic Agents, Photodynamic Action of, Dr. J. C. Mottram and Dr. I. Doniach, 933
- Cartesian Diver, Principle of the, Applied to Gasometric Technique, Dr. K. Linderstrom-Lang, 108
- Cathode Sputtering, Controlled, Dr. G. Timoshenko, 67
- Cell : Nucleus and Cytoplasm, Interaction between, Prof. C. Stern, 770 ; Nucleus and Cytoplasm, Interaction between, Dr. C. D. Darlington, 932
- Cells, Respiring, Prevention of Assimilation in, Dr. C. E. Clifton, 318
- Cellulose, Hydrate, Transformation of, into Native Cellulose, Prof. K. H. Meyer and N. P. Badenhuizen, jun., 281
- Central Nervous System, Choline Esterase in the, D. Nachmansohn, 427
- Cepheid Variables, Pulsation in, Maintenance of the, Dr. J. Woltjer, jun., 195
- Chicken Retina : Carotenoids of the, G. Wald and H. Zussman, 197 ; Photo-labile Pigments of the, Dr. G. Wald, 545
- Chlorophyll, Reversible Bleaching of, D. Porret and Dr. E. Rabinowitch, 321
- Chloroplast Pigments in Leaves during Senescence, Changes in, Prof. B. N. Singh and N. K. Anantha Rao, 728
- Cholesterol and Dehydroandrosterone, Oxidation of, by Means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466
- Choline Esterase : Activity of Superior Cervical Ganglia, D. Glick, 426 ; in the Central Nervous System, D. Nachmansohn, 427
- Chromium Hydride, CrH, Band Spectrum of, A. G. Gaydon and Dr. R. W. B. Pearse, 110
- Chromosomes, Double Structure of, Prof. R. R. Gates, 1013
- Chrysanthemum, Inflorescences of the Florists', Effect of Spraying Solutions of Growth Substances on the, L. G. G. Warne, 1065
- Cloeon dipterum*, Function of the Gills of the Mayfly Nymph, C. A. Wingfield, 27
- Coal : Dust, Fine, Spontaneous Electrical Charge of, Dr. S. C. Blacktin, 280 ; Gas, Extinguishing Flames by, Behaviour of Cylinders of Inflammable Gas in a Fire : Prof. K. C. Bailey, 503
- Cobalt, and Sheep Diseases, J. B. E. Patterson, 363
- Colchicine, 'Phytocarcinomata' and Plant Hormones, L. Havas, 191 ; Mechanism of Polyploidy through, B. R. Nebel, 1101
- Coloration, Concealing, Attitude and, J. J. S. Cornes ; Prof. G. D. Hale Carpenter, 684
- Colours, Discriminable, The Number of, Dr. G. B. Welch, 28
- Copepod Development, Variations in, Dr. S. G. Gibbons, 1064
- Corona, The, By Reflection from the Moon, Dr. A. V. Douglas, 156
- Coronal Emission Lines Observed at the Total Solar Eclipse of June 19, 1936, Prof. R. Sekiguti, 724 ; Prof. F. J. M. Stratton, 725
- Cosmic : Radiation, Longitude Effect and the Asymmetry of, Prof. G. Lemaitre, 23 ; Ray Measurements, Use of Krypton-filled Ionization Chambers for, Dr. S. Ziemecki, 150 ; Radiation, Absorption of the Soft Component of, Dr. W. Heitler, 235 ; Rays, Expulsion of Neutrons from Lead by, B. Arakatsu, K. Kimura and Y. Uemura, 277 ; Ray Intensity, World-wide Effect in, as Observed During a Recent Magnetic Storm, Prof. V. F. Hess and A. Demmelmair, 316 ; Rays and Magnetic Storms, Prof. S. Chapman, 423 ; Ray Intensity during Magnetic Storms, Variations of, Prof. C. Störmer, 549 ; Rays, Disintegration Processes by, with the Simultaneous Emission of Several Heavy Particles, M. Blau and H. Wambacher, 585 ; Ray Burst, A, at a Depth Equivalent to 800 m. of Water, Dr. Y. Nishini and C. Ishii, 774 ; Rays, Abnormal Zenithal Distribution of, M. G. E. Cosyns, 931
- Cottons, Wild and Cultivated American, Homologous Loci in, Dr. S. C. Harland, 467
- Coulter Compound, The, Lactoflavin, 'Cytochrome *b*', and Cytochrome *c*, Spectroscopic Observations of Reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
- Cozymase in Invertebrate Muscle, Dr. S. Ochoa and C. G. Ochoa, 1097
- Crystals : with Vitamin K Potency, H. J. Almquist, 25 ; Organic, Magnetic Anisotropy of, Temperature Variation of, P. Nilakantan, 29 ; Artificial Slip Formation in, A. W. Stepanow, 64 ; Volume-Rectification of, B. K. Sen, 1102
- Crustacea, Body Orientation in, A. G. Lowndes, 241
- Csonka-Straub, Specificity of the Salicylic Aldehyde, Reaction of, Prof. A. E. Braunstein, 427
- Cu and Fe, Intensity and Structure Changes of the *L a* Emission Lines of, on Intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
- CuSO₄·5H₂O, Crystal Structure and the Magnetic Anisotropy of, Prof. K. S. Krishnan and A. Mookherji, 896
- Cyclotron, Rays Produced by a, Biological Effects of the, Prof. M. Nakaidzumi, K. Murati and Y. Yamamura, 359
- 'Cytochrome : *b*', Lactoflavin, the Coulter Compound, and Cytochrome *c*, Spectroscopic Observations of Reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
- Cytoplasm : Cell Nucleus and, Interaction between, Prof. C. Stern, 770 ; Dr. C. D. Darlington, 932
- Dead Sea, Oestrogenic Substances in the, Prof. B. Zondek, 240
- Dehydroandrosterone, Cholesterol and, Oxidation of, by Means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466
- Deuterium, Heterogeneous Equilibria with, Prof. J. R. Partington and R. P. Towndrow, 156
- Deuteroethylenes, Raman Spectra of, Prof. M. de Hemp-tinne, J. Jungers and Dr. J. Delfosse, 323
- Diene Synthesis, A, Applicable to the Sterol Group, A. B. Meggy and Prof. R. Robinson, 282
- Diffraction Gratings and Replicas, Recent Improvements in, Prof. R. W. Wood, 723
- Diketopiperazine and Tetramethyldiketopiperazine, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193
- Drosophila* : Spontaneous Chromatin Rearrangements in, Prof. R. Goldschmidt, 767 ; Gene Doublets as Evidence for Adjacent Small Duplications in, Dr. H. Grüneberg, 932
- Duckweed (*Lemna*), Concentration of Mesothorium-I by, Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, 317
- Dust Control in Industry, J. D. Leitch and L. B. Leppard, 772 ; Prof. H. V. A. Briscoe, 773

- Egyptian Music, Modern, Modes in, M. Mokhtar and Dr. A. M. Mosharrafa, 548
- Electrodeless High-frequency Discharge, Effect of a Magnetic Field on the, E. W. B. Gill, 1061
- Electrolytes, Strong, Surface Tension of, Prof. M. Dole, 464
- Electron: Positron and, Pairs, Production of, by Bombardment of Mercury with β -Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105; Diffraction Studies of Oxides Formed on Iron, T. Iimori, 278
- Electronic Charge, Determination of, by the Oil Drop Method, Y. Ishida, I. Fukushima and T. Suetsugu, 29
- Electrons: Nuclear Absorption of, Measurement of the, by the Atmosphere up to about 10^{10} Electron-Volts, Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, 23; Orbital, Capture of, F. Hoyle, 235
- Element 43, Radioactive Isotopes of, C. Perrier and Prof. E. Segrè, 193
- Enol-Esters of Testosterone, The Effect of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
- Ethyl-chlorophyllide, Elementary Cell and Space Group of, Dr. J. A. A. Ketelaar and E. A. Hanson, 196
- Ethylene: Bromide, Thermal Decomposition of, Dr. T. Iredale and A. Maccoll, 24; Hydrocarbon Derivatives of, Oestrogenic Activity of Some, Prof. E. C. Dodds, M. E. H. Fitzgerald and W. Lawson, 772
- Experiment, The Function of, Dr. E. C. Childs, 852
- Fe-C, System, A New Equilibrium Diagram for the, Dr. I. Iitaka, 462
- Fe, Cu and, Intensity and Structure Changes of the $L\alpha$ Emission Lines of, on Intense cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
- Ferricyanide, Specific Action of, on Aerobic Glycolysis of Tumour Cells, Dr. B. Mendel and Miss F. Strelitz, 771
- Fish: Liver Oils, Freshwater and Marine, Differences in the Chromogenic Properties of, A. E. Gillam, Prof. I. M. Heilbron, Dr. E. Lederer, and V. Rosanova, 233; Freshwater, Blindness in, Dr. W. Rushton, 1014
- Force Constants and Molecular Structure, Dr. H. W. Thompson and J. W. Linnett, 1065
- Free Radicals in Solution, Dr. D. H. Hey and Dr. W. A. Waters, 934
- Frog's Eye, Electrical Response of the, Absorption Curve for Visual Purple and the, Prof. R. Granit, 972
- γ -Rays of Polonium, The, H. C. Webster, 852
- Galileo and Mathematical Demonstration, W. C. Fahie; G. J. Whitrow, 646
- Ganglia, Superior Cervical, Choline Esterase Activity of, D. Glick, 426
- Gases: Imperfect, The Cluster Theory of, Dr. C. F. Goodeve, 424; Rare, Chemical Properties of the, B. A. Nikitin, 643
- Gasometric Technique, Principle of the Cartesian Diver Applied to, Dr. K. Linderstrøm-Lang, 108
- Gene Linkage, Transitive Interference in, Prof. K. de Kőrösy, 322
- Genetics, The Position of, Prof. J. B. S. Haldane, 428
- Glass Electrode, Mechanism of the, G. Haugaard, 66
- Glucolysis, Embryonic, Glyceraldehyde and, Dr. J. Needham and H. Lehmann, 198
- Glyceraldehyde and Embryonic Glucolysis, Dr. J. Needham and H. Lehmann, 198
- Glycerophosphoric Dehydrogenase, Dr. H. Weil-Malherbe, 725
- Glycolysis in Muscle Extracts, The Initial Stages of, Dr. L. P. Kendal and Dr. L. H. Stickland, 360
- Gold: Films, Thin, Production of, Prof. C. S. Gibson, 279; Volatile Derivatives of, Phosphine and Arsine Derivatives of the Group I (b) Metals: Drs. F. G. Mann and A. F. Wells, 502; Mirrors, Constitution of Aurous Compounds, Prof. C. S. Gibson, 583
- Graphite, Colloidal, An Effect of X-Radiation on the ζ Potential of, Prof. J. A. Crowther and H. Liebmann, 28
- Gravitational Statics in Three Dimensions, S. G. Emslie, 729
- Hæmocyanin Molecule, Splitting of the, by Ultra-sonic Waves, S. Brohult, 805
- Haloec, Pleochroic, Some New Types of, Prof. G. H. Henderson, 191
- He, Li+ and, Ionization Energy of, H. A. S. Eriksson, 151
- Heat of Reaction, the Sign and Symbol of, Dr. H. J. S. Sand, 809
- Heavy Water, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099
- Helium: Liquid, Heat Conduction in, Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, 62; I and II, Refractive Indexes of, Prof. E. F. Burton, 1015
- Hetero-auxin, Effect of, on the Growth of Broad Bean Plants in Water Culture, Dr. H. L. Pearce, 26
- Heteroauxones, Role of, in Legume Nodule Formation, Beneficial Effects of Nodules, and Soil Fertility, Prof. G. K. K. Link, 507
- High-frequency Fields, Alleged Specific Effects of, on Biological Substances, Dr. J. B. Bateman, Dr. H. Loewenthal and Dr. H. Rosenberg, 1063
- Hippolyte varians*, Colour Changes in, Dr. L. H. Kleinholz and Dr. J. H. Welsh, 851
- Hydrogen: H α of, Structure of, Prof. N. A. Kent, Royal M. Frye and W. H. Robinson, 236; Bridges in Solid Pentaerythritol, I. Nitta and T. Watanabé, 365
- Hyperbolic Space, Dr. G. C. McVittie, 773
- Hypothesis, Judgment by, Dr. H. Dingle, 589
- Indian Diets, Some, Nutritional Value of, D. N. Mullick and Dr. J. T. Irving, 319
- Indophenol, Specificity of, in the estimation of Ascorbic Acid in Fermented Products, F. W. Fox and W. Stone, 234
- Inflammable Gas in a Fire, Behaviour of Cylinders of, Dr. O. C. de C. Ellis, 935
- Insects, Present-day, Ancestors of some groups of the, Prof. G. Zalessky, 847
- Insulin, The Two Crystalline Modifications of, Dr. D. Crowfoot, 149
- Iodoacetate, Action of, on Dehydrogenases and Alcoholic Fermentation, Dr. M. Dixon, 806
- Ionic: Mobilities, Effect of Viscosity on, D. Belcher, 810; Clouds, Irregular, in the E Layer of the Ionosphere, T. L. Eckersley, 846
- Ionization by Radioactive Gamma and Cosmic Rays in different Gases, J. Juilfs, 767
- Ionosphere: Artificial, Anomalous Dielectric Content of, Prof. S. K. Mitra and K. K. Roy, 586; 1066; E Layer of the, Irregular Ionic Clouds in the, T. L. Eckersley, 846; Absorption of Wireless Waves in the, Annual variation of the, Dr. F. W. G. White and L. W. Brown, 931;
- Ionospheric Disturbances, Catastrophic, An Effect of, on Low-frequency Radio Waves, K. G. Budden and J. A. Ratcliffe, 1060
- Ions, Slow Positive, Diffraction of, A. G. Emslie, 463
- Joule-Thomson Effect and Quantum Statistics, Dr. D. S. Kothari and B. N. Srivasava, 970
- Jute, Trisomic Mutations in, Dr. H. K. Nandi, 973
- Ketene, Preparation of, Products Formed during the, R. W. Hale, 1017
- Ketones, Aldehydes and, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
- Kineses, Taxes and, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064
- Krypton and Xenon, Packing Fractions of, Dr. F. W. Aston, 149
- $L\alpha$ Emission Lines of Cu and Fe, Intensity and Structure changes of the, on Intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
- L-Emission Bands of Zinc, Copper, Nickel and Cobalt Dr. J. Farineau, 508
- Lactoflavin, the Coulter Compound, 'Cytochrome b', and Cytochrome c, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
- Lead Crystal Growths in Silica Gel, Spiriform Morphology of some, N. Stuart, 589
- Lebistes*: Succession of Broods of, G. L. Purser, 155; Dr. O. Winge, 467
- Lecithin, Yolk, Origin of, L. Hahn and Prof. G. Hevesy, 1059

- Lecithinæmia following the Administration of Fat, Prof. G. Hevesy and E. Lundsgaard, 275
- Lemna minor*, A short periodic Growth Cycle and a Secular Variation in, H. Dickson, 112
- Lepidosiren*, Cytology of, Prof. W. E. Agar, 931; Prof. E. W. MacBride, 932
- Li + and He, Ionization Energy of, H. A. S. Eriksson, 151
- Light: The Neutrino Theory of, V. Fock, 113; Neutrino Theory of, in Three Dimensions, A. Sokolow, 810; thought to have been seen in the neighbourhood of Alternate Current Magnets, The, Lord Rayleigh, 423; Diffraction of, by Ultrasonics at Oblique Incidence, Dr. F. Levi, 969
- Lightning Discharges, Effect of near, on a Magnetometer, Dr. K. R. Ramanathan, 587
- Liquid Drops at Interfaces, Visible Adsorbed Films and the spreading of, Prof. D. H. Bangham, S. Mosallam and Z. Saweris, 237
- Liver, Fatty, Action of Pancreatic Extract on, B. Shapiro and Prof. E. Wertheimer, 771
- Locusts in the Field, Phase transformation in, J. S. Kennedy, 889
- Louse, Biting-, Distribution of the, N. J. B. Plomley and G. B. Thompson, 199
- Low-Temperature Thermostat, An inexpensive, L. C. Beadle and F. A. Booth, 279
- Lysozyme, Crystallization of, E. P. Abraham and Prof. R. Robinson, 24
- Magnetic Storms: Cosmic Rays and, Prof. S. Chapman, 423; Variations of Cosmic Ray Intensity during, Prof. C. Störmer, 549
- Meiosis and Mitosis, Artificial release of Crossing-over in, Prof. H. Friesen, 362
- M-Emission Bands of Zinc, Copper and Nickel, Dr. H. W. B. Skinner and J. E. Johnston, 508
- Mental: Factors, Selection and, Dr. G. H. Thomson, 934; Disturbances, Physiological Patterns and, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062
- Merino, Trio Follicles in the, Non-specificity of the, Dr. A. B. Wildman, 891
- Mesothorium-I, Concentration of, by Duckweed (*Lemna*), Prof. W. I. Vernadsky, B. K. Brunowsky, and C. G. Kunasheva, 317
- Metal Films, Thin, Structure and Resistance of, D. A. Wright, 107
- Metals: Rigidity of, Effect of Occluded Hydrogen on the, Father J. Lynch, 363; Oxide Film Formation on, Polarimetric studies of, A. B. Winterbottom, 364; of Hexagonal Structure, Asymmetry in, Dr. G. W. Brindley and P. Ridley, 461; Ferromagnetic, The Paramagnetic Magnetron Numbers of the, Prof. W. Sucksmith and R. R. Pearce, 970; Structure of, Dr. A. Müller, 1011
- Metabolism, Size and, Relation between, C. Ellenby, 853
- Metaphosphoric Acid, Reaction between Proteins and, Dr. H. Herrmann and G. Perlmann, 807
- Meteor, Bright, of November 9, A. E. Moon, 1102
- Meteorites: The number of Pultusk Stones, and the spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504; 809; Dr. L. J. Spencer, 589
- Methyl Halides, Carbon-Halogen Distance in the, Dr. G. B. B. M. Sutherland, 239
- Mice, Sensitization of the Skin of, to Light by Carcinogenic Agents, Dr. I. Doniach and Dr. J. C. Mottram, 588
- Milk, Off-flavoured, Acidosis and, Capt. H. Barkworth and L. W. L. Cole, 324
- Mitosis, Meiosis and, Artificial release of Crossing-over in, Prof. H. Friesen, 362
- Mitotic Spindle, Self-arrangement in the, under Mechanical Influence, Dr. H. H. Pfeiffer, 770
- Molecular: Compounds, Organic, Structure of, Dr. J. S. Anderson, 583; Structure, Force Constants and, Dr. H. W. Thompson and J. W. Linnett, 1065
- Molybdenum, Tellurium, Tungsten and, Hexaco-ordination of, J. Gupta, 685
- Monomolecular Films, Viscosity of, Prof. W. D. Harkins and R. J. Myers, 465
- Nd +++ Ion, Absorption Spectra evidence of the Decomposition of the Ground Term of, due to Crystalline Fields, Prof. D. M. Bose; Dr. W. G. Penney and G. J. Kynch, 109
- Nematodes, Physiology of, D. G. Davey, 645
- Neural: Induction by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula, Prof. G. A. Schmidt, 199; Induction by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*, M. N. Ragozina, 199
- Neutrino: Theory of Light, The, V. Fock, 113; Shower, β -Decay as due to a, N. S. Nagendra Nath, 278; Theory of Light in Three Dimensions, A. Sokolow, 810
- Neutron: Beams, Polarized, A method of obtaining, Dr. H. v. Halban, jun., 425; Levels, Resonance, of Silver, Rhodium and Bromine Nuclei, Spacing of the, C. Y. Chao and T. H. Wang, 768
- Neutrons: Production of Mutations by, Mary Nagai and G. L. Locher, 111; Expulsion of, from Lead by Cosmic Rays, B. Arakatsu, K. Kimura and Y. Uemura, 277; inside Magnetized Iron, The Magnetic Field acting upon, Dr. O. R. Frisch, Dr. H. von Halban, jun., and Dr. J. Koch, 360; Slow, Capture of, in Light Elements, Dr. O. R. Frisch, Dr. H. von Halban, jun., and Dr. J. Koch, 895
- Nickel Wire, Magnetic Quality of, as influenced by the Surface, Dr. T. F. Wall, 238
- Nile, Dry Crossing of the, E. J. Wayland, 811
- Nitric Oxide and Alkyl Ethers, Prof. M. W. Travers, 107
- Nitrogen: Excretion of, by Leguminous Plants, Prof. P. W. Wilson, 154; Prof. A. I. Virtanen; Dr. G. Bond, 683; Spectrum of, and Atmospheric Pressure at High Altitudes, R. Bernard, 930
- Nuclear Particles, Interaction of, Dr. N. Kemmer, 192
- CEstradiol Monobenzoate, Inhibition by, Response of the Pigeon Crop Gland to Prolactin: Dr. S. J. Folley and P. White, 505
- CEstrous Reactions, including Mating, produced by Triphenyl Ethylene, J. M. Robson and Dr. A. Schönberg, 196
- O₂+Bands, Visible, Rotational Analysis of the, T. E. Nevin, 1101
- O-H Raman Frequency in Inorganic Acids, The, Dr. C. S. Venkateswaran, 151
- Oil Drops, Collision of Two, and the Stability of a Non-spherical Oil Drop, Yoshio Ishida, 70
- Optical Contact, Propagation of, Dr. J. Weir French, 321; Sensitizing of Silver Halides by Dyes, Mechanism of, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096
- Oxidation Catalyst, A New, J. G. Dewan and D. E. Green, 1097
- Oxide Film Formation on Metals, Polarimetric studies of, A. B. Winterbottom, 364
- Oxides formed on Iron, Electron Diffraction studies of, T. Iimori, 278
- Oxonium Compounds, Raman Spectra of, Dr. G. Briegleb and W. L. Lauppe, 236
- Oxygen in Sea Water, Consumption of, under Controlled Laboratory Conditions, H. R. Seiwel, 506
- Oxyporphyrin Hæmatin Compound, An, as intermediate between Protohæmatin and Verdohæmatin, Dr. R. Lemberg, B. Cortis-Jones and M. Norrie, 65
- Oyster and the Salmon, Sex-Biology of the, Prof. J. H. Orton, 68
- Pacific Seismological Stations, Reliability of, Dr. H. Jeffreys, 237
- Pancreatic Extract, Action of, on Fatty Liver, B. Shapiro and Prof. E. Wertheimer, 771
- Papain, Natural Activation of, Prof. M. Frankel and R. Maimin, 1015
- Para-Cresol from the Urine of Pregnant Mares, Dr. P. G. Marshall, 362
- Pentaerythritol, Solid, Hydrogen Bridges in, I. Nitta and T. Watanabé, 365
- Personnel Organization, A Psycho-geometrical Representation of, W. R. Dunlop, 152
- Phosphate in Muscle, Coupling of Dismutations with Esterification of, Dr. Dorothy M. Needham and R. K. Pillai, 65

- Phosphine and Arsine derivatives of the Group I(b) Metals : Volatile derivatives of Gold, Drs. F. G. Mann and A. F. Wells, 502
- Phosphorus : and Calcium Deficiency Diseases as two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. I. Malan, 153 ; Exchange in Yeast, Prof. G. Hevesy, Dr. K. Linderström-Lang and N. Nielsen, 725
- Photographic Plates, Sensitized, Position of Maximum Optical Sensitivity of, S. Natanson, 197
- Photoperiodic After-Effect, Prof. R. H. Stoughton and D. R. Hole, 808
- Photosynthesis of Carbohydrates *in vitro*, Prof. E. C. C. Baly, 930
- Phycomyces*, Growth Factors for, H. M. Sinclair, 361
- Physiological Patterns and Mental Disturbances, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062
- 'Phytoparcinomata', Colchicine, and Plant Hormones, L. Havas, 191
- Pituitary Extracts, Anterior, Restropic effects of, C. Wetzler-Ligeti and Dr. B. P. Wiesner, 892
- Plankton Collector, A, For Fast Towing, E. L. Pierce, 1014
- Plant Hormones, Colchicine, 'Phytoparcinomata' and, L. Havas, 191
- Plants, Net Assimilation Rate in, Drift of, R. F. Williams, 1099
- Platyedra gossypiella* Saunders, Nocturnal Habits of, F. A. Squire, 69
- Polonium, The γ -Rays of, H. C. Webster, 852
- Poly-Acids, Constitution of the, Dr. J. Stuart Anderson, 850
- Polymerization, The Kinetics of, Prof. A. C. Cuthbertson, G. Gee and Prof. E. K. Rideal, 889
- Ploidy through Colchicine, Mechanism of, B. R. Nebel, 1101
- Porphyria, Congenital : Living Animal Cases of, P. J. Fourie and Dr. C. Rimington, 68 ; Porphyrins of the I and III Series in, Dr. C. Rimington, 105
- Positron and Electron Pairs, Production of, by bombardment of Mercury with β -Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105
- Potassium, Resonance Lines of, Intensity Ratios of the Hyperfine Structure Components of the, Dr. D. A. Jackson and H. Kuhn, 276
- Potato : Slopes, Standardization of, for Bacteriological Tests, D. Ward Cutler and Miss Mabel Dunkley, 1015 ; Flowers and Dissemination of Potato Viruses, Dr. G. Cockerham, 1100
- Progesterone alone, Effects on Ovariectomized Rats of, and in combination with the other Sexual Hormones, Dr. V. Korenchevsky and K. Hall, 154
- Prolactin : Response of the Pigeon Crop Gland to, Inhibition by $\text{Oestradiol Monobenzoate}$, Drs. S. J. Folley and P. White, 505
- Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation, G. S. Sperti, Prof. J. R. Loofbourow and Sister Cecilia Marie Dwyer, 643
- Proteins : and Metaphosphoric Acid, Reaction between, Dr. H. Hermann and G. Perlmann, 807 ; 'Fibrous' and 'Globular' Relation between, Dr. W. T. Astbury, 968
- Protoplasmic Streaming, Action of Auxin on, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807
- Protozoa, Effects of Salts on emergence from the Cyst in, K. V. Thimann and A. J. Haagen-Smit, 645
- Pultusk : Meteorite, Number of Fragments of the, Dr. E. Stenz, 113 ; Stones, the Number of, Meteorites : and the spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504 ; 809 ; Dr. L. J. Spencer, 589
- Purple, Visual, Absorption Curve for, and the Electrical Response of the Frog's Eye, Prof. R. Granit, 972
- Pyruvic Acid Dehydrogenation, Vitamin B, and Cocarboxylase, F. Lipmann, 25
- Quantum Statistics, Joule-Thomson Effect and, Dr. D. S. Kothari and B. N. Srivasava, 970
- 'Racemic Acid', Use of the name, Prof. A. Findlay, 22
- Radioactive Substances in the body of Rats, Retention of, and the Lethal Dose, Dr. F. Böhouněk and F. V. Novák, 106
- Raman Spectra : of Oxonium Compounds, Dr. G. Briegleb and W. Lauppe, 236 ; of Deuteroethylenes, Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse, 323
- Rare-Earth Sulphates, Magnetic Anisotropy of, and the Asymmetry of their Crystalline Fields, Prof. K. S. Krishnan and A. Mookherji, 549
- Rats : Adrenals of Normal and of Castrated Male, Histological changes produced by Castration and by Sex Hormones in the, K. Hall and Dr. V. Korenchevsky, 318 ; Liver Extract and Hæmoglobin in, A. L. Bacharach and H. E. Glynn, 896
- Reaction, Heat of, The Sign and Symbol of, Dr. H. J. S. Sand, 809
- Refraction Effect in certain Fatty Materials, A Double, L. Bellingham, 70
- Resins, Synthetic, Examination of, by X-Rays, N. J. L. Megson and W. A. Wood, 642
- Resorcinol, A New Form of, A. R. Ubbelohde and Dr. J. M. Robertson, 239
- Respiration, Artificial, Production of, by Rhythmic Stimulation of the Phrenic Nerves, Prof. R. A. Waud, 849
- Rickets, Experimental, of Rats, Protective Effect against, of a Single Massive Dose of Vitamin D, Dr. H. Rotter, 973
- River Flow Around Bends, Dr. B. Cunningham, 728
- Rubber, Nature of the Diffusion Process in, R. M. Barrer, 106
- Rye, Spring, Devernalization of, by Anaerobic conditions and Revernalization by Low Temperature, Prof. F. G. Gregory and O. N. Purvis, 547
- Salicylic Aldehyde Reaction of Csonka-Straub, Specificity of the, Prof. A. E. Braunstein, 427
- Salmon, Oyster and the, Sex-Biology of the, Prof. J. H. Orton, 68
- (*Scylliorhinus canicula*), Changes of Colour by injection of Pituitary Extracts in a Dogfish, D. R. Barry, 769
- Se₂ Molecule, The Ground State of the, Prof. S. S. Bhatnagar, Dr. H. L. Lessheim and Mohan Lal Khanna, 152
- Seasons, Nomenclature of the, Dr. J. R. Baker, 890
- Sedimentation, Ultracentrifugal, Analytical Measurements of, A. Tiselius, K. O. Pedersen and Prof. The Svedberg, 848
- Selection and Mental Factors, Dr. G. H. Thomson, 934
- Sex Behaviour, Effect upon, of a Diet Deficient in Vitamin E, Dr. B. P. Wiesner and A. L. Bacharach, 972
- Sheep Diseases, Cobalt, and, J. B. E. Patterson, 363
- Showers, Production of, by Heavy Particles, Dr. L. Landau and G. Rumer, 682
- Silica Dusts, Solubility of, Dr. E. J. King, 320
- Silver Halides, Mechanism of Optical Sensitizing of, by Dyes, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096
- Sinanthropus pekinensis*, Reconstruction of the Entire Skull of an Adult Female Individual of, Prof. F. Weidenreich, 1010
- Skatole as a Root-forming Substance, L. G. G. Warne and A. A. Jackson, 26
- Snow Crystal or Snowflake, Sir George Simpson, 729 ; G. Seligman, 730
- Snowflake, Snow Crystal or, Sir George Simpson, 729 ; G. Seligman, 730
- Solar : Eclipse of June 8, 1937, Observations of the, Prof. I. Yamamoto, 501 ; Corona, Polarization of the, K. G. Zakharin, 586 ; Eclipse, Total, of June 19, 1936, Coronal Emission Lines observed at the, Prof. R. Sekiguti, 724 ; Prof. F. J. M. Stratton, 725
- Sound-Films as Diffraction Gratings for the Visual Fourier Analysis of Sound-Waves, Dr. D. Brown, 1099
- Spark Discharge, Development of the, Dr. T. E. Allibono and J. M. Meek, 804
- Spectrometers, Two, for X-Ray Analysis, W. F. de Jong, 768
- Sterol Group, A Diene Synthesis applicable to the, A. B. Meggy and Prof. R. Robinson, 282
- Sterols and the Bile Acids, Stereochemistry of the, D. A. Peak, 280
- Stonefly, Graded Mutations in Wings of a, Prof. A. Willey, 112

- Styrene, Catalysed Polymerization of, Kinetics of, Dr. G. Williams, 363
- Substrate, Use of the word, Dr. N. K. Adam, 158
- Taxes and Kinases, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064
- Tellurium, Molybdenum and Tungsten, Hexaco-ordination of, J. Gupta, 685
- Tenthredinidæ, Thelytokously Parthenogenetic, Maturation in the, Prof. A. D. Peacock and Dr. Ann R. Sanderson, 240
- Ternary: Gas Mixtures, Analysis of, by Thermal Conductivity Measurements, J. L. Bolland and Dr. H. W. Melville, 63; Alloys, Investigation of Equilibrium Diagrams of, by X-Rays, A. J. Bradley, H. J. Goldschmidt, H. Lipson and A. Taylor, 543
- Testosterone, Effect of Enol-Esters of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
- Tetradeuteroethylene, Infra-red Spectrum of, Dr. G. B. B. M. Sutherland and G. K. T. Conn, 644
- Tetramethyldiketopiperazine, Diketopiperazine and, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193
- Thallium Hydride, Band Spectrum of, Dr. B. Grundström, 365
- Thorium, Disintegration of, Detection of α -Particles in the, A. Braun, Dr. P. Preiswerk and P. Scherrer, 682
- Time-Space Continuum", "The, Designation of, Dr. M. O'Gorman, 773
- Titanium Dioxide, Commercial, Darkening of some, in Daylight, W. O. Williamson, 238
- Tobacco Mosaic Virus Nucleoprotein, artificially prepared Visible Paracrystalline Fibres of, R. J. Best, 547
- Tri-brom Ethanol, Absorption of, through the Skin, Dr. D. I. Macht, 849
- Triphenyl Ethylene, Oestrous Reactions, including Mating, produced by, J. M. Robson and Dr. A. Schönberg, 196
- Tritium ?, Tritium or, Dr. K. C. Bailey, 590
- Tritium or Tritium ?, Dr. K. C. Bailey, 590
- Triton taeniatum*, Ectoderm of the Gastrula of, Neural Induction by Plant Tissues in the, M. N. Ragoza, 199
- Tumour Cells, Aerobic Glycolysis of, Specific action of Ferricyanide on, Dr. B. Mendel and Miss F. Strelitz, 771
- Tungsten, Tellurium, Molybdenum and Hexaco-ordination of, J. Gupta, 685
- Turbid Solutions in an Electric Field, Optical rotatory power of, Prof. J. Kunz and R. G. La Baw; Dr. E. B. Ludlam, A. W. Pryde and H. G. Rule, 194
- Ultra-sonic Grating, Circular, in Liquids, Miss J. Ceřovská, 425
- Uterus, Hæmodynamic Factors in the, during the Latter Part of Gestation, Dr. S. R. M. Reynolds, 546
- Veddahs, Blood-groups of, Prof. W. C. O. Hill, 548
- Vibration Temperature in relation to Rotation Temperature in Band Spectra, Dr. N. R. Tawde and S. A. Trivedi, 463
- Vijayalaya Cholisvaram, Temple of, in Pudukottah State, Technique of the painting process in the, S. Paramasivan, 198
- Virus Particles, Aggregation of, J. G. Bald and G. E. Briggs, 111
- Vitamin: A, A new source of, Dr. J. A. Lovern, Dr. J. R. Edisbury and Dr. R. A. Morton, 276; A₂, A Possible, Dr. J. R. Edisbury, Dr. R. A. Morton and G. W. Simpkins, 234; B₁, Reduction of, a coloured intermediate on, F. Lipmann, 849; C, Excretion of, in Sweat, R. E. Bernstein, 684; E Concentrates from Rice- and Wheat-germ Oils, Constituents of, Dr. A. R. Todd, Dr. F. Bergel, H. Waldmann and T. S. Work, 361; E Deficiency in the Suckling Rat, Miss M. M. O. Barrie, 426; P, A. Bentsáth and Prof. A. Szent-Györgyi, 426; P, Dr. S. S. Zilva, 588; E, A Diet Deficient in, Effect upon Sex Behaviour of, Dr. B. P. Wiesner and A. L. Bacharach, 972; D, A Single Massive Dose of, Protective Effect against Experimental Rickets of Rats of, Dr. H. Rotter, 973
- Water, Heavy, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099
- Whales Die? Why Do Stranded, Prof. W. A. Osborne, 1017
- Whirling Threads, Air-drag and the Equilibrium of, E. R. Goshawk, 194
- "Widmanstätten Figures", the spelling of, Meteorites: the number of Pultusk Stones and, Prof. F. A. Paneth, 504; 809; Dr. J. Spencer, 589
- Wireless Waves in the Ionosphere, Absorption of, Annual variation of the, Dr. F. W. G. White and L. W. Brown, 931
- Wires, Internal Friction of, Dr. C. Zener, 895
- Xenon, Krypton and, Packing Fractions of, Dr. F. W. Aston, 149
- X-Ray: Microscopes, The, Dr. L. v. Hámos, 30; Intensifying Screens adapted to Structure Analysis, Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst, 67; Analysis, Two Spectrometers for, W. F. de Jong, 768
- Yeast, Phosphorus Exchange in, Prof. G. Hevesy, Dr. K. Linderström-Lang and N. Nielsen, 725
- Yolk Lecithin, Origin of, L. Hahn and Prof. G. Hevesy, 1059
- Zinc-blende, Photo-conductivity and Phosphorescence of, Dr. A. L. Reimann, 501
- Zodiacal Light at a Total Solar Eclipse, The, Prof. F. J. M. Stratton, 682
- Zoological Nomenclature, Prof. T. D. A. Cockerell, 27
- Cosmic: Radiation, Longitude Effect and the Asymmetry of, Prof. G. Lemaître, 23; Dust Clouds, Evolution of, K. Hillebrand, 125; Ray Measurements, Use of Krypton-filled Ionization Chambers for, Dr. S. Ziemecki, 150; Radiation, Absorption of the Soft Component of, Dr. W. Heitler, 235; Rays, Expulsion of Neutrons from Lead by, B. Arakatsu, K. Kimura and Y. Uemura, 277; Bundles, Mechanism of the production of, P. Auger, P. Ehrenfest, jun., A. Freon and Mme. Thérèse Grivet, 292; Ray Intensity, World-wide effect in, as observed during a recent Magnetic Storm, Prof. V. F. Hess and A. Demmelmaire, 316; Rays and Magnetic Storms, Prof. S. Chapman, 423; Ray Intensity during Magnetic Storms, Variations of, Prof. C. Störmer, 549; Rays, Disintegration Processes by, with the Simultaneous Emission of several Heavy Particles, M. Blau and H. Wambacher, 585; Ray Burst, A, at a depth equivalent to 800 m. of Water, Dr. Y. Nishini and C. Ishii, 774; Rays, Abnormal Zenithal distribution of, M. G. E. Cosyns, 931
- Cottons, Wild and Cultivated American, Homologous Loci in, Dr. S. C. Harland, 467
- Coulter Compound, Lactoflavin, 'Cytochrome b', and Cytochrome c, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
- Counter, A Universal, A. Dauvillier, 477
- Countryside, Amenities of the (*Review*), 623
- Covent Garden Laboratory, Work of the, 17
- Cozymase in Invertebrate Muscle, Dr. S. Ochoa and C. G. Ochoa, 1097
- Creatinine, Compounds of, with Alkali Hydroxides, A. Bolliger, 377
- Cross, Dorothy Temple, research fellowships, award of, 103
- Cross-Channel Ferry Service, 1091
- Crossing-over, The Biology of, Dr. C. D. Darlington, 759
- Crustacea, Body Orientation in, A. G. Lowndes, 241
- Crystal Structure, Mineral Chemistry and, Prof. P. Niggli (*Review*), 783
- Crystallization, Oriented, N. Matsumoto; S. Shimadzu, 978
- Crystals: with Vitamin K Potency, H. J. Almquist, 25; Organic, Temperature variation of Magnetic Anisotropy of, P. N. Nilakantan, 29; Artificial Slip Formation in, A. W. Stepanow, 64; Sublimation and Condensation of, T. Alty, 814; Atomic Distances in, N. Elliott, 978; Volume-rectification of, B. K. Sen, 1102
- Csonka-Straub, Salicylic Aldehyde Reaction of, Specificity of the, Prof. A. E. Braunstein, 427
- Cu and Fe, Intensity and Structure changes of the L α Emission Lines of, on intense cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464

- Cultural Successions in British Archaeology, 1109
 $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Crystal Structure and the Magnetic Anisotropy of, Prof. K. S. Krishnan and A. Mookherji, 896
 Cultural, Geographical and, Regions, Prof. P. M. Roxby, 605
 Cyanin Synthesis (mixed solvent process), An improvement on, and the reaction of Orthothioformic Ester, T. Kimura, 695
 Cyclol Hypothesis, The, and the 'Globular' Proteins, Dr. D. M. Wrinch, 940
 Cyclones in the South Indian Ocean, N. R. McCurdy 34
 Cyclotron, Rays produced by a, Biological effects of the, Prof. M. Nakaidzumi, K. Murati and Y. Yamamura, 359
 'Cytochrome: *b*', Lactoflavin, the Coulter Compound, and Cytochrome *c*, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
 Cytological Technique for Plant Breeders, Outline of, 273
 Cytology: Recent Advances in, Dr. C. D. Darlington. Second edition (*Review*), 1033; The New, Dr. F. W. Sansome (*Review*), 1033
 Cytoplasm, Cell Nucleus and, Interaction between, Prof. C. Stern, 770; Dr. C. D. Darlington, 932
- Dalradian Rocks of the Sperrin Mountains, J. J. Hartley, 251
 Darwin in Uruguay, Dr. J. D. Falconer, 138
 Dates of Publication, Problem of, 499
 Davis Strait, Oceanography of, 687
 Daylight: Submarine, Measurement of, Dr. H. H. Poole, 50; Illumination necessary for Clerical Work, L. H. McDermott, 201
 Dead Sea, Œstrogenic Substances in the, Prof. B. Zondek, 240
 Death from the Skies: a Study of Gas and Microbial Warfare, H. Liepmann (with the scientific assistance of Dr. H. C. R. Simons). Translated by Eden and Cedar Paul (*Review*), 176
 Decapod Crustacea, Larvæ of, Dr. R. Gurney, 692
 Découverte: Palais de la, Congrès du, International Meeting in Paris, Prof. M. Polanyi, 710; Physics, J. G. Crowther, 710; Biology, 712; Biological Chemistry, Dr. E. F. Hartree, 714
 Deep: Drilling Problems, Geological Aspects of, W. E. V. Abraham, 73; Well Drilling, G. Elias, 1093
 Defence and Economic Adjustment, 907
 Dehydroandrosterone, Cholesterol and, Oxidation of, by means of Osmic Acid, Prof. M. Ushakov and A. Lutenberg, 466
 Dekane und Dekansterbilder: ein Beitrag zur Geschichte der Sternbilder der Kulturvölker, Dr. W. Gundel (*Review*), 701
 Delaware Ceremonies and Dances, F. G. Speck, 32
 Dental Amalgams, Dr. Marie L. V. Gayler, 858
 Design: a Treatise on the Discovery of Form, P. E. Nobbs (*Review*), 873
 Determinism, Free Will or, Dr. M. Davidson (*Review*), 871
 Deuterium, Heterogeneous Equilibria with, Prof. J. R. Partington and R. P. Towndrow, 156
 Deuteroethylenes, Raman Spectra of, Prof. M. de Hempinne, J. Jungers and Dr. J. Delfosse, 323
 Devil's Dyke, Wheathampstead, gift of, as an open space by Lord Brocket, 764
 Diatom Floras, Arctic and Antarctic, Dr. Mann, 1019
 Diborane, Structure of, S. H. Bauer, 552
 Diene Synthesis, A, applicable to the Sterol Group, A. B. Meggy and Prof. R. Robinson, 282
 Dietetics: Nutrition and (*Review*), 829; Simplified: the use of Foods in Health and Disease, Prof. L. Jean Bogert. With Laboratory section by Mame T. Porter (*Review*), 829
 Differential Systems, Prof. J. M. Thomas (*Review*), 950
 Diffraction Gratings and Replicas, Recent improvements in, Prof. R. W. Wood, 723
 Digestion, Artificial [1837], 167
 Diketopiperazine and Tetramethyldiketopiperazine, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193
 6:7-dimethoxybenzoparathiazine, Derivatives of, K. J. Baldick and F. Lions, 695
 Dirigible Balloons, Inflammation of, A. Milhoud, 518
 "Discovery" Investigations, 290; The Voyages of the, 529; Committee, Work of the, 571
 Dispersoids, Organic and Inorganic, Electrical Precipitation of the Disperse Phase of, by Radium Emanation, E. Epstein, 1074
 Domestic Fowl, Sex Ratio in the, and its Bearing upon the Sex-linked Lethal Theory of Differential Mortality, Prof. F. A. E. Crew, 1027
 Dorchester, Roman, Excavation of, 311
 Dove Marine Laboratory, Cullercoats, Report of the, 731
 Drilling of a Deep Pressure Test in India, G. F. Wilson, 430
Drosophila: pseudo-obscura, Eye Pigment Development in, Flora Cochran, 292; Spontaneous Chromatin Rearrangements in, Prof. R. Goldschmidt, 767; *melanogaster*: Ovary Transplants in, Meiosis and Crossing-over in Super Females, G. W. Beadle and B. Ephrussi, 779; Parallel Mutations in, Linkage relations of, Dr. A. H. Sturtevant and Dr. C. C. Tan, 812; New Mutation in, Prof. F. A. E. Crew and Dr. C. Auerbach, 898; Gene Doublets as evidence for adjacent Small Duplication in, Dr. H. Grüneberg, 932; *melanogaster*: Chromosomes of, Frequency of induced breaks in, B. P. Kaufmann and M. Demerec, 943; Puparium formation in Lethal Larvæ of, an accelerating effect of normal "ring-glands" on, E. Hadorn, 943; and *Lymnæa*, Temperature and the Growth of, T. Imai, 1067
 Drunkenness, Cure for [1837], 167
 Duckweed (*Lemna*), Concentration of Mesothorium-I by, Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, 317
 Dune Drainage System, A, V. J. Chapman, 592
 Durham University: Centenary of the, 55; conferment upon Prof. W. M. Thornton of the title of emeritus professor; Dr. E. Williams appointed lecturer in electrical engineering, 435; Philosophical Society, election of officers, 967
 Duše Rostlin (The Soul of Plants), Prof. B. Nèmec (*Review*), 1081
 Dust Control in Industry, J. D. Leitch and L. B. Leppard, 772; Prof. H. V. A. Briscoe, 773
 Dybø Fjord, Invertebrates of, Dr. K. Larsen, 1018
 Dynamics, A. S. Ramsey. Part 2 (*Review*), 217
- Ear, Response of the, to a Phase Reversal, C. S. Hallpike, Prof. H. Hartridge and Dr. A. F. Rawdon-Smith, 74
 Earl's Court Exhibition Centre, 188
 Earth Goddess: The, a Study of Native Farming on the West African Coast, G. Howard Jones (*Review*), 698
 Earthquake: Baffin's Bay, of 1933, Dr. A. W. Lee, 369; in Sussex, Recent, 498; in Kashmir, November 14, 886; Swarm of Itō Japan, F. Kishinouye, 977
 Earthquakes: Deep-focus, in the South-West Pacific, R. C. Hayes, 855; American, Recent, 899; off the Coast of Northern California, Prof. Byerly, 937; Tokyo, of 1936, 1093
 East Anglia and Germany, Pleistocene relations in, Dr. F. E. Zeuner, 647
 Easton Park, Dunmow, gift of, as a Nature Sanctuary by the Countess of Warwick, 800
 Eclipse Photography, Natural Colour, E. R. Hewitt, 271
 Eclipses of the Sun and Moon, Sir Frank Dyson and Dr. R. v. d. R. Woolley (*Review*), 991; The Physical Interest of (*Review*), 991
 Economic: Reforms required for Lasting Prosperity and Peace, A. G. McGregor, 354; Research and Industrial Policy, Prof. P. S. Florence, 411; Adjustment, Defence and, 907
 Ecuador, South-Western, Geology of, Dr. G. Sheppard. With a chapter on the Tertiary Larger Foraminifera of Ecuador, by Dr. T. W. Vaughan (*Review*), 1035
 Edinburgh: Astronomical Association, bequest to the, by J. H. Lorimer, 886; University: conferment of honorary doctorates on Prof. L. H. Baekeland, Sir William Bragg, Dr. N. Murray Butler, Sir Herbert

- Grierson and Dr. A. Morgan, 80; conferment on the Queen of an honorary doctorate, 98
- Education: in Industrial Management, E. S. Byng and G. A. Robinson, 79; Technical, Grammar Schools and, Dr. E. Benson, 79; The Informative Content of, H. G. Wells, 415; Early, Philosophy of, 479; General Physiology in, 659; Universities and, Prof. F. G. Baily and others, 689; Adult, in the United States, Dr. J. W. Studebaker, 816
- Educational: Equipment for the New Age, 85; Films, 540
- Eelworm, Root-Knot, G. F. Wilson, 898
- Egypt: Exploration Society, Excavations of the, in Nubia, 1936-37, 78; Lower, Temperature and Relative Humidity in the Atmosphere over, W. D. Flower, 813; Ancient, Bull Cults of, Dr. Drioton, 1067
- Egyptian: University Scientific Expedition to South-West Arabia, Dr. S. A. Huzayyin, 513; Music, Modern, Modes in, M. Mokhtar and Dr. A. M. Mosharafa, 548
- Elasmobranch Fishes, Colour Changes in, G. H. Parker, 469
- Electric: Furnaces, D. Campbell, 59; Cables, Earthing the Metal Sheathing of, 579; Spark in Air at Atmospheric Pressure, Influence of Electric and Magnetic Fields on the, L. Bull and P. Girard, 1110
- Electrical: Engineers, Institution of, election of officers, 104; award of scholarships of the, 422; Contacts, Commutable and Stable, G. A. Boutry and G. Tréherne, 251; Equipment, The, and Automobiles, Prof. S. Parker Smith. Third edition (*Review*), 704; Accidents in 1936, H. W. Swann, 887; Engineers, Institution of, Presentation to, of a Portrait of S. Evershed, 1094
- Electricity: in Solids, Conduction of, R. W. Pohl and others, 204; and Marketing, F. H. Slade, 311
- Electrification of the Paris-Orléans and Midi Railways, A. Bachellery, 1025
- Electrodeless High-frequency Discharge, Effect of a Magnetic Field on the, E. W. B. Gill, 1061
- Electrodynamics, Validity of Laws of, W. F. Dunton, 245; Dr. A. E. Clayton, 246
- Electrolytes: Strong, Surface Tension of, Prof. M. Dole, 464; Strong, Conductance of Mixtures of, K. A. Krieger and M. Kilpatrick, 1020
- Electrolytic Condensers: their Properties, Design and Practical Uses, P. R. Coursey (*Review*), 636
- Electron: Positron and, Pairs, Production of, by bombardment of Mercury with β -Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105; Tubes, The Physics of, Dr. L. R. Koller. Second edition (*Review*), 133; Diffraction Studies of Oxides formed on Iron, 278; Pairs, Creation of, by Nuclear Capture of Neutrons, H. S. W. Massey, 292; Diffraction: and Surface Structure, Prof. G. I. Finch (Bedson lecture), 800; in Crystals, Dr. P. P. Ewald, 928
- Electronic Charge, Determination of, by the Oil Drop Method, Y. Ishida, I. Fukushima and T. Suetsugu, 29
- Electrons: Measurement of the Nuclear Absorption of, by the Atmosphere up to about 10^{10} Electron-Volts, Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, 23; Orbital, Capture of, F. Hoyle, 235
- Electrostatic Valve, The, M. Pauthenier, M. Feldenkrais and L. Vigneron, 518
- Electrotor Smoke and Dust Meter, Dr. S. C. Blacktin, 331; 582
- Element: 43, Radioactive Isotopes of, C. Perrier and Prof. E. Segré, 193; 87 (MI), New Researches on the, H. Hulubei, 1111
- Elements, Constitution of, Richard Watson and the, Prof. H. A. Harris, 926
- Ellsworth Trans-Antarctic Flight, Map of, W. L. G. Joerg and O. M. Millar, 648
- Embryology, A Textbook of, Prof. H. E. Jordan and Prof. J. E. Kindred. Third edition (*Review*), 949; Human, Dr. F. H. A. Marshall (*Review*), 949
- Empiricism, Logic and, Dr. T. Greenwood (*Review*), 866
- Enke's Comet, 500
- Engineering: Fundamentals, Handbook of. Edited by O. W. Eshbach (*Review*), 91; Research in, Sir Alexander Gibb, 412; and Marine Exhibition at Olympia, 553; Military. Vol. 6: Water Supply (*Review*), 705; and Transport, Sir Alexander Gibb, 719; Progress of, Bryan Donkin, 798; Professions, Co-operation between the, Sir George Lee, 799; Progress in the Navy, Prof. C. J. Hawkes, 1024
- England under Trust: the Principal Properties held by the National Trust in England and Wales. Described and illustrated by J. Dixon-Scott (*Review*), 623
- Enol-Esters of Testosterone, The effect of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
- Entomological Society [1837], 250
- Enzyme: Research (*Review*), 563; Chemistry, Dr. H. Tauber (*Review*), 948
- Enzymforschung, Ergebnisse der, Herausgegeben von F. F. Nord und R. Weidenhagen. Band 6 (*Review*), 563
- Enzymologia*, vols. 3 and 4, 923
- Estate Woodlands, Present and Future of, Hon. Nigel Orde-Powlett, 817
- Estuary Channels and Embankments, Dr. B. Cunningham (Vernon-Harcourt lecture), 1046
- Ethnological Museums: Methods and Limitations, Dr. H. S. Harrison, 57
- Ethyl-chlorophyllide, Elementary Cell and Space group of, Dr. J. A. A. Ketelaar and E. A. Hanson, 196
- Ethylene: Bromide, Thermal Decomposition of, Prof. T. Iredale and A. Maccoll, 24; Hydrocarbon Derivatives of, Oestrogenic Activity of some, Prof. E. C. Dodds, M. E. H. Fitzgerald and W. Lawson, 772
- Europaischen und mediterranen Ottern und ihre Gifte: Die Grundlagen zur Darstellung eines Wirksamen Schlangenserums, Prof. R. Bieling, and others (*Review*), 744
- European Ethnology and Folklore, International Association for, Conference at Edinburgh, 206
- Evans' Biological Institute, Extension of, 676
- Everest, Conquering, Problems of, E. Shipton, 394
- Everglades National Park, U.S.A., The proposed, Dr. J. K. Small, 263
- Evolution: Directive (*Review*), 870; A Catechism of (*Review*), 912; and its Modern Critics, Dr. A. Morley Davies (*Review*), 912
- Evolutionary Thought, The History of, as recorded in Meetings of the British Association, Sir Edward B. Poulton, 395
- Examiners, Indulgent [1837], 434
- Excitation in Living Material, Transmission of, A. L. Hodgkin and others; Dr. W. A. H. Rushton, 118
- Exhibition, 1851, studentships and scholarships, award of, 60
- Experiment, The Function of, Dr. E. C. Childs, 852
- Faraday House Electrical Engineering College, Earl of Rothes appointed chairman of governors, 190
- Faraday and Schönbein [1837], 517
- Faraday's: Diary [1837], 655; Experimental Researches [1837], 1072
- Faroese: Invertebrates of the, Dr. A. D. Imms, 733; Zoology of the, Edited by A. S. Jensen, W. Lundbeck, T. Mortensen and R. Sparck. Vol. 2, part 1, 733
- Fast, A Simulated [1837], 904
- Fatigue and Air Movement in Rooms, J. R. Henderson, 976
- Fe-C, System, A New Equilibrium Diagram for the, Dr. I. Iitaka, 462
- Fe, Cu and, Intensity and Structure Changes of the $L\alpha$ Emission Lines of, on intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
- Fermente und ihre Wirkungen, Die, Prof. C. Oppenheimer. Supplement. Lief 6 (*Review*), 873
- Fernrohre, Die, und Entfernungsmesser, Dr. A. König. Zweite Auflage (*Review*), 831
- Ferns, Hybrid [1837], 819
- Ferret, Embryology of the, W. J. Hamilton, 775

- Ferricyanide, Specific action of, on *Æro*bic Glycolysis of Tumour Cells, Dr. B. Mendel and Miss F. Strelitz, 771
- Ferromagnetism, Size of Particles responsible for, D. Beischer and A. Winkel, 202
- Ferskvandsfaunaen, biologisk belyst: Invertebrata, Prof. C. Wesenberg-Lund. Bind 1, 2 (*Review*), 992
- Fibres Cores in Winding Ropes, 818
- Finney-Howell Research Foundation, The, 1009
- Finsler Comet, 1937f, Rapid Changes in the Tail of the, J. Ellsworth, 985
- Fireball Train, Observation of a, M. A. Ellison, 244
- Fires, Fighting, Devices for, T. Rich, 271
- Fish: Oils, New Zealand, F. B. Shorland, 223; Liver Oils, Freshwater and Marine, Chromogenic properties of, Differences in the, A. E. Gillam, Prof. I. M. Heilbron, Dr. E. Lederer and V. Rosanova, 233; Japanese, Barbels of, M. Sato, 429; Mentality of, Dr. J. Gray, 496; Freshwater, Blindness in, Dr. W. Rushton, 1014
- Fishes: Indian, Researches on, Sunder Lal Hora; P. Sen, 367; Giant, Whales and Dolphins, J. R. Norman and Dr. F. C. Fraser (*Review*), 911
- Fjord Formation, N. E. Odell, 855
- Flavonols: Synthesis of, Oxidation of Flavindogenides, Prof. J. Algar and Isabella P. Carey, 292
- Fletcher, late Sir Walter Morley, Memorial to, 357
- Flight, Interpretative History of, M. J. B. Davy (*Review*), 637
- Flints and Flint-working, Exhibition of, at the British Museum (Bloomsbury), 677
- Floral Morphology: a New Outlook, with special reference to the interpretation of the Gynæceum, Miss E. R. Saunders. Vol. 1 (*Review*), 132
- Flower, The Structure of the (*Review*), 132
- Fluid Mechanics, An Introduction to, A. H. Jameson (*Review*), 635
- Fluids, Insulating Power of [1837], 434
- Fluorine: Intoxication, K. Roholm (*Review*), 483; Poisoning, Dr. M. M. Murray (*Review*), 483
- Fluoroform, A. L. Henne, 593
- Flying Records, New, Flying-Officer A. E. Clouston and Mrs. Kirby-Green, 888; 929; M. Codos, 929
- Folk-Lore, Scientific Study of (*Review*), 785
- Food: Science and the Conservation of, T. Macara, 203; Investigation Board, Report of the, for the year 1936, 956
- Foods and Nutrition, Elements of, Mary T. Dowd and Prof. Alberta Dent (*Review*), 829
- Foodstuffs, Transport and Storage of, Progress in the, 956
- Foot-and-Mouth Disease, 925
- Forbes, J. D., among the Dolomites [1837], 476
- Force Constants and Molecular Structure, Dr. H. W. Thompson and J. W. Linnett, 1065
- Forest Bibliography to 1933, 1092
- Forestry: Commission, Sixteenth annual report of the, 692; in Great Britain, 692; Research in Malaya, 1091
- Forthcoming Books of Science, 638
- Fortified Hill-top Site in Sussex, 540
- Fossil: Insects from Kansas Rocks, late Dr. R. J. Tillyard; A. Martynov; F. M. Carpenter, 116; Discoveries in France [1837], 556; Man in Minnesota, 596; Insects from the Permian of Kansas, late Dr. R. J. Tillyard, 1104
- Foulerton Research Fellowship, Dr. M. C. G. Israels appointed to a, 1058
- Fractionation Coefficients of Salts possessing several Hydrates, B. Goldschmidt, 477
- France: La Société Astronomique de, Jubilee of, 17; College de, [1837], 1026
- Franklin Institute [1837], 693
- Free: Will: or Determinism, Dr. M. Davidson (*Review*), 871; Science and (*Review*), 871: Radicals in Solution, Dr. D. H. Hey and Dr. W. A. Waters, 934
- French: Railway, First [1837], 333; Society of Chemical Industry: Seventeenth Congress in Paris, 672
- Freud and Marx: a Dialectical Study, R. Osborn (*Review*), 344
- (*frigidreactions*), New Transformations produced at Low Temperatures, A. Debierne and L. Goldstein, 656
- Frog's Eye, Electrical Response of the, Absorption Curve for Visual Purple and the, Prof. R. Granit, 972
- Fruit: Supplies in 1936, 581; -cooling Plant at Cape Town, 802
- Fruits: Insects and allied Pests of, G. Fox-Wilson (*Review*) 215; and Hops, The Pests of, Dr. A. M. Massee (*Review*), 215
- Fuel Interests, Co-ordination of, Sir Philip Dawson, 763
- Fulgurites from Witsands, Kalahari, A. D. Lewis, 368
- Fungi, Polyporaceous, Dr. S. R. Bose, 592
- Fungus Gall, A New, Miss Janet M. Wilson, 1019
- γ -Rays of Polonium, The, H. C. Webster, 852
- γ -Rays, X- and, Biological action of, Some Quantitative aspects of the, C. M. Scott, 936
- Gagea spathacea*, Cytology of, Dr. M. Westergård, 551
- Galileo and Mathematical Demonstration, W. C. Fahie; G. J. Whitrow, 646
- Gallium: Das, eine kritische Würdigung der Erkenntnisse mit experimentellen Beiträgen, Dr. E. Einecke (*Review*), 566; F. Sebba and W. Pugh (4), 656; Germanium and, Preparation of, Sir Gilbert Morgan and Dr. G. R. Davies, 688
- Galvani: Bicentenary of, 391; 836; The, and the Aldini Writings on Animal Electricity, a Bibliographical Study of, Prof. J. F. Fulton and Prof. H. Cushing, 840
- Galvanometer Shunt, a Convenient form of, for use with Rectifier Photo-cells, H. H. Poole, 376
- Game: Research, 616; Sanctuaries or National Parks, 651
- Ganglia, Superior Cervical, Choline Esterase activity of, D. Glick, 426
- Gā People, Religion and Medicine of, Miss M. J. Field (*Review*), 869
- Gardening, No. 1, 1008
- Gas: Warfare, Offence and Defence in, Major-Genl. C. H. Foulkes (*Review*), 3; Thermometers, Differences in the Indications of, W. Jacyna, 167; Engineers: Institution of, Autumn Research Meeting, H. J. Hodsmann, 903
- Gases: and Metals: an Introduction to the Study of Gas-Metal Equilibria, Dr. C. J. Smithells (*Review*), 385; Imperfect, The Cluster Theory of, Dr. C. F. Goodeve, 424; Rare, Chemical Properties of the, B. A. Nikitin, 643; Permanent, Pressure of Some, at Low Temperatures in the Presence of Silica Gel, R. Delaplace, 985; Pure, Conductivity of, at High Pressures, J. Clay and G. van Kleef, 1111
- Gasometric Technique, Principle of the Cartesian Diver applied to, Dr. K. Linderstrøm-Lang, 108
- Gassendi, Pierre, Prof. P. Humbert, 732
- Geissler Discharge, Stratified, in Different Gases at Atmospheric Pressure, J. Jaffray, 477
- Gem-Stones (*Review*), 703
- Gems: The Story of the, a popular Handbook, H. P. Whitlock (*Review*), 703
- Gene Linkage, Transitive Interference in, Prof. K. de Kőrösy, 322
- General Register Office, Centenary of the, 56
- Genetical Society, Summer Meeting, 314
- Genetics: and Plant Breeding in the U.S.S.R., 296; Mendel, Morgan and, Prof. E. W. MacBride, 348; The Position of, Prof. J. B. S. Haldane, 428; and Taxonomy, Dr. W. B. Turrill, and others, 572; Eighth International Conference of, 803
- Génétique, Exposés de, 2: L'Effet de position et la théorie de l'hérédité, Prof. T. Dobzhansky (*Review*), 788
- Geodesy, International, Development in, Dr. J. de Graaff Hunter, 75
- Geographical: Association, Sir Thomas Holland elected president of the, 582; and Cultural Regions, Prof. P. M. Roxby, 605
- Geological: Congress, International, Seventeenth, Prof. W. T. Gordon, 789; Society of London, Dr. W. A. J. M. van Waterschoot van der Gracht, Dr. W. J. Jongmans, Dr. A. Renier and Dr. F. E. Wright elected foreign fellows and Prof. N. L. Bowen, Prof. R. M. Field, Baron F. von Huene and Prof. H. Stilles,

- foreign correspondents, 883; Investigation, A Century of, Prof. W. W. Watts (*Review*), 915; Survey of Great Britain, The first hundred years of the, Sir John Smith Flett (*Review*), 915
- Geology: Engineering, Prof. H. Ries and Dr. T. L. Watson. Fifth edition (*Review*), 259; in Engineering, Dr. B. H. Knight (*Review*), 259; in Schools, The Teaching of, 595
- Géométrie infinitésimale, *Éléments de*, Prof. G. Julia. Deux. édition (*Review*), 950
- Geonemertes dandyi* Dakin, a Land Nemertean in Wales, A. R. Waterson and H. E. Quick, 292
- German: Scientific Association [1837], 655; Physical Society, award of the Planck medal to Prof. E. Schrödinger, 722
- Germanium and Gallium, Preparation of, Sir Gilbert Morgan and Dr. G. R. Davies, 688
- Germany: Economic Position and Outlook in, A. Parker, 541; Physical Education in (*Review*), 561; Population Policy in, Dr. Danzer; Dr. A. Moritz, 678
- Gibbs: J. Willard: A Commentary on the scientific writings of. Vol. 1, edited by Prof. F. G. Donnan and Prof. A. Haas; Vol. 2, edited by Prof. A. Haas (*Review*), 298; and his work (*Review*), 298
- Gibraltar Man, 961
- Giorgi's System of Units, Dr. A. E. Kennelly, 20
- Glaciation of the Midlands, Prof. L. J. Wills, 409
- Glacier Lakes and local Glaciers of the Wicklow Hills, Map of the, Prof. J. K. Charlesworth, 251
- Glasgow: and West of Scotland College of Domestic Science, Anne R. Macarthur, 421; University: Prof. G. Barger appointed regius professor of chemistry, 537, 556; Dr. N. Morris appointed professor of materia medica and therapeutics, 556; Dr. P. Bacsich appointed lecturer in embryology; Dr. H. E. C. Wilson appointed lecturer in pathological and biochemistry at the Royal Hospital for Sick Children, 654
- Glass Electrode, Mechanism of the, G. Haugaard, 66; and Silica, Surface Layers on, Lord Rayleigh, 470; Technology, Society of, Twenty-first anniversary of the, 884; Technology, Twenty-one years of, 1071
- Glasshouse Industry, Development of the, Dr. W. F. Bewley; F. A. Secrett, 887
- Glastechnische Fabrikationsfehler, Dr. H. Jebseb-Marwedel; M. Parkin (*Review*), 830
- Glazes, Chinese, Scientific aspect of, Sir Gilbert Morgan (*Review*), 382
- Gliadin, Individuality of, Prof. A. G. Kuhlmann, 119
- Gliding, Progress in, 146
- 'Globular' Proteins, The Cyclol Hypothesis and the, Dr. D. M. Wrinch, 940
- Glucolysis, Embryonic, Glyceraldehyde and, Dr. J. Needham and H. Lehmann, 198
- Glyceraldehyde and Embryonic Glucolysis, Dr. J. Needham and H. Lehmann, 198
- Glycerophosphoric Dehydrogenase, Dr. H. Weil-Malherbe, 725
- Glycogen, Cellulose, Starch and, Prof. H. Staudinger, 1071
- Glycolysis in Muscle Extracts, The Initial Stages of, Dr. L. P. Kendal and Dr. L. H. Stickland, 360
- Gmelins Handbuch der anorganischen Chemie Achte Auflage. System-Nummer 36: Gallium; System-Nummer 37: Indium; System-Nummer 23: Ammonium. Lief 2: Verbindungen bis Ammonium und Kalium, Hydrazonium, Hydroxylammonium; System-Nummer 59: Eisen. Teil A, Lief. 8: Fe-C (Fortsetzung); mechanische und thermische Eigenschaften; Systeme Fe-C-H bis Fe-Be-K; System-Nummer 59: Eisen. Teil D: Magnetische und elektrische Eigenschaften der legierten Werkstoffe (*Review*), 953
- Goethe medal for art and science, award of the, to Prof. E. Lexer, 148
- Gold: in Plant Ash, Prof. B. Némec, 73; Mining with the aid of Aeroplanes, W. Bullock, 100; The Metallurgy of, Sir Thomas Kirke Rose and W. A. C. Newman. Seventh edition (*Review*), 258; Films, Thin, Production of, Prof. C. A. Gibson, 279; Standard, A Managed, E. A. Meyer, 354; Volatile Derivatives of, Phosphine and Arsine Derivatives of the Group I (b) Metals: Drs. F. G. Mann and A. F. Wells, 502; Mirrors, Constitution of Aurous Compounds: Prof. C. S. Gibson, 583
- Golden: Bough, Aftermath: a Supplement to the, Sir James George Frazer (*Review*), 260; Gate Fair, 1056
- Gossage and the Alkali Industry [1837], 291
- Göttinger Sieben", "The, [1837], 1110
- Government: Experimental Distillery [1837], 655; Chemist, Deputy, Dr. A. G. Francis appointed, 844
- Graham Thomas, at University College, London [1837], 81
- Grammar Schools and Technical Education, Dr. E. Benson, 79
- Gran Chaco, Meteorites of the, 1006
- Grand Junction Railway [1837], 39
- Graphite, Colloidal, an effect of X-Radiation on the ζ Potential of, Prof. J. A. Crowther and H. Liebmann, 28
- Grass: Drying, E. J. Roberts, 243; Dr. R. E. Slade, 1089; and the Nation's Food Supply, Dr. R. E. Slade, 456
- Grassland: Management in Great Britain, Prof. R. G. Stapledon, 99; Congress, Fourth International, 248; Dr. D. S. Huizinga elected president of the fifth congress, 249
- Gravimetric Analysis: a Laboratory Manual with special reference to the analysis of Natural Minerals and Rocks, W. van Tengeren (*Review*), 665
- Gravitational Statics in Three Dimensions, S. G. Emslie, 729
- Gravity in the Levant, Acceleration of, P. Lejay, 694
- Great Western*, S.S., Launch of the [1837], 123
- Greenland: Culture: (1) The Norsemen, Dr. A. Roussel and others, 52; (2) The Eskimo, 177; and Europe, Meteorological Connexions between, Dr. F. Loewe, 593; the Birch 'Forests' of, Dr. N. Polunin, 939
- Greifswald University, Prof. T. Vahlen made an honorary professor in, 21
- Gresham College [1837], 777
- Grid System, British, J. Wright, 394
- Growth: Factors, Prof. F. Kögl and others, 161; Substances, Relation of, to Horticultural Practice, Dr. M. A. H. Tincker, 594
- Gutenberg, Monument to [1837], 291
- Gynandromorphism and Lateral Asymmetry in Birds, Prof. F. A. E. Crew and S. S. Munro, 1027
- Gyro Compass on the Hudson Bay Route, 311
- Haboobs in the Sudan, J. S. Farquharson, 687
- Haemocyanin Molecule, Splitting of the, by Ultra-sonic Waves, S. Brohult, 805
- Hæmorrhagic States, The, Prof. L. J. Witts and others, 243
- Hailey National Park, E. A. Smythies, 651
- Haldane: Lord, A Life of (*Review*), 989; 1856-1915: the Life of Viscount Haldane of Cloan, K.T., O.M., Major-Genl. Sir Frederick Maurice (*Review*), 989
- Halle Academy, The, 1652-1937, 179
- Hallucinations scientifiques (les portulans), Prince Yousouf Kamal (*Review*), 662
- Haloos, Pleochroic, Some New Types of, Prof. G. H. Henderson, 191
- Hamburg Observatory, Astronomical work at the, 649
- Hanseatic Scholarships, Foundation of, 719
- Harmonic Analyser, A new, J. Harvey, 74
- Harvard University: Physics at, 356; Medical Schools, Dr. J. E. Gordon appointed professor of preventive medicine and epidemiology, 582
- Hawaii, Interracial Marriage in, Dr. R. Adams (*Review*), 665
- Hawthorn, A Disease of, W. J. Dowson and W. A. R. Dillon Weston, 116
- Hay Railway, 1810-1864, History of the, Capt. F. B. Ellison, 964
- He, Li⁺ and, Ionization Energy of, H. A. S. Eriksson, 151
- Health: Ministry of, Eighteenth annual report of the, 271; and the Community, 493; 538; and a Day, Lord Horder (*Review*), 705; Nutrition and, 874; Legislation in Industry, Wider Issues of, Dr. L. P. Lockhart, 1090

- Heat: Production, Nutrition and Growth in Man, Dr. E. P. Poulton, 413; of Reaction, The Sign and Symbol of, Dr. H. J. S. Sand, 809
- Heavy Water, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099
- Helium: Liquid, Heat Conduction in, Dr. J. F. Allen, Dr. R. Peierls and M. Zaki Uddin, 62; α -Particles in, Loss of charge of, F. Viehfeiger, 125; Hydrogen and, Isotopes of, of Mass 3, The search for the, Lord Rutherford, 303; I and II, Refractive Indexes of, Prof. E. F. Burton, 1015
- Hemipterous Insects of the family Peloridiidae, I. W. Helmsing and W. E. China, 326
- Herbage: and Foreign Seeds, G. Evans, 1018; F. J. Crider and M. M. Hoover, 1019; Plants, Associated Growth of, H. C. Trumble and T. H. Strong; H. C. Trumble and R. E. Shapter, 1067
- Heteroauxin and Cambial Activity, A. B. Brown and R. G. H. Cormack, 898
- Hetero-auxin, Effect of, on the growth of Broad Bean Plants in Water Culture, Dr. H. L. Pearce, 26
- Heteroauxones in Legume Nodule Formation, Role of, Beneficial Host effects of Nodules and Soil Fertility, Prof. G. K. K. Link, 507
- High-frequency Fields, Alleged Specific Effects of, on Biological Substances, Dr. J. B. Bateman, Dr. H. Loewenthal and Dr. H. Rosenberg, 1063
- Highway, Modern, Science and the, Dr. B. H. Knight (*Review*), 441
- Himalayan, Eastern, Blood-groups, Miss Eileen W. E. Macfarlane, 591
- Hippolyte varians*, Colour changes in, Dr. L. H. Kleinholz and Dr. J. H. Welsh, 851
- Holarctic Fauna and Flora, Evolution of the, Dr. B. P. Uvarov (*Review*), 129
- Holarktis, Die, W. F. Reinig (*Review*), 129
- Holocentrus*, Squirrel Fish, Colour changes due to erythro-phores in, G. H. Parker, 83
- Horniman Museum, retirement of Dr. H. S. Harrison, 227; Dr. L. W. G. Malcolm appointed curator, 228
- Horticultural: Note Book, J. C. Newsham. Fifth impression (*Review*), 527; Practice, The relation of growth substances to, Dr. M. A. H. Tincker, 594
- Horticulture": Practical Hints in (*Review*), 527; Recent Advances in, 860; "Scientific, 1937, 860
- Hospitals, Reforms in the [1837], 556
- House: Plants, R. van Tress, 420; -Rat in the United States, 355
- Human: Biology, Need for the Study of, Prof. R. Pearl, 145; Societies, Control in, Prof. J. Dowd (*Review*), 481; Skeletal Remains in London, Dr. A. J. E. Cave, 497; Nature: The Nature of, and other Essays in Social Psychology, Prof. E. Faris (*Review*), 566
- Humidity, a Coefficient of, of General Applicability, A. Angström, 160
- Hydrangea Flowers, Colour of, E. M. Chenery, 326
- Hydro-electric: Practice in India, The, Prof. B. C. Chatterjee. 2 Vols. (*Review*), 442; Power Scheme, A New, in Sweden, 817
- Hydrogen: Isotope 2 of, Compounds of the, with the Alkali Metals (alkaline deuterides), L. Hackspill and A. Borocco, 82; Heavy, in Scientific Research, H. S. Taylor (Bruce-Preller lecture), 124; Structure of Ha of, Prof. N. A. Kent, Royal M. Frye and W. H. Robinson, 236; and Helium, Isotopes of, of Mass 3, The search for the, Lord Rutherford, 303; Bridges in Solid Pentaerythritol, I. Nitta and T. Watanabé, 365
- Hydroid, A New, from Norway, E. Westblad, 1104
- Hydroxy Compounds, Infra-red absorption of, near 3μ , Drs. J. J. Fox and A. E. Martin, 937
- Hyla arborea* L., Influence of the Central Nervous System on the Adaptation of the Colour of, Martha Geiringer, 41
- Hymenoptera Symphyta, Cytology of Parthenogenetic Reproduction of, F. Greenshields (1), 124
- Hyperbolic: Space, Dr. G. C. McVittie, 773; or Spherical Space, Dr. G. C. McVittie, 1105
- Hypophysis: Morphogenetic Activity of Different Parts of the, A. A. Voitkevich, 599; 821; and the Thyroid Gland, Posterior Lobe of the, O. Peczenik and L. Popper, 821;
- Hypothesis, Judgment by, Dr. H. Dingle, 589
- Iceland, Zoology of, R. Spärck; E. Wesenberg-Lund, 419
- Ideology and Utopia: an Introduction to the Sociology of Knowledge, Prof. K. Mannheim (*Review*), 481
- Imperial College of Tropical Agriculture, Trinidad, E. Harrison appointed professor of agriculture, 1009
- India: The Millipedes of, Dr. C. Attems, 72; British, Public Health in, during 1934, 189; National Institute of Sciences of, grant-in-aid to the, 270; Plant Diseases and Pests, Some of, and their control, A. Mitra, 272; The Law of Trade and Merchandise Marks in, Dr. S. Venkateswaran (*Review*), 342; Trade Marks in (*Review*), 342; Industrial Research in, 352; Survey of, Annual Report for 1936, 460; Meteorological Department, Report for 1935-36, 499; Spirit Drinking in [1837], 556; and Burma, Aquatic and Marsh Plants of, K. P. Biswas, 592; Broadcasting in, 614; Agricultural Meteorology in, 651; Archaeological Research and the Pre-history of, 925; National Institute of Sciences, election of fellows, 928; Mails from, [1837], 984
- Indian: Ethnography, R. E. Enthoven (*Review*), 213; Institute of Science, Bangalore, Sir C. V. Raman appointed professor of physics, 232; Science Congress Association: Silver Jubilee, 313; Diets, Nutritional Value of some, D. N. Mullick and Dr. J. T. Irving, 319; Institute for Medical Research, Report for 1935-36, 422; Hydro-Electric Technics (*Review*), 442; Coleoptera, Larvæ of, J. C. M. Gardner, 592; Science Congress: The British Association and the, a scientific delegation to India, 609; Trees, Some Beautiful, late Rev. E. Blatter and W. S. Millard (*Review*), 633; Science Congress Association, jubilee meeting of the, Sir James Jeans to preside over the, 803; Hydro-Electric Development, 841; Sites, Early, in Virginia, U.S.A., D. I. Bushnell, jun., 854; Science Congress, The British Association and the, 921
- Indiana. 1: Leben, Glaube und Sprache der Quiché von Guatemala; 2: Mythen in der Muttersprache der Pipil von Izalco in El Salvador (*Review*), 788
- Indophenol, Specificity of, in the estimation of Ascorbic Acid in Fermented Products, F. W. Fox and W. Stone, 234
- Industrial: Accidents, Scientific Aspects of, 559; Psychology, National Institute of, Work of the, Lord Dudley, 1088
- Industry: Research and, 437; Location of, H. C. Emerson and others, 515; in Great Britain, Location of, 1075
- Infant Speech: a Study of the beginnings of Language, M. M. Lewis (*Review*), 172
- Inflammable Gas in a Fire, Behaviour of Cylinders of, Dr. O. C. de C. Ellis, 935
- Inland Water Survey: Committee: Second Annual Report, 1936-37, 1106; in Great Britain, Dr. B. Cunningham, 1106
- Insanity, Civilization and [1837], 693
- Insects: present-day, Ancestors of some groups of the, Prof. G. Zalessky, 847; and Mites of Stored Grain, R. T. Cotton and N. E. Good, 936
- Insolation and Relief, Miss A. Garnett, 776
- Institute of Patentees, Dr. S. C. Blacktin awarded the silver medal of the, and the Founder's silver medal, 1058
- Insulin: The Two Crystalline Modifications of, Dr. D. Crowfoot, 149; Structure of, Cyclol Theory of the, Dr. Dorothy M. Wrinch, 286; Protamine, Use of, 315; Early work on, Sir Frederick Banting, 901
- Integrative Levels: a Reevaluation of the Idea of Progress, Dr. J. Needham (Herbert Spencer lecture), 679
- Intellectual: Co-operation and International Science, 121
- Unemployed in France, Aid for, 612

- Intelligence and Civilization, Prof. G. H. Thomson (Ludwig Mond lecture), 59
- Intensities, Law for Minimal Discrimination of, A. H. Holway and W. J. Crozier (2), 943
- International: Co-operation in Social and Economic Problems, 1; Congress of Agriculture, Seventeenth, at the Hague, 35; Geodesy, Development in, Dr. J. de Graaff Hunter, 75; Union of Biological Sciences, next general assembly of the, 147; Tin Research and Development Council, Statistical Year Book, 1937, of the (*Review*), 176; Agreement for the Regulation of Whaling, 180; Association for European Ethnology and Folklore: Conference at Edinburgh, 206; Grassland Congress, Fourth, 248; Dr. D. S. Huizinga elected president of the fifth congress, 249; Co-operation in Science, 337; Acoustical Conference, First, 370; Congress for Short Waves in Physics, Biology and Medicine, Vienna, Dr. J. B. Bateman, 372; Population Congress in Paris, 471; Society of Leather Trades' Chemists: Conference at Copenhagen, 516; Council of Scientific Unions, Prof. J. Sakurai elected vice-president of the, 641; Geological Congress, The Seventeenth, Prof. W. T. Gordon, 789; Conference of Genetics, Eighth, 803; Conference on the Theory of Probability, Prof. E. L. Dodd and J. Neyman, 938
- Inventions, New, Exhibition, Dr. S. C. Blacktin, 982
- Iodine: Value of Drying Oils, Variation of the, according to their origin, P. Balavoine, 125; Vapour, Some Electrical and Optical properties of, Prof. K. G. Emel us, E. B. Cathcart and C. M. Minnis, 251; Diamagnetism of Solutions of, and the Purity of the Alcohol, C. Courty, 518; Electrode, Potential of the, R. G. Bates and W. C. Vosburgh, 776; Prof. Irvine Masson, 1005
- Iodoacetate, Action of, on Dehydrogenases and Alcoholic Fermentation, Dr. W. M. Dixon, 806
- Ion UO_2^{++} , Thermomagnetic Properties and Constant Paramagnetism of the, in Some Uranyl Salts in Aqueous Solution, A. Nicolau, 985
- Ionic: Mobilities, Effect of Viscosity on, D. Belcher, 810; Clouds, Irregular, in the *E* Layer of the Ionosphere, T. L. Eckersley, 846
- Ionization: Theory and Radiobiological Phenomena, C. E. Nurnberger, 83; by Radioactive Gamma and Cosmic Rays in different Gases, J. Juilfs, 767
- Ionosphere: Artificial, Anomalous Dielectric Constant of, Prof. S. K. Mitra and K. K. Roy, 586; 1066; Ionization of Lower Part of, Mme. Ir ne Mihul and Constantin Mihul, 694; Disturbances, Dr. J. H. Dellinger, 732; Observations in Japan during a Solar Eclipse, T. Minohara and Y. Ito, 814; *E* Layer of the, Irregular Ionic Clouds in the, T. L. Eckersley, 846; Wireless Waves in the, Annual Variation of the Absorption of, Dr. F. W. G. White and L. W. Brown, 931
- Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions, Dr. D. F. Martyn and G. H. Munro, A. J. Higgs and Dr. S. E. Williams, 603; Disturbances, Catastrophic, An Effect of, on Low frequency Radio Waves, K. G. Budden and J. A. Ratcliffe, 1060
- Ions: Slow Positive, Diffraction of, A. G. Emslie, 463; Negative, in Discharge Tubes, Dr. K. G. Emel us and J. Sayers, 1111
- Iran, Exploration in (*Review*), 523
- Iraq, Early Sculpture from, Sidney Smith, 647
- Ireland: The Peasant Farmers of (*Review*), 299; Archaeological Investigations in, 720
- Irish: Countryman: The, an Anthropological Study, Dr. C. M. Arensberg (*Review*), 299; Pilgrimage An (*Review*), 870
- Iron: and Steel Institute, Prof. L. Guillet nominated an honorary vice-president of the, 104; Passivity of, W. H. Cone and H. V. Tartar, 117; and Steel Industry, Research in the, 353
- Isotopes: of Hydrogen and Helium of Mass 3, The Search for the, Lord Rutherford, 303; of Strontium, 475
- Italy, Artificial Wool Production in, 1090
- Jamaica, Flora of, W. Fawcett and Dr. A. B. Rendle Vol. 7, late S. Le Marchant Moore and Dr. A. B. Rendle (*Review*), 302
- Japan: Astronomy in, 60; Decapod Crustacea of, Z. I. Kobjakova, 72; Western Science in, Beginnings of, Prof. J. Sakurai, 205; Crust Displacements in, Prof. N. Miyabe, 776; Earthquake Swarm of It , F. Kishinouye, 977
- Japanese: Trawlers in Indian Waters, 270; Slugs, Self-Fertilization of, K. Ikeda, 591
- Jenkins, Rhys, The Collected Papers of (*Review*), 301
- Jersey, Geology of, 249
- Jerusalem: Hebrew University of, Appeal for funds, 231; Roman, 578
- Jews in Poland, 925
- Joule-Thomson Effect and Quantum Statistics, Dr. D. S. Kothari and B. N. Srivasava, 970
- Julaber's Grave, Kent, Excavation of, 228
- Jupiter's Atmosphere, Physical State of, B. M. Peek, 776
- Jute, Trisomic Mutations in, Dr. H. K. Nandi, 973
- Kaiser Wilhelm Society for the Advancement of Science, Prof. C. Bosch elected president of the, 274
- Kansas, Permian Rocks of, Fossil Insects from the, late Dr. R. J. Tillyard, 116; 1018; 1104
- Kashmir Earthquake of November 14, 886
- Katalytische Umsetzungen in homogenen und enzymatischen Systemen, Dr. W. Frankenburger (*Review*), 827
- Kelvin and the Atomic Theory, C. Turnbull, 888
- Ketene, Preparation of, Products formed during the, R. W. Hale, 1017
- Ketones, Aldehydes and, Photo-decomposition of, Prof. R. G. W. Norrish and C. H. Bamford, 195
- Kew Gardens [1837], 777
- Kh ri s, The, Sarat Chandra Roy and Ramesh Chandra Roy. 2 Vols. (*Review*), 213
- Kidney: Influence of Temperature on the Activity of the, in relation to its influence on Oxygen Consumption. Prof. E. J. Conway, J. M. O'Connor and D. K. O'Donovan, 40; Mammalian, Structural Laws of the, with Theoretical Derivations, Prof. E. J. Conway, 40
- Kiel University, Dr. W. Kuhn appointed professor of physical chemistry in, 358
- Kinematography, Fifth Annual Exhibition of, 964
- Kineses, Taxes and, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064
- Komodo 'Dragons' at Edinburgh Zoological Park, 721
- Krypton and Xenon, Packing Fractions of, Dr. F. W. Aston, 149
- Kxatla Culture, Modern, Contributions of Western Civilization to, Prof. I. Schapera, 16
- L* α Emission Lines of Cu and Fe, Intensity and Structure Changes of the, on intense Cooling of their Anticathodes, Prof. K. Prosad and A. T. Maitra, 464
- L*-Emission Bands of Zinc, Copper, Nickel and Cobalt, Dr. J. Farineau, 508
- Li⁺ and He, Ionization Energy of, H. A. S. Eriksson, 151
- Labour, Displacement of, by Machinery, H. D. Henderson, 679
- Lac in Malaya, N. C. E. Miller, 510
- Lactoflavin: in Milk, Determination of, C. H. Whitnah, B. L. Kunerth and M. M. Kramer, 430; The Coulter Compound, 'Cytochrome *b*', and Cytochrome *c*, Spectroscopic observations of reactions between, Prof. F. Urban and Dr. M. D. Eaton, 466
- Lake District as a National Park, The, 433
- Lamellibranch Gills, Ciliary Currents in, A. Graham, 687
- Land: Drainage: Act, 1930, Report on, 823; in England and Wales, 823; Speed Record, New World, Capt. G. E. T. Eyston, 929; for the People (*Review*), 1031
- Langmuir-Blodgett Films of Stearic Acid, Structure of, L. H. Germer and K. H. Storks, 779
- Language in Europe: Borderlands of, and their Relation to the Historic Frontier of Christendom, Dr. Vaughan Cornish (*Review*), 994

- Lankester, Ray, Investigator, at Plymouth, Dr. S. Ochoa appointed, 190
- Lantern Slides, German and British, 718
- Larvæ in Timber, Destructive, Detection of, Dr. R. L. Smith-Rose, 512
- Latin Clarity and the Sciences of Life, Dr. J. Needham (*Review*), 664
- Lead: Borates, R. F. Geller and E. N. Bunting, 34; A New Oxide of, C. Holtermann and P. Laffitte, 293; Crystal Growths in Silica Gel, Spiriform Morphology of some, N. Stuart, 589; Ores, Origin of, Prof. A. Holmes, 937
- League of Nations, Health Committee of the, Dr. T. Madsen re-elected president of the, 315
- Learning, The Higher, Dr. R. C. Wallace, 541
- Leather Trades' Chemists: International Society of, Conference at Copenhagen, 516
- Lebistes*, Succession Broods of, G. L. Purser, 155; Dr. Ö. Winge, 467
- Lecithin, Yolk, Origin of, L. Hahn and Prof. G. Hevesy, 1059
- Lecithinæmia following the Administration of Fat, Prof. G. Hevesy and E. Lundsgaard, 275
- Leeds University: endowment of the Clive Behrens lectureship, Hon. Mrs. Behrens, 166; conferment of title of emeritus professor on Dr. G. W. Watson, 778; scheme for promotion of physical fitness, 886; Dr. J. W. Orr elected reader in experimental pathology; Dr. H. G. Garland appointed clinical lecturer in medicine and honorary demonstrator in medical pathology, Dr. J. A. Price honorary demonstrator in medicine, N. Lissimore honorary demonstrator in pathology, F. R. W. Hemsley and I. J. Keidan honorary demonstrators in anatomy and Miss Florence O. Bell research assistant in textile physics, 942
- Legendre Functions, Zeros of, P. G. Gormley, 81
- Légion d'Honneur, La Croix de Chevalier de la, conferment of, on G. E. Pearson, 315
- Legumes and Non-legumes, Associated growth of, A. I. Virtanen, 248
- Leicester, Roman, Excavation of, 229
- Leisure: Utilization of, Survey on the, 229; The Problem of, 941
- Lemna minor*, A Short Periodic Growth Cycle and a Secular Variation in, H. Dickson, 112
- Leopold, Order of, Profs. J. Bordet and P. Nolf awarded the Grand Cross of the, 104
- Lepidosiren*, Cytology of, Prof. W. E. Agar, 931; Prof. E. W. MacBride, 932
- Leukæmia in Mice, Inheritance of, Dr. E. C. MacDowell, 368
- Leverhulme Research Fellowships, and Research Grants, award of, 102
- Leviathan, The (*Review*), 911
- Lhuyd's Maps of England and Wales, Dr. F. J. North, 813
- Lichens found in Ireland—Chemical Constituents of: *Pertusaria concreta*, J. Breen, J. Keane and T. J. Nolan, 333; *Parmelia conspersa*, Ach, Margaret Mohan, J. Keane and T. J. Nolan, 376
- Life: Here and Now: Conclusions derived from an Examination of the Sense of Duration, Arthur Ponsonby (Lord Ponsonby of Shulbrede), (*Review*), 341; Reflections on, R. Brightman (*Review*), 341; The Little Things in, the Vitamins, Hormones and other minute Essentials for Health, Prof. B. Sure (*Review*), 829
- Light: the Neutrino Theory of, V. Fock, 113; Anomalies of the Dispersion of, by Colloidal solutions of Silver, C. Jausseran, 209; Depolarization of, diffused by Argon, New Measurements of the Factor of, A. Rousset, 251; thought to have been seen in the neighbourhood of Alternate Current Magnets, The, Lord Rayleigh, 423; in the Service of Man, Prof. N. R. Dhar (*Review*), 444; Sources, High Intensity, Dr. J. A. V. Fairbrother, 552; Neutrino Theory of, in Three Dimensions, A. Sokolow, 810; Diffraction of, by Ultrasonics at Oblique Incidence, Dr. F. Levi, 969
- Lighting: Appraisal of, Dr. C. C. Paterson (Guthrie lecture), 763; in Factories and Workshops, Appointment of a committee on, 845; Public, Control of, 1090
- Lightning: Discharges, Effect of near, on a Magnetometer, Dr. K. R. Ramanathan, 587; Ball, A Theory of, T. Neugebauer, 814
- Lilium Harrisii*, Bud Development in, following treatment with Indoleacetic Acid, J. M. Beal, 519
- Linear Operators: The Theory of, from the Standpoint of Differential Equations of Infinite Order, H. T. Davis (*Review*), 174
- Linguistics, Contemporary, The Dilemma of, Prof. B. Malinowski (*Review*), 172
- Lipids, The Biochemistry of the, Dr. H. B. Bull (*Review*), 787
- Liquid: Drops at Interfaces, Visible Adsorbed Films and the Spreading of, Prof. D. H. Bangham, S. Mosallam and Z. Saweris, 237; Hydrocarbons, Light, Products Formed by the Incomplete Combustion of, A. Maillard and R. Friedrich, 985
- Liquids, Natural Convection in, M. Atanasiu, 985
- Lister Institute of Preventive Medicine, Forty-third annual report, 766
- Liver, Fatty, Action of Pancreatic Extract on, B. Shapiro and Prof. E. Wertheimer, 771
- Liverpool Naturalists' Field Club, Seventy-sixth annual proceedings of the, 357
- Liverpool, S.S., Launch of [1837], 693
- Living World, The (*Review*), 484
- Lockyer, Norman, Observatory, Annual Report, 1936-37, 965
- Locust Outbreak in Africa and Western Asia, Fifth survey of the, Dr. B. P. Uvarov and Miss W. Milnthorpe, 33
- Locusts in the Field, Phase Transformation in, J. S. Kennedy, 889
- Logic and Empiricism, Dr. T. Greenwood (*Review*), 866
- Lomonosov and Early Science in Russia, S. S. Ivanoff (*Review*), 784
- Lomonosova, Trudy M. V., po Fizike i Chimii, Prof. B. N. Menshutkin (*Review*), 784
- London: Electrical Society [1837], 208; University: award of postgraduate studentships; J. P. Quilliam awarded a university studentship in physiology; O. A. Saunders appointed Clothworkers' reader in applied thermodynamics at the Imperial College—City and Guilds College, 38; A. A. Miles appointed professor of bacteriology at University College Hospital Medical School and Prof. J. H. Dible professor of pathology at the British Postgraduate Medical School, 166; Sir Robert Pickard elected vice-chancellor and Prof. J. C. Philip deputy vice-chancellor; Dr. W. Wardlaw appointed professor of physical chemistry at Birkbeck College; conferment of title of professor on Dr. G. R. Cameron and that of reader on H. Torrey, 207; T. C. Stamp appointed reader in bacteriology at the British Postgraduate Medical School; Dr. A. R. Todd appointed reader in biochemistry at the Lister Institute of Preventive Medicine; conferment of the title of reader in zoology on H. R. Hewer and that of emeritus professor on Prof. H. V. Blackman; gift by A. Chester Beatty for a scholarship in radiology, 778; conferment of an honorary doctorate on the Queen, 862; J. D. Bernal appointed professor of physics at Birkbeck College, 904; Prof. A. J. Allmand appointed Daniell professor of chemistry at King's College, Dr. L. P. Garrod reader in bacteriology at St. Bartholomew's Hospital Medical College, Dr. C. F. Goodeve reader in chemistry, C. W. Dannatt reader in metallurgy at the Imperial College—Royal School of Mines and Dr. H. J. T. Ellingham reader in physical chemistry at the Imperial College of Science and Technology, 942; College: Prof. J. B. S. Haldane first holder of the chair of biometry, 612; Prof. S. Sugden appointed professor of chemistry and Prof. C. K. Ingold director of the Chemistry Laboratories, 654; conferment

- upon Prof. T. Yeates, of the title of emeritus professor, 1026; New buildings for, 1088; conferment of the title of reader in civil engineering on Dr. A. L. Higgins, and that of emeritus professor of chemistry on Prof. F. G. Donnan; award of a doctorate on Miss Katherine Warington and Miss Katherine Tansley, 1110; College, Extension of Buildings, 964; Mathematical Society, election of officers, 1094
- Long Ashton Research Station, Annual Report for 1936, 861; Barrow, Origin of the, S. Piggott, 1103
- Longitudes, An Annual Change in, Dr. F. Schlesinger, 1068
- Loris: a Journal of Ceylon Wild Life, 720
- Louse, Biting, Distribution of the, N. J. B. Plomley and G. B. Thompson, 199
- Low-Temperature Thermostat, An inexpensive, L. C. Beadle and F. A. Booth, 279
- Lubrication and Lubricants, 815; 859
- Lubricants, Lubrication and, 815; 859
- Lyell: in Germany [1837], 375; to Leonard Horner [1837], 617
- Lymnæa, *Drosophila* and, Temperature and the Growth of, T. Imai, 1067
- Lysozyme, Crystallization of, E. P. Abraham and Prof. R. Robinson, 24
- M-Emission Bands of Zinc, Copper and Nickel, Dr. H. W. B. Skinner and J. E. Johnston, 508
- Mackintosh, Dr. John [1837], 736
- Magma, Das, und seine Produkte. Teil 1: Physikalisch-chemische Grundlagen, Prof. P. Niggl (Review), 913
- Magmatic Differentiation, Dr. C. N. Fenner, 327
- Magnetic: Declination at Cracow during the period 1914-36, A. Kania, 335; Storms: Cosmic Rays and, Prof. S. Chapman, 423; Variations of Cosmic Ray Intensity during, Prof. C. Störmer, 549; Permeability, Effect of Surface Treatment on, Dr. T. F. Wall, 856; Observations in America [1837], 904
- Magnesium: Alloys, H. Endô and S. Morioka, 978; Chloride with Oxygenated Organic Compounds, Classification into two Groups of the Complex Compounds of, According to the Nature of the Oxygen Linkage, Mlle. Marie Louise Quinet, 985
- Magneto-Electric Currents [1837], 250
- Magnetostriction, Dr. Y. Masiyama, 552; W. Alexander and J. Swaffield, 1068
- Maiden Castle, Dorchester: Excavations in 1937, 186; Discoveries at, 677
- Malaya: Forestry Research in, 1091; Rubber Research Institute, Report for 1936, 1093
- Malayan Agriculture, An Outline of, D. H. Grist (Review), 7
- Mammals: and Man in America, Extinct, J. H. Cotter, 243; of Ireland, C. B. Moffat, 292
- Man: and the Machine Age, Prof. A. Meusel (Review), 45; and his Work, Museum Study of, de La Valette, 1108
- Manchester University: Prof. F. Wood Jones appointed professor of anatomy in, 15; A. D. Ritchie appointed Sir Samuel Hall professor of philosophy and public administration, Prof. P. M. S. Blackett, Langworthy professor of physics, H. Davenport, P. Du Val and W. W. Sawyer, assistant lecturers in mathematics, G. D. Rochester, assistant lecturer in physics, D. G. Evans, assistant lecturer in chemistry, E. L. Patterson, assistant lecturer in anatomy and Miss Margaret I. Williams assistant lecturer in applied physiology, 207; Scientists' Peace Association, Address to, by Prof. H. Levy, 1055
- Marconi: the Man and his Wireless, O. E. Dunlap, jun. (Review), 260; Guglielmo, and the Development of Radio Communication, Sir Ambrose Fleming, 963; School of Wireless Communication, 1005
- Marine: Engineering, Progress of, S. J. Pigott, 539; Engineering and, Exhibition at Olympia, 553; Eggs, Action of certain Substituted Phenols on, in relation to their Dissociation, A. Tyler and N. H. Horowitz, 779
- Marketing, Electricity and, F. H. Slade, 311
- Marriage Manual: A, a Practical Guide-book to Sex and Marriage, Dr. Hannah M. Stone and Dr. Abraham Stone (Review), 445
- Mars and Venus, Occultations of, 103
- Marum, Martin Van (1750-1837), 1110
- Marvels: A Book of, Lt.-Comdr. R. T. Gould (Review), 87; An Inquiry into, Surgeon Rear-Admiral C. M. Beadnell (Review), 87
- Maryland, Structural Geology of, 1019
- Mass: -Observation: C. Madge, 229; C. Madge and T. Harrison, 843; Spectograph, second-order focusing and Isotopic Weights by the Doublet Method, Dr. F. W. Aston, 905
- Materie und Strahlung (Korpuskel und Feld), Prof. L. Hopf (Review), 386
- Maternal Mortality, Reports on, 1093
- Mathematical: Analysis, Operational Symbolism in (Review), 174; Analysis, The Elements of, Prof. J. H. Michell and M. H. Belz. 2 Vols. (Review), 631
- Mathematics: Higher School Revision, L. Crosland (Review), 7; Practical, Studies in, A. C. Aitken (2), 124; Elementary, History of (Review), 255; Men of, Prof. E. T. Bell (Review), 525; Teaching of, Discussion on the, 555; Higher, Aspects of (Review), 950
- Mathematik, Elementar-, Geschichte der, in systematischer Darstellung, Dr. J. Tropfke. Band 3. Dritte Auflage (Review), 255
- Matter in Space, Distribution of, Observational Evidence for the, J. H. Reynolds, 387
- Mauritius, Atmospheric Pressure at, M. Herchenroder, 855
- Maxwell's, Clerk, Electric Ideas, Origins of, 614
- Meare, Somerset, Recent Excavation at, 498
- Mechanistic Biology and Animal Behaviour, T. H. Savory (Review), 49
- Mechanization in the Modern World, 498
- Medal Striking [1837], 556
- Medical: Research Council, W. M. Goodenough appointed a member and treasurer of the, 21; Science, Advancement of [1837], 80; Education, Some thoughts on, Prof. R. J. Johnstone, 186; Research Council: Prof. L. J. Witts and Prof. G. E. Gask appointed members of the, 190; award of fellowships to Dr. F. Hawking, D. A. Cannon, L. J. Dales and I. M. MacKichan, 274; Treatment, Modern, Essentials of, Dr. V. Norman (Review), 486; Research, A Weakness of, Dr. W. P. Murphy, 901
- Medicine: Stamp Duties, Report on, 17; Modern, the Development of, an Interpretation of the Social and Scientific Factors involved, Prof. R. H. Shryock (Review), 386; Quack, [1837], 1110
- Medizinisch-naturphilosophischen Aphorismen und Kommentare des Magister Urso Salernitanus, Die. Nach Handschriften Lateinisch und Deutsch herausgegeben von Dr. R. Creutz (Review), 386
- Meiosis and Mitosis, Artificial Release of Crossing-over in, Prof. H. Friesen, 362
- Melanin in Fishes, Some Quantitative Relations between visual stimuli and the Production or Destruction of, F. B. Sumner and P. Doudoroff, 83
- Melbourne University Medical School, Gift to, 1057
- Mellon Institute, Pittsburgh, Dedication of the new building of, 901
- Men and Mathematicians (Review), 525
- Mendel, Morgan and Genetics, Prof. E. W. MacBride, 348
- Mendeléeff Centenary in Russia, Epilogue to the (Review), 90
- Mendeléev, Congrès Jubilaire, Travaux du. 2 Vols. (Review), 90
- Mental: Disease, Birmingham Joint Board of Research for, Annual Report for 1936-37, 314; Factors, Selection and, Dr. G. H. Thomson, 934; Disturbances, Physiological Patterns and, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062
- Mercurous Perchlorate as a Volumetric Reagent for Chlorides and Bromides, W. Pugh, 656
- Merino: Australian, The Evolution of the, E. W. Cox (Review), 870; Trio Follicles in the, Non-specificity of the, Dr. A. B. Wildman, 891

- Mesolithic Site in Surrey, Excavation of a, Dr. J. G. D. Clark, 144
- Mesothorium-I, Concentration of, by Duckweed (*Lemna*), Prof. W. I. Vernadsky, B. K. Brunowsky and C. G. Kunasheva, 317
- Messianic Radiation (*Review*), 171
- Metabolism, Body-size and, Relation between, C. Ellenby, 853
- Metal: Films, Thin, Structure and Resistance of, D. A. Wright, 107; -Ammonia Ions, Prof. A. A. Grünberg, 422; -Spraying, R. R. Sillifant, 1105
- Metallic: Corrosion, Passivity and Protection, Dr. U. R. Evans (*Review*), 629; Aluminium, Determination of Alumina in, G. B. Brooke and A. G. Waddington, 858
- Metalle, Elektronentheorie der, Dr. H. Fröhlich (*Review*), 953
- Metallurgy and the Aero Engine, Dr. D. R. Pye, 516
- Metals: Institute of, Journal of the. Vol. 59. Edited by G. Shaw Scott (*Review*), 176; Hardness of, Dr. F. C. Lea (*Review*), 260; Rigidity of, Effect of Occluded Hydrogen on the, Father Joseph Lynch, 363; Oxide Film Formation on, Polarimetric studies of, A. B. Winterbottom, 364; Gases and, an Introduction to the study of Gas-Metal Equilibria, Dr. C. J. Smithells (*Review*), 385; of Hexagonal Structure, Asymmetry in, Dr. G. W. Brindley and P. Ridley, 461; Corrosion of (*Review*), 629; The Theory of, based on an Essay awarded the Adams prize in the University of Cambridge, 1931-1932, A. H. Wilson (*Review*), 702; and Alloys, Studies of, 857; Ferromagnetic, The Paramagnetic Magneton Numbers of the, Prof. W. Sucksmith and R. R. Pearce, 970; Structure of, Dr. A. Müller, 1011
- Metaphosphoric Acid, Proteins and, Reactions between, Dr. H. Herrmann and G. Perlmann, 807
- Meteor, Bright, of November 9, A. E. Moon, 1102
- Meteor Shower, Tenham, of 1879, Dr. L. J. Spencer, 369
- Meteorite Craters, 801
- Meteorites: the number of Pultusk Stones, and the spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504, 809; Dr. L. J. Spencer, 589; of the Gran Chaco, 1006
- Meteorological Elements, Monthly, 146
- Meteorology: of Great Floods in the Eastern United States, C. F. Brooks and A. H. Tiessen, 511; Agricultural, in India, 651; in the Navy, 1057
- Meteors: Orionid, Observation of, 928; 1009
- Methyl Halides, Carbon-Halogen Distance in the, Dr. G. B. B. M. Sutherland, 239
- Metric System and British Export Trade, Rev. A. J. Stubbs; Sir Isidore Salmon, 1089
- Mexico, New, North-Eastern, Prehistoric Archaeology of, Prof. E. B. Renaud, 72
- Mice: Sensitization of the Skin of, to Light by Carcinogenic Agents, Dr. I. Doniach and Dr. J. C. Mottram, 588; Male, Production of Sterility in, by Irradiation with Neutrons, G. N. Snell and P. C. Aebersold, 779
- Microbial: Suspension, Rapid Counting of a, G. Carrisson, 376; Broths, Absorption Spectra of, J. Debiasse, 985
- Microscopy: The Quekett Microscopical Club, 273
- Midlands, West, The Pleistocene History of the, Prof. L. J. Wills, 995, 1036
- Migrations, A Compilation on, Prof. C. Daryll Forde (*Review*), 89
- Milk: Nutritive: Qualities of, Effect of Pasteurization of the, 115; Value of, Influence of Pasteurization in the absence of air on the, H. Simonnet, G. Guittonneau, G. Mocquot and A. Eyrard, 209; Supply and National Health, 295; Off-flavoured, Acidosis and, Capt. H. Barkworth and L. W. L. Cole, 324; Pasteurized, The Nutritive Value of, 389; Clean, and Pasteurization, Dr. G. Arbour-Stephens, 614
- Mind: In the Realm of, Dr. C. S. Myers (*Review*), 705
- Mineral: Position of the British Empire, 285; Wealth, The Empire's, 801
- Mineralogical Society, election of officers, 888
- Minerals: Atomic Structure of, Prof. W. L. Bragg (George Fisher Baker lecture) (*Review*), 783; Field Tests for, E. H. Davison (*Review*), 830
- Mining Engineers, Institution of, award of medals to Dr. C. Beyling and Prof. R. V. Wheeler, 967
- "Minnesota: Man", Prof. A. E. Jenks, 578; Dr. A. Hrdlička, 1103; Fossil Man in, 596; Pleistocene Man in, a Fossil Homo Sapiens, Dr. A. E. Jenks. With a chapter on the Pleistocene Geology of the Prairie Lake Region, by Dr. G. A. Thiel, 596
- Minos, Palace of, Index to the, Dr. Joan Evans. With special sections classified in detail and chronologically arranged, by Sir Arthur Evans (*Review*), 486
- Mitogenetic: Analysis of the excitation of the Nervous System, Prof. A. G. Gurwitsch (*Review*), 565; Radiation and the Theory of Nerve Excitation, Dr. J. B. Bateman (*Review*), 565; Rays? A. Hollaender and W. D. Claus, 1007
- Mitosis, Meiosis and, Artificial release of Crossing-over in, Prof. H. Friesen, 362
- Mitotic Spindle, Self-arrangement in the, under Mechanical Influence, Dr. H. H. Pfeiffer, 770
- Moeurs et coutumes des indiens sauvages de l'Amérique du sud, Marquis de Wavrin (*Review*), 344
- Moine Schists, Petrofabric Study of, F. C. Cole, 429
- Molecular: Films, Built-up, K. B. Blodgett and Dr. I. Langmuir, 470; Compounds, Organic, Structure of, Dr. J. S. Anderson, 583; Structure, Force Constants and, Dr. H. W. Thompson and J. W. Linnett, 1065
- Molecules, Large, The Synthesis of, Prof. H. Mark, 8
- Molge cristata* Laur., Local Transformation of Solid and Hollow Bones of, O. Hrabik, 1074
- Mollusca, Fresh Water, Development of Teeth in the Radula of, F. G. Cawston, 1028
- Molluscs, Polyplacophoran, Digestion in, Vera Fretter, 976
- Molybdenum: Blues, V. Auger and Mlle. Nina Ivanoff, 293; Tellurium, Tungsten and, Hexaco-ordination of, J. Gupta, 685
- Molybdotartaric Complex Compounds in Water, Two, Study by the Raman Effect of, Mlle. Marie Théo-doresco, 209
- Mongalia Province, A Tribal Survey of. Edited by L. F. Nalder (*Review*), 632
- Mongolian Fungus, An edible, 'pai-mo-ku', S. Imai, 695
- Monkeys: Longevity of, Prof. W. C. Osman Hill, 72; and Man, Embryonic, Prof. W. C. Osman Hill, 115
- Monomolecular Films: E. Havanga and J. de Wael, 160; Viscosity of, Prof. W. D. Harkins and R. J. Myers, 465
- Moon's Equatorial Horizontal Parallax [1837], 819
- Morgan, Mendel and Genetics, Prof. E. W. MacBride, 348
- Morse Recording Electric Telegraph [1837], 597
- Mortality, Selective Action of, Prof. F. A. E. Crew, 410
- Mosses, Submerged, River Liffey, Chironomid Fauna of the, C. F. Humphries and Winifred E. Frost, 976
- Motor: -Car Engine Cylinders, Wear of, 147; -Boat Speed Record, Sir Malcolm Campbell, 460; -Car Headlights, Coloured Light for, 679
- Mould and Bacteria Killed by New Lamp, 844
- Mountains of the Moon: an Expedition to the Equatorial Mountains of Africa, P. M. Syngé (*Review*), 951
- Mud: Fluid for Pressure Drilling Conditions, Dr. J. T. Evans, 202; Drilling, P. Evans and A. Reid, 1025
- Museum Collections, Improvement of, Dr. W. E. Swinton, 734
- Museums: Association, Annual Conference of the, Presidential Address by Alderman C. Squire, 164; Empire grants committee for, 499; and the People, 734
- Musket's Discovery of Blackband Ironstone [1837], 80
- Music: Physics of (*Review*), 947; and Sound, Ll. S. Lloyd (*Review*), 947; Science and, Sir James Jeans (*Review*), 947
- Mysidacid Crustaceans, New Species of, Prof. W. M. Tattersall, 775
- Mysticism, Theory and Art of, Prof. R. Mukerjee (*Review*), 636
- Mytilus, Miss Kathleen M. White (*Review*), 633
- Myxobacteria—The, Cellulose-degrading Agents, Mme. H. Krzemieniewska and S. Krzemieniewski, 167

- N_x⁺⁺⁺ Ion, Decomposition of the Ground Term of, Absorption spectra evidence of the, due to Crystalline Fields, Prof. D. M. Bose; Dr. W. G. Penney and G. J. Kynch, 109
- National: Physical Laboratory, Inspection by the General Board, 36; Institute for Research in Dairying, Dr. G. W. Scott Blair appointed head of the chemistry department of the, 61; Museums of Natural History, F. Chapman, 272; Health, Milk Supply and, 295; Fitness: the First Steps (*Review*), 561; Research Council, gift to the, by the John and Mary R. Markle Foundation of New York, 582; Institute of Agricultural Botany, Value of System of substations of the, Capt. D. M. Wills, 843
- Nation's Intelligence, The, J. L. Gray (*Review*), 528
- Nature: the Mechanism of, being a Simple Approach to Modern Views on the structure of Matter and Radiation, Prof. E. N. da C. Andrade. Revised and enlarged edition (*Review*), 260; Photography: Thirty years of, a Personal Record of two observers, Seton Gordon (*Review*), 302
- Natural History: Outlook, Prof. J. Ritchie, 417; in the Schools, 421
- Nauka Polska. Tom (Vol.) 22 (*Review*), 133
- Naval: Architects, Institution of, award of the Sir William White postgraduate scholarship to A. M. Baxter, 422; Architecture and Engineering, 597; Architects, Institution of, award of scholarships to S. F. Rice, A. Silberblatt and P. Martin, 722
- Navy: Engineering Progress in the, Prof. C. J. Hawkes, 1024; Meteorology in the, 1057
- Neanderthal Tooth, A Lost, 961
- Nebulae: in Pisces, A New Cluster of, F. Zwicky, 293; Red Shifts and the Distribution of the, Dr. E. Hubble, 649
- Nematodes: Parasitic in Animals, Dr. G. Lapage (*Review*), 526; Physiology of, D. G. Davey, 645; of Horses and Sheep, Control of, I. W. Parnell, 686
- Neodymium Acetylacetonate, Influence of the Solvent on the Absorption Spectra of, Mlle. Milka Radoitchitch, 81; Atomic Weight of, Hönigschmid, 1104
- Neural Induction: by Fragments of Dead Tissues and Organs of Amphibia and Mammalia in the Ectoderm of the Anuran Gastrula, Prof. G. A. Schmidt, 199; by Plant Tissues in the Ectoderm of the Gastrula of *Triton taeniatus*, M. N. Ragozina, 199
- Neutrino: Theory of Light, The, V. Fock, 113; Shower, β -Decay as due to a, N. S. Nagendra Nath, 278; Theory of Light in Three Dimensions, A. Sokolow, 810
- Neutron: Beams, Polarized, A Method of obtaining, Dr. H. v. Halban, jun., 425; Levels, Resonance, of Silver, Rhodium and Bromine Nuclei, Spacing of the, C. Y. Chao and T. H. Wang, 768
- Neutrons: Production of Mutations by, Mary Nagai and G. L. Locher, 111; from Lead, Expulsion of, by Cosmic Rays, B. Arakatsu, K. Kimura and Y. Uemura, 277; inside Magnetized Iron, The Magnetic Field acting upon, Dr. O. R. Frisch, Dr. H. von Halban, jun. and Dr. J. Koch, 360; Slow, in Light Elements, Capture of, Dr. O. R. Frisch, Dr. H. von Halban, jun. and Dr. J. Koch, 895
- Newcomen Society, Annual General Meeting; Eng.-Capt. E. C. Smith elected president, 964
- Newfoundland Amphipoda and Decapod Larvæ, Miss Nancy Frost, 898
- New York Botanical Garden, *Journal of the*, Papers by Dr. J. K. Small, 274
- New Zealand: Fish Oils, F. B. Shorland, 223; Australia and, Science in, 231
- Nickel: Wire, Magnetic quality of, as influenced by the Surface, Dr. T. F. Wall, 238; Cementation of, by Beryllium, J. Laissus, 251
- Nicotinic Acid and the Pellagra-Preventing Vitamin, Dr. L. Harris, 1070
- Nigeria, Indirect Rule in, R. S. Rattray (*Review*), 826
- Nigerian Tribe: Law and Authority in a, a Study in Indirect Rule, Dr. C. K. Meek (*Review*), 826
- Night Sky: in August, 190; in September, 358; in October, 581; in November, 766; in December, 929
- Nile, Dry-crossing of the, E. J. Wayland, 811
- Nitric: Oxide: and Alkyl Ethers, Prof. M. W. Travers, 107; NO, Magnetic Rotatory Power of Compressed and of Liquefied, H. Bizette and B. Tsai, 208; Acid, Reduction of, to Hydroxylamine by the Higher Plants, M. Lemoigne, P. Monguillon and R. Desveaux, 293
- Nitrogen: Organic Chemistry of, Prof. N. V. Sidgwick. New edition, revised and rewritten by T. W. J. Taylor and Dr. W. Baker (*Review*), 4; Excretion of, by Leguminous Plants, Prof. P. W. Wilson, 154; Heavy, Prof. H. C. Urey, 496; Isotope, Concentration of, Prof. H. C. Urey, M. Fox, J. R. Huffman and H. G. Thode, 512; Excretion of, by Leguminous Plants, Prof. A. I. Virtanen; Dr. G. Bond, 683; Spectrum of, and Atmospheric Pressure at High Altitudes, R. Bernard, 930; Fixation, Symbiotic Mechanism of, P. W. Wilson and, E. B. Fred (2), 943
- Nobel: prize for medicine, award of the, to Prof. A. von Szent-Györgyi, 798; prizes: award for physics to Dr. C. J. Davisson and Prof. G. P. Thomson and for chemistry to Prof. W. N. Haworth and Prof. P. Karrer, 882
- Nocht, Bernard, Medal, awards of the, 1009
- Noise: Meters, Performance of, in terms of the Primary Standard, B. G. Churcher and A. J. King, 331; and the Nation, Dr. G. W. C. Kaye, 408; 446; 490; Dr. A. H. Davis (*Review*), 637
- North: -East Coast Institution of Engineers and Ship-builders, awards made to H. Hunter, H. E. L. Martin and R. A. Lyall, 500; Pole Station, 765; Sea and Baltic, Parasitic Copepods of the, G. M. van Oordele Lint and J. H. Schuurmans, 686; -West Passage," New, 802; Polar Station, The Soviet, 1040
- Northumbrian Art, Scandinavian Influence on, T. D. Kendrick, 1090
- Norway, Medical Literature of [1837], 598
- Nova Herculis, Spectrum of, D. B. McLaughlin, 593
- Nuclear Particles, Interaction of, Dr. N. Kemmer, 192
- Nuffield College, Oxford, 799
- Nutrition: and Dietetics (*Review*), 829; and Health, 874; Final Report of the Mixed Committee of the League of Nations on the relation of Nutrition to Health, Agriculture and Economic Policy, 874
- Nutritional Science: Social and Political Application of, 305; Social Aspects of, 865
- O₂⁺ Bands, Visible, Rotational Analysis of the, T. E. Nevin, 1101
- O Σ 79, Orbit of, L. T. S. Syms, 688
- Oakhurst Shelter, George, Archaeology of the, A. J. H. Goodwin, and others, 167; A. J. H. Goodwin (6), 334; (6 and 7), 656
- Occipital Perforation in the Anthropoids, Prognathism, Cranial Capacity and Area of the, E. Pittard and H. A. Seylan, 737
- Octanes, A. Maman, 656
- (Estradiol Monobenzoate, Inhibition by, Response of the Pigeon Crop Gland to Prolactin: Drs. S. J. Folley and P. White, 505
- Œstrous Reactions, including Mating, produced by Triphenyl Ethylene, J. M. Robson and Dr. A. Schönberg, 196
- Official Statistics of the United Kingdom, Guide to Current, for 1936, 1057
- Ohio—Mississippi Floods of 1937, The, R. W. Davenport, 666
- O—H Raman Frequency in Inorganic Acids, The, Dr. C. S. Venkateswaran, 151
- Oil: Drops, Collision of Two, and the Stability of a Non-spherical Oil-drop, Yoshio Ishida, 70; Well Casing, a New Type of, Threaded Connexion for, W. M. Frame, 117; from Coal, Commercial Production of, Lord McGowan, 143; Drops, Two, Collision of, and the Stability of a Non-spherical Oil Drop, Y. Ishida, 158; Transport in the Middle East, Col. H. E. Medlicott, 312; Industry, Education and Training for the, Prof. A. W. Nash, 459; Engine, Two-stroke Cycle, Development of the, W. S. Burn, 597; Industry, Indian, P. Evans, 765; Origin of, Dr. P. D. Trask, 857

- Oils from Irish-grown Plants, 843
- Oldoway-Expedition 1913, *Wissenschaftliche Ergebnisse der, Herausgegeben von Prof. H. Reck. Neue Folge, Heft 4 (Review)*, 6
- Omnibus Workers, Digestive Troubles Among, 269
- Ophelia cluthensis* McGuire, Anatomy of, R. S. Brown, 292
- Opium, Indian, Chemistry of, Dr. H. B. Dunncliff, 92
- Optical: Contact, Propagation of, Dr. J. Weir French, 321; Sensitizing of Silver Halides by Dyes, Mechanism of, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D. Walker, 1096
- Optics: Experimental (*Review*), 216; Introduction to, Dr. G. B. Deodhar (*Review*), 216
- Orcades*, The S.S., 498
- Organic: Syntheses, L. F. Fieser, editor-in-chief. Vol. 17 (*Review*), 49; Evolution, Processes of, 379; Oxides, Dissociable, C. Dufraisse and J. Houpillart, 1027
- Osiris, Marriage of, G. D. Hornblower, 854
- Osteopathy?, What is, Drs. C. Hill and H. A. Clegg (*Review*), 788
- Overheads, Control of, 354
- Owl, Little, Food of the, 1103
- Oxford: Farming Conference, Forthcoming, 928; University: Dr. A. D. Gardner appointed reader in bacteriology; conferment of title of professor on Dr. A. D. Gardner; Dr. A. H. T. Robb-Smith appointed assistant director of pathology at the Nuffield Institute; G. L. Camm awarded the senior mathematical scholarship; Dr. H. M. Sinclair elected an official fellow and tutor in physiology at Magdalen College; J. F. Hope Simpson elected a senior scholar in botany and J. A. Moy-Thomas re-elected a lecturer in zoology; M. Abercrombie elected a junior research fellow at Queen's College and E. P. Abraham to a taberdarship; R. Campbell Thompson elected Shillito reader in Assyriology, 38; E. H. Leach appointed William Hulme lecturer in physiology at Brasenose College; M. S. Wills awarded the Scott scholarship in physics; F. G. W. Knowles elected to the Naples biological scholarship, and F. Fulton awarded the Radcliffe scholarship in pharmacology, 166; Prof. J. H. Burn appointed professor of pharmacology, 227; R. H. Hodgkin elected provost of Queen's College, 676; further gifts from Lord Nuffield, 679; Dr. G. M. B. Dobson elected an official fellow of Merton College and Prof. R. Campbell Thompson a professorial fellow; Dr. S. Flexner and Dr. J. A. Gunn elected supernumerary fellows of Balliol College, Dr. J. H. Burn a professorial fellow and J. St. L. Philpot a senior research fellow; Dr. A. A. Bake appointed a senior research fellow of Brasenose College, 694; Lord Nuffield's new gifts to, 697; Nuffield College, 799; conferment of the degree of M.A. on Lord Nuffield; Dr. L. J. Witts appointed Nuffield professor of clinical medicine; award of the Scott scholarship for research in physics to J. G. Daunt; gift from the Rockefeller Foundation, 819; conferment of an honorary doctorate on Dr. R. R. Marett; K. A. H. Murray elected fellow and bursar of Lincoln College, 862; conferment of an honorary doctorate on Dr. R. R. Marett, 923; Dr. J. V. Harrison elected lecturer and demonstrator in geology; students in receipt of financial assistance, 1026; Early Astronomical Instruments, Dr. R. T. Gunther, 1089
- Oxiana, The Road to, R. Byron (*Review*), 788
- Oxidation: in the Living Cell, Distinguishing the Zones of, by the Method of Cobalt Salts, P. Joyet-Lavergne, 125; Catalyst, A New, J. G. Dewan and D. E. Green, 1097
- Oxide Film Formation on Metals, Polarimetric studies of, A. B. Winterbottom, 364
- Oxides: in the Extreme Infra-red, Transmission of some, M. Parodi, 208; formed on Iron, Electron Diffraction Studies of, T. Iimori, 278
- Oxonium Compounds, Raman Spectra of, Dr. G. Briegleb and W. Lauppe, 236
- Oxyacids, Polarimetric Titration of the, F. Gorski, 167
- Oxygen, Consumption of, in Sea Water under Controlled Laboratory Conditions, H. R. Seiwel, 506
- Oxy-hydrogen Blow-pipe, Hare and the [1837], 291
- Oxyporphyrin Haematin Compound, An, as Intermediate between Protohaematin and Verdohaematin, Dr. A. Lemberg, B. Cortis-Jones and M. Norrie, 65
- Oyster: Sex-Biology of the, and the Salmon, Prof. J. H. Orton, 68; and other Fisheries of Great Britain (*Review*), 952; Biology and Oyster Culture: being the Buckland lectures for 1935, Prof. J. H. Orton (*Review*), 952
- Oysters in Tanks, Breeding of, H. A. Cole, 854
- Ozone in the Oxidation of Aldehydes, Catalytic action of, E. Brnar and E. Perrottet, 737
- Pacific Seismological Stations, Reliability of, Dr. H. Jeffreys, 237
- Pain Nerves, T. Lewis and E. E. Pochin, 325
- Paintings, The Natural Philosophy of, F. I. G. Rawlins, 219
- Palæmon, The Indian River Prawn, Dr. S. S. Patwardhan, 580
- Palæolithic: Man: in Brittany, R. Mazères, 352; in Norfolk, J. E. Sainty, 731; Succession in England, T. T. Paterson, 775
- Palæozoic Strata near Taralga, N.S.W., G. F. K. Naylor, 377
- Palao Biological Station, 735
- Paleocene: Faunas of the San Juan Basin, New Mexico, late Dr. W. D. Matthew (*Review*), 46; Mammals (*Review*), 46
- Palestine: Early, Fauna and Climate of, Prof. L. Picard, 497; foundation of a Hillel prize for medical work in, 722; *Journal of Botany and Horticultural Science*, 1057
- Pancreatic Extract, Action of, on Fatty Liver, B. Shapiro and Prof. E. Wertheimer, 771
- Papain, Natural Activation of, Prof. M. Frankel and R. Maimin, 1015
- Papua, Mount Hagen, Natives of, F. E. Williams, 115
- Parachute Descent, A Fatal [1837], 166
- Para-Cresol* from the Urine of Pregnant Mares, Dr. P. G. Marshall, 362
- Paraguay, Fishes of, Prof. N. E. Pearson, 510
- Parahydrogen, Liquid, R. B. Scott and F. G. Brickwedde, 1020
- Parallelism, A Remarkable, R. Goldschmidt, 83
- Paralysis, Potassium and, Aitken, Allott, Castleden and Walker, 367
- Paramagnetic Solutions, Two, Thermomagnetic study of, A. Nicolau, 905
- Paramecium*: Fragments, Movement within, T. Hosoi, 647; *aurelia*: Sex, Sex Inheritance and Sex Determination in, T. M. Sonneborn, 779; Inheritance of Sex at Endomixis in, R. F. Kimball, 943
- Parapsychology*, *Journal of*, Prof. W. McDougall, 272
- Parasitic Nematodes, Physiology of the (*Review*), 526
- Paris: Academy of Sciences, election of Prof. P. Montel as a member of the Section of Geometry, 104; International Exhibition, 1937, The Palace of Discovery at the, Dr. P. Biguard, 328; University, Dr. Roussy elected rector of, 888; Faculty of Medicine, Dr. Crozon appointed professor of social medicine in the, 929; -Orléans and Midi Railways, Electrification of the, A. Bachellery, 1025
- Parliament, Science in [1837], 333
- Parliamentary Science Committee, Executive of the, 721
- Partridge Stocks and Mortalities, 616
- Passerine Birds of Ethiopia and Kenya, 591
- Pasture Problems, Dr. Winifred E. Brenchley, 918
- Pavlov: and his School: the Theory of Conditioned Reflexes, Prof. Y. P. Frolov. Translated by C. P. Dutt (*Review*), 700; Biological Station in memory of, 803
- Peace: the Promotion of, A Petition on, 185; Year Book, 1937, 420
- Peaches and Plums, Ripening, Evolution of a Growth-Inhibiting Emanation from, W. E. Isaac, 1027

- Pellagra-Preventing Vitamin, Nicotinic Acid and the, Dr. L. Harris, 1070
- Penguin-breeding Record at Edinburgh, New, 187
- Pennsylvanian Society of New York, award of the medal for distinguished service to Dr. V. G. Heiser, 274
- Pentaerythritol: Solid, Hydrogen Bridges in, I. Nitta and T. Watanabé, 365; Crystalline Structure of, F. J. Llewellyn, E. G. Cox and T. H. Goodwin, 430
- P E P (Political and Economic Planning): Report on International Trade (*Review*), 133
- Periodical Publications in the University Libraries of the British Isles, Union Catalogue of the, excluding titles in the World List of Scientific Periodicals, 1934, Marion G. Roupell (*Review*), 786
- Periodicals, A Census of, F. W. Clifford (*Review*), 786
- Peroxides, Dissociation of, and the Cold Flame of Hydrocarbons, M. Neumann and P. Toutakin, 598
- Persia, Southern, Sir Aural Stein's Expedition in, 885
- Personality Survives Death: Messages from Sir William Barrett. Edited by his wife (*Review*), 1078
- Personnel Organization, A Psycho-geometrical Representation of, W. R. Dunlop, 152
- Persons injured by Accidents, Rehabilitation of, 357
- de Perthes, Boucher, and the Foundations of Prehistoric Archaeology, L. Aufrère, 261
- Petroleum: and Allied Products, Apparatus for Testing, 271; Fuels in Canada, 978
- Peruvian Textiles, Early, Dr. Lila M. O'Neale, 32
- Phanerogams. Living and Fossil, Comparative Ontogeny of, P. Bertrand, 1111
- Pharmaceutical Society of Great Britain, Prof. J. H. Gaddum appointed professor of pharmacology and director of the pharmacological laboratories of the, 717
- Pharmacy: To-day—its Responsibilities, T. E. Lescher, 228; and Physic, Historical Relation of, Sir Humphry Rolleston, 676
- Phaseolus vulgaris*, Influence of Irradiated Metal Compounds on the growth and development of, O. Ried, 335
- Philological Report for 1936, 230
- Philadelphia Academy of Natural Sciences, Report of the, 420
- Phillippines, Rust Fungi of the, J. C. Arthur and G. B. Cummins, 648
- Philosophical Overhaul, O. Lungström, 615
- Philosophie scientifique, Congrès International de, Sorbonne, Paris, 1935, Actes du, 8 Fasc. (*Review*), 866
- Phlogiston, Levity of Prof. J. R. Partington and Dr. D. McKie, 1089
- Phoridae, Irish Species of the Dipterous Family, H. Schmitz, 1111
- Phosphate in Muscle, Coupling of Dismutations with Esterification of, Dr. Dorothy M. Needham and R. K. Pillai, 64
- Phosphine and Arsine Derivatives of the Group I (b) Metals: Volatile Derivatives of Gold, Drs. F. G. Mann and A. F. Wells, 502
- Phosphors, Effect of Pressure on, N. Riehl and H. Ortmann, 593
- Phosphorus: and Calcium Deficiency Diseases as two Etiologically Distinct Entities, Dr. P. J. Du Toit and Dr. A. S. Malan, 153; Radioactive, Effect of, upon the blood of Growing Chicks, K. G. Scott and S. F. Cook, 293; Exchange in Yeast, Prof. G. Hevesy, Dr. K. Linderström-Lang and N. Nielsen, 725; Atomic Weight of, Hönigschmid, 856; Pentachloride, Stereochemical Structure of, H. Moureu, M. Magat and G. Wetrouff, 863
- Phosphorylation and Respiration, H. Kalckar, 1103
- Photochemie, Allgemeine, Prof. J. Plotnikow. Zweite Auflage (*Review*), 444
- Photo-electric Control in Industry, A. L. Whiteley, 927
- Photographic: Plates, Sensitivity, Position of Masition of Maximum Optical Sensitivity of, S. Natanson, 197; Process, Mechanism of the, E. R. Davies; Dr. S. O. Rawling; Prof. N. F. Mott; Dr. W. F. Berg, 997; Latent Image, Theory of the Photolysis of Silver Bromide and the, Dr. R. W. Gurney and Prof. N. F. Mott, 1037.
- Photography: Stereoscopic, Practical, Dr. J. Moir Dalzell (*Review*), 528; Dr. C. E. K. Mees (*Review*), 566
- Photoluminescence, réunion Internationale de, Varsovie, 20-25 Mai 1936, Rapports sur la photoluminescence présentés à la, Prof. S. Piéńkowski et Dr. W. Kapitciński; W. C. Price (*Review*), 787
- Photoperiodic After-Effect, Prof. R. H. Stoughton and D. R. Hole, 808
- Photosynthesis of Carbohydrates *in vitro*, Prof. E. C. C. Baly, 930
- Phycomyces*, Growth Factors for, H. M. Sinclair, 361
- Physical: Society, award of the Duddell medal to Prof. W. G. Cady, 55; Units, Standardization of, L. J. Briggs, 122; Fitness, National Factors of, Prof. A. V. Hill (*Review*), 561
- Physics: Keeping Pace with, Dr. W. H. George (*Review*), 443; Reports and Progress in. Vol. 3, General Editor: Prof. A. Ferguson (*Review*), 443
- Physikalischen Eigenschaften und chemischer Konstitution, Zusammenhänge zwischen, Prof. R. Krenmann. Mitbearbeitet von Dr. M. Pestemer (*Review*), 831
- Physikers, Die mathematischen Hilfsmittel des, Prof. E. Madelung. Unter Mitarbeit von Dr. K. Boehle und Dr. S. Flügge. Dritte Auflage (*Review*), 218
- Physiological Patterns and Mental Disturbances, J. W. Thompson, W. Corwin and J. H. Aste-Salazar, 1062
- Physiology: in Health and Disease, Prof. C. J. Wiggers. Second edition (*Review*), 133; in General Education, 659
- 'Phytocarcinomata', Colchicine and Plant Hormones, L. Havas, 191
- Pig Production, Bacon Development Board. Report No. 7, Selected Abstracts on, 965
- Pigmy Cemetery, A [1837], 291
- Pilgrim Trust Lecture, Sir William Bragg on the, 961
- Pipes: and Smoking in South Africa, P. W. Laidler, 656; Bands and Joints, Geometry of Conical, W. Sellar, 900
- Pitch Recorder, A Direct-reading, and its applications to Music and Speech, J. Obata and R. Kobayashi, 695
- Pituitary: Extracts and Gastric Ulcers, Prof. E. C. Dodds, 159; Amphibian, Gonadotropic activity of, H. Zwarenstein, 656; Extracts, Anterior, Restropic effects of, C. Wetzler-Ligeti and Dr. B. P. Wiesner, 892
- Planet, New Minor, close to the Earth, 928
- Plankton: Animals, Biology of, R. S. Wimpenny, 284; Collector for Fast Towing, A. E. L. Pierce, 1014
- Plant: Diseases of Great Britain: The, a Bibliography, compiled and annotated by Dr. G. C. Ainsworth (*Review*), 91; Influence of one, on another which is remote from it, H. Molisch, 125; Hormones, Colchicine, 'Phytocarcinomata' and, L. Havas, 191; Protection: the Scientific Principles of, with special reference to Chemical Control, Dr. H. Martin (*Review*), 384; Hormone Investigations, 720; Ecology of Limestone Pavements, Miss A. Bennett, 731; Products, Overseas, J. H. Holland (*Review*), 914; Life Forms, Prof. C. Raunkiaer. Translated by H. Gilbert-Carter, 1035; Materials, Drying of, A. H. Burgess, 1104
- Plants: Growth Hormones in, Prof. B. Jensen. Translated and revised by G. S. Avery, jun., and P. R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer (*Review*), 257; Growth in, Mechanism of, Prof. J. H. Priestley (*Review*), 257; Arctic and Temperate, Annual Changes in the Osmotic Value of some, H. G. Wager and Elizabeth M. Wager, 376; Modern Study of, Education and the, Prof. E. J. Salisbury, 415; 669; 707; Ornamental, Diseases of, D. E. Green; A. Beaumont and P. H. Gregory, 511; in the Western portion of the Little Karoo, Geographical distribution of, M. R. Levyns, 657; Drift of Net Assimilation Rate in, R. F. Williams, 1099
- Platyedra gossypiella* Saunders, Nocturnal Habits of, F. A. Squire, 69
- Pleistocene History of the West Midlands, The, Prof. L. J. Wills, 995

- Pleuronectidæ, Feeding Habits in, H. Muir Evans, 116
 Ploughing by Steam [1837], 81
 Pneumonia, Problem of Chemotherapy in, Dr. W. W. G. MacLachlan, 901
Poa, genus, Cytology of the, J. M. Armstrong, 368
 Poetry and Astronomy, Prof. F. W. Grover, 146
 Poland, Universities of, 231
 Polar Year Expedition, British, Fort Rae, N.W. Canada, 1932-33. 2 Vols. (*Review*), 825
 Pollen of some Ranunculaceæ, Composition of the, and on their Systematic Position, Mme. C. Sora Bourdoui, 656
 Pollution of Sea and Shore by Oil, Prof. N. K. Adam, 100
 Polonium: α -Particles: Shortening of the range of, by Oblique Emission from the source, J. Schintlmeister, 821; Short-range Particles emitted when, are scattered by Heavy Nuclei, W. Jentschke and G. Stetter, 821; The γ -Rays of, H. C. Webster, 852
 Poly-acids, Constitution of the, Dr. J. S. Anderson, 850
 Polygons, Potential of, and Elementary Geometry, G. Bilger, 376
 Polymerization, The Kinetics of, Prof. A. C. Cuthbertson, G. Gee and Prof. E. K. Rideal, 889
 Polymorphic Transitions of Inorganic Compounds to 50,000 kgm./cm.², Prof. P. W. Bridgman, 83
 Polymorphism under Pressure, Prof. P. W. Bridgman, 899
 Polynesia: Central, Religion and Social Organization in, R. W. Williamson. Edited by Dr. R. Piddington (*Review*), 1080; through Many Eyes, A. M. Hocart (*Review*), 1080
 Polyploidy, Mechanism of, through Colchicine, B. R. Nebel, 1101
 Polypores, Wood-rotting, Enzymes of, Dr. S. R. Bose and S. N. Sarkar, 813
 Pomo Culture, E. W. Gifford and Prof. A. L. Kroeber, 686
 Pond Life (*Review*), 992
 Pontifical Academy of Sciences, First Annual Report, 965
 Population: Density, Problems of, Prof. R. Pearl, 32; Changing Distribution of, Prof. C. B. Fawcett, 411; Congress, International, in Paris, 471; Statistics, 1003
 Popular Statistics, 1044
 Porcellanids and Pinnotherids from Tropical North American Waters, S. A. Glassel, 33
 Porous Structure, Investigation of, G. Graue and N. Riehl, 327
 Porphyrinuria, Congenital: Living Animal Cases of, P. J. Fourie and Dr. C. Rimington, 68; Porphyrins of the I and III Series in, Dr. C. Rimington, 105
 Portolan Charts, The Problem of the (*Review*), 662
 Positron and Electron Pairs, Production of, by bombardment of Mercury with β -Particles of Low Energy, Dr. F. C. Champion and A. Barber, 105
 Postular Fever and Purpura Fever of the Rocky Mountains, Crossed immunity between the, G. Blane and M. Baltazard, 905
 Potassium: Isotopes of, J. H. Yoe and R. T. Hall, 34; Resonance Lines of, Intensity Ratios of the Hyperfine Structure Components of the, Dr. D. A. Jackson and H. Kuhn, 276; and Paralysis, Aitken, Allott, Castle-eden and Walker, 367
 Potato: The, in its Early Home and Its Introduction into Europe, Dr. R. N. Salaman (Masters lectures), 159; Vitamin C in the, J. B. H. Ijdo, 977; Synonym Committee, Report for 1936, 1008; Slopes, Standardization of, for Bacteriological Tests, D. Ward Cutler and Miss Mabel Dunkley, 1015; Flowers and Dissemination of Potato Viruses, Dr. G. Cockerham, 1100
 Pottery in the Palæolithic period, J. P. T. Burchell, 800
 Prediction: Some Cases of, A Study, Dame Edith Lyttelton (*Review*), 1078
 Pregnancy, Nutritional Requirements of, Sir Robert McCarrison; Dame Louise McIlroy, 186
 Prehistoric: Archæology, Boucher de Perthes and the Foundations of, L. Aufrère, 261; Finds at Glasgow, 540
 Primates from the Miocene of Lower Austria, Two new remains of, K. Ehrenberg, 125
 Privilege, Registration and, 660
 Probability, Theory of, International Conference on the, Prof. E. L. Dodd and Dr. J. Neyman, 938
 Professional Civil Servants, Institution of, Eighteenth annual report for 1936, 580
 Progesterone alone and in combination with the other Sexual Hormones, Effects on Ovariectomized Rats of, Dr. V. Korenchevsky and K. Hall, 154
 Prohibition and Cirrhosis of the Liver, Dr. C. C. Weeks, 20
 Prolactin: Response of the Pigeon Crop Gland to, inhibition by (Estradiol Monobenzoate, Drs. S. J. Folley and P. White, 505
 Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation, G. S. Sperti, Prof. J. R. Loof-bourou and Sister Cecilia Marie Dwyer, 643
 Prontosil in Puerperal Infections, G. F. Gibberd and others, 284
 Prosperity Beckons: Dawn of the Alcohol Era, Dr. W. J. Hale (*Review*), 637; Protein, Structure of, Prof. C. R. Harington and others, 491
 Proteins: Patterns of, Dr. Dorothy M. Wrinch, 244; and Metaphosphoric Acid, Reaction between, Dr. H. Hermann and G. Perlmann, 807; 'Fibrous' and 'Globular', Relation between, Dr. W. T. Astbury, 968
 Proton tracks, Measurement of the length of, by the Photographic Method, Dr. Marietta Blau and Dr. Hertha Wambacher, 252
 Protoplasm, Structure of, Dr. A. R. Moore, 367
 Protoplasmic Streaming, Action of Auxin on, Prof. K. V. Thimann and Miss Beatrice M. Sweeney, 807
 Protozoa, Effects of Salts on Emergence from the Cyst in, K. V. Thimann and A. J. Haagen-Smit, 645
 Prussian Academy of Sciences, Philosophical and Historical Section, Prof. F. W. Thomas elected a corresponding fellow of the, 55
 Psittacosis, Laboratory Diagnosis of, 32
 Psychology: Medical, Modern Discoveries in, Dr. C. Allen (*Review*), 343; in Autobiography, A History of, Vol. 3, J. R. Angell and others (*Review*), 830; Down the Ages, Prof. C. Spearman. 2 Vols. (*Review*), 909; Science in, Prof. F. Aveling (*Review*), 909
 Psychopathology, A Survey of (*Review*), 343
 Public Health in Great Britain, Sir Arthur MacNalty, 927
 Pultusk: Meteorite, Number of Fragments of the, Dr. E. Stenz, 113; Stones, Meteorites: and the Spelling of "Widmanstätten Figures", Prof. F. A. Paneth, 504; Dr. L. J. Spencer, 589; Prof. F. A. Paneth, 809
 Purple, Visual, Absorption Curve for, and the Electrical Response of the Frog's Eye, Prof. R. Granit, 972
 Pygmy Hosts, Revisiting My, Dr. P. Schebesta. Translated by G. Griffin (*Review*), 445
 Pyrimidine and Thiazole Intermediates as Substitutes for Vitamin B₁, W. J. Robbins, Mary A. Bartley, A. G. Hogan and L. R. Richardson, 779
 'Pyrotenax', a Fire-resisting Cable, 887
 Pyrroles Derived from Acetylacetone, S. J. Hazlewood, G. K. Hughes, F. Lions and others, 695
 Pyruvic Acid Dehydrogenation, Vitamin B₁, and Carboxylase, F. L. Lipmann, 25
 Quantiques, theories, Introduction mathématique aux, Prof. G. Julia (*Review*), 950
 Quantitative Inheritance, Relation of Gene to Character in, E. W. Sinnott, 83; Analysis: a Theoretical approach, Prof. W. Rieman, III and Dr. J. D. Neuss (*Review*), 914
 Quantity Surveying for Builders, W. L. Evershed. Fourth edition (*Review*), 7
 Quantum: Statistics, Joule-Thomson Effect and, Dr. D. S. Kothari and B. N. Srivasava, 970; Low, Ionizing Radiations of, Emitted Spontaneously by the Ordinary Metals, G. Reboul and J. Reboul, 1073
 Quaternary Deposits in the Traun Valley Region above Gmunden, Geological Analysis of the, G. Gotsinger, 41
 Quaternions, Functions of, V. C. A. Ferraro, 1111
 Queen Mary: and the Bodleian Extension, 15; College Jubilee Celebration, 1003
 Quinault Indians, Washington, U.S.A., 201

- 'Racemic Acid', Use of the name, Prof. A. Findlay, 22
Races et Racisme, 458
 Racial: Doctrine and Social Evolution, 945; Evolution and Archaeology, Prof. H. J. Fleure (Huxley memorial lecture), 945, 981
 Radcliffe Observatory, Pretoria, 841
 Radiant Energy, Measurement of. Edited by W. E. Forsythe; Dr. N. R. Campbell (*Review*), 828
 Radio: Communication: Fading in, Reduction of, 76; Phase Fading in Long-distance, Control of, Drs. A. L. Green and O. O. Pulley, 76; Exhibition, The, at Olympia, 474; Waves in the Atmosphere, Reflection of, R. A. Watson-Watt, A. F. Wilkins and E. G. Bowen, 512; Research, Foundation by J. W. O. Hamilton of prizes for, 641; Fadings, Bright Solar Eruptions and, in 1935-36, H. W. Newton and H. J. Barton, 688; -phosphorus in Tissues of Growing Chicks, Deposition of, S. F. Cook, K. G. Scott and P. Abelson, 944; -sodium in Normal Human Subjects, Rates of Absorption of, J. G. Hamilton, 944; Communication, Guglielmo Marconi and the Development of, Sir Ambrose Fleming, 963
 Radioactive: Substances in the body of Rats, Retention of, and the Lethal Dose, Dr. F. Běhounek and F. V. Novák, 106; Measurements, Utilization of Photoelements with semi-conducting layer for, P. Bonét-Maury, 208; Elements, Artificial, Production of, A. Eckardt, 649
 Radiology: British Institute of, Annual Congress and Exhibition, 1069
 Radish and Turnip, Crosses between, L. E. Morris and R. H. Richharia, 285
 Radium: Therapy, Research on, 313; Committee, Report for 1936, 333; Therapy, Science in, 1108
 Rain, Observations on [1837], 819
 Rainfall, British, 1936 (*Review*), 873
 Rainstorms, Run-off after, J. R. Daymond, 470
 Raman Spectra: of Oxonium Compounds, Dr. G. Briegleb and W. Lauppe, 236; of Deuteroethylenes, Prof. M. de Hemptinne, J. Jungers and Dr. J. Delfosse, 323; of the Two Forms of Phosphorus Pentachloride, H. Moureu, M. Mogat and G. Wétroff, 598; of Acrylic Acid and of Methyl Methacrylate, both monomer and polymerized, D. Monnier, B. Susz and E. Briner, 737
 Ramsay Memorial Fellowships, award of, 1008
 Random Observations, Tests for, W. O. Kermack and A. G. McKendrick, 369
 Rare: Earths, Separation of the, Fischer, Dietz and Jübermann, 74; Earth Sulphates, Magnetic Anisotropy of, and the Asymmetry of their Crystalline Fields, Prof. K. S. Krishnan and A. Mookherji, 549
 Rathmullen District, Co. Donegal, Structure of the, W. J. McCallien, 167
 Rats: Adrenals of Normal and of Castrated Male, Histological Changes produced by Castration and by Sex Hormones in the, K. Hall and Dr. V. Korenchevsky, 318; Liver Extract and Hæmoglobin in, A. L. Bacharach and H. E. Glynn, 896
 Raw Materials, Distribution of, Prof. I. Högbon, 801
 Reaction: Heat of, The Sign and Symbol of, Dr. H. J. S. Sand, 809; Kinetics, Discussion on, 902
 Reading University: Dr. G. W. Scott Blair appointed head of the Dairy Chemistry Department of the National Institute for Research in Dairying, 654; Sir Samuel Hoare elected chancellor, 694
 Reality in Physics, Problem of, Prof. R. Ortway, 313
 Rebels: Faithful, a Study in Jewish Speculative Thought, Dr. I. Levine (*Review*), 218
 Recollections of My Life, Santiago Ramón y Cajal, translated by Prof. E. H. Craigie, with the assistance of Prof. J. Cano (*Review*), 617
 Red: Compounds formed by Picric Acid and Creatinine in the Presence of Sodium Hydroxide, A. Bolliger, 519; Rocks, Origin of the, Dr. R. L. Sherlock and others, 554
 Refraction Effect, a Double, in Certain Fatty Materials, L. Bellingham, 70
 Registration: and Privilege, 660; and Population Trends, Dr. R. R. Kuczynski, 966
 Relativity: Double Stars and, Prof. T. Levi-Civita, 470; The Philosophy of, Prof. A. P. Ushenko (*Review*), 636; Theory of Protons and Electrons, Sir Arthur Eddington (*Review*), 742
 Renaissance française, award of the Paul Appel prize and gold medal of the, to the French League against Cancer, 104
 Rengma Nagas, The, J. P. Mills (*Review*), 564
 Rensselaer Polytechnic Institute, Work of the, 419
 Repton School Science Society, 18
 Research and Industry, 437
 Reservoir Dams, Fault-movements and the Safety of, G. D. Louderback, 160
 Resins, Synthetic, Examination of, by X-Rays, N. J. L. Megson and W. A. Wood, 642
 Resorcinol, A New Form of, A. R. Ubbelohde and Dr. J. M. Robertson, 239
 Respiration, Artificial, Production of, by Rhythmic Stimulation of the Phrenic Nerves, Prof. R. A. Waud, 849
 Retina, Structure of the, and the Role of its Visual Purple, Dr. R. J. Lythgoe (Thomas Young oration), 1045
 Rhodes-Livingstone Memorial, Proposed, 57
 Rhodesia, Antiquity of Man in, A. L. Armstrong, Rev. N. Jones and H. B. Maufe, 469
 Rhododendron: A Pest of the, G. F. Wilson, 202; Hybrids of the, F. C. Puddle, 813
 Rice, Genetics of, B. S. Kadam and others, 1068
 Rickets: Experimental, Influence of Iodine and of Some Inorganic and Organic Iodine Compounds on the Bone Lesions of, R. Lecoq, 334; Experimental, of Rats, Protective Effect against of a Single Massive Dose of Vitamin D, Dr. H. Rotter, 973
 Riga, Institution of an Institute for Anatomy, Physiology and Hygiene at, 21
 Rigi Railway, Electrification of the, 355
 Ritchie, F. R. S., Prof. William, [1837], 476
 River Flow Around Bends, Dr. B. Cunningham, 728; Records, Capt. W. N. McClean. Series A: River Garry. Sheet No. 1; Sheet B: River Moriston. Sheet No. 1, Series C: River Ness. Sheets 1-14 (*Review*), 872
 Rivers, R. K. Gresswell, 496
 Riveted Joints in Boilers, Chemical Intercrystalline Fracture of, Dr. S. F. Dorey, 597
 Road: Engineering, Principles of, Prof. H. J. Collins and C. A. Hart (*Review*), 441; Rules of the, Enforcement of the, Dr. H. C. Dickinson, 580; Design and Road Safety, F. C. Cook, 650; Research: Board, Report of the, for year ended 31st March, 1936, 983; Progress in, 983
 Roads, Coloured, C. W. Manlove, 1091
 Roaring Sands of the Kalahari Desert, A. D. Lewis, 285
 Rock Magmas and their Products, Prof. C. E. Tilley (*Review*), 913
 Rockefeller: Travelling Fellowships in Medicine, award of, 61; Institute for Medical Research, Hospital of the, retirement of Dr. R. Cole and appointment of Dr. T. M. Rivers as director, 104; Foundation, Activities of the, in 1936, R. Fosdick, 500
 Rocks and Minerals, Chemical Analysis of, R. C. Wells, 202
 Roman: Site at Wroxeter, Excavations on the, 352; Britain: Local Government in, 394; Recent Excavations in, 654; Pottery from Ewell, Surrey, 924
 Röntgenstrahlen, Materialprüfung mit, Prof. R. Glocker. Zweite auflage (*Review*), 914
 Ropes, Winding, Fibre Cores in, 818
 Ross Institute, Activities of the, 581
 Royal: Aero Club, Miss Jean Batten awarded the gold medal of the, 844; Aeronautical Society, award of medals and prizes, 1094; Agricultural Society, ninety-seventh volume, 357; Asiatic Society, award of universities essay prizes to D. P. Costello and J. Bowman, 967; Cancer Hospital, gift to the, by A. Chester Beatty, 844; College of Physicians of London, award of the Baly medal to Prof. E. L. Kennaway, 232;

- presentation of the Baly medal to Prof. E. L. Kennaway, 722; College of Surgeons of England, opening of the Bernhard Baron laboratories, 1045; Cornwall Polytechnic Society, Annual Report, 59; Geographical Society, [1837], 1026; Institute of British Architecture, Sir William Bragg elected an honorary associate of the, 21; of International Affairs, Prof. A. G. B. Fisher appointed professor of international economics, 842; Meteorological Society, award of the Howard prize to Cadet Ralph Wills, 21; award of the Symons gold medal to Dr. G. M. B. Dobson, 929; Prof. A. S. Spilhaus elected a foreign member of the, 1058; Navy, The Engineering Branch of the, [1836], 123; Observatory, Greenwich, Dr. R. d'E. Atkinson appointed chief assistant in the, 457; Society: J. D. G. Davies appointed assistant secretary, 460; award of Royal medals to Prof. N. V. Sidgwick and Prof. A. H. R. Buller, Copley medal to Sir Henry Dale, Davy medal to Prof. H. Fischer, Buchanan medal to Gen. F. F. Russell, Sylvester medal to Prof. A. E. H. Love and Hughes medal to Prof. E. O. Lawrence; Sir William Bragg recommended for re-election as president, 840; new barometer [1837], 862; Anniversary of the, [1837], 941; Anniversary meeting and presentation of medals, 979; Society of Arts, Annual Report, 1008; of Canada, annual meeting; award of the Flavelle medal to Dr. F. D. Adams, the Lorne Pierce medal to Prof. S. Leacock and the Tyrrell medal to A. Fauteux; Prof. A. G. Huntsman elected president for 1937-38, 287; of Edinburgh: election as honorary fellows of Dr. W. T. Calman, J. L. Baird, Prof. C. U. A. Kappers, Prof. M. T. Bogert and Prof. Max Planck, 61; election of officers, 766; of Tropical Medicine and Hygiene, award of the Chalmers medal to Prof. R. M. Gordon, 98; Veterinary College and Hospital, opening of new buildings of the, 884
- Rubber, Diffusion Process in, Nature of the, R. M. Barrer, 106
- Rubidium-Cæsium Alloys, Diagram of Solidification and Electrical Conductivity of the, E. Rinck, 518
- Rural Hygiene, Far Eastern Conference on, 353
- Russia: Medical Practitioners in, [1837], 39; Medical Schools in, [1837], 81; Hospitals in, [1837], 207
- Rutherford, Lord, Prof. A. S. Eve, 746; Prof. J. Chadwick, 749; Sir J. J. Thomson, 751; Sir William Bragg, 752; Prof. Niels Bohr, 752; Prof. F. Soddy, 753; Prof. E. N. da C. Andrade, 753; Sir Frank Smith, 754; funeral of, 754; further tributes to the late, Prof. S. Meyer, 1047; Prof. A. Norman Shaw; Prof. Niels Bohr, 1048; Prof. G. Hevesy, 1049; Duc de Broglie, 1050; Prof. J. Stark; Prof. O. Hahn, 1051; Prof. E. Fermi, Prof. L. Wertenstein, 1052; Dr. P. Kapitza, 1053
- Rye, Spring, Devernization of, by Anaerobic Conditions and Revernization by Low Temperature, Prof. F. G. Gregory and O. N. Purvis, 547
- Se, Molecule, The Ground State of the, Prof. S. S. Bhatnagar, Dr. H. Lessheim and Mohan Lal Khanna, 152
- Saccharimeter, New Form of, 678
- Sahara, The Threat of the, Prof. E. P. Stebbing, 460
- Sailing Yachts, Shapes of, A Law of Hydrostatics and its Influence on the, Eng. Rear-Admiral A. Turner, 597
- St. Andrews University: J. Dewar appointed lecturer in chemistry in the United College, T. G. Cowling lecturer in mathematics, and R. E. Stedman, lecturer in philosophy in University College, Dundee, 38; honorary doctorates to be conferred on Prof. G. F. Stout and Dr. W. T. Calman, 80; J. M. Brown appointed lecturer in political science in the United College, and B. S. Robertson lecturer in regional anatomy in Dundee University College, 207; conferment of honorary doctorates on R. F. J. Fairlie, Sir John Simon, Prof. G. F. Stout and Sir Leonard Woolley, 654; conferment of an honorary doctorate on Dr. W. T. Calman, 694
- Salcombe Hill, Preservation of, 679
- Salicylic Aldehyde Reaction of Csonka-Straub, Specificity of the, Prof. A. E. Braunstein, 427
- Salmon: Sex-Biology of the Oyster and the, Prof. J. H. Orton, 68; Migrations of, W. J. M. Menzies, 326; Prof. H. B. Ward, 355
- Salts' Institute for Industrial Chemistry, awards made to A. M. Baxt, R. H. Freak, J. L. Tuck and D. H. Wade, 274; Sir Robert Robertson appointed director of the, 722
- Samarium, Micro-estimation of, M. Servigne and E. Vassy, 124
- Sanriku Earthquake, Seawaves of, 1936, N. Miyabe, 1020
- Saps, Vacuolar and Cytoplasmic, Concentration of Solutes in, Dr. E. Phillis and Dr. T. G. Mason, 370
- Sarawak, Intoxicants in, E. Banks, 936
- Sardine, California, and its Fishery, Frances N. Clark, 858
- Sarothamnus scoparius*, Constitution of Scoparoside (Scoparine) of, M. Mascré and R. Paris, 125
- Savage Hits Back: The, or the White Man through Native Eyes, Prof. J. E. Lips. Translated by V. Benson (Review), 619
- Scale Insects of North America, Atlas of the, Prof. G. F. Ferris (Review), 632
- Schmidt, Johannes, medal, award of the, to H. G. Maurice, 104
- Schönbein and Faraday, [1837], 39; 777
- Science: and Learning, Freedom of, 169; in Social Services, 253; Museum, Annual Report for 1936, 353; and the Life of the Community, Committee on, 358; History of, Cultural Basis of the (Review), 439; in Everyday Life, Dr. J. E. R. Constable, 457; and Society, D. Sarnoff, 459; of Life Series, H. G. Wells, Dr. J. Huxley and G. P. Wells. 9 Vols. (Review), 484; Agriculture and Industry, Interrelation between, Sir Harry Lindsay, 652; and the Community, J. Ramsay MacDonald (Radford Mather lecture), 756; Invention and Society, W. Kaempffert, 803; and Free Will (Review), 871; and Common Sense: an Aristotelian Excursion, Dr. W. R. Thompson (Review), 872; in Psychology, Prof. F. Aveling (Review), 909; News a Century Ago, 39; 80; 123; 166; 207; 250; 291; 333; 375; 434; 476; 517; 556; 597; 655; 693; 736; 777; 819; 862; 904; 941; 984; 1026; 1072; 1110; and Music, Sir James Jeans (Review), 947; and the Unobservable, Prof. H. Dingle, 963; Social Contacts of, Committee on, election of officers, 983; in History, The Spirit of, Prof. C. Singer, 1021; and Technology, History of, Fourth International Congress, 1021; Prof. A. Raymond elected president, 1022; and Social Service, Sir Richard Gregory, Bt., 1088; History of, 1089; in Radium Therapy, 1108; an Institution for the Advancement of, [1837], 1110
- Scientific: and Industrial Research, Advisory Council to the Committee of the Privy Council for, Dr. G. M. B. Dobson, Lt.-Col. J. H. M. Greenly and S. K. Thornley appointed members of the, 680; Lord Riverdale appointed chairman and Sir William Bragg a member of the, 888; and Technical Books: British, Select List of Standard, 357; Recent, July 31, v; August 28, v; September 25, v; October 30, v; November 27, v; December 25, iii; Endeavour and Inferiority Complex (Review), 617; Training, Necessities of, Lord Leverhulme, 144
- Scotland, Astronomer Royal for, retirement of Prof. R. A. Sampson, 227; 47th Annual Report, 229
- (*Scylliorhinus canicula*), Changes of Colour by Injection of Pituitary Extracts in a Dogfish, D. R. Barry, 769
- Scyphostegia borneensis*, Male Inflorescence of, C. Baehni, 737
- Sea-Fish Supply, The Nation's: being the Buckland Lectures for 1936, E. Ford (Review), 952
- Seasons, Nomenclature of the, Dr. J. R. Baker, 890
- Sedimentation, Ultracentrifugal, Analytical Measurements of, A. Tiselius, K. O. Pedersen and Prof. The Svedberg, 848
- Seismology, Bibliography of, Edited by E. A. Hodgson, 616
- Selection and Mental Factors, Dr. G. H. Thomson, 934

- Sempervivum*, A New Species of, Dr. W. B. Turrill, 1057
 Serbian: Gypsy Feast-days, Dr. A. Petrovič, 115;
 Royal Academy of Sciences, fiftieth anniversary, 422
 Severn, River, Hydrography of the, Prof. S. M. Dixon,
 G. Fitzgibbon and Dr. M. A. Hogan, 73
 Sex: Chromosomes, Human, Dr. P. C. Koller, 429;
 Ratio, The, Prof. F. A. E. Crew, 449; Prof. F. A. E.
 Crew and others, 958; Behaviour, Effect upon, of a
 Diet Deficient in Vitamin E, Dr. B. P. Wiesner and
 A. L. Bacharach, 972
 Sexual Periodicity, Dr. F. H. A. Marshall, 284
 Sheep: Diseases, Cobalt, and, J. B. E. Patterson, 363;
 Cobalt Chloride Treatment of, J. K. Dixon, 898
 Sheffield University, J. W. Watson appointed assistant
 lecturer in geography, G. Forbes lecturer in forensic
 medicine, J. M. Kennedy lecturer in infectious
 diseases and G. A. de Belin assistant lecturer and
 research assistant in the department of metallurgy,
 207; gift by the City Council for the Extension
 Fund; E. T. Goodwin and T. D. H. Baber appointed
 assistant lecturers in mathematics and Dr. Helen
 Mellanby part-time demonstrator for medical and
 dental students; resignation of J. W. Frame, J.
 Jenkins and Dr. E. S. Duthie, 735; twenty-first
 anniversary of the Society of Glass Technology; new
 buildings for the department of glass technology,
 884; H. J. Barrie appointed demonstrator in
 pathology and R. B. M. Jenkins assistant lecturer in
 civil engineering, 904
 "Shiva's Temple", Arizona, Investigation of, 537; Dr. H.
 Anthony, 613
 Shoreham Harbour, Excessive Marine Growth in, 966
 Short: Waves in Physics, Biology and Medicine, Inter-
 national Congress for, Vienna, Dr. J. B. Bateman, 372
 Short-Mayo Composite Aircraft, 539
 Show Cases, Illuminated, 312
 Showers, Production of, by Heavy Particles, Dr. L.
 Landau and G. Rumer, 682
 Silica Dusts, Solubility of, Dr. E. J. King, 320
 Silicon in Steels, Determination of, G. Charpy, 820
 Silkworms, Diet of, [1837], 207
 Silver: Nitride, Slow Thermal Dissociation of, Ultra-
 Violet Emission Spectrum of the, R. Audubert, 518;
 Halides, Optical Sensitizing of, by Dyes, Mechanism
 of, Dr. S. E. Sheppard, Dr. R. H. Lambert and R. D.
 Walker, 1096
Sinanthropus pekinesis, Reconstruction of the Entire
 Skull of an Adult Female Individual of, Prof. F.
 Weidenreich, 1010; VI, Prof. F. Weidenreich, 1067
Sirius, The Iron Ship, [1837], 556
 Siwa, Oasis of, Egyptian Libya, Zoological Expedition to
 the, J. Omer-Cooper, 919
 Skatole as a Root-forming Substance, L. G. G. Warne and
 A. A. Jackson, 26
 Sladen, Percy, Expedition to Lake Titicaca, H. C. Gilson,
 877
 Sleep and Narcosis, Promotion of, by Dyes, H. Konzett, 821
 Smith, Theobald, award in medical science, Dr. R. D.
 Evans presented with the, 460
 Smithsonian Institution, Field Work of the, in 1936, 356;
 List of the Publications of the, Helen Monro, 616
 Smoke Abatement Society: National, Annual Conference
 at Leeds, Dr. A. L. Roberts, 691
 Snake Venoms, The European (*Review*), 744
 Snow: Crystals, Prof. U. Nakaya and others, 345;
 Falling, Physical Investigations on, G. Seligman,
 345; Crystal or Snowflake, Sir George Simpson,
 729; G. Seligman, 730
 Snowflake, Snow Crystal or, Sir George Simpson, 729;
 G. Seligman, 730
 Social: and Economic Problems, International Co-
 operation in, 1; Services, Science in, 253; Theory
 and Discipline, R. Brightman (*Review*), 481; Research
 Organization of, 521; Evolution, Racial Doctrine
 and, 945; Contacts of Science, Committee on, election
 of officers, 983; Problem Group? A, Edited by Dr.
 C. P. Blacker (*Review*), 993; Sciences Lag, Why,
 Dr. J. Mayer, 1021; Service, Science and, Sir
 Richard Gregory, Bt., 1088
 Sociology: The Development of, Prof. F. N. House
 (*Review*), 481; Medical and Psychological Aspects
 of (*Review*), 993
 Soft X-Ray Region, Absorption Edges in the, H. W. B.
 Skinner and J. E. Johnston, 732
 Soil: Erosion and its Control, Prof. Q. C. Ayres (*Review*),
 445; Engineering Properties of, C. A. Hogentogler
 and others (*Review*), 635; Erosion: The Growth of
 the Desert in Africa and Elsewhere, Sir Daniel Hall,
 886
 Solar: Eclipse: of June 19, 1936, The, Prof. F. J. M.
 Stratton and others, 11; Longest, Observations of
 the, Prof. J. Q. Stewart and T. Stokley, 143; of
 June 8, 1937, Observations of the, Prof. I. Yama-
 moto, 501; Corona, Polarization of the, K. G.
 Zakharin, 586; Eruptions, Bright, and Radio
 Fadings in 1935-36, H. W. Newton and H. J. Barton,
 688; Eclipse, Total, of June 19, 1936, Coronal
 Emission Lines Observed at the, Prof. R. Sekiguti,
 724; Prof. F. J. M. Stratton, 725; Radiation,
 Absorption of, by the Atmosphere in Band A, P.
 Lejay, 943
 Solenoid, Self-inductance of a, Coefficient of, R. Esnault-
 Pelterie, 1073
 Solids, The Grain-like Structure of, Sir William Bragg,
 954
 Solubility of a Pure Substance, Equation of, Forming a
 Solid Compound with the Solvent, J. Perreu, 477
 Solutes in Vacuolar and Cytoplasmic Saps, Concentration
 of, Dr. E. Phillis and Dr. T. G. Mason, 370
 Solvent Dewaxing, M. Ba Thi, T. G. Hunter, Prof. A. W.
 Nash and others, 1105
 'Sonti' Fermentation, K. Rami Reddi and Dr. V. Subrah-
 manyan, 33
 Sooty Mould Fungi, Ecology of, Miss Lilian Fraser, 1104
 Sorbonne, Paris, retirement of Prof. C. Fabry, 883
 Soufrière of Saint-Vincent, Reality of an Eruption of the,
 in, 1718, A. Lacroix, 656
 Sound: Intensity, Absolute Measurements of, Prof.
 E. N. da C. Andrade and R. C. Parker, 34; Music
 and, Ll. S. Lloyd (*Review*), 947; -Films as Diffraction
 Gratings for Visual Fourier Analysis of Sound-waves,
 Dr. D. Brown, 1099
 South: Africa: Native Lands in, A "New Deal", 458;
 Moisture and Farming in, W. R. Thompson (*Review*),
 698; African: Protectorates, Gen. Hertzog and
 Malcolm MacDonald on the, 99; The Future of the,
 127; Fishes of the Families Sparidae and Denticidae,
 J. L. B. Smith, 334; Native Cattle, H. H. Curzon
 and R. W. Thornton, 551; Australia: Mining and
 Geology in, 312; Natural History and Science in,
 Dr. C. T. Madigan, 419; -West Essex Technical
 College, Dr. H. Lowery appointed principal of the,
 803; African Larval Trematodes with Forked Tails,
 F. G. Cawston, 1028
 Soviet: Russia, Birth-rate of, 148; North Polar Station,
 Work at the, 244; Universities, Staff and Student
 Stipends in, 1007; North Polar Station, The, 1040
 Spark Discharge, Development of the, Dr. T. E. Allibone
 and J. M. Meek, 804
 Sparrow, Song, Population Study of the, Margaret M.
 Nice, 159
 Special Libraries and Information Bureaux, Association
 of, fourteenth annual conference, 652
 Spectrometers, Two, for X-Ray Analysis, W. F. de Jong,
 768
 'Spheroidal': A Mutant in *Drosophila funchis* Affecting
 Egg Size and Shape, and Fecundity, Prof. F. A. E.
 Crew and C. Auerbach, 124
Sphinx, The, 314
 Spiders, South African Harvest, Odoriferous Glands of,
 R. F. Lawrence, 209
 Spiritualism, Academic (*Review*), 1078
Sporobolus, R. Br., South African Species of, A. P.
 Goossens, 905
 Sport, Mechanics of, Sir Gilbert Walker, 567
 Spray Deposits, Protective, Fajans and Martin, 511
 Standardization, A Survey of the Present Organization of,
 National and International, 19

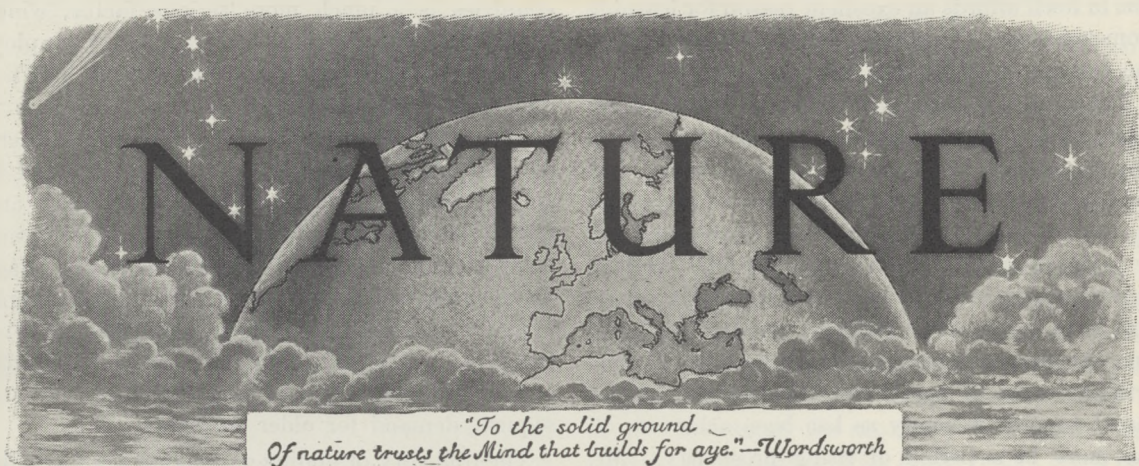
- Stane Street, With a Spade on, S. E. Winbolt (*Review*), 486
- Star-Begotten: a Biological Fantasia, H. G. Wells, 171
- Starch, Cellulose, Glycogen and, Prof. H. Staudinger, 1071
- Stars: Variable, of the Cepheid Type, Pulsation of, G. Tiercy and P. Javet, 125; Rotating, Prof. J. A. Carroll, 162; Binary, Masses and Parallaxes of, Dr. C. Barnes, 286; Double, and Relativity, Prof. T. Levi-Cevita, 470
- State Intervention and Agriculture, 601
- Statistical Mechanics: the Theory of the Properties of Matter in Equilibrium, Prof. R. H. Fowler. Second edition (*Review*), 382
- Steam Frigate, The First, [1837], 375
- Steels, Very Pure, Some Physical and Chemical Properties of, W. Broniewski, S. Przedpelski and S. Sulowski, 334
- Stellar: Colour Indexes, Definition of, P. Rossier, 125; Rotation, A Method of Determining, 162; Spectra, Classification of, W. W. Morgan, 430
- "Sterilamp", The, 844
- Sterol Group, A Diene Synthesis Applicable to the, A. B. Meggy and Prof. R. Robinson, 282
- Sterols and the Bile Acids, Stereochemistry of the, D. A. Peak, 280
- Stomatopoda of the Bingham Oceanographic Collection, G. R. Lunz, 551
- Stone Age, New, Problems of the, H. J. E. Peake, 551
- Stonefly, Graded Mutations in Wings of a, Prof. A. Willey, 112
- Storage Reservoirs, G. B. Williams (*Review*), 635
- Storström Bridge, The, 577
- Strangeways Research Laboratory, Report for 1936, 1092
- Stratosphere: Balloon Experiment, Belgian, M. Cosyns, 54; Flight in the, Capt. J. L. Pritchard, 165
- Stresses in Engineering Materials, Tests for, D. W. Ginns, 858
- Strontium, Isotopes of, 475
- Styrene, Catalysed Polymerization of, Kinetics of, Dr. G. Williams, 363
- Subject Index to Periodicals, 1936 (*Review*), 665
- Subjective Tones, Cancellation, Reinforcement and Measurement of, D. Lewis and M. J. Larsen, 779
- Submarine: Daylight, Measurement of, Dr. H. H. Poole, 50; Canyons, Formation of, P. H. Kuenen, 117
- Substrate, Use of the Word, Dr. N. K. Adam, 158
- Subterranean Forest, [1837], 736
- Sudan, Southern, Native Science in, Prof. F. C. Bartlett (*Review*), 338
- Sugar in the Body, Distribution of, and the Action of Insulin, L. Pollak and G. Flaum-Fehér, 821
- Sulphur as a Factor in the Corrosion of Iron and Steel Structures in the Sea, W. J. Copenhagen (2), 1028
- Sun, Continuous Observation of the, International Co-operation for the, and its First Results, L. d'Azambuja, 208; Apparent Enlargement of the, at the Time of Rising and Setting, Dr. Vaughan Cornish, 1082
- Sun's Outer Envelope, 310
- Sunshine Records, Effect of, Obstacles on, E. G. Bilham, 648
- Sunspot: Activity, Recent, 327; Large, Return of a, 358; Photography with a Small Visual Refractor, C. Maby, 552; An Active, 616
- Sunspots, A Naked-eye Group of, 190
- Super-Nova in *Canes Venatici*, Discovery of a, 500
- Superphysical: The, a Review of the Evidence for Continued Existence, Reincarnation, and Mystical States of Consciousness, A. W. Osborn (*Review*), 1078
- Supraconductivity: Dr. F. B. Silsbee, 420; A New Conception of, F. London, 793; 834
- Surface Action in Biology, Prof. E. K. Rideal, 671
- Suspensions, Frictionless Torque-free, Dr. F. T. Holmes, 1105
- Suva, Fiji, The Central (Native) Medical School, Sir James Barrett, 472
- Swansea Technical College, Dr. F. Heathcoat appointed vice-principal and head of the chemistry department of, 1058
- Sweden, A New Hydro-Electric Power Scheme in, 817
- Swedish Turnip, Yellow-fleshed, A Non-bulbing Derivative of, M. J. Gorman, 333
- Swiss; Society of Natural Sciences, Work of the, 58; Earthquake Service, 189
- Sydney University, Dr. E. Ashby appointed professor of botany, 883
- Synthesen (Organische), (Organic Syntheses), Dr. R. Asmus (*Review*), 486
- Systematics in Relation to General Biology, Association for the Study of, 163
- Systèmes de référence et mouvements (physique classique), Prof. A. Sésmat. Parts 5, 6, 7 (*Review*), 994
- Tanaina, Ethnography of the, Dr. C. Osgood, 898
- Tanning Liquors, Effect of Moulds upon, L. Baens and F. M. Yencko, 687
- Taxes and Kineses, Classification of, Dr. D. L. Gunn, J. S. Kennedy and D. P. Pielou, 1064
- Taxonomy, Genetics and, Dr. W. B. Turrill and others, 572
- Taylor's Scientific Memoirs [1837], 862
- Tea, A New Purine in, T. B. Johnson, 814
- Technical: Institutions, Association of, summer meeting at Blackpool, 79; Processes, Development of New, Dr. H. C. Urey, 901
- Technischen Zeitalters: Die Tragik des, Mensch und Maschine im 19 Jahrhundert, O. Veit (*Review*), 45
- Technological History (*Review*), 301
- Telegraphic: Communication on Railways [1837], 166; Transmitter, Long Wave, Service Area of a, A. L. Green, 900
- Teleostomes, Cheek Bones of, T. S. Westoll, 72
- Telephone, Extra Receiver for the, 230
- Telephony, International, Practical Difficulties in, A. Lignell, 312
- Television: Projection, Dr. V. K. Zworykin, W. H. Painter and Dr. R. R. Law, 286; Cable, The, A. Rosen, 355; Equipment, Improvements in, 962; Cyclopaedia, A. T. Witts (*Review*), 1032; on a Large Screen, 1046
- Televisor, Telegraphy, Telephone, 188
- Tell Duweir, Archaeological Excavations at, 1936-37, 99
- Tellurium, Molybdenum and Tungsten, Hexacoordination of, J. Gupta, 685
- Temperature, Secular Trends of, Miss L. F. Lewis, 899
- Tenthredinidæ, Thelytokously Parthenogenetic, Maturation in the, Prof. A. D. Peacock and Dr. Ann R. Sanderson, 240
- Termites, Communal Life Among, H. Donnisthorpe (*Review*), 622
- Ternary: Gas Mixtures, Analysis of, by Thermal Conductivity Measurements, J. L. Bolland and Dr. H. W. Melville, 63; Alloys, Investigation of Equilibrium Diagrams of, by X-Rays, A. J. Bradley, H. J. Goldschmidt, H. Lipson and A. Taylor, 543
- Terrestrial Life: Foundations of, The Soil and the Green Plant, Sir Frederick Keeble, 1107
- Terror, H.M.S., Capt. Back's Voyage in [1837], 862
- Testosterone, The effect of Enol-Esters of, Dr. K. Miescher, W. H. Fischer and E. Tschopp, 726
- Tetradeuteroethylene, Infra-red Spectrum of, Dr. G. B. B. M. Sutherland and G. K. T. Conn, 644
- Tetramethylammonium, Pharmacology of, A. J. Clark and J. Raventos, 325
- Tetramethyldiketopiperazine, Diketopiperazine and, Infra-red Spectrum and Molecular Structure of, Dr. L. Kellner, 193
- Téviéc: station-nécropole mésolithique du Morbihan, Marthe et Saint-Just Péquart, M. Boule et H. Vallois, 329
- Textile Institute, award of the medal of the, to Dr. F. W. Eurich, 675
- Thallium Hydride, Band Spectrum of, Dr. B. Grundström, 365
- Theism: Restated (*Review*), 485; The Philosophical Bases of, Prof. G. Dawes Hicks (Hibbert lectures), (*Review*), 485
- Thermionic Valve Data, 1046
- Thermodynamic Scale below 1° K., W. Jacyna, 863

- Thermodynamical Quantities, Symbols for, 802
 Thermo-electric Light [1837], 597
 Thiazole and the Growth of Excised Tomato Roots, W. J. Robbins and Mary A. Bartley, 779
 Thomas-Gilchrist Basic Process, F. W. Harbord, 1057
 Thorium : α -Particles from, Redetermination of the range of, J. Schintlmeister, 519 ; Disintegration of, Detection of α -Particles in the, A. Braun, Dr. P. Preiswerk and P. Scherrer, 682 ; to Uranium in Rocks and in the Sea, Abundance Ratio of, H. Pettersson, 821
 Thorpe's Dictionary of Applied Chemistry, Prof. J. F. Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol. 1 (*Review*), 1076
 Thunderclouds, Electricity in, Distribution of, Sir George Simpson and F. J. Scrase, 732
 Timbers, Gurjun, Apitong, Keruing, Kapur and allied, S. H. Clarke, 326
 Time : Measurement, Part 2, 499 ; -Space Continuum," "The, Designation of, Dr. M. O'Gorman, 773
 Tissues, Living, The Metabolism of, Dr. E. Holmes (*Review*), 91
 Titanium Dioxide, Commercial, Darkening of some, in Daylight, W. O. Williamson, 238
 Titicaca, Lake, The Percy Sladen Expedition to, H. C. Gilson, 877
 Tobacco : Virus, Mutation in, Dr. H. H. McKinney, 33 ; Mosaic Virus Nucleoprotein, Artificially prepared Visible Paracrystalline Fibres of, R. J. Best, 547 ; Habit, Dr. J. D. Rolleston, 615 ; Mosaic Protein, Dr. W. M. Stanley, 648
 Tomato 'Spotted Wilt' Virus, Ecology of, Dr. J. G. Bald, 1019
 Torpedo Craft, Evolution of, Sir J. E. Thornycroft, 763
 Torus Mandibularis, The, and its ultimate Phylogenetic Signification, A. Perier, 737
 Trades Union Congress and Science, E. Bevin, 457
 Transformation, A New Mode of, A. Debiere, 518
 Transplanting, Economic Value of an Experiment in, 101
 Transport in France, F. J. Wymer, 1056
 Travellers, Instructions for [1837], 819
 Tree : remains in and under Peat, Some Climatic Theories in connexion with, A. C. Forbes, 81 ; Growth, Climatic Cycles and, W. S. Glock, 855
 Treub Foundation of Buitenzorg, Java, first report, 230
 Tri-brom Ethanol, Absorption of, through the Skin, Dr. D. I. Macht, 849
 Trigonometry : a Text Book of, for Colleges and Engineering Schools, W. H. H. Cowles and J. E. Thompson (*Review*), 344
 Trihornometry : a New Chapter of Conformal Geometry, E. Kasner, 519
 Tring Museum, 842
 Triphenyl Ethylene, Cestrous Reactions, including Mating, produced by, J. M. Robson and Dr. A. Schönberg, 196
 Tritium ?, Tritium or, Dr. K. C. Bailey, 590
 Tritium or Tritium ?, Dr. K. C. Bailey, 590
 Triton taeniatus, Neural Induction of Plant Tissues in the Ectoderm of, M. N. Ragozina, 199
 Tuberculous, Care and After-care of the, Sir Kingsley Wood, 101
 Tuberculosis : (Attested Herds) Scheme, 102 ; Origin of, and nature of the Tubercle Bacillus, Prof. J. Tissot, 775
 Tumour Cells, Aerobic Glycolysis of, Specific action of Ferricyanide on, Dr. B. Mendel and Miss F. Strelitz, 771
 Tungsten : Anodic Polarization of, J. P. E. Duclaux, 208 ; Tellurium, Molybdenum and, Hexaco-ordination of, J. Gupta, 685 ; Clean and of Thoriated, Temperature Variation of the Work Functions of, Dr. A. L. Reimann, 1073
 Turbid Solutions in an Electric Field, Optical Rotatory power of, Prof. J. Kunz and R. G. La Baw ; Dr. E. B. Ludlam, A. W. Pryde and H. G. Rule, 194
 Twenty-one Years : a Professor Looks out on the Glass Industry, Prof. W. E. S. Turner, 1071
 Tyneside Geographical Society, Jubilee of the, 842
 Typhoid : Fever, The Bournemouth outbreak of, late Dr. V. Shaw, 145 ; and Typhus Fevers [1837], 250
 Ultra-sonic Grating in Liquids, Circular, Miss J. Čefovská, 425
 United States : Meteorology in the [1837], 123 ; Examinations in, 189 ; Zoological Expedition to Far East, 356 ; Regional Planning in, 579 ; Soil Erosion in the, Mrs. E. Huxley, 687 ; Adult Education in the, Dr. J. W. Studebaker, 816
 Units, Physical, Standardization of, L. J. Briggs, 122
 Unst, Shetland Island, Metamorphic Rocks of, Prof. H. H. Read, 731
 Upper Air, Investigation of the, Prof. D. Brunt and others, 876
 Uranium Dioxide Starting Resistances, 900
 Uranyl Phosphites, A. Chrétien and J. Kraft, 251
 Universities and Education, Prof. F. G. Baily and others, 689
 University : in Modern Life, The, 987 ; The, and the National Life, Dr. R. E. Priestley, 1007 ; Graduates, Employment of, 1022
 U.S.S.R. : Fauna of the, 19 ; Genetics and Plant Breeding in the, 296
 Uterus, Hæmodynamic Factors in the, during the Latter Part of Gestation, Dr. S. R. M. Reynolds, 546
 Uwins, David (1780-1837), 517
 Vaccination, Encouragement of [1837], 694
 Vacuoles, Vital Coloration of the, Conditions under which Neutral Red produces the, A. Guilliermond and R. Gautheret, 40
 Vacuum Tubes, Fundamentals of, Prof. A. V. Eastman (*Review*), 953
 Vakuumspektroskopie, Dr. H. Bomke (*Review*), 528
 Vale of White Horse, Berks, Iron Age Site in the, 1006
 Veddahs, Blood-groups of, Prof. W. C. O. Hill, 548
 Vegetables and Fruit in the Well-balanced Diet, Place of, Dr. G. E. Friend, 615
 Vehicle Tests on Motor Roads, 888
 Vektor- und Tensor-rechnung, Einführung in die, Prof. H. Schmidt (*Review*), 302
 "Velan", a Water-proofing Agent for Textile Goods, 612
 Venus, Mars and, Occultations of, 103
 Verein deutscher Eisenhüttenleute, award of the Carl Lueg gold medal to Sir Harold Carpenter ; election of J. Henderson as an honorary member, 675
 Vibration Temperature in relation to Rotation Temperature in Band Spectra, Dr. N. R. Tawde and S. A. Trivedi, 463
 Victoria Nyanza, Boats of, G. W. B. Huntingford, 812
 Victoria regia, Discovery of the [1837], 434
 Vie, La (Encyclopédie française), Tome 4, A. Mayer (*Review*), 664
 Vienna, Academy of Sciences, Annual Meeting : Prof. O. Redlich elected president ; elections ; award of the Ignaz L. Lieben prize to Drs. Marietta Blau and Hertha Wambacher, the Rudolf Wegscheider prize to Dr. O. Brunner and the Fritz Pregl prize to O. M. Haitinger, 332
 Vijayalaya Cholisvaram, Temple of, in Pudukottah State, Technique of the Painting Process in the, S. Pamasivan, 198
 Virus : Particles, Aggregation of, J. G. Bald and G. E. Briggs, 111 ; Proteins, Dr. R. W. G. Wyckoff, 648
 Viruses, Crystalline Preparations of, F. C. Bawden and N. W. Pirie, 1018
 Vision, Role of Electric, Photochemical and Diffusion Phenomena in, J. F. Schouten, 41
 Visual : Freehold, Instantaneous, after Light Adaptation, S. Hecht, 83 ; Excitation, Specific Constants for, W. J. Crozier, E. Wolf and Gertrud Zerrahn-Wolf, 943
 Vitamin : A₂, A Possible, Dr. J. R. Edisbury, Dr. R. A. Morton and G. W. Simpkins, 234 ; A New Source of, Dr. J. A. Lovern, Dr. J. R. Edisbury and Dr. R. A. Morton, 276 ; E Concentrates, Constituents of, from Rice- and Wheat-germ Oils, Dr. A. R. Todd, Dr. F. Bergel, H. Waldmann and T. S. Work, 361 ; E Deficiency in the Suckling Rat, Miss M. M. O. Barrie, 426 ; P, A. Bentsáth and Prof. A. Szent-Györgyi, 426 ; P, Dr. S. S. Silva, 588 ; C in Sweat,

- Excretion of, R. E. Bernstein, 684; B₁, Reduction of, A Coloured Intermediate on, F. Lipmann, 849; B₂, Synthesis of, J. K. Cline, R. R. Williams and J. Finkelstein, 856; B₃, Intermediates of, and Growth of Phycomyces, W. J. Robbins and F. Kavanagh, 943; E, Effect upon Sex Behaviour of a Diet Deficient in, Dr. B. P. Wiesner and A. L. Bacharach, 972; D, Protective Effect against Experimental Rickets of Rats of a Single Massive Dose of, Dr. H. Rotter, 973; C in the Potato, J. B. H. Ijdo, 977; A, Crystalline, H. N. Holmes and R. E. Corbet, 1020; Pellagra-Preventing, Nicotinic Acid and the, Dr. L. Harris, 1070
- Vitamins in Theory and Practice, Dr. L. H. Harris. New edition (*Review*), 302
- Vocational Guidance, Factors of, Dr. Oeser, 284
- Volcanic Eruption, Precursors of a, R. Takahasi and T. Minakami, 470
- Volkstumatlas von Niedersachsen, Dr. W. Pessler. Lief. 1 u. 2 (*Review*), 785
- Voltaic Battery, Dr. Andrew Fyfe on the [1837], 333
- Volumetric Analysis, A. J. Mee (*Review*), 831
- Votive Offerings from Chichen Itza, Yucatan, 159
- Wales, Fisheries of, C. Matheson, 721
- Wallis Island, Ethnology of, E. G. Burrows, 812
- Wandering Spirit: The, a Study of Human Migration, Dr. R. Numelin (*Review*), 89
- Warren Research Fellowships, appointments to, of G. S. Hartley and J. T. Randall, 232
- Washes, Egg-Killing, Kearns, Martin and Wilkins, 469
- Water: and Heavy Water, Surface Tension of, J. Trimmermans and H. Bodson, 293; Structure of, P. C. Cross, J. Burnham and P. A. Leighton, 512; Light and Heavy, Densities of Mixtures of, L. G. Longworth, 900; Supply and Public Works, G. H. Thielton-Dyer; H. Dewey, 963; E. G. Bilham; Dr. W. H. J. Vernon and Dr. F. Wormwell, 964; Light and Heavy, Overvoltage in, Prof. J. Heyrovský and Dr. J. Novák, 1022; Heavy, Adiabatic and Isothermal Compressibilities of, Prof. S. Bhagavantam and B. Sundara Rama Rao, 1099; Survey: Committee, Inland, Second Annual Report, 1936-37, 1106; Inland, in Great Britain, Dr. B. Cunningham, 1106
- Watson, Prof. Richard, work of, Prof. J. R. Partington, 803
- Way that I Went: The, an Irishman in Ireland, Dr. R. L. Praeger (*Review*), 870
- Weeds, Weeds, Weeds, Sir Charles Vernon Boys (*Review*), 994
- West: Indian Hurricane, A. S. Durst, 117; Middlesex Main Drainage, D. M. Watson, 733; African People, Religion and Medicine of a, Dr. R. S. Rattray (*Review*), 869; Midlands, The Pleistocene History of the, Prof. L. J. Wills, 995, 1036
- Wettest Place in the British Isles, Dr. J. Glasspoole, 540
- Whales, Blue, Age and Stock of, A. H. Laurie, 201; Die? Why do Stranded, Prof. W. A. Osborne, 1017
- Whaling, International Agreement for the Regulation of, 180
- Whirling Threads, Air-drag and the Equilibrium of, E. R. Goshawk, 194
- White Ant, The Soul of the, E. N. Marais. With a biographical note by his son and translated by Winifred de Kok (*Review*), 622
- Wicklow Hills, Map of the Glacier Lakes and Local Glaciers of the, Prof. J. K. Charlesworth, 977
- Wide Horizons: Wanderings in Central Australia, R. H. Croll (*Review*), 1081
- 'Widmanstätten Figures', Meteorites: the number of Pultusk Stones and the spelling of, Prof. F. A. Paneth, 504, 809; Dr. L. J. Spencer, 589
- Wien-Planck correction in the Calculation of the Magnitude of a Star, P. Rossier, 125
- Wilson Track Photographs, Exhibition of, 841
- Wireless: Signal Variations, Control of, Drs. A. L. Green and G. Builder, 76; Servicing Manual, W. T. Cocking. Third edition (*Review*), 914; Pioneers, Monuments to, 926; Waves in the Ionosphere, Annual Variation of the Absorption of, Dr. F. W. G. White and L. W. Brown, 931; Communication, Marconi School of, 1005
- Wires, Internal Friction of, Dr. C. Zener, 895
- 'Woman: Marriage' in Dahomey, Dr. M. J. Herskovits, 284; The Future of, A. M. Ludovici (*Review*), 486
- Wood: as Fuel for Motive Power, Utilization of, R. Vultrin, 59; -pulp, Bleaching of, 314; -destroying Insects, Research on, Dr. R. C. Fisher, 368
- Woods on Private Estates, 817
- Wool, Artificial, Production in Italy, 1090
- Woolf, Arthur [1837], 736
- World: Power Development, Tendencies of, Dr. E. F. Armstrong, 706; The, from a Window Garden, Grace E. Pulling, 722; Structure, Prof. E. Schrödinger (*Review*), 742; Power Conference: Vienna Sectional Meeting, 1009
- X- and γ -Rays, Biological Action of, Some Quantitative Aspects of the, C. M. Scott, 936
- Xenon, Krypton and, Packing Fractions of, Dr. F. W. Aston, 149
- X-Ray: Microscope, The, Dr. L. v. Hámos, 30; Intensifying Screens adapted to Structure Analysis, Dr. N. H. Kolkmeijer, C. J. Krom and H. Kunst, 67; Waves, Effects of the length of, on Seeds, A. A. Bless, 83; Analysis, Two Spectrometers for, W. F. de Jong, 768; Methods in the Investigation of Failure in Service, Dr. H. J. Gough and W. Wood, 1069
- X-Rays: Genetic effects of, Influence of Wave-length on, H. Fricke and M. Demerec, 519; Emission of, by Vacuum Tubes of very small dimensions, submitted to a High-frequency Current, L. Maillet, 557; and Wool Fibre, Dr. W. T. Astbury, 1069; Biological Action of, A Theoretical Review, Prof. J. A. Crowther (Silvanus Thompson memorial lecture), 1069; in Industrial Diseases, Use of, Dr. G. Shearer, 1069; Rapid Survey of Ternary Alloy Systems by, Dr. A. J. Bradley and H. Lipson, 1069
- Yale University, gift for cancer research by S. W. Childs, 21
- Yeast: Pure, Practical Management of, the application and examination of Brewery, Distillery and Wine Yeasts, A. Jorgensen. Third edition, revised by A. Hansen (*Review*), 705; Phosphorus Exchange in, Prof. G. Hevesy, Dr. K. Linderström-Lang and N. Nielsen, 725; Diploid and Haploid Colonies of a, Winge and Laustsen, 1104
- Yellow Enzyme, Protein of, Prof. R. Kuhn and P. Deshuelle, 936
- Yolk Lecithin, Origin of, L. Hahn and Prof. G. Hevesy, 1059
- Young's Modulus Apparatus, J. W. Cuthbertson, 511
- Zahlentheorie, additiven, Über einige neuere Fortschritte der, Prof. E. Landau (*Review*), 950
- Zeiss Works, Lectures and demonstrations at the, 718
- Zero to Eighty: Being my Lifetime Doings, Reflections and Inventions, also my Journey Around the Moon, Akkad Pseudoman (Dr. E. F. Northrup), (*Review*), 872
- Zinc: -blende, Photo-conductivity and Phosphorescence of, Dr. A. L. Reimann, 501; in Alkaline Solution, Volumetric Micro-estimation of, C. Cimerman and P. Winger, 737; Coatings, Methods of Testing, L. Kenworthy, 858
- Zodiacal Light at a Total Solar Eclipse, The, Prof. F. J. M. Stratton, 682
- Zoo, A Female Rhinoceros in the [1837], 250
- Zoogeography: Fundamentals of, Dr. B. P. Uvarov (*Review*), 663; General, Prof. V. G. Heptner (*Review*), 663
- Zoological: Nomenclature, Prof. T. D. A. Cockerell, 27; Society of Scotland, Progress of the, 460; Society [1837], 777; Expedition to the Oasis of Siwa, Egyptian Libya, J. Omer-Cooper, 919
- Zoology and Botany, Magazine of [1837], 291

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International Co-operation in Social and Economic Problems

AT a time when confidence in the League of Nations is being sadly shaken, the progress of the International Labour Organization, as shown by the recently issued annual report, is a welcome reminder of the realities of international co-operation. The emphasis which the tragic events of the last few years has laid upon the necessity of social justice as a condition of peace, both internal and external, has brought the aims and the potentialities of the Organization into stronger relief.

Beyond question the Organization has emerged stronger, and not weaker, from the slump. Its advisory and information services have been increasingly recognized by countries all over the globe. Its activity has been more than sustained, and there was never a time when a wider prospect of constructive work could be discussed; even in membership, the withdrawal of Germany in 1933 has been offset by the entry of the United States, the U.S.S.R. and Egypt.

The outstanding features of the past year have been the success of the American Labour Conference at Santiago, which has stimulated the publication of a series of valuable monographs on economic and social conditions in South America, the Maritime Conference dealing with hours of work at sea and the World Textile Conference convened at Washington at the end of the year.

Despite all political and ideological differences which impede international relations at the present time, the good will necessary for international agreement is still to be found in the social field. The technical aspects of migration problems are once again receiving attention, and a fresh start is being made in dealing with the social problems of the countryside.

What gives especial interest to the annual report prepared by Mr. H. B. Butler, director of the International Labour Office, however, is the admirable survey which he presents of the international situation as a whole. Avoiding the snare of excessive occupation with the details of the progress of the International Labour Organization itself, he gives us a balanced and impartial discussion of many of the national tendencies and policies, upon the integration of which the future of our economic and social order depends. In the present report, for example, he reviews the extent of recovery from the slump, seeks to indicate certain lessons to be learnt and to emphasize some of the main problems and tendencies at the present moment.

To-day there can be no doubt that a large measure of recovery has been accomplished, but there are widespread doubts as to the attainment of any real stability or equilibrium. Moreover, the recovery has been achieved mainly by the

positive action of Governments and peoples, and this in itself affords an excellent reason for learning from experience of a slump to build barriers against the recurrence of similar catastrophes.

The evidence of recovery afforded by charts of production and unemployment is decisive. It is less convincing in statistics of world trade, and freer international trade remains one of the prime necessities if any real confidence about stability or permanence of recovery is to be felt. Only a beginning has been made in stabilizing currencies and in reducing trade barriers, and in the meantime the growth of armaments and the uneconomic activity which it represents constitute a serious threat to such recovery as has been achieved, all the more in a period of rising prosperity. Mr. Butler's survey should leave no one in doubt as to the menace which recent developments in this field present to economic and social progress until a peace system guaranteed by an effective League of Nations has been organized.

It is, however, in his discussion of the lessons of the slump and of current problems and tendencies that Mr. Butler is most suggestive. Against the uncomfortable realization that prosperity does not of itself move along a straight and even course but is inclined to proceed by upward and downward waves, he sets a firm conviction that the experience of the slump has demonstrated that man is capable of exerting a degree of control over his economic destiny. This is the more important because the buffets of economic misfortune are no longer accepted with the same docility as in the past. In fact, the demand for a national economic policy may become as insistent as was the demand for a public health policy fifty years ago.

The experience of the slump has already revolutionized the traditional view of the unemployment problem. It has disposed of the old fetish that there is no such thing as involuntary idleness, and that efforts to provide work or sustenance for the unemployed are an unjustifiable interference with the law of supply and demand. The positive value of State aid to the unemployed has been demonstrated beyond question, independently of its economic value.

Sir Josiah Stamp's recent plea for investigation of population questions finds further support in some of Mr. Butler's comments on population changes in relation to unemployment. The greater difficulty of reabsorbing displaced workers is not due entirely to the greater impact of technical change on the volume of employment; the decline

in the rate of population increase in all Western countries is a much more serious factor, which aggravates the effect of technological unemployment. Moreover, technical changes mean now not merely new vocations for the younger workers or entrants to industry, but also actual displacement of those already at work. Vocational training to an increasing extent involves the training and re-adaptation of the older workers. This situation is the more serious because, while the changing age distribution in population is increasing the supply of older and decreasing that of younger persons, the accelerating tempo of industry is constantly reducing the age of maximum efficiency and consequent demand for older workers.

The difficulty of finding employment for middle-aged workers of all types is enhanced by the natural prejudice in favour of young men and women, even in the newer and growing occupations for which middle-aged men are quite suitable, and one of the gravest dangers at the present time is that the 'hard core' of elderly unemployed will continue to grow, with serious consequences to the whole economy of social services. Fortunately, the experience of the slump provides welcome evidence of the ability of social insurance as an institution to meet the exceptional and unprecedented demands upon it and even to extend its operations. This fact, however, stresses the necessity for close attention to the effect of the changing technique of industry on the character of the insured population and to the biological changes in the composition of almost all Western populations. Only by careful investigation of the problems thus presented can we hope to secure the stability of our social insurance systems under growing pressure.

It is remarkable, in some ways, that the depression has led to increasing recognition of the value of the minimum wage, and that the dogma that the most effective way of combating depression lay in the reduction of wages has largely been refuted. At the same time, it is increasingly recognized that incomes, not wage rates, form the foundation of living standards, and considerable progress has been made in raising the standard of civilization by supplementary methods such as family allowances, educational allowances or social insurance. Equally remarkable is the fact that the problem of leisure has been accentuated, not retarded by the slump. The tendency has been towards shortening the working week and not lengthening it, as in previous slumps. The problem of leisure, whether from the point of view of

holidays with pay or education, forms part of a general demand for a better and wider life which is the present trend of social progress.

Mr. Butler makes pertinent comments upon the importance of monetary policy in its international aspects, but even here he can point to evidence of the beginnings of a new monetary technique, which may assist in dealing with some of these social and economic problems in accordance with the ideal of social practice. Moreover, in the extension of Government intervention in the economic world he sees further possibilities of progress, if only the horizons of thought are widened and not limited to nationalist boundaries. He recognizes that it is almost inevitable for nations to attempt some degree of national self-sufficiency, clearly as he recognizes the dangers and disturbance to progress caused by the voluntary isolation of so large an economic unit as Germany. He reiterates the importance of foresight and planning in connexion with armaments and avoiding another depression,

and the necessity for developing an adequate technique for this purpose in time.

No reader of this report can be in any doubt as to the seriousness of the consequences of certain tendencies in national policies in economic and social affairs at the present time, or to the imperative need for thorough scientific investigation of population and allied questions. Nor does Mr. Butler leave us in any reasonable doubt as to the efficiency of existing international co-operation in social and economic questions. Even the few examples he cites of recent experiments at control within national boundaries indicate how hopeful the future might be if public opinion could be stirred to demand the necessary investigation and co-operate planning. This latest report gives us a most encouraging prospect of the possibilities of social control at the very time when scientific workers have come to consider, on a scale more widely than ever, just what might be done to elaborate an adequate programme and technique.

Offence and Defence in Gas Warfare

Chemicals in War :

a Treatise on Chemical Warfare. By Dr. Augustin M. Prentiss. With Chapters on the Protection of Civil Populations and International Situation, by Major George J. B. Fisher. Pp. xviii + 739. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 45s.

THE author's intention in the publication of this comprehensive work is to present to the public an authentic account of a much misrepresented and misunderstood subject, to give the American point of view on chemical warfare and to trace its development from its beginning in the World War to the present time. He is well qualified to undertake such a task, as he served in the War as assistant to General Fries, who was chief of the Chemical Warfare Service of the American Expeditionary Forces, and he has been on continuous duty in the American Chemical Warfare Service ever since.

Colonel Prentiss describes in full detail all the chemical agents that were used by each of the nations engaged, and also their method of manufacture and their comparative success, and he discusses the probabilities of their future employment as well as post-War developments. He refers to the sensational articles which appear from time to time about some new super-gas, a few hundred

pounds of which, dropped from aeroplanes, could destroy New York. These, he says, are invariably the figments of the imagination of writers who have neither technical nor professional knowledge, and they are found to be, when analysed, without the slightest foundation of fact. But this does not mean that there may not be much more effective chemical agents in the future, though there is little to be gained in finding them while the full possibilities of those already known remain unexploited. For example, an average of only 33 casualties resulted in the War from the use in battle of 1 ton of mustard gas, whereas it has been proved experimentally that there is enough potential poison in this quantity to kill 45 million men!

The evolution of the tactics employed in discharging gas clouds and artillery and trench mortar gas projectiles is traced, and the opinion is expressed that gas troops were more highly developed and more extensively employed by the British (the Special Brigade) than by any other nation. He also confirms the opinion held in Great Britain that the use by the French of prussic acid gas in their shells (of which four millions were filled with the substance) and by the Germans of their Blue Cross shells (of which fourteen millions were filled) were two of the major errors in the gas war. Far too many chemical agents were used in the field, and there were long delays in their

production; and gas was filled into shells designed for high explosive, which, with the fuses supplied, were quite unsuitable for the purpose. In fact, a heavy price was paid for lack of pre-war preparation, and the wonder is now how the amazing results achieved were ever accomplished.

The author has some interesting remarks to offer on the gassing of cities, and he considers that the effects of volatile gases, such as phosgene, can be largely avoided by taking refuge in buildings, closing the windows and doors and seeking the upper floors. Mustard gas sprayed from aeroplanes would be much more effective, and if it reached the target aimed at, it might result in serious non-fatal casualties to all unprotected persons exposed to the vapours for a period of half an hour.

Major Fisher, also of the U.S. Chemical Warfare Service, who has written the chapter on the protection of civilian populations, is of the same opinion. He thinks that the spraying of liquid chemicals from aircraft necessitates flying at altitudes of not more than 300 ft. and the deposit of spray directly on exposed personnel; but that this task would be so difficult that the employment of such liquids in aerial attacks would be limited to the dropping of vesicant-filled containers. "All military experience with chemical warfare,"

he says, "shows that gas may be countered by organized protection. Careful planning and preparation to this end must, therefore, appeal to and elicit the co-operation of every public-spirited citizen." It is interesting to note that the measures he advocates are precisely those recommended in the Air Raid Precautions handbooks published by the British Home Office, namely, the utilization of designated rooms within homes or residential or commercial buildings, and sealing them as gas refuges.

There are very complete chapters on chemical defence, and in summarizing the effectiveness of chemical warfare in the field the author tabulates a great deal of information collected from all available sources to show the increasing use that was made of gas in the War and its relative value to other weapons in casualty production: gas was four to five times more effective. Each casualty required 500 lb. of high explosive or 5,000 rounds of rifle and machine-gun ammunition, whereas a casualty resulted from the firing of every 22½ mustard gas shells.

This volume contains more than seven hundred pages, and is well illustrated. It comprises a very complete and impartial study of chemical warfare in all its phases, and is therefore a valuable book of reference.

C. H. FOULKES.

Organic Chemistry of Nitrogen

The Organic Chemistry of Nitrogen

By Prof. N. V. Sidgwick. New edition, revised and rewritten by T. W. J. Taylor and Dr. Wilson Baker. Pp. xix + 590. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 25s. net.

IT is refreshing to find a book which not only is thoroughly interesting to read on account of the way in which the subject-matter is presented, but is also sufficiently comprehensive to serve, for ordinary purposes, as a reference book for the range of material treated. The second edition of N. V. Sidgwick's "Organic Chemistry of Nitrogen", which has been entirely rewritten by T. W. J. Taylor and Wilson Baker, preserves that balance between interest and comprehensiveness which made the original so valuable. These authors have, in fact, adhered closely to the plan of the first edition in dealing only with the simpler organic compounds of nitrogen, although necessarily the newer book is longer, as it presents much material only discovered since 1910, the date of the first edition. For the most part the actual chapter headings of the two books are the same: the new

edition omits the chapter on derivatives of uric acid, only heterocyclic compounds which contain one nitrogen atom being treated; it omits also the subsection on the simpler alkaloids; it replaces the subsections on amino-acids and on aliphatic diazo-compounds and hydrazoic acid by separate chapters; and it treats all the carbonic acid derivatives together in one instead of two chapters.

Much of fundamental theoretical importance has happened in the twenty-seven years which have elapsed since the publication of the first edition. An old controversy in the chemistry of organic nitrogen centred around the question as to whether nitrogen could exert five valencies. The electronic theory of valency has since provided an answer to this question, leading to the formulation of nitro- and azoxy-compounds, the nitrile and amine oxides, and compounds of the type NR_5 as derivatives of quadri-covalent nitrogen.

In the introduction, Prof. Sidgwick stresses his belief that the conception of resonance is the most important development which structural chemistry has had since its extension to three dimensions by

van't Hoff. Use has been made of this idea throughout the book to explain the remarkable stability of certain compounds (for example, aromatic compounds), the notable modifications often exerted by one group on the properties of another (for example, the amino- on the carbonyl group and vice versa in an amide), and generally the absence of isomers to be expected from the older structural formulæ.

As in the original book, questions of structure are treated very fully, and physical as well as chemical methods of determining configuration are discussed. Here the new edition contains much fresh matter, owing to the development of physical methods. Among these may be mentioned the use of (a) Raman spectra, for example, to prove the presence of traces of HN:C in HC:N , and to elucidate the structure of the *isocyanides*, the cyanogen halides and the thiocyanate ion; (b) the electron diffraction method, to prove that diazomethane has an open-chain structure; (c) X-ray

analysis, to show that the azide ion is linear; (d) dipole moments, to distinguish between *syn*- and *anti-N*-ethers of oximes, to fix the structure of azobenzene as *trans*- and to confirm the structure of the *isocyanides*; (e) heats of formation of links from atoms, to prove the structure of the cyanogen halides.

The book should be of great value to students: for whereas, under the present system of short intensive courses, it would scarcely be possible for a science degree student to master the whole contents, yet the greater part of it may be said to be useful examination knowledge; whilst to read the whole book cannot but be interesting and stimulating, since it shows how problems are attacked, and indicates, to some extent, further subjects requiring elucidation. To more senior people, no longer students in the technical sense, the new volume will be welcome as an old and valued friend, after long absence returned with added charm and strength. E. H. I.

Coronation Ceremonial

A History of the English Coronation

By Prof. P. E. Schramm. Translated by Leopold G. Wickham Legg. Pp. xv+283. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 12s. 6d. net.

NOW that the coronation of His Majesty King George VI is a thing of the past, it is possible to take stock of the more immediate results which have emerged. Among these not the least impressive is the manner in which it has been emphasized on all sides, as never before, that this ceremonial has a living meaning for the peoples of the British Empire. It has been, in fact, from first to last, and not merely on one day and within the Abbey walls, a solemn act of mutual dedication between king and people. In this unprecedented appreciation of the solemnity of the occasion, science has played no small part by the application of its resources to meet the needs of the occasion, especially in methods of record and transmission of news, and more particularly by the manner in which the general public has been enabled to participate in the varied ceremonial and pageantry through the development of wireless telephony and the cinematograph.

This expansion beyond the immediate scene of action in essence breaks no new ground. It follows tradition in incorporating the coronation rite in the life of the people. This has been brought out

by the more serious attempts which have been made to trace the history of the observances marking the inauguration of a king in British history. Among these, Dr. Schramm's account takes its stand in the first rank, if only for its appreciation of distinctive features in a peculiar product of English methods in practical affairs.

In the matter of the English coronation, indeed, Dr. Schramm is something of an enthusiast. His book conveys the impression that not only is it pivotal in the English constitution, but also that its history is a mirror of the relations of king, church and people in domestic affairs, just as, at least in the early stages, it was made a determinant of the status of the English monarch in Continental contacts and policies. In form, Dr. Schramm holds it to be completely an expression of the English character, while in a sense it is its supreme political achievement. His study of the English royal inaugural rite falls into two sections, of which the first is a comparative history of the practices of northern Europe from the time of the earliest records, and the second contains three essays on the theory of the coronation, which deal respectively with the rite of anointing, the electoral element in the acclamation and recognition, and the contractual element in the coronation oath.

Dr. Schramm writes with an authority which is firmly based on a close study of the English coronation *ordines*. His profound knowledge of the medieval mentality towards questions of a

theologico-legal nature, such as for example investiture, adds weight to his judgment in matters of doubtful interpretation; and when, as on occasion, he differs from generally accepted opinion, his verdict cannot be lightly set aside. His analysis of the development of the rite in relation to the growth of constitutional theory out of current events in the successive periods of English history is both stimulating and suggestive.

The rite, as we know it from textual evidence, is traced by the author to St. Dunstan in the tenth century, its derivation being West Frankish; but the elements of the rite, it is admitted, were of a much more ancient origin. Dr. Schramm

makes the pregnant suggestion that early practice must be viewed in the light of the fact that, in the passing of possession, the Saxons made no distinction between 'public' and 'private'; while the enthronement of the heir is compared with the pagan custom of seating the one who carries on the succession on the burial mound of his predecessor as a clue to the resolution of the apparent opposition between inheritance and election. While Dr. Schamm points out that there is a magical background to the ceremonial throughout, he has barely touched on this aspect. This is the more to be regretted, as he has thereby weakened his treatment of the origins of the rite in what is otherwise an excellent study.

African Pleistocene Mammals

Wissenschaftliche Ergebnisse der Oldoway-Expedition 1913

Herausgegeben von Prof. Dr. H. Reck. Neue Folge, Heft 4. Pp. 142+8 plates. (Berlin: Dietrich Reimer, 1937.) 34 gold marks.

THE fossil remains of mammals found in the Middle Pleistocene freshwater deposits at Oldoway in Tanganyika Territory are interesting because they include several survivors from the Pliocene period, mingled with a typical modern African fauna. Primitive elephants, such as *Dinotherium* and *Mastodon*, and three-toed horses, which became extinct in Europe before the Pleistocene period, lived in east Africa until towards the end of this period, and were associated with numerous mammals which are only varieties of those still existing on the same continent. We therefore welcome another instalment of Dr. H. Reck's valuable volume on the collection of these fossil mammals which he made in 1913, and look forward to the early publication of a similar report on the second collection made in 1931 by Dr. Leakey's expedition, in which Dr. Reck also took part.

The new instalment of the German report begins with an exhaustive description of the remains of antelopes by Dr. Ernst Schwarz. For this work Dr. Schwarz found it necessary to study and compare the skeletons of the existing African antelopes more closely than they had been studied and compared before; and his observations suggest some changes in the generally accepted classification, which he discusses and tabulates. Among the fossils he recognizes only fourteen species, which are very few compared with the number of species now living round Oldoway. He also notes that some

of the fossils belong to species which at present exist only farther north in Africa. With rare exceptions the fossil forms must be regarded as merely varieties of the existing species, but they are sometimes of smaller size with less developed horns. A variety of the brindled gnu is so common that it seems to have lived on the spot in large herds, and a considerable proportion of the remains belong to young individuals.

In the next two chapters Dr. W. O. Dietrich describes some fragmentary remains of pigs and giraffes, among which two teeth and a metacarpal bone of *Sivatherium* are the most interesting. The teeth were at first referred by Schlosser to *Helladotherium*, but the later discoveries by the Leakey expedition suggest that the new determination is more likely to be correct.

In another chapter Dr. A. T. Hopwood describes the remains of horses, among which the distal half of the associated three metatarsals belongs to a three-toed form like *Hipparion*. The teeth, which probably represent the same species, seem to be referable to *Stylohipparion*; this occurs fossil in the Orange Free State. With these fragments have also been found teeth and bones of ordinary one-toed horses, among which the well-preserved lower jaw of an apparently new species of zebra is noteworthy.

In a concluding chapter Dr. Reck himself describes the frontlet with horn-cores of a remarkable antelope, which seems to belong to a new extinct genus. He is to be congratulated on having thus completed the task of making known the Oldoway fossil mammals which he and his colleagues began more than twenty years ago. There now remains only the geological report, which will complete the work. A. S. W.

Annual Reports on the Progress of Chemistry for 1936 Vol. 33. Pp. 512. (London: Chemical Society, 1937.) 10s. 6d.

THE annual reports on the progress of chemistry, published by the Chemical Society, have for long tended to become collections of monographs on selected phases of the process whereby the science is advancing along the parallel paths of experiment and theory. In this way both professional chemists and other readers interested in the progress of the natural sciences can best be presented with an outline sketch of what is in reality a rapidly expanding and frequently changing picture.

The subject-matter is broadly divided into radio-activity and sub-atomic phenomena, general and physical chemistry, inorganic chemistry, crystallography, organic chemistry, biochemistry and analytical chemistry. The method of treatment may be exemplified by quoting the titles of the sections of organic chemistry, as follows: stereochemistry; carbohydrates; natural resins; aromatic compounds; dehydrogenation in the determination of structure; synthesis of polycyclic hydroaromatic compounds; natural products of the sterol group; heterocyclic compounds; alkaloids; vitamin B₁ and thiochrome. Under "Chemical Kinetics", the quantal theory of chemical change, the object of which is to predict the absolute magnitude of the velocity of chemical reactions of all kinetic orders in homogeneous and heterogeneous systems, is discussed. The chapter on atomic weights refers to the importance of establishing an invariable standard for chemical work, a requirement which has arisen from the discovery that oxygen in air is heavier than oxygen combined in water. A summary of recent work on fluorine and its compounds and on the rare earths is given; it is interesting to be reminded that the rare earths as a whole are not particularly rare, being as plentiful in Nature as lead, zinc or cobalt.

Reference is made to a new modification of insulin therapy involving the use of protamine insulinate, and considerable space is devoted to the phenomena of photosynthesis in plants, whilst the new magneto-optic method of chemical analysis is briefly criticized. Since in every case the authors are investigators of acknowledged authority, the volumes of this series are of permanent value as well as of immediate interest.

A. A. E.

An Outline of Malayan Agriculture

Compiled by D. H. Grist. (Malayan Planting Manual, No. 2.) Pp. xiii+388+86 plates. (Kuala Lumpur: Department of Agriculture, 1936.) 3 dollars.

THIS handbook, which has been prepared by the Agricultural Department in Malaya, is an enlarged and completely revised edition of one published some years ago. It supplies information on all aspects of Malayan agriculture.

The first chapters are devoted to a general discussion on agricultural conditions (including land tenure) and agricultural practice throughout the Peninsula. Part 3 of the volume deals in detail with the major crops, which are rubber, coco-nuts, rice,

oil-palms and pineapples. Parts 4 and 5 are devoted to the numerous secondary and minor crops of that region, including the large groups represented by fruits, vegetables and spices. Although some of the crops or plants dealt with, such as the durian mangosteen and rambutan are typically Malayan or East Indian, most of the others are cultivated generally throughout the tropics. The book should therefore be of interest or value to agriculturalists in other parts of the tropics besides Malaya. In the section on livestock, cattle, pigs, poultry and freshwater fish are dealt with, and in the appendix there are lists of import and export duties, Malayan weights and measures and a full bibliography. A large number of photographs are used to illustrate the text.

The authentic nature of the information and the amount of detail contained in this handbook, combined with the care and thoroughness with which it has obviously been prepared, should place it in the front rank of works on tropical agriculture.

Higher School Revision Mathematics

By L. Crosland. Pp. viii+164+xviii. (London: Macmillan and Co., Ltd., 1937.) 3s. 6d.

THE usefulness of the author's "Revision Mathematics" for the First School Certificate Examination has led to a request from teachers for a similar book dealing with the pure mathematics required by the non-specialist for the Second or Higher Certificate Examination. The present volume has therefore been compiled to supply this demand.

The book provides a large number of exercises arranged in four main groups: algebra, trigonometry, geometry and calculus. Each section is introduced by some fully worked-out questions which are well chosen to illustrate the main points essential for adequate revision. The graphical illustrations are especially clear, and should lead pupils to see that, what they sometimes consider to be rather a dull part of the subject, is really very interesting and stimulating. The section on integration, too, deserves special mention for its clarity and completeness. It should certainly help to pilot the pupil through the great sea of the calculus.

The concluding section consists of a very useful set of typical examination papers illustrating the standard required by the various examining authorities.

The book is excellently adapted to its purpose, and may be confidently recommended. We notice a few errors which will no doubt be corrected in a future issue.

Quantity Surveying for Builders:

a Text-Book for Surveyors, Civil Engineers, Builders and Contractors. By Wilfrid L. Evershed. (Directly-Useful Technical Series.) Fourth edition, revised. Pp. xix+282+12 plates. (London: Chapman and Hall, Ltd., 1936.) 10s. 6d. net.

THE fact that this work has necessitated four editions in fourteen years shows that it is fulfilling a definite need. Designed to illustrate methods commonly used in the best London practice, and clearly illustrated and set out, it can be recommended with confidence not only to students of quantity surveying, but also to the practitioner.

The Synthesis of Large Molecules*

By Prof. H. Mark, University of Vienna

NORMAL molecules with which the organic chemist has been concerned for many years, and which have led to an enormous number of interesting and important chemical combinations with valuable properties, have molecular weights between 50 and 2,000. Only a very few of them are smaller and few are larger, but even then they do not exceed these limits by a considerable amount.

For some time, it has been known that certain types of chemical reactions lead to products which do not crystallize and to which therefore was attributed the name of 'resins' or 'resin-like' substances. To identify and reproduce them was very difficult; hence for a long time it was considered that they could not be taken as objects for scientific investigation. But these substances offered mechanical, thermal and electrical qualities which made them very important from the technical point of view, and interest in their structure and synthesis began to develop.

On the other hand, the study of such natural products as cellulose, proteins, rubber, starch, silk, chitin, etc., led to the conclusion that their structural principles were the same as those of the synthetic resins; and the interest in this group of bodies was intense in view of their biochemical and technical qualities. Therefore a number of scientific workers began to investigate large molecules with enthusiasm; and our knowledge of them has rapidly increased.

It was found that two types of large molecules exist, one with chain-like molecules, another with large molecules which have the structure of a two- or three-dimensional network. In both cases, the number of atoms which are held together by normal chemical main valencies is very large—between 10^3 and 10^5 —and hence their molecular weight lies between 10^4 and 10^6 ($O = 16$). Several other qualities of these large molecules have been studied and cleared up; for example, their shape, reactivity, mechanical and optical behaviour, etc.

After our knowledge on the outstanding qualities of these bodies had reached a certain point, interest was aroused in that type of chemical reaction by which such macro-molecules are built up, and it is proposed to give a very short survey of the present state of evidence of this kind of chemical reactions, the so-called *polymerization* and *polycondensation* reactions.

* Friday evening discourse delivered at the Royal Institution on April 23.

THE POLYMERIZATION REACTION

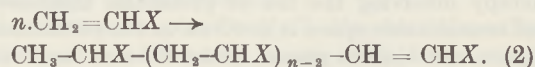
Small organic molecules with one or more double bonds have the peculiarity of polymerizing under certain conditions of temperature, pressure, etc. This polymerization leads mostly to macromolecular substances, which are therefore also often called *high polymers* or *high polymeric* substances. Let us consider the most simple chemical molecule with a double bond, namely, ethylene and its derivatives.

In this case the total polymerization reaction (of an ethylene derivative) is given by the relation



In this equation, X signifies the substituent ($\text{H}, \text{CH}_3, \text{Cl}, \text{C}_6\text{H}_5, \text{OH}$, etc.), n is a number of the order of magnitude between 10^3 and 10^4 . The left side of the equation (1) represents a great number of *independent small* molecules, each of which is completely known regarding its structure and contains a double C-C linkage. The right side gives a large molecule, the structure of which is not quite clear in all its details, which contains all the atoms contributed by the n molecules linked together by main valence bonds.

Frequently the macro-molecules built up from ethylene monomers are *chains*, and in such cases one may write equation (1) in more detail thus:



In this case, a certain assumption is made as to the internal structure of the chain-like macro-molecule, an assumption which is justified in some cases by considerable experimental evidence. Many chain polymerization processes were carried out with substances of this kind and formulated by relations of type (2), and it may be pointed out that Staudinger in Germany and Carothers in the United States especially have worked systematically in preparing macro-molecules by the aid of such processes.

Besides the material which is built up hereby, and which at first absorbed the whole attention of investigators, the *mechanism of the process* by which such long chains are formed is also of great interest and hence should be studied systematically. We have therefore in Vienna in the last five years carried out some series of experiments to elucidate

the different steps of typical polymerization reactions.

From the beginning, it is clear that the numerous independent particles on the left side of equation (1) cannot be linked together in *one single* collision process, which would have a vanishing probability, but that there must be a kind of growth, which builds up the long chain. This *growth process* is the aim of our studies; it seems to be not only of scientific interest in connexion with the physical-chemical problem of reactivity, but also of technical and biochemical importance. The technical significance may be confirmed by the fact that a great number of synthetic high polymers are of considerable interest, such as artificial rubber, insulators, varnishes, etc., while the biochemical importance is indicated by the observation that our own bodies and the skeletal substances of all plants and animals are built up of high polymeric substances and that therefore the growth processes of organized Nature may be connected with the reactions studied. In any event, a profound knowledge of the simplest polymerization reactions will be indispensable for the understanding of natural growth. We thought, therefore, that it might be worth while to devote some work to a thorough investigation of the kinetics of polymerization.

The general situation was not unfavourable: the kinetics of normal chemical reactions even of a rather complicated type was cleared up recently to a considerable extent by such scientific workers as Abel, Bodenstein, Bonhoeffer, Hinshelwood, Polanyi, Rideal, Semenov, H. S. Taylor and others. The experimental procedure is not too complicated and the methods of following gradually the rate of the process are more or less worked out. Besides our own studies (carried out in the Chemical Institute of the University in Vienna by Breitenbach, Dostal, Jorde, Marecek, Pilch, Raff, Rudorfer and Süss) in the last four or five years, authors such as Bawn, Chalmers, Flory, Melville, Norrish, Rideal, Schulz, Taylor, Vernon and others have contributed valuable results, and one can summarize the present state of our knowledge in the following way.

(1) The whole polymerization process is very *complicated*, even when only chains are built up, and depends to a high degree on such experimental conditions as temperature, pressure, solvent, presence of catalytically active bodies, etc. But in the simpler cases—and only these have been studied carefully up to date—one can always distinguish three typical steps in a reaction of this kind.

(a) *The building of germs or nuclei.* No polymerization can take place if there is not an *initiation process*, by which unsaturated and highly

reactive 'germs' are formed. This process can be monomolecular, bimolecular or of another order, and furnishes the *centres* of growth. It consists in the fact that in a certain molecule a very high amount of activation energy or unsaturation is concentrated either by impact with another particle of high energy, or by absorption of a photon or by the formation of an intermediate combination. In any event, this *germ-building reaction* is rather slow and very dependent on the temperature or on the presence of a catalyst (including light).

This first step has been called the 'starting' process, and we can formulate a thermal bimolecular starting reaction, for example,



where the nucleus on the right side has two free chemical main valencies and therefore represents a very high free energy. Consistent observations by different workers led to the conclusion that the *activation energy* of the starting reaction in the case of polymerization of ethylene derivatives lies between 20,000 and 30,000 cal. per mol. The reaction is therefore slow and the germs are produced with a limited velocity.

(b) *The reaction of growth.* If an unsaturated germ is formed in the solution, there are two possibilities for its further fate. It may collide with another molecule (monomeric substance or solvent) and be *desactivated* by the impact. In this case, the nucleus just produced is annihilated again and no polymerization is started. But the germ may also *react* with the colliding particle and, if it is a monomeric molecule, may add it according to the relation:



This is a '*growth step*' and processes of this type lead to the result required, namely, to long chains, supposing that they follow one another very quickly. Really high polymeric bodies can only be formed when a slow germ production is followed by a quick growth reaction.

In fact the rate of reaction (b) is very much higher than that of (a). Measurement shows that (b) goes at least 10⁴-fold quicker than (a); every nucleus is built, begins at once to grow, and rapidly gives a chain of considerable length. This high velocity is easily understood: the free valencies at the end of the germ and of all intermediate members of the growing chain represent a high energy, and therefore the activation energy of the addition reaction (b) is rather low, lying between 4,000 and 8,000 cal. per mol., and explains the rapid growth, which is nearly independent of

temperature. Very interesting results concerned with the steric factor of growth would lead us much too far and cannot be considered here.

If the growing chains meet no obstacle during their period of adding monomolecular material, they will grow so long as molecules of the polymerizing substance are available, and the result of the whole process will depend only on the velocity of *germ formation*, k_1 , and of *growth rate*, k_2 . The competition of these two influences was discussed quantitatively by Dostal and Mark, and formulæ have been derived and compared with the experimental results. It seems that only in very special cases one can reduce the whole complicated polymerization process to these two steps alone; mostly it is necessary to take into account a third elementary effect, which interferes with these two steps, namely, the *breaking-off* of the growth.

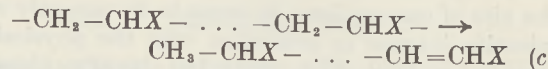
(c) *Breaking-off processes and sudden finishing of growth.* Our general knowledge of addition reactions between molecules shows that with increasing size of the reacting particles the probability for a successful collision, that is, the addition of a new member in the chain, decreases very rapidly with increased size of the molecules, even if the activation energy remains quite constant. Investigations of Evans, Eyring, Hellmann, Polanyi, Syrkin and Wassermann show that the reactivity falls off very quickly even with medium molecular weight (200-400). It is therefore to be expected that the rate of growth would be very much dependent on the actual chain length, an influence which was introduced into the formulæ by Dostal and Mark, with the consequence that the growth-rate of an individual chain falls off slowly. Comparison with experiment showed that under certain conditions the polymerization of styrene seems to be remarkably influenced by this peculiar effect.

On the other hand, one must be aware of the fact that a *third type of reaction* finishes the growth of the chains by annihilating the active groups at their ends. Thus we have to introduce a third reaction constant, k_3 , which summarizes all possibilities for the saturation of the reactive spots. They are rather numerous, and it is therefore difficult to get a clear idea of the chain-breaking process.

(1) When the chains are flexible, it may happen that the two free valencies on their ends react with one another producing a ring molecule of many members. Such molecules are known from the work of Müller, Ruzicka and others, and even the kinetics of their formation was cleared up to a certain degree by Freundlich and Salomon. We do not yet know exactly how much this factor influences a given polymerization reaction, because we have no effective means of finding out how

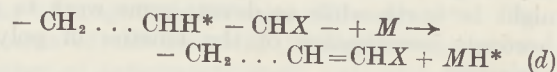
many ring molecules are present in the product of a particular polymerization reaction. In this connexion, new experimental evidence is wanted such a breaking-off reaction would be monomolecular.

(2) A growing system can lose its active ends if a hydrogen atom wanders along the chain and if a double bond is formed at one end:



The probability of such *isomerization* will be inversely proportional to the actual length of the chain, and a breaking-off reaction of this type will be of the first order, short chains being in greater danger of undergoing this isomerization than longer ones. Actually, in the case of short chains ($n=2$ or 3), the final products of this reaction could be isolated in one or two cases, but it is not yet clear what role this type of chain-cutting plays in the whole process.

(3) The annihilation of a single active group at one end of the growing thread-like molecule can also be accomplished during a collision according to the equation



Here the hydrogen atom H^* jumps under the influence of the collision with M from the penultimate carbon atom to the colliding particle M , and a double bond is formed. Several types of this reaction have been discussed by Dostal, Flory, Mark and Schulz. The probability of such a process is proportional to the concentration of the unsaturated ends and to the concentration of M . The latter partner may be any molecule able to take up a hydrogen atom present in the reacting system, for example, a normal monomeric particle, another growing chain, a solvent molecule or any impurity of the solution. Even the wall of the vessel could produce the change expressed by the relation (d). Therefore it is not easy in a given case to say precisely what will happen.

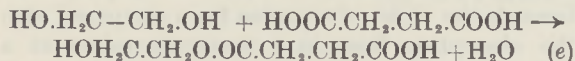
An important and interesting question is: What happens to the energy which is set free by the process (d)? As a new C-C bond is formed, we may estimate the energy excess of (d) to be about 70,000 cal. per mol. It may remain in the chain and increase its internal vibrations and rotations; perhaps with the effect that after a certain average life-time the second end of the chain is also stabilized by a similar action. But the energy may also be transferred to M and create a highly active particle. If M is a monomeric molecule, it can be transmuted into a new germ, so that one chain is ended by (d) but another is started. There are signs that something like that happens under

certain experimental conditions. If M is a solvent molecule, the energy may be dissipated by consecutive collisions, but it may also be attached to one monomeric particle in the course of reproduction of a germ with the aid of the solvent. In recent papers of Dostal, Flory, Mark, Schulz and others, these various possibilities are discussed and brought into relation with the experimental facts.

The result is that at present no polymerization process can yet be resolved quite clearly into all its elementary steps, but there is no doubt that the three above-mentioned processes, namely, chain start, chain growth, and chain ending always take the outstanding role during a polymerization reaction. Increasing experimental material will enable us to separate more and more neatly the different possible steps and to work out something like a fine structure of polymerization reactions.

POLYCONDENSATION REACTIONS

This is the second type of reaction by which high polymers can be produced. Here also we will confine ourselves to reactions which lead to pure chain polymers. In a condensation reaction a new molecule is built by removal of a part of the reactant particles; this part is usually water. If a dibasic acid, for example, succinic acid, reacts with glycol one gets:



This esterification leads to a molecule which can again react with an alcohol or with an acid, producing further reactive molecules and growing thus *slowly* to a long chain with alternate alcohol and acid members.

Reactions like this have been investigated recently by Dostal, Flory, Marecek, Raff and others. They are much easier to deal with because the intermediate products are not unsaturated but of the same type as the monomeric substance. It is therefore not a chain reaction, which we have before us, but a *stepwise esterification* for which kinetic formulæ can be derived without serious difficulties. The problem of the mutual interaction of three different elementary processes as it has to be solved in the case of polymerization is here reduced to the mathematical study of a step reaction with many steps. The production of 'germs' is here of the same order of magnitude as the velocity of growth, and therefore the chains which are formed are much shorter than in the case of polymerization. Therefore a fairly good agreement was obtained by comparing the results of experiments with the above-mentioned formulæ, and the problem of polycondensation reactions does not offer serious difficulties to a quantitative understanding.

This is a reason why the efforts of workers are being more and more concentrated on the study of polymerization processes, which still offer a great number of unsolved and interesting problems.

The Solar Eclipse of June 19, 1936

AN old practice was revived on May 27, when a joint meeting of the Royal Society and the Royal Astronomical Society was held to receive reports on the expeditions organized by the Joint Permanent Eclipse Committee of the two societies for the total solar eclipse of June 19, 1936. It was sad to observe that on this occasion the tradition by which the president of the Royal Astronomical Society sat facing the audience alongside the president of the Royal Society was allowed to lapse.

Prof. F. J. M. Stratton opened the discussion with an account of the expedition to Kamishari in Hokkaido, staffed from the Solar Physics Observatory, Cambridge, with the addition of Dr. T. Royds, of the Kodaikanal Observatory, sent by the Government of India. He mentioned that the site was chosen after consultation with the Meteorological Office and consideration of the data supplied by the National Research Council of

Japan. Unfortunately, the prevailing wind which should have given the desired weather for the eclipse chose the wrong week to prevail, and the day of the eclipse was cloudy. The second half of the partial phase was happily clear, and Dr. Royds was enabled to carry through most of his programme successfully; second contact was observed through gathering clouds which spoilt by scattering light the programme of observing intensities of chromospheric spectral lines at different heights above the sun's limb, though flash spectra were obtained; within five seconds of the commencement of totality the sun was completely covered by cloud too thick even for the infra-red cameras to penetrate; the sun did not emerge into a clear sky until 10 minutes after the end of totality.

It was unfortunate that the half of the eclipsed sun which was in clear sky for second contact and for the first few seconds of totality was on the

opposite limb to that of second contact, and valuable observations were lost by a margin of seconds only in the race of moon and clouds to cover the sun. Prof. Stratton devoted his remarks to the part of the programme which was lost due to the clouds—the polarization of the coronal light to be observed by Dr. C. W. Allen with a double camera and a Nicol prism in front of one lens, and the direction of polarization of skylight in the neighbourhood of the eclipsed sun, to be observed photographically by himself and visually by Dr. F. W. Aston with a set of Nicol prisms and Savart plates. Prof. Stratton paid a tribute to the generous help and assistance received from the Japanese authorities and scientific colleagues, and mentioned that, of the three neighbouring Japanese expeditions, all of whom had a clear sky for the eclipse, one was led by Prof. Matsukuma, of Sendai University, who had stood down from his original plan to go to Kamishari to make room for the English party.

Dr. Royds next gave an account of his measures of the displacement of the Fraunhofer lines at the centre and limb of the sun's disk with and without an eclipse. His values were as follows:

Intensity of lines	Mean displacement to red			
	Without eclipse		During eclipse	
	Centre	Limb	Centre	Limb
	A.	A.	A.	A.
11.0	0.0100	0.0122	0.0078	0.0126
5.2	0.0084	0.0148	0.0088	0.0151
3.0	0.0050	0.0122	0.0058	0.0116

It was clear from Dr. Royds' eclipse observations that the values obtained from the limb without eclipse had not been seriously affected by light scattered from the bright centre of the disk, which would especially affect the weak lines. Observations had been made at distances from the centre of the sun's disk of 0, 0.28, 0.57, 0.76, 0.90, 0.95, 0.97 times the sun's radius: the observation at 0.992 and the hoped-for observation of chromospheric lines were lost owing to clouds. The explanation in terms of convection currents for lines of different intensities originating at different levels in the sun, which had been offered for the discrepancies at the centre of the sun, could not hold for the limb, and the divergencies from the predicted Einstein displacements had yet to be explained.

Dr. R. O. Redman discussed the advantages from spectrophotometry of the chromosphere of a jumping slit spectrograph (taking a series of exposures with a fixed plate) over a continuously moving slitless spectrograph: there was less trouble from scattered light, higher resolution, greater purity of spectrum, and no trouble such as arises from the varying width of the steadily narrowing crescent photographed with the slitless

instrument. He described the moving back camera specially designed by Mr. C. R. Davidson and himself for the eclipse, the instrumental set up, and the programme of exposures at intervals of one second carried out at the eclipse through second contact. As defined by the final disappearance of the Fraunhofer spectrum, totality commenced 1 second late on the computed time.

Dr. A. D. Thackeray gave an account of the flash spectra secured by Dr. Redman with the moving plate camera and by himself with the Hills quartz spectrograph fed by light from an aluminized mirror. While in both cases the original plan of observing the changes of intensity of spectral lines with solar heights had to be abandoned because of light scattering by the clouds, yet much of value could be learned from the plates. In particular, Dr. Redman's spectra included one of the finest for the study of the transition from absorption to emission spectra that had ever been secured. He directed attention to the following points of special interest: (a) the presence of a bright line at 3969.40 Å. between $H\epsilon$ and [H] never previously recorded in flash spectra and evidence of the excellent definition secured by Dr. Redman; (b) the presence in absorption of the subordinate series $3^2P^0 - n^2S$ of Na at a stage where the D lines had practically vanished in transition from absorption to emission; (c) the displacement towards the violet of emission lines compared with the absorption lines in a spectrum taken at a distance 0.9994 r from the centre of the sun's disk; (d) the gradient of the Balmer series in emission from $H\beta$ to $H26$, with a value of lower weight for the total emission of $H\alpha$: the gradient showed manifest departure from the values given by the Schrödinger-Pauli formula, as had been found by Davidson and Stratton in the 1926 eclipse.

Prof. J. A. Carroll described the equipment of the expedition from Aberdeen to Omsk: the objective interferometer prepared for a monochromatic image of the whole corona crossed by interference rings which should show by their displacements internal movements in the corona; a high-dispersion echelon spectroscope with 35 plates immersed in fluid and giving an effective thickness to each plate of 1 mm. in air; and a spectrograph for the extreme infra-red spectra of the corona and chromosphere. He then dealt in detail with the method of reducing the daily range of temperature of 12°C. to the range that could be allowed without loss of definition for the instruments, 0.1° for lenses and prisms, 0.01° for the interferometer and 0.001° for the echelon. Large thermal inertia in the optical parts and small and slow changes in the surround of each instrument were required. The hut was doubled-walled and

lagged inside; it was also equipped with heating and refrigerating plant controlled by thermostats and by fans for stirring the atmosphere. The instruments in their turn were surrounded by a further lagged cover with again a thermostatically controlled heating circuit inside. This first serious attempt at delicate temperature control under eclipse camp conditions had worked very successfully.

Mr. E. G. Williams spoke of the results obtained with the infra-red spectrograph. A composite plate had been used of special rapid panchromatic for 5800–6700 Å., Agfa 800 for the 8000 region and Agfa 950 for the region beyond 9000 Å. It had been intended to use Agfa 1050 for the region beyond 10,000 Å., but though the plates were specially flown over from Berlin to Moscow they were no longer sensitive when the day of eclipse arrived and could not be used. They were, therefore, unable to secure the lines at 10,746.80 Å., 10,797.95 Å. recently reported by Iyot. They did get a line at 7591.3 Å. in the coronal spectrum for which Curtis and Babcock in 1928 gave the

wave-length 7896 Å. and Iyot more recently from the Pic du Midi gave 7891.9 Å. No trace was found of the line about 9609 Å. to be expected if the coronal spectrum came from a doubly excited helium atom. In the chromospheric spectrum lines of the Paschen series were obtained, for the first time at an eclipse, from P4 to P17, and other lines were identified as due to He, O, Mg and Ca⁺.

In the subsequent discussion Mr. J. Evershed, referring to Dr. Royds' excellent spectra, pointed out that to reduce his shifts from an arc in air to an arc *in vacuo* meant an increase of 0.003 Å. and meant that the displacement at the limb was twice the predicted Einstein value. Prof. A. Fowler, in sympathizing with the Cambridge party on their failure, said that it was a magnificent failure. He was very much impressed by the mechanism of Dr. Redman's camera and with the very interesting and beautiful results he had obtained. He would also like to congratulate Mr. Williams on his infra-red spectra.

Obituary Notices

Prof. A. G. Perkin, F.R.S.

PROF. A. G. PERKIN died at his Leeds residence on May 30. Born at Sudbury, Middlesex, in December 1861, he was the second son of the late Sir William Perkin, brother of the late W. H. Perkin, jun., Waynflete professor of chemistry in the University of Oxford, and half-brother of the late Dr. F. M. Perkin, who was well known as a consulting chemist.

A. G. Perkin grew up in an atmosphere of chemistry and zeal for scientific investigation. His education was varied: he followed in his father's footsteps by attending the City of London School, and from 1877 until 1879 studied under Frankland and Guthrie at the Royal College of Chemistry, South Kensington, where he carried out the investigation leading to his first paper, "The Action of Nitric Acid on Di-*p*-tolylguanidine", communicated to the Chemical Society in 1880. He next spent a year at Anderson's College, Glasgow, under E. J. Mills, and finally a year in the Dyeing Department, Yorkshire College, Leeds, where he worked with J. J. Hummel on new compounds derived from the colouring matters of brazilwood and logwood. Perkin always paid generous tribute to the abilities and personality of Prof. Hummel, to whom he owed his first, and lasting, enthusiasm for the study of the natural colouring matters.

In 1882 Perkin left the Yorkshire College to take up an appointment as chemist at the alizarin factory of Hardman and Holden, Ltd., Manchester, and was

promoted to the position of manager in 1888. During this commercial period he continued scientific investigations and published papers on the action of nitric acid on anthracene, and in collaboration with W. H. Perkin, jun., on derivatives of anthraquinone, and on the colouring matter of the Indian dyestuff, kamala.

Perkin resigned his position with Hardman and Holden, Ltd., in 1892 to join the staff of the Dyeing Department, Yorkshire College, as lecturer and research chemist. Then followed a period of more than twenty years of intensive research, mainly concerned with the isolation of the colouring principles of natural products and the investigation of their constitutions. The profound knowledge of natural colouring matters that he gained by his brilliant researches established his international reputation in this field. He examined numerous natural colouring matters by degradative methods, and in certain instances deduced their constitutions, many of which, for example, those of catechin, luteolin, gossypetin, quercetagenin, etc., have since been confirmed synthetically by other workers.

In later years, Perkin devoted more of his time to the chemistry of anthraquinone derivatives. A study of the migration of the acyl group in partially acylated phenolic compounds led to the synthesis of, *inter alia*, some hydroxyanthraquinone methyl ethers, originally isolated from the Indian natural dyestuff, chay root, but not hitherto obtained synthetically. The constitutions of numerous hydroxyanthranols were

established by conversion into corresponding benzanthrones and examination of the methylation products of the latter. The formation of hydroxy-anthracenes, -dianthrones, -dianthraquinones, -dianthraquinonyls and -helianthrones also was investigated and the constitutions of these compounds established.

Perkin's original papers, including those published in the *Proceedings of the Chemical Society*, all of which did not appear afterwards more comprehensively in the *Transactions*, exceeded 270. He was also author of numerous articles on natural colouring matters in "Thorpe's Dictionary of Applied Chemistry", and, in collaboration with Dr. A. E. Everest, he published the classical monograph "The Natural Organic Colouring Matters" in 1918.

Perkin was elected a fellow of the Institute of Chemistry in 1887, a fellow of the Royal Society of Edinburgh in 1893, a fellow of the Royal Society in 1903, and was awarded the Davy Medal of the Royal Society in 1924. He was also a vice-president of the Society of Dyers and Colourists, and a member of the Biochemical Society, the Chemical Society, the Pharmaceutical Society, Society of Chemical Industry, the Textile Institute, and the Livery of the Worshipful Company of Leathersellers.

In 1916, Perkin succeeded A. G. Green as professor of colour chemistry and dyeing in the University of Leeds. During the Great War he carried out investigations for the Ministry of Munitions, and also directed the work on intermediates and synthetic dyes carried out by the colony of research chemists of British Dyes Ltd. in his Department.

During his professorship, Perkin did much to widen the fundamental education of his undergraduates and to enhance the reputation of his Department as a scientific training ground for recruits for the dyestuffs, dyeing and allied industries. The very large number of students who entered for courses in colour chemistry and dyeing in the immediate post-War years were attracted at least as much by the opportunity of working under him as by the popular appeal of these subjects at that time. His students were very successful in securing appointments on completion of their courses and most of them now occupy important positions in industry.

Perkin exerted a profound, but unobtrusive, influence on his colleagues and students. He was a very gentle man with a most charming and lovable personality. He did most of his work with his own hands, and it was a privilege to observe him at work in his laboratory. He was not only a great chemist in his generation, but also he was so imbued with a passionate zeal for unravelling the secrets of Nature that all who came in contact with him were inspired by his pioneering spirit.

On his retirement in 1926, Perkin was accorded the title of emeritus professor, and in 1927 the University of Leeds conferred upon him the degree of D.Sc., *honoris causa*. In fact, he never retired, for he continued to prosecute his researches without any interruption in the professor's laboratory in the Colour Chemistry and Dyeing Department of the University of Leeds until his health began to

fail in February this year. At that time he was endeavouring to determine the constitution of a green vat dye which he had obtained some years previously by heating the hydroxylated anthranol, derived from alizarin, with tetrachlorothiophen and an alkylating agent.

Perkin was well known in the Isle of Man, for many years spending all vacations at his house at Port Erin, and he was a governor of King William College. He was very fond of animals and took the greatest interest in his dogs, his pony and his tortoise. He also inherited a great love of music, and was an accomplished performer on the flute and bassoon. He was a leading member of amateur orchestras in Yorkshire. He married Annie, daughter of the late J. E. Bedford, of Leeds, who survives him. There were no children.

E. J. CROSS
F. M. ROWE.

Prof. S. H. Langdon, F.B.A.

THE study of Assyriology must nowadays be held to embrace, in principle, the whole of the archaeology, history, culture and languages of ancient western Asia. In this immense field the labourers are still few, and no country can at present boast more than a handful of them. The loss of any one is therefore serious, since replacement, much less reinforcement, is problematical. That loss is the more sensible when so active a worker as Prof. S. H. Langdon, professor of Assyriology in the University of Oxford, is withdrawn by death, on May 19, at the early age of sixty-one years.

Since the boundaries of the study have been so vastly extended by recent discovery, it has become inevitable in Assyriology, as in other sciences, that a man should specialize. Langdon's chosen branch was Sumerian, the primitive language of Babylonia, virtually extinct by the end of the third millennium B.C., but of paramount importance as belonging to a people who have been revealed, time and again, as the originators of most of the vital elements in the whole pre-Hellenic culture of western Asia. At the time when Langdon was beginning his career, knowledge of this language had scarcely passed the stage of entire dependence upon the translations furnished in bilingual texts by late Assyrian scribes, while the scepticism of Halévy still preoccupied the minds of many. Some of Langdon's early work, however, was devoted to the Sumerian religious texts without Semitic translation which have survived in large numbers, and because of their great difficulty of interpretation still remain to-day among the obscurest parts of the literature written in cuneiform.

This observation is, of course, in itself a criticism of Langdon's achievement, for throughout his working life it was upon these texts that his abundant energy was mainly concentrated; editions of the originals and translations make up a large part of his bibliography, whereas few of his contemporaries cared to venture upon so hazardous a ground. But it must be owned that, in the editions, his copies were not always of the most reliable, and that he failed to detect this

and other faults in his translations (though never unready to admit mistakes) chiefly because of a certain lack in comprehension of the practical sense of a phrase or of a text, and this allowed him too often to put forward merely verbal translations. It must be remembered, however, that some of the literature to which he devoted himself is jejune in content, and must necessarily look rather absurd in the baldness of translation. How carefully he had prepared himself for this work is shown by his "Sumerian Grammar" (1911), which, if it cannot be said to have marked a decisive advance, has the credit of being the first full-length treatment of the subject.

To the study of the Akkadian (Semitic) language, which is better known, Langdon's contributions were less copious. But he has to his credit at least one book which is still a standard work of reference, "Die neubabylonischen Königsinschriften" (1912) and, despite certain oddities, his "Babylonian Epic of Creation" (1923) contains much which subsequent translators have been glad to use. Besides one or two philological books of less importance he wrote in 1931 a general work on "Semitic Mythology" which, somewhat belying its name, drew very largely upon the Sumerian religious literature which he knew so well. But many will think that one of Langdon's

most remarkable achievements was that he, essentially a man of the study who had hitherto shown little interest in archæology, seized the opportunity after the Great War to excavate in Iraq, and with great enthusiasm proposed, organized, and even raised part of the money for, an expedition which made important discoveries at Kish. He himself spent two seasons on the site, much to the detriment of his health, and afterwards began two series of volumes devoted to the archæological and epigraphical results of the work. In his latest years he often spoke of a Sumerian dictionary which he had long been preparing, and he had announced a future edition of the Assyrian texts upon which his recent Schweich lectures were based.

WE regret to announce the following deaths :

Prof. A. Erman, formerly director of the Egyptian Section of the Berlin Museum, and professor of Egyptology in the University, on June 26, aged eighty-three years.

Dr. H. H. Jeffcott, secretary of the Institution of Civil Engineers, on June 29.

Prof. T. Mather, F.R.S., emeritus professor of electrical engineering in the City and Guilds (Engineering) College, Imperial College of Science and Technology, on June 23, aged eighty-one years.

News and Views

Queen Mary and the Bodleian Extension

QUEEN MARY was given a warm and affectionate welcome when, on June 25, in royal weather, she visited Oxford to lay the foundation-stone of the great Bodleian extension to be erected in Broad Street opposite the Clarendon Building. A special Convocation of members of the University was held in the Sheldonian Theatre to which the public were admitted without ticket, and which was so filled in every part that although no one was turned away, twenty more could not have been accommodated in comfort. There an address of thanks was presented to Queen Mary by the Chancellor, Lord Halifax, and the Vice-Chancellor, the Master of Balliol. They spoke of how proud Oxford is of its ancient, Bodleian library, and how urgent it is for the work now being done in all branches of teaching and research that it should be properly maintained and extended. The Queen then crossed Broad Street to a stand raised above the enormous hole in the ground which is at present the site. There was assembled another large party representative of Oxford life, academic and civic, and of those entrusted with the erection of the building, Sir Giles Gilbert Scott, the architect, was present. The Queen then laid the foundation-stone on which the following words have been inscribed :

AEDIFICII NOVI BODLEIANI
HVNC PRIMVM LAPIDEM
POSVIT MARIA REGINA
REGIS GEORGII VI MATER
DIE XXV MENS. IVN. A.D. MCMXXXVII

Prof. F. Wood Jones, F.R.S.

PROF. FREDERIC WOOD JONES, at present professor of anatomy in the University of Melbourne, has accepted an invitation to fill the chair of anatomy in the University of Manchester, in succession to Prof. J. S. B. Stopford, who has asked to be relieved of the duties of the chair, in view of the increasing responsibilities of his administrative work as vice-chancellor of the University. Prof. Wood Jones graduated in science in the University of London in 1903, and in medicine and surgery in 1904. In 1910 he was awarded the degree of D.Sc. in zoology of the University of London. He was elected to the Royal Society in 1925 and to the fellowship of the Royal College of Surgeons in 1930. Prof. Wood Jones has held professorial chairs in the London School of Medicine for Women (anatomy) and in the Universities of Adelaide (anatomy), and Hawaii (physical anthropology) in addition to the chair of anatomy at Melbourne, to which he was appointed in 1930. In 1932-33 he acted as temporary director of the Peiping Union Medical College. His experience in other fields includes the duties of a medical officer in the Far East, anthropologist to the Egyptian Government, and membership of the Archæological Survey of Nubia. On four occasions he has delivered the Arris and Gale Lectures of the Royal College of Surgeons. Among his numerous published works are "Coral and Atolls", "Arboreal Man", "The Mammals of South Australia" and "Man's Place among the Mammals".

Sir Morell Mackenzie (1837-1892)

SIR MORELL MACKENZIE, the eminent throat specialist of the Victorian era, was born at Leytonstone, Essex, on July 7, 1837. He came of a medical family, his father being a distinguished general practitioner, and his younger brother Stephen a prominent physician on the staff of the London Hospital. After qualifying in 1858, he went to Paris, where he attended the clinics of Trousseau, Nelaton, Ricord and others, and then to Vienna, where he studied under Oppolzer, Skoda, Rokitansky and Hebra, and finally to Budapest, where he made the acquaintance of Czermak, who was experimenting with the laryngoscope invented by Manuel Garcia. On his return to London, after holding the posts of resident medical officer and registrar at the London Hospital, he set up in practice in George Street, Hanover Square. In 1863 he gained the Jackson prize of the Royal College of Surgeons by an essay on the pathology and treatment of diseases of the larynx and in 1866 was appointed assistant physician to the London Hospital, becoming full physician in 1873. His chief publication was his work on "Diseases of the Throat and Nose", of which the first volume appeared in 1880 and the second in 1884, and at once became the standard book on the subject. He was also the author of "The Use of the Laryngoscope in Diseases of the Throat" (1865), "Diphtheria: Its Nature and Treatment" (1879) and "Hay Fever and Paroxysmal Sneezing", of which the fourth edition was published in 1887.

MACKENZIE'S eminence as a specialist won him many distinctions. He was elected an honorary member of the medical societies of Vienna, Budapest and Prague and one of the two foreign honorary fellows of the American Laryngological Association. In 1887 he was knighted, and in 1888 he received the Grand Cross and Star of the Royal Order of Hohenzollern for his attendance on the Emperor Frederick, the story of whose illness he relates in the book entitled "The Last Illness of Frederick the Noble", for which he incurred the censure of the Royal Colleges. Though a strong advocate for specialism in medicine, as he showed by two articles published in the *Fortnightly Review* in 1885, Mackenzie always maintained that a very complete medical training should be the basis of education for the specialist. Apart from his literary work, Mackenzie deserves to be remembered for his addition of a large number of instruments to the armamentarium of throat surgery and his skill as an operator in the removal of laryngeal growths. Like many other celebrated men, Mackenzie was the subject of asthma, from which he suffered for thirty years, and his death at the comparatively early age of fifty-five years took place on February 3, 1892.

Acculturation and Native Policy

IN commenting on the recent debate in the House of Lords on policy in native administration in the Empire (see NATURE, June 26, p. 1083) it was urged that the contribution of anthropological science

should not be overlooked when the possible effect of administrative action, and its bearing on future policy were under consideration. A concrete example of the results which may be expected to emerge from such scientific investigation of the effects of cultural impact on a relatively simple people is afforded in a study by Prof. I. Schapera of the BaKxatla, a Bantu-speaking people, who migrated from the western Transvaal to evade the Boers about 1840 and settled in what afterwards became the Bechuanaland Protectorate. Here their earlier contact with Western civilization was continued, at first through missionaries, and afterwards through traders and administrative officials. Prof. Schapera in this study ("Contribution of Western Civilization to Modern Kxatla Culture" *Trans. Roy. Soc. S. Africa*, 24, 3) analyses both the acceptances and the rejections by the BaKxatla of the elements of Western culture and their consequences with the somewhat remarkable result that he finds that, while some traditional elements of their own culture are retained and new elements from Western culture are incorporated with little change, an entirely novel cultural pattern is also growing up out of the contact. His paper must be consulted for details, but one instance may be mentioned. As a result of the introduction of Christianity, ancestor worship has virtually died out, but magic is retained. At the same time, the Christianity which is their official religion has come to be something very different from the doctrine as it was first introduced among them. Although it is not possible to generalize from one African tribe to another without testing the premises of the argument, it is clear that investigation on these lines has been shown to be essential before the risk is run of making any fundamental changes of principle or detail in policy.

School of Colonial Administration at Oxford

ANTHROPOLOGISTS will be afforded an opportunity of bringing these and kindred matters to the notice of administrative officers of the Colonial Services at the Oxford University Summer School of Colonial Administration, which will meet at St. Hugh's College, Oxford on July 3-17. The arrangements have been made in connexion with the Social Studies Research Committee of the University. The School is intended primarily for the benefit of members of the Colonial Administrative Services, more especially, though not exclusively, those serving in Africa. The problems of native administration in tropical Africa will be discussed in a series of lectures, in which they will be brought into relation on broad lines with world problems of economics and politics; while the experience of other countries in tropical administration in relation to such matters as local government, education, elementary and adult, the co-operative movement and the like will be demonstrated. Leading foreign experts will lecture on a number of other topics, and more especially on methods of native administration in territories under other than British rule. The School will be opened by the Right Hon. W. G. A. Ormsby-Gore on July 4, and on the same day an inaugural address will be delivered by Lord Lugard. Among those who have promised to take

part in the proceedings and discussions are Sir Alfred Zimmern, Sir Arthur Salter, Lord Lothian, the Warden of All Souls, and Sir Donald Cameron. A number of anthropologists have been invited to join in the discussions and talks, dealing with problems affecting administration in different regions and from different aspects. About one hundred and seventy officers on leave have intimated their intention of attending the School. Although not 'official', the School has had the cordial support and assistance of the Colonial Office.

An Astronomical Jubilee

LA SOCIÉTÉ ASTRONOMIQUE DE FRANCE, the creation of Camille Flammarion, who did so much to popularize astronomy in France, has recently celebrated its jubilee. The chief event in the festivities which were held to commemorate the occasion was a great reception on June 16 in the Great Theatre of the Sorbonne, at which nearly three thousand people were present; the President of the French Republic attended and the Minister of Education, M. Jean Zay, presided. M. Jules Baillaud, the present president of the Society, gave an account of the history of the Society and of the work done for it successively by Camille Flammarion and his widow. After a short address by the Minister of Education, Prof. C. Fabry gave a charming account of the progress or revolution in the astronomical outlook in the past fifty years, and some beautiful slides which had been taken by Mr. Ritchey and by M. de Kerolyr at Fourcalquier were shown by M. Baldet. A film was shown of Camille Flammarion's activities in connexion with the Society, and a recorded speech of his was repeated to the audience. A concert followed in which artists from the Opera assisted, while at an earlier stage artists from the Comédie-Française and elsewhere recited poems and read extracts from Camille Flammarion's works. A memorable evening, such as could scarcely have been held anywhere outside Paris, concluded with some ballets danced by pupils of the late Loïe Fuller.

THE celebrations were attended by astronomers from Belgium, Czechoslovakia, Denmark, Great Britain, Italy and the United States to add their greetings and congratulations to the Society, its president and its secretary, Madame Camille Flammarion. Opportunity was taken of the presence of many astronomers in Paris for a discussion on various aspects of the problem of interstellar matter in space, which is to be the subject of a conference in Paris on July 11-17 at the Institut Henri-Poincaré. Messrs. M. G. Darmois, J. Baillaud, Lacroute, F. Perrin, Chalonge, Barbier and Mineur gave an account of the present state of our knowledge on interstellar calcium, absorption in space, the structure of the galaxy, the nature and distribution of absorbing clouds and their effect on stellar spectra and colour indices.

Covent Garden Laboratory

FOR the last eleven years, contact has been maintained between the work of the Department of

Scientific and Industrial Research on the transport and storage of food and an important branch of industry through the Department's Covent Garden Laboratory in Endell Street, London. This Laboratory has provided an excellent place for keeping under survey the condition of produce passing through our markets generally and for diagnosing or tracing to their source the different types of wastage and deterioration in fruit and vegetables. Samples of fruits showing wastage or abnormal features are collected from the market or are brought to the Laboratory by salesmen. Often the trouble can be diagnosed at once, but sometimes it is desirable to get the diagnosis confirmed by the Low Temperature Research Station at Cambridge or the Ditton Laboratory. The Covent Garden Laboratory also receives for examination samples of consignments of fruits new or comparatively new to Great Britain, such as mangoes, mangosteens and papaws. The interest taken in this work has now made it necessary to leave Endell Street for larger premises, which were opened by Sir Frank Smith on June 28. These are situated on the top floor of Nos. 9-13 Kean Street.

THE new accommodation includes two chemical laboratories, a large 'ice box' for cooling fruit to -30° F. and three cold stores. One, maintained at 34° F., will be used for delaying ripening and for observations on apples; another at 45° F. for work on citrus fruits, and the third at 65° F. will be used as a conditioning room for initiating ripening. The two colder stores will also be used for studying the advantages of temporary cold storage for wholesalers or retailers, that is, storage of, say, mushrooms and melons for short periods. In the chemical laboratories estimations of the sugar and acid content of the fruit will be carried out. The sugar content of apples, of course, varies between individual specimens, and to get a representative sample the apples are frozen solid and then ground up into a fine powder. Another important measurement to be made is the rate of respiration of the fruit. This not only gives an indication of the age of the apple, but also is important in connexion with research which is being carried out on the mechanism by which sugar breaks down to carbon dioxide. The alcohol content of apples increases as they grow older, and this is also a subject of measurement, as it is hoped that this factor will prove an important diagnostic indication. Produce from the Empire overseas is inspected before being shipped in order that nothing may be exported which is not up to standard. Facilities will be available at the new Laboratory for officers of the Dominions and Colonies engaged in following up this work.

Medicine Stamp Duties

DUTIES in respect of medicines were first imposed so far back as 1783. The tax then was twofold, as it is to-day. It was imposed on all persons who sold medicines, not being doctors, apothecaries, etc., and secondly a duty was 'laid on the medicines' themselves when sold by such persons. A Select Committee

was appointed in November 1936 to consider the duties of excise chargeable under the Acts of 1802, 1804 and 1812, and any amendments thereto, and to report thereon and to make recommendations, and its report has now been issued (London: H.M. Stationery Office, 1937; price 3*d.* net). Complete abolition of these duties has been advocated, but the Committee recommends that the duties ought to continue and should apply to a wider field, and bring in a much larger revenue. At the same time, it recommends that the duty should be at the rate of twopence instead of threepence in the shilling, and should be graduated less steeply. The recommendations are of a far-reaching character, and bring in everything that looks like a drug or smells like one. As drafted, it would even seem that medicines prescribed or dispensed by medical practitioners are included, though it can scarcely be believed that this was intended. The Committee also sees no reason why the "modern chemist" should have "a very valuable preference" in the sale of preparations which claim the "known, admitted, and approved remedy" exemption which has hitherto enabled them to sell unstamped certain types of preparations liable to duty if sold by ordinary shopkeepers. Despite defects, the recommendations are on the whole in the interests of the public, and with certain amendments should prove acceptable.

Acquisitions at the British Museum (Natural History)

H.M. THE KING has presented to the Museum an exceptionally fine specimen of a black leopard from India. The skin is very dark and the spots are scarcely visible in certain lights. In March 1936, Mr. H. St. J. B. Philby set out on a journey through the districts of Asir and Najram in Arabia, returning to Jidda in the early part of this year. During this trip, Mr. Philby made large natural history collections which he has presented to the Museum. Apart from the birds which number 747 specimens belonging to some 100 species, the collections include mammals, reptiles, fishes, mollusca, a large number of insects, 230 botanical specimens, some minerals, and about 400 rocks. Among the birds, three are new to science, namely, a race of the common magpie, a small Scops owl, and an emerald cuckoo. His collection includes a number of eggs previously unknown. The Department of Entomology has received from Mrs. Tillyard a collection of 500 mayflies and 700 dragonflies which formed part of the late Dr. R. J. Tillyard's collection. Among the dragonflies are included the type specimens of 105 species, and among the mayflies of 8 species. This gift is perhaps the most valuable addition to the Museum collections in these groups that has been received for many years. Accessions to the Department of Geology include a collection of about 20,000 fossil invertebrates (including 60 type and figured specimens) from the Ordovician and Silurian strata of the Girvan district of Ayrshire. The collection was made by the late Mrs. Robert Gray of Edinburgh and her daughters. Mr. F. N. Ashcroft has presented a further series of 747 specimens from his collection of Swiss minerals.

Repton School Science Society

At the triennial conversazione of the Repton School Science Society on June 25 and 26, some forty demonstrations were shown. In the biology section a way of recording the heart beat of a frog and the effect of stimulation by nerves, by electricity and by drugs, was shown and also a collection of local zoological and botanical specimens. Recent developments in chemical industry were illustrated by the moulding of bakelite cups in a home-made electrically heated press producing a pressure of 1½ tons per sq. in., by the manufacture of rubber gloves from the latex by a simple dipping process using an experimental plant, and by electro-plating and bronzing on a semi-technical scale. A lecture was given in the physics section on electrical illumination dealing with the development of lighting from the carbon filament lamp to the modern vapour discharge lamps. There were also demonstrations of a way of eliminating dazzle from motor-car headlights using the new polaroid screens and of a home-made model railway fitted with a system of automatic signalling and train control.

Scientific and Industrial Research in Australia

THE tenth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1936, and in addition to reports on the five main divisions of the Council's work, refers to co-operation in research with New Zealand and to the meetings of the Standing Committee of Agriculture appointed as an advisory body to the Australian Council of Agriculture established in 1934 (Canberra: Government Printer, 1936. 4*s.*). Numerous reports to this Committee were furnished by the Council of Scientific and Industrial Research, dealing with such subjects as codling moth pest, survey of potato virus diseases, tobacco investigations, seed testing, weed pest investigations, soil drift, grasshopper investigations, etc. The Council also acts as a liaison with the Commonwealth Government on behalf of the Standards Association of Australia, and in this capacity provided reports on standardization of wearing parts of agricultural machinery, primary products, dusting sulphur, wire-netting and other galvanized products. During the year, the activities of the Council were extended to cover investigations into the problems of Australia's secondary industries, and a special committee has been set up to define the field and make recommendations regarding problems for investigation and the staff and organization required. A new Forest Products Laboratory approached completion during the year. This Division completed a full investigation of the veneer and plywood industry in Queensland with special reference to gluing practice, which has already led to a marked improvement in the quality of the products.

THE Division of Plant Industry has been responsible for work on the control of downy mildew of tobacco by benzene vapour in covered seed beds; this has made possible the prevention of a most destructive

disease which previously resisted all attempts at control. Considerable progress in the investigation on the control of the peach moth is reported by the Division of Economic Entomology and very favourable results have been obtained with nicotine-bentonite-sulphur sprays. The same Division has been responsible for work on termite control, while the work carried out on the control of weeds has been considerably extended by reorganizing the botanical and entomological phases in one section under joint control of the chiefs of the two Divisions. The Division of Animal Health Nutrition has been responsible for investigations on pleuro-pneumonia in cattle and on the treatment of internal parasites of sheep, while its fundamental investigations on the nutrition of sheep have already led to an increase of nearly 150 per cent in the yield of wool as well as to a remarkable variation in its character. Valuable contributions to viticulture and regarding the role of organic matter in plant nutrition have been made by the Soils Division, while the Food Preservation Section has obtained promising results in investigations on the storage of peaches and plums from the point of view of export to Great Britain which should decrease the wastage in export. The Radio Research Board has continued its investigations; appreciable advance in the control and eradication of prickly pear by biological methods is again reported, and a programme of fisheries research has also recently been initiated.

National and International Standardization

REALIZATION of the advantages of standardization of industrial materials and requirements has led in most of the industrially developed countries to the establishment of organizations to promote such standardization, and already a high degree of standardization has been reached in many countries. A most informative account of the work of the various national authoritative bodies engaged in this work is given in "A Survey of the Present Organization of Standardization—National and International", published by the World Power Conference. In Great Britain, the British Standards Institution is the national standardizing organization and is responsible for the determination of British standard specifications. Though the Institution has a strict rule that it does not initiate standardization but waits to be approached by a recognized outside authority such as a trade association, technical institution, or Government department, it has already issued more than 560 British Standard Specifications, exclusive of some 160 specifications for aircraft materials and components issued in co-operation with the Air Ministry.

INTERNATIONAL standardizing organizations, such as the International Federation of the National Standardizing Associations (ISA) or the International Electrotechnical Commission (IEC) have also been established. ISA, for example, federates the national standardizing organizations of nineteen countries and was founded in New York in 1926 with the object of

promoting co-operation, co-ordination and interchange of information. But international co-operation, in contrast to the development of standardization along national lines, has made slow progress. It was indeed the need for further development in this direction that led the International Executive Council of the World Power Conference to initiate this inquiry, and the report has been published with the hope that it may serve as a stimulus to a greater degree of co-operation in national standardization and to a closer co-ordination of the activities of international organizations engaged in standardization, to the end that duplication and overlapping may be avoided and international standardization may be more speedily effected.

Scientific Basis of Birth Control

IN *Science and Society* of June–September 1937, there appears an article on "The Scientific Basis of Birth Control" by Dr. C. V. Drysdale, president of the Malthusian League. The author remarks that the true, present-day application of the Malthusian doctrine may best be understood by reference to the affairs of an ordinary married couple. "The average young man marries when his income is sufficient to support a wife and perhaps one child, and, if that income were fixed, every additional child would mean a lowering of the family standard of existence." But, in many occupations, salaries rise with age and service, and if additional children come when there has been a sufficient rise in income, no lowering of the standard need take place. "This is the population problem as it confronts almost every middle-class couple." If children arrive at a greater rate than can be allowed for by increases of salary, then such a family is "over-populated". It amounts to this, that, in general, in civilized countries, birth-control has assisted in the preservation of the amenities and standards of living. Another aspect of birth-control is, of course, its application to what is called negative eugenics, that is, the avoidance of parenthood by persons afflicted with transmissible disease or defect. Dr. Drysdale looks forward to a future in which a planned social economy shall ensure general early marriage with reasonable family limitation. But it will be necessary to arrange that the limitation does not go too far, and the question is: How?

Fauna of the U.S.S.R.

SOME years before the Great War, the Russian Academy of Sciences launched an ambitious scheme of publishing detailed monographs on all groups of animals occurring within the Russian Empire and in neighbouring countries, under the title "Faune de la Russie et de pays limitrophes". The programme of the publication was so extensive that the first few volumes which appeared were sufficient to show the virtual impossibility of continuing the work on the same scale. The idea, however, was not abandoned, and the Academy of Sciences of the U.S.S.R. has now commenced the publication of a new "Faune de l'URSS", which aims at giving a full, but concisely written, monographic treatment mainly

of the systematics and distribution of all animals already found, or expected to occur, in the Soviet territories. Six volumes and two smaller parts, mostly dealing with insects, have already appeared, and they make a very good impression, particularly as regards the generally high scientific standard, although the paper, printing and illustrations might be improved. Unfortunately, not all the volumes are by outstanding experts in the systematics of the groups treated, and some have apparently been prepared by authors who may be excellent specialists, but not in the groups they had to monograph. All foreign zoologists will be pleased to see that each volume has a very full summary in a Western language, in which all determination keys, new descriptions and more important notes are given. Since the "Fauna" covers the whole of extra-tropical Asia and eastern Europe, its value for systematists working on the palæarctic region will be inestimable, and volumes on their respective groups will be eagerly awaited by all zoologists.

The Botanical Society of Edinburgh

THE *Transactions and Proceedings of the Botanical Society of Edinburgh*, 32, Part 1, 1936, is a particularly interesting number, including as it does the record of the centenary meeting of this Society. The main contribution is in effect a local flora—a list of the flowering plants and ferns from Fife and Kinross by William Young. The address delivered by Prof. F. O. Bower at the centenary meeting is included. No more appropriate speaker could have been found for that interesting occasion, and his appreciation of botanical progress during the period of activity of the Society could only have been delivered by a veteran whose reminiscences still feed his botanical enthusiasm. Prof. Bower points out how plant physiology has gained since 1836 by the precision that can now be assigned to the medium in which vital functions are proceeding, through the advances in cytology and anatomy. With arresting phrase and breadth of vision, in a few pages the main movements of botanical thought during the century are brought before the reader. The last half century, it is pointed out, because it is an age of specialization, has increased the need for the services of such general societies as the Botanical Society of Edinburgh. Prof. Bower indicates how the 'herd sense' among his fellow botanists is probably responsible for the temporary ascendancy of one field of investigation, thus leading to "multiplying instances of what has been already demonstrated". He then shows himself fully aware where the 'herd' is gathering now when he ends an eloquent plea for a modern morphology, based upon developmental studies of the meristem, with the speculation that hormones may then prove the key to unlock those phenomena of symmetry that are expressed in appendages. The Botanical Society of Edinburgh began principally as a means to the formation of a herbarium for its members, and has taken a prominent part in the creation of the magnificent herbarium that is now housed at the Royal Botanic Gardens.

Giorgi's System of Units

DR. A. E. KENNELLY recently presented a report from the historical point of view, to the Society for the Promotion of Engineering Education, in regard to the adoption of the m.k.s. (metre-kilogram-second) system of units ("The M.K.S. System of Giorgi adopted by the International Electrotechnical Commission (I.E.C.) in June 1935"). Dr. Kennelly has done his work well, giving a fair statement of the present position. Unfortunately, physicists and engineers are not yet agreed as to the best system of units to adopt. Many of them are in favour of following Heaviside and completely rationalizing the system of units. Others are more conservative, and think that the change, although saving much arithmetic, would scarcely be worth the labour involved in learning all the relations connecting the new and the old units. The two leading organizations are in agreement that a fourth unit is theoretically necessary to link internationally adopted electrical units with the dynamical units of the m.k.s. system. They agree that this fourth unit may preferably be 'space permeability' taken at the definite numerical value of 10^{-7} (unrationalized). This report of Dr. Kennelly can do nothing but good.

Prohibition and Cirrhosis of the Liver

At an address given at the recent annual meeting of the Royal Institute of Public Health at Margate, Dr. C. C. Weeks stated that, in the United States when prohibition really was prohibiting, there was a marked decrease in the death-rate from cirrhosis of the liver and a rise as 'boot-legging' became more extensive. The liquor sold under 'boot-legging' conditions was much more alcoholic than usual, ethyl alcohol being so high as 70 per cent in much of the whisky sold. There was consequently a good deal of acute alcoholism attributed to all sorts of causes, whereas the one effective cause was that the whisky was 50 per cent stronger than usual. Since the repeal of prohibition, there has been a slight but steady increase in deaths due to alcoholism. Official figures for 1935 showed that, out of 24 States, 20 had an increase in the death-rate from cirrhosis, while only 11 showed an increase in the death-rate for alcoholism as compared with 1932. The steady drinking of a more normal alcoholic beverage was leading inevitably to more cirrhosis of the liver but to less acute alcoholism.

Society of Chemical Industry: Food Group

At a recent meeting of the Food Group of the Society of Chemical Industry, it was decided, in view of the growing interest in food science and the diversity of the subject, to form panels within the Group. These panels will be responsible for directing the activities of the Group in connexion with their respective divisions of the science. The first two panels, of which there will be several, are now in process of formation, namely, a nutritional panel and a microbiological panel.

Studentships and Fellowships for Medical Research

THE Medical Research Council invites applications for a second series of studentships and fellowships for research into disease together with experimental work of an immediately relevant kind. Six post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Four research fellowships are also offered for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. These fellowships are intended as probationary appointments for research in clinical science or experimental pathology. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

Announcements

SIR WILLIAM BRAGG, president of the Royal Society and director of the Royal Institution, has been elected an honorary associate of the Royal Institute of British Architects.

By an order of the Committee of Privy Council, Mr. W. M. Goodenough has been appointed a member of the Medical Research Council on the retirement of the Right Hon. Lord Mildmay of Flete. Mr. Goodenough also succeeds Lord Mildmay as treasurer of the Council.

THE Howard Prize for 1937 of the Royal Meteorological Society has been awarded to Cadet Ralph Wills of H.M.S. *Conway* School Ship. Cadet Julius Cornel Donner and Cadet John Easton Neils Carter of H.M.S. *Worcester*, were placed second and third respectively. The subject of the essays was "The Meteorology of the Voyages of Discovery to America and to South Africa".

ON the occasion of the seventy-fifth birthday of Prof. E. Leclainche and of his election to the presidency of the Paris Academy of Sciences, the National French Syndicate of Veterinarians recently organized a ceremony in his honour. Prof. Leclainche is honorary director of the French Veterinarian Services and president of the International Office of Epizootics.

PROF. KARL NEUBERG, founder and editor of the *Biochemische Zeitschrift* and formerly director of the Biochemical Institute of the Kaiser-Wilhelm Gesellschaft, celebrates his sixtieth birthday on July 29. An issue of the periodical *Enzymologia*, with which he is associated, is to be published in honour of this anniversary; more than seventy authors, chiefly his pupils, have contributed to the number.

It is announced by the New York correspondent of *The Times* that a fund of about £2,000,000 for cancer research has been given to Yale University by Mr. Starling W. Childs. It is to be called the Jane Coffin Childs Memorial Fund for Scientific Research, and the deed of gift provides that, if the problem of cancer should be solved, the Foundation is to devote itself to other unsolved medical problems or to problems in other fields of science.

A GENERAL Discussion on reaction kinetics has been arranged by the Faraday Society, to be held in the Chemistry Theatre of the University of Manchester on September 13-15. As is usual at these discussions, a number of distinguished foreign investigators have agreed to take part. Further particulars can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

READERS interested in psychology may like to know that a Graphological Society has been formed and the first public meeting will take place in October. The honorary secretary is Mrs. Paula Friedenhain, 50 Heathway Court, West Heath Road, London, N.W.3.

THE second Congress of the Austrian Society of Röntgenology will be held in the Central Röntgen Institute of the General Hospital at Vienna on July 10-11. Further information can be obtained from the Secretariat, Zentral Röntgen Institut, Allgemeines Krankenhaus, Alserstrasse 4, Wien IX.

AN institute for anatomy, physiology and hygiene is shortly to be opened at Riga.

DR. THEODOR VAHLEN, professor of applied mathematics at Berlin, has been made an honorary professor in the University of Greifswald.

THE fourth International Leprosy Congress will be held at Cairo on March 21, 1938. Further information can be obtained from the Secretary, 131 Baker Street, W.1.

THE Congress of the International Union of Towns will be held in Paris on July 5-19, when a discussion will be held on the campaign against smoke in various countries, and other subjects. Further information can be obtained from M. R. Hummery, 28 rue de Liège, Paris.

WE have received List No. 25, a catalogue of old medical books, issued by Messrs. E.P. Goldschmidt and Co., Ltd., 45 Old Bond Street, London, W.1. Among 214 items, are several early works on bacteriology and parasitology of Behring, Ehrlich, Koch and Laveran, and a collection of French X-ray photographic prints, made about 1896. It also includes a copy of the rare third edition of Harvey's "De Motu Cordis", a first edition of Laennec's "De l'Auscultation mediate", and early works on anaesthesia, ophthalmology, pharmacology and physiology.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 31.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Use of the Name 'Racemic Acid'

THE discovery of racemic acid by Karl Kestner or Koestner, a chemical manufacturer at Thann, in the Vosges, and the elucidation of its relationship to ordinary tartaric acid, more especially by Gay-Lussac, Berzelius and Pasteur, constitute one of the most important episodes in the history of organic chemistry. Upon an account of the nature of racemic acid there is no need, and we do not intend, to enter here; but, owing to the confusion which exists in chemical literature regarding the authorship of the name *racemic acid* (variously attributed to Gay-Lussac, Gmelin and Berzelius), a note on this subject may be of interest to students of the history of chemistry.

The author of the term *racemic acid* is Gay-Lussac. The first occurrence of the term in print is found in a publication, "Cours de Chimie par M. Gay-Lussac, comprenant l'histoire des sels, la chimie végétale et animale", published in Paris by Pichon et Didier, in 1828. In the "Summary" at the beginning of the 24th Lecture, one finds the term, "Acide racénique", and on p. 23 one reads: "Ce serait ici le lieu de parler de l'acide racénique". The mis-spelling which is found here, *racénique* (with or without the accent) in place of *racémique*, finds its explanation in the fact that the "Cours de Chimie" was reproduced from shorthand notes of the course of lectures "professé à la Faculté des Sciences" by Gay-Lussac, and published without the co-operation or sanction of the lecturer. Gay-Lussac, in fact, protested vigorously against this *nouveau genre d'industrie*, which had arisen in Paris, of publishing the lectures of certain professors without their permission or supervision. "Je ne sais", wrote Gay-Lussac¹, "jusqu'à quel point il est juste de s'approprier ainsi des leçons publiques, contre la volonté même des professeurs; . . . Mais il n'est pas indifférent que l'on sache que je n'ai pris aucune part à cette nouvelle spéculation de librairie . . . Je déclare donc que mes leçons de chimie sont imprimées contre mon gré; que j'ai refusé les émoluments qu'on m'a offerts pour me faire coopérer à leur publication, et que je n'y prends absolument aucune part."

Meanwhile, the publishers had issued a note that "le désir que nous avons de terminer la publication de cet ouvrage presque aussitôt que le Cours du Professeur; la promptitude avec laquelle il a fallu par conséquent corriger les épreuves; et d'ailleurs la nécessité où nous fûmes de recourir à une autre personne que le Professeur, pour faire cette correction à laquelle il ne voulait pas se livrer lui-même, ont été cause que plusieurs fautes d'impression se sont glissées dans quelques-unes des Livraisons que nous avons adressées à nos Souscripteurs". The text was

read by M. Gaultier de Claubry and a list of errata was drawn up. In this list, *racémique* is corrected to *racémique* (without an accent on the *e*). The unaltered text, however, was republished, with its errors, in 1833 by the firm of de Just Rouvier et E. Le Bouvier, Paris.

The authorship of the term, *acide racémique*, is established also by a footnote which appears in the French translation² of Berzelius's original Swedish paper. The French translation is entitled: "Composition de l'acide tartrique et de l'acide racémique (traubensäure), etc", and the footnote to this reads "M. Gay-Lussac a donné, en 1828, le nom d'*acide racémique* à l'acide dont il est ici question." Thomas Thomson, who made an examination of racemic acid³ also states in his "Chemistry of Organic Bodies Vegetables" (1838), p. 66: "This acid has been described in the Chemistry of Inorganic Bodies (Vol. ii, p. 69) under the name of *vinic acid*. But the term *racemic acid*, given it by M. Gay-Lussac in 1828, is better."

While the authorship of the specific term *acide racémique*, applied to the isomer of tartaric acid which Berzelius, in 1830, proposed to call *paratartaric acid*⁴, must undoubtedly be attributed to Gay-Lussac, the general application of the term racemic to the optically inactive, resolvable isomer of a substance, must be credited to Pasteur⁵.

With regard to the position of Gmelin and Berzelius in the naming of the acid called racemic by Gay-Lussac, the facts are as follows. Walchner, in 1827, had carried out an investigation of racemic acid and its salts⁶, and his results were communicated in Gmelin's "Handbuch der theoretischen Chemie", 3rd Edit., vol. 2, p. 53 (published in 1829). Here the acid is called, for the first time, *Traubensäure*; and in his paper communicated to the Swedish Academy of Sciences, Berzelius (p. 64) states: "Gmelin har gifvit den namnet drufsyra, Traubensäure". In this same paper, Berzelius suggested the name paratartaric acid, and this name was widely used. To sum up. To the acid discovered by Kestner and first called by John, "Säure aus den Voghesen", Gay-Lussac, in 1828, gave the name, *acide racémique*. In 1829, Gmelin called it *Traubensäure* (rendered by Berzelius in Swedish as *drufsyra*), and, in 1830, Berzelius called the acid, *acidum paratartaricum*.

ALEX. FINDLAY.

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University, Aberdeen.
June 2.

¹ *Ann. Chim.*, 37, 441 (1828).

² *Ann. Chim.*, 46, 113 (1831).

³ *Records of General Science*, ii., 97, 161, 241 (1835).

⁴ *Kongl. Vetensk. Acad. Handl.*, 49 (1830).

⁵ *Ann. Chim.*, 61, 488 (1861).

⁶ *Schweigger's J.*, 49, 238 (1827).

Measurement of the Nuclear Absorption of Electrons by the Atmosphere up to about 10^{10} Electron-Volts

ACCURATE observations on cosmic ray intensities as measured by Neher electroscopes have been made in the equatorial belt (Madras, India, mag. lat. 3° N.) and in San Antonio, Texas (mag. lat. 38.5° N.) up to between 98 and 99 per cent of the way to the top of the atmosphere. The most significant results of these measurements may be summarized as follows:

(1) Cosmic rays, whatever their nature, are so rapidly absorbed as a whole in the outer layers of the atmosphere that even in the equatorial belt, where the effect of the earth's magnetic field upon them is a maximum, they get into equilibrium with their secondaries and produce their maximum ionization before they have penetrated through the first tenth of the atmosphere. (This effect was suggested as a possibility by Millikan and Cameron in 1927¹ in their report made at the Leeds meeting of the British Association on their first voyage (1926) made from Los Angeles to Peru to look for the effect of the earth's magnetic field on incoming electrons. The words then used were: "If the northern hemisphere and the southern hemisphere curves [of ionization with altitude] coincided, it would go a long way toward eliminating the possibility that the rays are generated by the incidence of high-speed beta rays on the very outer layers of the atmosphere. . . . For such beta rays would be expected to be influenced by the earth's magnetic field so as to generate stronger radiation over the poles than over the equator". This is precisely what the present experiments show to be the case for the whole field-sensitive portion of the cosmic rays.)

(2) From that point on, they fall off exceedingly rapidly in intensity, following an exponential equation, their law of absorption being like that of X-rays and not like that of particles that exhibit range phenomena such as low-energy beta rays, proton rays or alpha rays.

(3) The depth beneath the top of the atmosphere at which the maximum ionization is attained, always less than a tenth of an atmosphere, changes but slightly in going from San Antonio, where no electrons of energy less than 6×10^9 electron volts can get vertically through the blocking effect of the earth's magnetic field, to Madras where no electron-rays of energy less than 17×10^9 electron-volts can similarly get through.

(4) The difference between the San Antonio and the Madras curves makes possible for the first time the determination of the complete curve of ionization produced in the atmosphere by incoming charged particles contained within a sharply limited band of energies having a weighted mean value of 10×10^9 electron-volts.

(5) Down to a depth of a third of an atmosphere from the top (3 metres of water) this curve is in good agreement with the Bethe-Heitler theory of nuclear electron absorption as recently extended by Carlson and Oppenheimer as well as by Bhabha and Heitler.

(6) The exceedingly rapid absorption of this latitude-sensitive radiation, with an absorption coefficient which is nearly constant and independent of incident energy, qualitatively justifies the 'shower theory' of Millikan and Cameron as the main cause of the ionization of the atmosphere produced by incoming electrons even of this huge energy.

(7) The latitude-sensitive part of the cosmic ray ionization found in the lower part of the atmosphere

is considerably more penetrating than is predicted by the foregoing extended Bethe-Heitler theory of electron absorption; nevertheless, while at a distance of one twentieth of an atmosphere from the top, these 10×10^9 electron volt field-sensitive rays are producing 160 ions per c.c. per sec., at sea-level their total ionizing influence has fallen to but 0.3 ion per c.c. per sec., that is to less than 1/500 of its value near the top of the atmosphere.

(8) The two foregoing results in (7) show that the process of nuclear absorption of electrons is more complicated and involves the production of more penetrating secondaries than is pictured in the simple physical assumptions underlying the Bethe-Heitler theory, but, at the same time, that the whole progeny of secondaries, whatever their nature, has been reduced almost to zero by the time sea-level has been reached, not more than about one tenth of the sea-level ionization being accounted for by field-sensitive rays at all.

(9) The latitude-sensitive part of the cosmic ray ionization found in the lower atmosphere is practically all due to the secondary effects of varied nature resulting from the absorption of the incoming electrons in the upper tenth of the atmosphere.

(10) The apparent absorption coefficient, namely, 0.54 per metre of water, of the actual curve representing the whole progeny of secondary influences resulting down to sea-level from the absorption of incoming electrons in the very top layers of the atmosphere is approximately the same as that found by Johnson and by Neher for the east-west effect, thus proving that the particles causing the latitude and the east-west effect are of the same type. Both absorption coefficients are such as to suggest that these particles are electrons (predominantly positive), not protons.

I. S. BOWEN.
R. A. MILLIKAN.
H. V. NEHER.

California Institute of
Technology,
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June 15.

¹ NATURE, 121, 20, 1937.

Longitude Effect and the Asymmetry of Cosmic Radiation.

In a recent letter, Dr. M. S. Vallarta¹ has emphasized the discrepancy which arises from the comparison of the variation of intensity of the cosmic rays along the magnetic equator (longitude effect) and the position of the magnetic centre of the earth as determined from magnetic observations. According to Hoerlin, the longitude of the magnetic centre as determined by cosmic rays should be 100° E. instead of 160° E. as found directly.

The theory according to which the cosmic ray observations are interpreted is that the angle of opening of the cone $\pi/2 + \theta$ must be computed by Störmer's formula

$$\sin \theta = \frac{2}{r} - \frac{1}{r^2}$$

with a value of $r = r_0(1 - \rho \cos L + \dots)$ proportional to the distance to the magnetic centre and therefore dependent on the eccentricity ρ of the dipole and on the difference of longitude L reckoned from the dipole (positive towards the east).

It should be noted that the angle θ in Störmer's formula is reckoned, not from the vertical of the place

but from the line joining the dipole to the point of observation. If we take account of this circumstance, we find that the change of the angle of opening becomes

$$\Delta\theta = -\alpha\rho \cos L + \rho \sin L;$$

where the first term is the effect due to the change of distance from the dipole and the last term is the new parallactic effect. The coefficient

$$\alpha = \frac{2}{r_0} \left(\frac{1}{r_0} - 1 \right) / \cos \theta$$

varies with the energy of the rays. For the rays just able to come from the zenith ($\theta = 0$), it is equal to 4 and its minimum value is $\sqrt{2}$.

For negative particles, the angle of opening of the cone must be taken not from the west but from the east, and therefore the sign of the new term must be inverted. The usual theory is therefore correct only if the rays are a mixture of positive and negative rays in equal amount. This is not the case, as the asymmetry measurements have shown that the positive rays are more important.

If we write $\tan \beta = 1/\alpha$ we get

$$\Delta\theta = \frac{-\rho}{\sin \beta} \cos(L + \beta),$$

showing that the improvement of the theory essentially amounts to reckoning the longitudes from an origin at an angle β west of the position of the dipole. This angle β , which is 0 for rays just able to reach the equator, is 14° for rays of 0.5 Störmer, that is, 15×10^9 eV. (for protons) and goes up to 35° for the limiting case of 60×10^9 eV. Although this correction is far from the 60° asked for by Hoerlin, it is in the right direction and will substantially reduce the discrepancy between theory and observation.

The fact that the longitude effect is different according to the effective value of the intensity of the rays and therefore according to the screens used, and also depends on the sign of the charge, will make the analysis more difficult; but when it is achieved, due to improvement in observations and also to progress in the working out of the details of the theory, it will probably afford information on the sign of the charge and the distribution of the intensity of the rays.

University of Louvain,
May 22.

¹ NATURE, 139, 24 (1937).

G. LEMAÎTRE.

Crystallization of Lysozyme

THE occurrence in nasal mucosa of a substance capable of lysing certain bacteria was noted by Fleming¹, and this or a similar compound was later obtained from egg-white by Wolff² who, however, did not recognize the true chemical nature of the substance. Meyer, Thompson, Palmer and Khorazo³, adopting an entirely different procedure, showed that lysozyme is a protein giving some of the typical reactions; they also quoted analytical data.

Dr. E. A. H. Roberts, of the Department of Pathology, has further improved the technique of the preparation and his results will shortly be published in another place. In the meantime we have undertaken the purely chemical side of the investigation of this interesting protein, and we wish to express our gratitude to Dr. Roberts and Prof. Florey for the facilities provided.

The material made according to the method of Roberts seems to possess a high degree of homogeneity and it may be crystallized by one operation from solution in $N/20$ acetic acid and concentration over aqueous potassium hydroxide in a vacuum desiccator. The crystals (Fig. 1, photomicrograph by Mr. H. M. Powell) appear to be dodecahedra, and Miss D. Crowfoot has kindly undertaken the crystallographic examination.

Crystalline lysozyme is about as active as the Roberts specimen in bringing about lysis of *Micrococcus lysodeikticus*, but comparisons by the methods used are not capable of great accuracy.

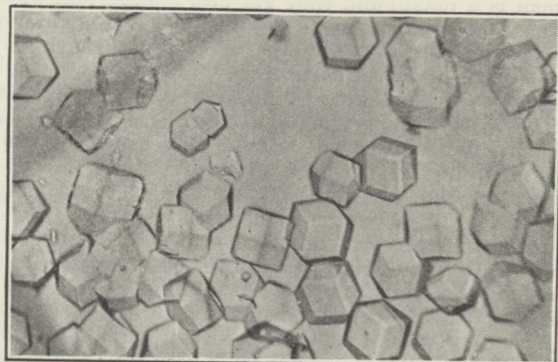


Fig. 1.

Mr. H. S. Philpot has kindly studied the behaviour of lysozyme in the ultracentrifuge, and the molecular weight appears to be of the order of 18,000, a quite provisional estimate.

The ultra-violet absorption shows the usual tyrosine-tryptophan band at about 2770 Å. in acid solution; this is shifted to about 2870 Å. in $N/10$ sodium hydroxide solution. Using the method of Holiday⁴, analysis of the curves indicates the presence of 4.4 per cent of tyrosine residues and of 2.2 per cent of tryptophan residues in the molecule.

Dyson Perrins Laboratory,
University, Oxford.

E. P. ABRAHAM.
R. ROBINSON.

¹ Fleming, A., *Proc. Roy. Soc., B*, 93, 306 (1922).

² Wolff, L. K., *Z. Immunitätsforsch.*, 50, 88; 54, 188 (1927).

³ Meyer, K., Thompson, R., Palmer, J. W., and Khorazo, D., *J. Biol. Chem.*, 113, 303 (1936).

⁴ Holiday, E. R., *Biochem. J.*, 30, 1795 (1936).

Thermal Decomposition of Ethylene Bromide

WHILE we were investigating the behaviour of certain gaseous alkyl and alkylene bromides at high temperatures, with the view of finding out how the energy of activation was related to the zero point energies (or vibration frequencies) of adjacent bonds (for example, tert.-butyl bromide with three C-C bonds might be expected to require a less activation energy than normal butyl bromide with two C-H and one C-C bonds) we found that the homogeneous nature of the decomposition could not always be predicted, and that the calculations made for ethylene bromide ($C_2H_4Br_2$) by Sherman and Sun¹ based on the Eyring method were somewhat misleading.

We used an all-glass pyrex apparatus, with a diaphragm gauge (electrical contact) balanced against a mercury manometer. The decomposition of ethylene

bromide took place in a pyrex vessel immersed in a molten metal bath. The temperatures ranged from 340° to 400° C. and were controlled by a chromel-alumel thermocouple and potentiometer system. At 340°-370° the decomposition is heterogeneous; the introduction of pyrex glass tubing leads to considerable increases in the reaction velocity. The final pressure is double the initial pressure, the products of decomposition are vinyl bromide (C₂H₃Br) and hydrogen bromide, and the reverse reaction is not appreciable at these temperatures. The reaction follows the first order equation very well.

There is no decomposition into ethylene and bromine. The calculations of Sherman and Sun lead us to believe that the decomposition into ethylene and bromine would take place at an appreciable rate at 350° with an activation energy of 50,000 calories. We have calculated an approximate activation energy for the heterogeneous reaction of about 30,000 calories.

Since the ethylene bromide molecule prefers to dissociate into vinyl bromide and hydrogen bromide, we would be inclined to look for some structural explanation of this phenomenon. The *trans* form of ethylene bromide is considered to be the more 'stable' (preferred) form, even at high temperatures². This interesting theory may explain how it is that ethylene bromide can become attached to the surface in such a way as to give rise to these decomposition products. It is very different from the behaviour of ethylene iodide (C₂H₄I₂), where an iodine atom (or an adsorbed iodine atom) acts as a catalyst for the decomposition into ethylene and iodine³. Also, the molecule decomposes homogeneously into the same products. Here one of the iodine atoms in the molecule acts as a sort of 'intramolecular catalyst'. One would expect the *cis* form of ethylene iodide to be its normal condition, but there do not appear to be any definite data on this point. Recently, however, the idea that ethylene iodide dissociates directly into ethylene and iodine has been disputed⁴.

Further data and experimental details will be published shortly.

Department of Chemistry,
University, Sydney.
May 4.

T. IREDALE.
A. MACCOLL.

¹ *J. Amer. Chem. Soc.*, **56**, 1096 (1934).

² Trumpy, *Z. Phys.*, **93**, 624 (1935).

³ Arnold and Kistiakowsky, *J. Chem. Phys.*, **1**, 166 (1933); Iredale and Martin, *J. Phys. Chem.*, **38**, 365 (1934).

⁴ Ogg, *J. Amer. Chem. Soc.*, **58**, 607 (1936).

Pyruvic Acid Dehydrogenation, Vitamin B₁ and Cocarboxylase

It had been found by Davis¹ that pyruvic acid is oxidized by the acetone preparation of *Bacterium Delbrückii*. This preparation has proved to be very useful for a closer study of pyruvic acid dehydrogenation².

A codehydrase could be removed from the acetone-treated lactic acid bacteria by washing with phosphate of pH 8. The washed preparation was activated by the addition of decoctions of animal tissues (kidney, brain, liver). The addition of vitamin B₁ was without effect. Therefore cocarboxylase was tried, which had been found by Lohmann to be a vitamin B₁ pyrophosphate³. A pure preparation of cocarboxylase was

most kindly supplied to me by Dr. K. Lohmann, with which the following experiment was carried out.

Activator	None	Kidney decoction	20% cocarboxylase
Oxygen consumed in 30 minutes (c.mm.)	8	137	176

The effect of cocarboxylase is surprising, because no decarboxylation to aldehyde and carbon dioxide was found with the bacteria. Pyruvic acid was broken down only by dehydrogenation to acetic acid and carbon dioxide.

With highly concentrated organ extracts, the activation found was notably higher than with cocarboxylase at saturation. Probably the additional activation is due to the presence of flavin phosphate in the concentrates. A highly purified, but not pure, preparation of flavin phosphate from heart together with cocarboxylase gave the same additional activation.

Furthermore, it was found that no dehydration takes place with the complete system in the absence of free phosphate. Phosphate is easily removed from the acetone preparation by washing with an acetate mixture of pH 4.7. The effect of phosphate is shown by the following experiment.

Phosphate (10 ⁻² M. per lit.)	0	1.4	2.8	5.5
Oxygen consumed in 60 minutes (c.mm.)	9	45	79	132

Phosphopyruvic acid was found to be inactive as hydrogen donor.

In the catatorulin test of Peters⁴, free vitamin B₁ activates pyruvic acid oxidation with brain tissue. But from certain experiments, Peters *et al.* concluded that after the addition of vitamin, a substance *x* is converted into *y*, *y* being the activator of pyruvic acid oxidation. The experiments reported here suggest that the *x* of Peters is vitamin itself and the *y* vitamin pyrophosphate, into which it is converted by the tissue.

FRITZ LIPMANN.

Biological Institute of the
Carlsberg Foundation,
Copenhagen.
May 18.

¹ Davis, J. G., *Biochem. Z.*, **265**, 90 (1933).

² See also Lipmann, *NATURE*, **138**, 1097 (1936) and *Skand. Arch. f. Physiol.*, **76**, 186 (1937).

³ Lohmann, K., *Naturwissenschaften*, **25**, 26 (1937).

⁴ Peters, R. A., *Biochem. J.*, **30**, 2206 (1936).

⁵ Peters, Rydin and Thompson, *Biochem. J.*, **29**, 53 (1935).

Crystals with Vitamin K Potency.

THE evidence for the existence of anti-hæmorrhagic vitamin (K) required by the chick for preservation of normal blood clotting time has been reviewed in a former paper¹.

This vitamin has been obtained in a crystalline fraction isolated from concentrates obtained in molecular distillation by cooling such concentrates in absolute methanol with solid carbon dioxide. The colourless crystal fraction obtained by this method was recrystallized from methanol three times by the same cooling procedure. Two such lots of crystals have been obtained.

The first lot was found capable of restoring normal blood clotting time within four days when added to the basal deficient diet given to five chicks with clotting time greater than 30 minutes. The second lot, tested by preventive assay, maintained normal

blood clotting time in chicks when added to the basal diet, while the clotting time of chicks receiving no vitamin K supplement was in every case greater than 30 minutes.

Some vitamin still remained in solution. On the basis of comparative clotting times, the crystal fraction was approximately eight times as potent as the fraction not crystallized out by cooling with solid carbon dioxide.

H. J. ALMQUIST.

University of California,
Berkeley.

¹ Almquist, H. J. "The Anti-hemorrhagic Vitamin (Review)" *Poultry Science*, 16, 166 (1937).

Effect of Hetero-auxin on the Growth of Broad Bean Plants in Water Culture

HITCHCOCK and Zimmerman¹ induced responses in the shoots of tomato and tobacco plants by applying a solution of hetero-auxin to the soil. These responses included bending, swelling, the production of adventitious roots on the stems, and epinasty of the leaves. This letter describes the relative effect of adding small amounts of hetero-auxin to the culture solution bathing the roots, and spraying approximately the same quantity on the shoots by the method described by Pearse². *Vicia Faba* (Dobbie's Champion Long Pod) was used as the test plant, and



Fig. 1.

THE SHOOTS OF THE PLANTS ON THE LEFT HAVE BEEN SPRAYED WITH HETERO-AUXIN, THOSE IN THE CENTRE ARE THE CONTROLS, WHILE THOSE ON THE RIGHT HAVE BEEN SUPPLIED WITH HETERO-AUXIN IN THE CULTURE SOLUTION TO THE ROOTS.

the seedlings were three weeks old at the time of the first applications of hetero-auxin; the shoots were then about 10 cm. high. Fig. 1 shows the result of one week's treatment; the plants on the left were sprayed daily with 1 c.c. of a 0.01 per cent solution of hetero-auxin, those in the centre are the controls, while those on the right were supplied daily with 1 c.c. of a 0.01 per cent solution in 500 c.c. of culture solution.

In Table 1 the average total length of lateral root for three plants, and the average dry weights of root and shoot are given.

Fig. 1 and Table 1 show that supplying hetero-auxin to the solution has retarded the growth length of the roots, although the total root weight practically unaltered, while spraying the shoots with hetero-auxin has slightly decreased the weight of root growth without altering its form. The shoot growth was retarded by both treatments, but whereas spraying induced swelling of the stem and epinasty of the leaves, the plants receiving hetero-auxin in the culture solution did not exhibit any such symptoms. The immediate effects of the treatments therefore appeared to be strictly local in each case, and the subsequent retardation of the growth of the parts of the plants other than those receiving the hetero-auxin would seem to be due to an alteration in the dynamic equilibrium of the plant, rather than to its movement within the plant body. The movement of hetero-auxin from the soil into the shoots of tomato plants noted by Hitchcock and Zimmerman may have been due to the much greater amount of hetero-auxin applied.

TABLE 1.

Series	Total length of lateral root (cm.)	Root dry weight (mgm.)	Shoot dry weight (mgm.)
Control	385.4	356	917
Shoots sprayed daily with 1 c.c. of a 0.1 per cent solution of hetero-auxin	356.3	335	680
1 c.c. of a 0.1 per cent solution of hetero-auxin added daily to culture solution	180.6	352	642

The terminal bud was inhibited by spraying, an effect previously noted by Pearse³ when spraying tomato plants with phenylacetic acid, and with indolebutyric acid. Thimann and Skoog⁴ cause inhibition of the lateral buds of plants of *Vicia Faba* by applying hetero-auxin to the cut-off stump of the terminal bud; but here it has inhibited the growth of the terminal bud itself.

A full account of this work is being prepared for publication.

H. L. PEARSE.

East Malling Research Station,
East Malling, Kent.
May 11.

¹ Hitchcock, A. E., and Zimmerman, P. W., *Contrib. Boyce Thompson Inst.*, 7, 447 (1935).

² Pearse, H. L., *NATURE*, 138, 363 (1936).

³ Pearse, H. L., *J. Pom. and Hort. Sci.*, 14, 365 (1937).

⁴ Thimann, K. V., and Skoog, F., *Proc. Roy. Soc.*, B, 114, 31 (1934).

Skatole as a Root Forming Substance

THE activity of skatole as a growth-promoting substance has been noted by Glover¹. We have carried out experiments which show that skatole accelerates root formation in cuttings. Cuttings of *Leptospermum scoparium* and of *Ficus repens* were treated with an aqueous solution of skatole in the manner described by Hitchcock and Zimmerman² and the cuttings planted in a mixture of coco-nut fibre and sand in a propagator. The treatment accelerated root production. With *Leptospermum scoparium* cuttings, treatment for six hours with skatole solution of a concentration of 20 mgm. per 100 c.c. on March 19 gave 60 per cent of the cuttings well rooted in 20 days. A control set showed 30 per cent only of the cuttings to be slightly rooted. With

Ficus repens, a more marked response was obtained. Cuttings planted on April 22 and examined after 19 days showed in the control set 10 per cent rooted with an average of 0.3 roots per cutting and an average length of root per cutting of 1.6 mm. Of cuttings treated for 3 hours with a skatole solution of a concentration of 20 mgm. per 100 c.c., 90 per cent were rooted with an average of 4.2 roots per cutting and an average length of root per cutting of 38.4 mm.

Parallel experiments showed *l*-tryptophane to be inactive.

L. G. G. WARNE.

A. A. JACKSON.

Botany Department,
Victoria University of Manchester.

June 1.

¹ NATURE, 137, 320 (1936).

² Contrib. Boyce Thompson Inst., 8, 63 (1936).

Function of the Gills of the Mayfly Nymph, *Cloeon dipterum*

It is generally supposed that the plate-like abdominal gills occurring in some ephemeropterid nymphs are respiratory organs, although little experimental evidence is available to support this view. Moreover, both Dewitz¹ and Cuénot² have shown that these gills are not essential to life. Recently, another function has been ascribed to these structures by Eastham³, who shows that in the nymph of the mayfly, *Ecdyonurus venosus*, they act as paddles which bathe with water the gill tufts attached to their bases.

In order to test whether or not these gill plates are truly respiratory in nature, the oxygen consumption of both the normal and gill-less nymphs of the mayfly, *Cloeon dipterum*, has been measured at 10° C. at various oxygen concentrations. The results are shown in Fig. 1, each point in which is the average of three to eight experiments. This figure may be compared with Fig. 1 of Fox, Wingfield and Simmonds⁴.

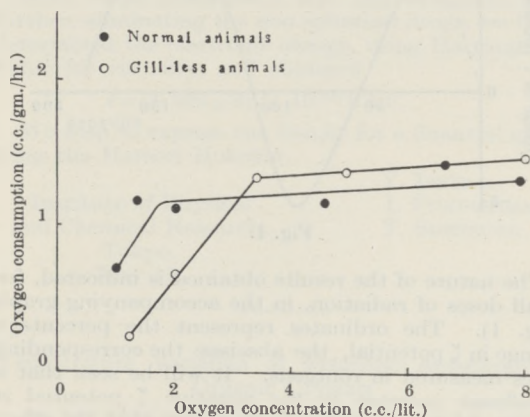


Fig. 1.

It will be seen that, as the oxygen content of the water is decreased, the oxygen consumption of both the normal and the gill-less nymphs remains nearly the same until a concentration of about 3 c.c./lit. is reached. Below this concentration the oxygen consumption of the gill-less nymphs falls off rapidly, but this marked decrease does not occur in the

normal animals until the oxygen content of the water is reduced to about 1.5 c.c./lit. It is clear that the gills in this species of mayfly nymph only aid the oxygen consumption in water of low oxygen concentration, that is, below 3 c.c./lit.

At high oxygen concentrations, the gills of *Cloeon dipterum* only beat intermittently, but as the oxygen content of the water falls the quiescent periods are much reduced, thus causing a greater volume of water to pass over the dorsal surface of the animal in a given time.

It is not yet clear whether at low oxygen concentrations the level of oxygen consumption in the normal animal is maintained by gaseous exchange taking place at the gill surface, or whether under these conditions the gills merely act as paddles which pass a greater volume of water over the respiratory surfaces of the animal. Either of these processes would enable the animal to maintain its normal level of oxygen consumption at low oxygen concentrations.

The results summarized above will be published in full elsewhere.

C. A. WINGFIELD.

Zoology Department,
University of Birmingham.

May 14.

¹ Dewitz, H., *Zool. Anz.*, 13, 525 (1890).

² Cuénot, L., "L'Adaptation", Paris (1925).

³ Eastham, L., *J. Exp. Biol.*, 14, 219 (1937).

⁴ Fox, H. Munro, Wingfield, C. A., and Simmonds, B. G., *J. Exp. Biol.*, 14, 210 (1936).

Zoological Nomenclature

IN spite of various criticisms, it must be admitted that the system of nomenclature used by zoologists and botanists is fundamentally sound and serviceable. Much depends, however, upon uniformity of practice, and certain irregularities which are becoming current are likely to cause serious confusion.

The International Code, Article 10, states: "When it is desired to cite the name of a subgenus, this name is to be placed in parenthesis between the generic and the specific names. Example: *Vanessa (Pyrameis) cardui*." The example is not well chosen, *Pyrameis* being a synonym of *Vanessa*; but the meaning is clear.

In the admirable *Review of Applied Entomology*, it has become the custom to cite an alternative generic name as if (according to the above rule) it were a subgenus. Thus, in the part for February 1937 we read "*Aonidiella (Chrysomphalus) aurantii*", for the red scale of the orange. *Chrysomphalus* is the older name, and opinions differ as to whether the red scale should be referred to that genus, with *Aonidiella* as a subgenus, or whether *Aonidiella* should be raised to full generic rank. The method of citation used by the Imperial Institute of Entomology, and indeed by others, would be intelligible were it not for the instructions given (following the usage of many decades) in article 10. If the method proposed in article 10 is abandoned, it is difficult to see how subgenera can be properly cited.

A quite different tendency, which seems to be on the increase, is to cite subgenera as if they were genera. An example (many more might be found) is furnished by C. Frick's "Horned Ruminants of North America", just published. A new subgenus *Stockoceros* is proposed for *Tetrameryx conklingi* of Stock; but although

it is repeatedly stated to be a subgenus only, the species is written *Stockoceros conklingi*, or in one place *S. (Tetrameryx) conklingi*, and a subfamily Stockocerotinae is proposed (p. 36) to include the group containing *Stockoceros*. Evidently the subfamily should be Capromerycinae, based on the oldest genus, and in no case, according to the rules, can it be based on a subgenus. It might be possible to argue, perhaps, that in spite of his intention, Frick had in fact raised *Stockoceros* to generic rank by his mode of citation. Should this view prevail, Stockocerotinae might be retained.

Another problem relates to the permissible length of generic and subgeneric names. Frick has, for example, a new subgenus *Pseudoparablastomeryx*. I have for many years followed a suggestion made by an author whose name I have forgotten, that such names should never exceed six syllables. There must be a limit somewhere, and perhaps the six-syllable rule would be acceptable, at least for future proposals.

T. D. A. COCKERELL.

University of Colorado,
Boulder.
May 12.

The Number of Discriminable Colours

ALTHOUGH a calculation of the approximate number of discriminable colours must depend upon the individual concerned, 'normal' persons may be expected to furnish data which agree to the correct order of magnitude. The method used here involves the choice of an arbitrary colour solid, the well-known Titchener-Ebbinghaus double pyramid, to which available experimental data are applied with simplifying assumptions, in order that ordinary geometry may be used in the calculations. A straight line connecting the apexes of this double pyramid represents the *black-white*, or brilliance series; the *saturation* series is represented by lines running from the central axis to the surface; and the *hue* series is given by lines on the surface of the figure parallel to the base.

The observations of König¹, ranging from threshold to blinding intensity, give 660 discrete steps as the length of the brilliance axis. Jones², utilizing the measurements of Steindler, Nutting and himself, found 128 just noticeable chromaticity steps in the spectrum. Smith³ obtained 28 hues in the psychological purples. For the total number of hues, equivalent to the perimeter of the base, we have 156. Data for saturation are taken from the incomplete experiments of Geissler⁴, the work being done with coloured papers and covering only certain limited ranges. The results show 90 discrete steps from neutral grey to red. While Geissler did not determine the number of steps to each of the other corners, he measured the *relative* saturations from which the appropriate data may be computed: yellow, 35; green, 28; and blue, 67.

These values indicate that the base of the pyramid, if drawn to scale, could not be represented by conventional geometry. For the degree of approximation required here we may take arithmetical averages. We find 39 hue steps between each corner of the base and 55 saturation steps from the periphery to central grey. We shall assume that the number of hues, a function of the saturation, decreases linearly from periphery to centre, thus giving 78 hues at mean saturation. The number of colours in the base becomes 4,290. This is not the 'area', but the total

colour sensations, the spacing of which depends upon location. Since König's results are approximately symmetrical, we may use the ordinary formula for the volume of a double pyramid, and thus we obtain for the number of discriminable colours, to two significant figures, the value 9.4×10^6 . If a double cone is chosen, the results will be the same.

GEORGE B. WELCH.

Department of Physics,
Northeastern University,
Boston, Mass.

May 1.

¹ König, A., *Z. für Psych. u. Physiol. der Sinnesorg.*, 8, 375 (1891).

² Jones, L. A., *J. Opt. Soc. Amer.*, 1, 63 (1917).

³ Smith, F. O., *J. Exper. Psych.*, 8, 381 (1925).

⁴ Geissler, L. R., *Amer. J. Psych.*, 24, 171 (1913).

An Effect of X-Radiation on the ζ Potential of Colloidal Graphite

IN the course of our attempts to elucidate the nature of the action of X-rays on colloids, we have been investigating the effect of irradiation on the ζ potential of the colloidal particles. The sol selected for the preliminary experiments was an artificial graphite dispersed in conductivity water with the aid of traces of ammonia. This sol is practically homogeneous towards X-radiation, and has a low electrolytic content. It is stable, and the ζ potential of a given stock shows no significant changes over a period of four months. The ζ potential is deduced from measurements on the electrophoretic velocity of the particles. The experimental technique employed in our laboratory has been fully described by Lane and White¹, who have shown that the probable error of a single observation is of the order of $2\frac{1}{2}$ per cent.

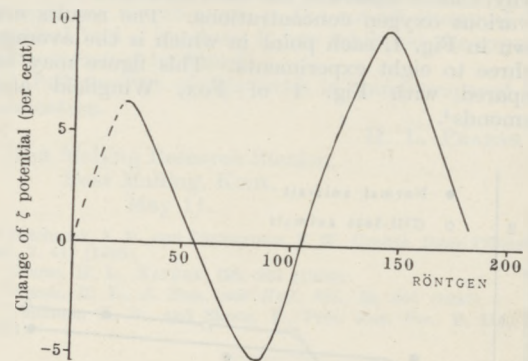


Fig. 1.

The nature of the results obtained is indicated, for small doses of radiation, in the accompanying graph (Fig. 1). The ordinates represent the percentage change in ζ potential, the abscissæ the corresponding doses measured in röntgens. It will be seen that a significant increase in the negative ζ potential is produced by a dose of only 25 r., but that the effect is not a monotonic function of the dose. The oscillations persist, with undiminished amplitude, but with increasing wave-length, up to doses of 25,000 r. Effects of a similar kind were also obtained with gamma radiation. For one of the sols measured the percentage changes in potential at the first maximum (25 r.), first minimum (85 r.) and second maximum (143 r.) were $+ (7.0 \pm 0.6)$ per cent, $- (6.0 \pm 0.5)$

per cent and (9.6 ± 1.1) per cent respectively. The scatter of the separate observations for a particular dose was, in all cases, consistent with the estimate of the probable error of a single observation given by Lane and White.

The demonstration of a significant physical effect in a stable colloid by X-radiation amounting to no more than 25 röntgens is, so far as we can ascertain, novel: as is also the peculiar relation between effect and dosage. The experiments, in which we have been aided by a grant from the British Empire Cancer Campaign, are being continued.

J. A. CROWTHER.
H. LIEBMANN.

Department of Physics,
University, Reading.
June 1.

¹ *Phil. Mag.*, 23, 824 (1937).

Determination of Electronic Charge by the Oil Drop Method

WE have eliminated the convection current and the effect of the arc and minimized the variation of time of descent of the drops and the greatest common divisor, by using our new oil.

The battery used was two ampere-hour lead cells, highly insulated, giving constant potential with drop of less than two volts per 10,000 volts per five hours. This high potential enabled us to reduce the number of charges on the drop considerably. The water of the bath was constantly circulated and its temperature controlled to within a few thousandths of a degree centigrade for a period of weeks. The condenser plates, having a diameter of 22 cm. and thickness of 2.5 cm., were of stainless steel, optically polished and separated by the quartz prisms. The air used in the tank was dry and free from foreign matters. The timings were recorded on the Société Genevoise printing chronograph, which was controlled every second by the Riefler master clock of the Institute, the variation of which is less than one hundredth of a second per day.

With these precautions and improvements, and further, eliminating the non-spherical drops, we have determined the electronic charge, using Harrington's value for viscosity, and obtained

$$e = (4.806 \pm 3) \times 10^{-10} \text{ E.S.U.}$$

We wish to express our thanks for a financial grant from the Hattori Hokokai.

Institute of Physical
and Chemical Research,
Tokyo.
May 15.

Y. ISHIDA.
I. FUKUSHIMA.
T. SUETSUGU.

Temperature Variation of Magnetic Anisotropy of Organic Crystals

As has been shown by Krishnan¹ and his collaborators, the study of the magnetic anisotropy of organic crystals enables us in many cases to determine the orientation of the molecules in the crystal lattice. A natural extension of this important line of work, suggested to me by Sir C. V. Raman, is the investigation of the effect of temperature on magnetic anisotropy, which may be expected to yield valuable information regarding the character of the thermal

motions (for example, oscillations and hindered or free rotations) of the molecules in the crystal lattice and to elucidate the mechanism of fusion.

I have carried out measurements in the case of resorcinol over a range of temperature from 26° C. up to the melting point (110° C.) of the substance. Resorcinol was chosen because the crystal is stable and does not volatilize easily. The structure of the crystal has been studied by Robertson² by X-ray analysis, and the magnetic anisotropy at room temperature has also been determined by K. Lonsdale³. The method described by Krishnan⁴ was adopted for the measurement of anisotropy, a modified technique being employed for fixing the crystal at the end of the quartz fibre and for making the measurements at the higher temperatures.

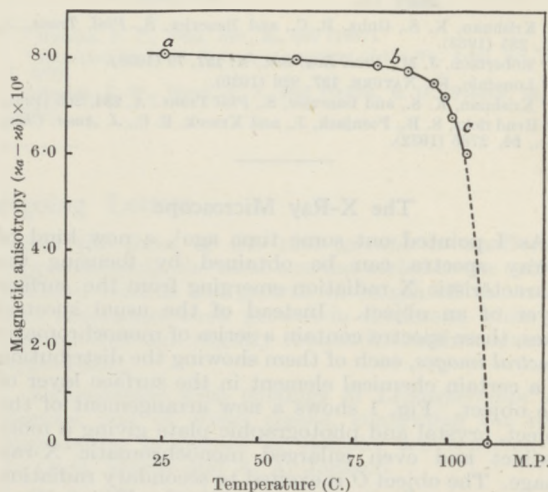


Fig. 1.

The following experimental procedure was adopted. For any setting of the crystal, the magnetic anisotropy in the plane concerned was first of all determined at room temperature. The crystal was then raised to the desired temperature by electrically heating the surrounding tube, the temperature at the region near the crystal being measured by means of a calibrated thermo-element. The magnetic anisotropy at the high temperature was then measured. The crystal was finally allowed to cool down to room temperature and the anisotropy again measured. It was found that when the high temperature did not exceed 105° C., the initial value of the anisotropy was almost fully restored. In all cases the mean of the initial and the final values of the magnetic anisotropy at room temperature was used in the calculations.

The variation of the magnetic anisotropy with temperature when the crystal is suspended with the *c* axis vertical is shown in Fig. 1. Up to about 15° C. below the melting point, the change of anisotropy is comparatively small. From *b* to *c* on the curve the variation is pronounced. From *c* onwards the transition is very rapid, indicating a state of instability. When the crystal was heated until it began to melt, the anisotropy practically disappeared. It is significant that the effect of temperature becomes prominent only in the vicinity of the melting point.

A determination of the magnetic anisotropy of resorcinol at room temperature gave the values: $\chi_a - \chi_b = 8.13 \times 10^{-6}$, $\chi_c - \chi_b = 13.30 \times 10^{-6}$, $\chi_c - \chi_a = 5.22 \times 10^{-6}$, whence assuming Pascal's value

-67.2×10^{-6} , for the mean susceptibility, we get $\chi_a = -66.2 \times 10^{-6}$, $\chi_b = -74.3 \times 10^{-6}$, $\chi_c = -61.0 \times 10^{-6}$, and $\alpha = 55.9^\circ$, $\beta = 47.0^\circ$, $\gamma = 62.1^\circ$, in satisfactory agreement with the results of K. Lonsdale.

I have also made a preliminary investigation of the magnetic anisotropy of ammonium nitrate at different temperatures up to the melting point of the crystal. The magneocrystalline data seem to lend support to the findings of X-ray analysis⁵ in regard to the variation of the crystalline structure of ammonium nitrate with temperature.

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May 18.

¹ Krishnan, K. S., Guha, B. C., and Banerjee, S., *Phil. Trans.*, A, 231, 235 (1933).

² Robertson, J. M., *Proc. Roy. Soc.*, A, 157, 79 (1936).

³ Lonsdale, K., *NATURE*, 137, 826 (1936).

⁴ Krishnan, K. S., and Banerjee, S., *Phil. Trans.*, A, 234, 265 (1935).

⁵ Hendricks, S. B., Posnjak, J., and Kracek, E. C., *J. Amer. Chem. Soc.*, 54, 2766 (1932).

The X-Ray Microscope

As I pointed out some time ago¹, a new kind of X-ray spectra can be obtained by focusing the characteristic X-radiation emerging from the surface layer of an object. Instead of the usual spectral lines, these spectra contain a series of monochromatic *spectral images*, each of them showing the distribution of a certain chemical element in the surface layer of the object. Fig. 1 shows a new arrangement of the object, crystal and photographic plate giving a more distinct and even enlarged monochromatic X-ray image. The object *O* is excited to secondary radiation by primary X-rays. The secondary radiation is reflected on the concave side of the cylindrical crystal *K* and collected to the true monochromatic X-ray image *I*. If the dimensions of the object are small compared with the radius *R* of the crystal, it is possible to satisfy the conditions for a *true enlarged image* by adjusting the positions and inclinations of object and photographic plate.

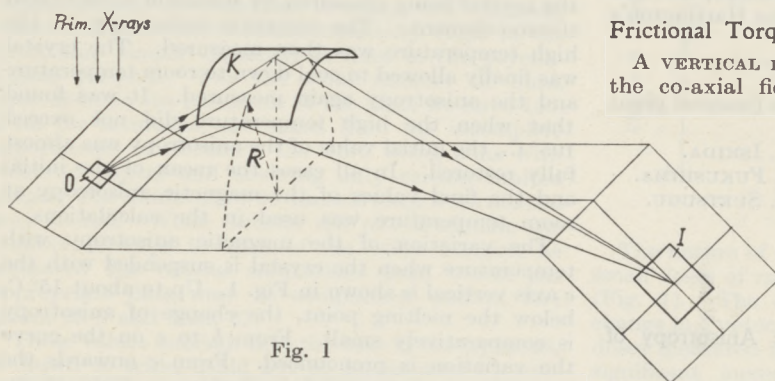
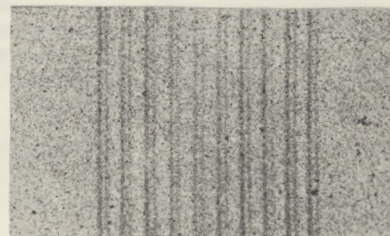


Fig. 1

The test-object for the method was a packet of thin metal foil polished perpendicular to the planes of the different layers. Fig. 2 shows the X-ray photomicrograph of such a test-object (above), with the dimensions of the different layers (below). The X-ray photo-micrograph corresponds to the iron *K- α* radiation, and as this radiation consists of two slightly different wave-lengths, the image of the iron foil appears twice.

By such X-ray photomicrographs chemical analysis for a great number of chemical elements in object not larger than 10^{-8} c.c. is made possible without dissipating the sample.

A more detailed theory of this X-ray microscope will be published in the *Journal of Scientific Instruments*.



1mm.

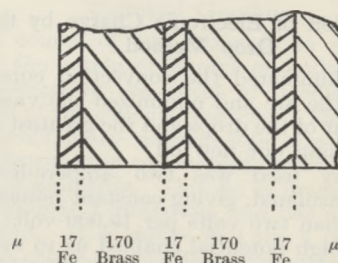


Fig. 2

I wish to acknowledge my grateful thanks to Prof. G. Aminoff for giving me the opportunity to carry out this investigation at the Mineralogical Department of the Riksmuseum, Stockholm, and to Prof. W. L. Bragg for suggestions concerning the publication of this paper.

Riksmuseum,
Stockholm, 50.
April 19.

L. v. HÅMOS.

¹ *NATURE*, 134, 181 (1934).

Frictional Torque of an Axial Magnetic Suspension

A VERTICAL needle of iron suspended *in vacuo* by the co-axial field of a solenoid theoretically may have infinitesimal frictional torque against axial rotation. The purpose of the present note is to report an observed value of this frictional torque.

The arrangement used is a modification of that previously reported by one of us¹. A solenoid carrying a steady direct current produces a magnetic field sufficiently strong to support a large fraction of the weight of the needle. A vane mounted on the needle controls

the amount of light striking a photo-cell. The current from this cell is amplified and fed to a second lifting solenoid. Thus the needle is automatically maintained at a pre-determined height. Vertical oscillations about this position were damped out by using a large resistance in, and capacitance across, the power supply for the amplifier output tube².

For this experiment the vane was a solid aluminum

alloy disk, 15 mm. in diameter and 5 mm. thick, mounted co-axially with the needle. The entire unit had a mass and moment of inertia of about 6 gm. and 0.8 gm. cm.² respectively. It was spun *in vacuo* by the action of the field of a small bar magnet mounted horizontally on an air-driven turbine³ spinning below the disk at about 1,500 rev./sec.

The rotor was speeded up to about 1,200 rev./sec. Its action was such as to indicate that small or large rotors probably can be taken up to their bursting speeds with macroscopic stability, and that many types of drive may be used.

Damping observations were carried out at speeds in the neighbourhood of 600 rev./sec. with the driving magnet removed. Under these conditions, one encounters a frictional torque due to residual gases, and three torques of electromagnetic origin due to misalignment and the earth's magnetic field. In this preliminary work the residual gas pressure was estimated to be of the order of magnitude of 10⁻⁵ mm. mercury, alignment was done roughly, and no attempt

was made to neutralize the earth's field. However, the observed deceleration at the above speed was about 2×10^{-3} rev./sec.², corresponding to a frictional torque of about 10⁻² dyne cm.

It is believed that this device offers possibilities in experiments in which it is necessary to suspend rotatable systems under a variety of conditions. The low frictional torque exhibited suggests its use in experiments in which this property is useful directly, or indirectly as in the attainment of relatively constant rotational speeds for use in velocity of light determinations, etc.

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J. W. BEAMS.

May 12.

¹ Holmes, F. T., *Phys. Rev.*, **51**, 689 (1937).

² Reported by F. T. Holmes at meeting of the Va. Acad. Sci., May 7, 1937.

³ Beams, J. W., Weed, A. J., and Pickels, E. G., *Science*, **78**, 338 (1933).

Points from Foregoing Letters

Measurements of cosmic ray intensities at various atmospheric heights at Madras, India and San Antonio, Texas, indicate, according to Prof. I. S. Bowen, Prof. R. A. Millikan and Dr. H. V. Neher, that the incident cosmic rays produce their maximum ionization before they penetrate more than one tenth of the atmosphere. The authors deduce, from the absorption coefficient down to sea-level, that the particles in the cosmic rays are predominately positive electrons, not protons.

Prof. G. Lemaître points out that the discrepancy in the position of the magnetic centre of the earth, as determined from magnetic measurements and as calculated (from the variations in the intensity of cosmic rays along the magnetic equator), is considerably reduced if one takes into consideration that the cosmic rays consist mainly of positively charged particles.

A photomicrograph of crystals of lysozyme, a protein occurring in the nasal mucosa, capable of lysing certain bacteria, is submitted by E. P. Abraham and Prof. R. Robinson. From the ultra-violet absorption spectrum, the presence of 4.4 per cent of tyrosine and 2.2 per cent of tryptophane is deduced.

Dr. T. Iredale and A. Maccoll find that ethylene bromide (C₂H₄Br₂) decomposes at 340°–370° in a pyrex vessel into vinyl bromide (C₂H₃Br) and hydrogen bromide. This reaction is heterogeneous. No decomposition into ethylene and bromine was observed. The authors suggest that the *trans* form of ethylene bromide is the more stable at high temperatures.

Addition of cocarboxylase to acetone-treated lactic acid bacteria (which had thereby lost the ability to dehydrogenate pyruvic acid) restores their power of dehydrogenation, or oxidation, according to F. Lipmann. The presence of phosphate is essential to the reaction.

H. J. Almquist reports that vitamin K, which preserves normal blood-clotting in chicks, has been obtained in crystalline form.

Dr. H. L. Pearse finds that hetero-auxin sprayed on to the shoots of plants of the broad bean grown in water culture causes swelling of the stem, epinasty of the leaves, and inhibition of the terminal bud,

while the form of the root growth is unaffected. Approximately the same amount added to the culture solution retards the growth in length of the roots, and accelerates their growth in thickness, while the shoots, although slightly retarded, remain normal in appearance.

Experiments with cuttings of *Leptospermum scoparium* and of *Ficus repens*, confirming the root-stimulating properties of skatole, are reported by L. G. G. Warne and A. A. Jackson.

C. A. Wingfield has compared the oxygen consumption of normal and gill-less nymphs of a mayfly at various oxygen concentrations. It appears that the gills play little or no part in respiration at high oxygen concentrations, and only aid the oxygen consumption when the oxygen content of the water is reduced to a low value.

Using the Titchener-Ebbinghaus colour pyramid as the psychological colour solid, Dr. G. B. Welch calculates the number of discriminable colours to be of the order of 940,000.

A curve submitted by J. A. Crowther and H. Liebmann shows that when a colloidal dispersion of graphite is treated with increasing doses of X-rays, its zeta-potential (measured by the velocity of the suspended particles in an electric field) alternately increases and decreases.

A new determination of the charge of an electron by Y. Ishida, I. Fukushima and T. Suetsugu, with additional precautions and improvements, gives a value of $e = (4.806 \pm 3) \times 10^{-10}$ e.s.u.

An X-ray microscope by means of which a true enlarged image of chemically different layers, about 1/100th millimetre apart, was obtained, is described by Dr. L. V. Hamos. It depends on the focusing of the characteristic secondary radiation emitted from a surface layer of an object subjected to primary X-ray irradiation.

Drs. F. T. Holmes and J. W. Beams describe a macroscopically stable axial magnetic suspension which has a very small frictional torque. A six gram rotor when coasting at 600 r.p.s. required about eight minutes to lose one revolution per second.

Research Items

Delaware Ceremonies and Dances

MR. FRANK G. SPECK, who has made a detailed study of the Big House ceremonial of the Delaware, or Lenape Nation, now turns his attention to other ceremonies of no less importance, but of lesser duration (*Mem. Amer. Phil. Soc.*, Philadelphia, 7; 1937). The Big House ceremonial lasts for twelve consecutive nights, and is the periodical communal ceremony, which is the consummation of Delaware religious fervour. It expresses their attitude towards the benign Supreme Being. In their annual cycle, however, there is a number of other rites and ceremonies, in which they enter into relation with other spiritual beings, from whom, for the most part, evil is anticipated. Even though the Lenape have been removed from their original home in Pennsylvania and New Jersey to Oklahoma, these ancient rites have continued in practice down to the present day. It is probable that they are of a more ancient origin than the Big House ceremony. Some of them, as for example the Grease Drinking ceremony and the Doll dance, are family properties handed down as obligations to the tribe within the family group. The ceremonies are supposed to have originated through the mythical association of family ancestors with supernatural agencies. This is usually explained in a mythical narrative. Their purpose is to satisfy an offended spiritual force and to prevent a recurrence of the original misfortune avoided by the rite. The group performing the ceremony gains an added blessing in some form, such as an augmentation of crops. There are various officials of the ceremonial, of whom the chief is a master of ceremonies. The performance usually takes place at night. In addition to the description of the ceremonies, an account is given of the Delaware form of the dance taking place when the bones of the dead, from which the flesh has been stripped, are buried.

Early Peruvian Textiles

A LARGE number of specimens of textiles from early sites in the Nasca valley, Peru, numbering one hundred and sixty in all, collected by Prof. A. L. Kroeber in 1926, on behalf of the Field Museum, Chicago, have been described by Dr. Lila M. O'Neale, associate curator of textiles in the Museum of Anthropology at the University of California (*Anthropology: Memoirs*, Field Museum, Chicago, 2, 3). In an introductory note, Prof. Kroeber points out that Early Nasca textiles were not previously well known, and in fact were scarcely recognized; but the present material affords adequate data for satisfactory study, owing to the fact that he was able to establish the archæological associations of his specimens. It has now been shown by Dr. Tello's archæological investigations at Paracas that the finely embroidered polychrome shawls and garments, at first identified as Ica and then as Nasca, are now to be associated with Paracas. The stylistic relation between Early Nasca pottery designs and those of Paracas textiles is so close as to leave little doubt of a common origin, the pottery probably being the earlier. The Early Nasca textile art discovered in association with Early Nasca pottery is largely decorative and tends to the geometrical, while its representations of naturalistic

impulses are relatively undeveloped. Nasca pottery and Paracas fabrics go together, while Nasca fabrics and Paracas pottery are alike in not attempting naturalistic representation. When the Early Nasca peoples wanted a picture on cloth, they painted it on. One example of this was found, duplicating in design a well-known Early Nasca pottery type, birds in attitude and placement in the design being identical with birds painted on double-spouted jars. The most striking feature of the Early Nasca textiles is their range of colours. They show a total of 190 hues by comparison with a colour scale, the majority to be described in terms of red, orange and yellow. The material used is a finely spun cotton yarn. Five of the eight standard weaves known to modern weaving were known to the Early Nascans, and in addition they did wrapped weaving, as in basketry.

Problems of Population Density

THE biological principles affecting populations are discussed by Raymond Pearl (*Amer. Naturalist*, 71, 50), with references to experimental work on animal populations. He points out that the fundamental underlying principles are the same in man and in other animals; and that population growth or decrease has had an important effect in shaping political conduct and national policies, human populations differing in size, growth and quality. He is inclined to conclude that the human population of the earth grew very slowly until about three centuries ago, and then, as a result of scientific discoveries, took a great spurt and so increased from some 445 millions to more than 2,000 millions, or 40 persons per square mile of the earth's land surface. He regards this cycle of population growth as about two-thirds completed, and compares it with the cycles of lessening population. He interprets these cycles as beginning with a period in which the population remains relatively constant, followed by abatement of some of the natural checks, which leads to rapid increase. Population density finally reaches a point where new stimuli, reinforced by gregariousness, lead to migratory movements and ultimate destruction of masses of individuals. In the same journal, Dr. Thomas Park discusses in detail the recent experimental work on insect populations, with special reference to density effects.

Laboratory Diagnosis of Psittacosis

PSITTACOSIS or 'parrot' fever is a virus disease of cage birds, and is communicable to man, in whom it causes a serious and often fatal malady. This disease was comparatively prevalent in Great Britain and in the United States some years ago, and was of sufficient importance for the Ministry of Health to issue a memorandum, with recommendations upon its diagnosis and prevention. As a result of recent investigations, it has become possible to give more precise indications for the detection of the disease in man and in animals, and the Ministry of Health has published a report containing details of the technique of laboratory diagnosis (Laboratory Diagnosis of Psittacosis. Reps. on Pub. Health and Med. Subjects, No. 80. London: H.M. Stationery Office. 6d. net). The examination of suspected birds and

of suspected human beings is described. The staining of smears of material for virus bodies, and the microscopic appearance of the virus are also described, and the appearances found are illustrated in an excellent coloured plate.

Feeding of *Chirocephalus*

SIR E. RAY LANKESTER in his essay on *Apus* (1881) first used the term 'gnathobase' for the proximal endite of the trunk limb, stating that it was a jaw-process which clearly had the function of assisting, by means of apposition to its fellows on the opposite side, in seizing and moving particles which may be introduced into the mouth. A. G. Lowndes, in his recent paper on *Chirocephalus* (The Term "Gnathobase" (Lankester). *Proc. Zool. Soc. Lond.*, B, Part 1; 1937), is in complete agreement with Lankester, and concludes from direct observations and by the use of his strobographic method, described in *NATURE* (135, 1006; 1935) that the setules of the basal endites can and do act in apposition while the limbs are working normally. He finds, however, that they do not do so always, and this, he believes, confirms his previous observation that the endites are under both muscular and nervous control and that one need not look upon the passage of food particles towards the mouth as being in any way automatic. Mr. Lowndes and his pupils have examined hundreds of specimens of *Chirocephalus* for gut contents, and find that the food consists almost entirely of quite coarse particles, such as remains of vascular bundles of leaves, etc., which are to be found at the bottom of most ponds. Other detritus such as algal filaments, leaves of moss, and dead Entomostraca are also found in the gut.

New Porcellanids and Pinnotherids

UNDER the title "Porcellanids and Pinnotherids from Tropical North American Waters", Mr. Steve A. Glassel describes several interesting forms, mostly collected by himself (*Trans. San Diego Soc. Nat. Hist.*, 8, No. 21; 1936) from the west coast of Mexico and from the Gulf of California. Four new species of *Petrolisthes*, three of *Pisosoma*, two of *Pachycheles* and three of *Porcellana* are included. The new genus *Orthochela* in the Porcellanidae is created for another new species, *O. pumila*, which is very peculiar in the shape of its carapace, resembling *Uroptychus* in the family Galatheidae. This crab is figured and also the outer maxillipedes of the three new species of Pinnotheridae, *Fabia unguifalcula*, *Dissodactylus xantusi* and *Pinnixia richardsoni*. Otherwise the paper is not illustrated.

Locust Control

THE Committee on Locust Control of the Economic Advisory Council has issued a fifth survey of the locust outbreak in Africa and Western Asia. The latest of these surveys deals with the situation in 1935 and has been prepared by Dr. B. P. Uvarov, in collaboration with Miss W. Milnthorpe, of the Imperial Institute of Entomology. It appears that the outbreak of the three species of locusts, which have brought about so much damage during the past eleven years, is subsiding. At the same time it is pointed out that no relaxation in the campaign of locust investigation would be justified on this account. The desert locust, for the first time since 1926, had not invaded North Africa. The appearance of a swarm in May, 1926, in the Darfur province of the

Anglo-Egyptian Sudan is disquieting, since its origin must be in an unexplored coastal area of the Red Sea. The possibility that it may sooner or later develop into a new invasion needs to be kept in mind. As regards the African migratory locust, it is now known that the outbreak centres are in the Middle Niger region. It is believed that this area is the only real danger spot in the whole continent of Africa in so far as this species is concerned. Practical measures are being planned for the permanent supervision of that outbreak area. With the red locust, heavy mortality has been caused by the fungal disease *Empusa grylli* among both the hoppers and winged forms. Viewed generally, the outbreak of this species is on the decline; but swarms are likely to be still produced for some years to come.

Mutation in Tobacco Virus

MUTATIONS in viruses are the subject of a paper by Dr. H. H. McKinney (*J. Hered.*, 28, No. 2), who cites experimental work, especially with mosaics of tobacco. While these viruses tend to remain true to type over long periods, yet they give rise in local zones of the infected plant to aberrant viruses which when isolated induce distinct symptoms. Some of these aberrant viruses in turn give rise to others. This is interpreted as a mutational phenomenon. Such mutants differ in the changes they produce in the chlorophyll mechanism of the leaf, some producing no disturbance, others a slight disturbance (light green mottling), others a yellowish-green, yellow or even almost white colour. Temperature has an important effect on these disturbances. Nearly a hundred mutants have been isolated from the common mosaic, but the number of distinct types is uncertain. Sub-mutants are also produced, the whole system of types tending to show certain relationships. The generation of these bodies is believed to be different from that of an enzyme from its precursor. The primary virus and its mutants are regarded as a series of closely related compounds which function essentially as genes.

A Rice Fermentation

ALCOHOLIC fermentations fall into three groups: (1) the direct inoculation of the fruit juice by yeasts as in wine production; (2) the fermentation of a grain extract after pretreatment as the malted grain in beer; and (3) the reinoculation of a partially cooked plant material. Rice as a source of alcohol has had to be approached from this third angle by K. Rami Reddi and Dr. V. Subrahmanyam, of the Indian Institute of Science, Bangalore, who have published a most interesting paper upon 'Sonti' fermentation (*Trans. Nat. Inst. Sci., India*, 1, No. 11, 1937), which describes and analyses traditional methods of rice fermentation handed down from father to son, often as secret customs in small village communities, and then gives a preliminary estimate of their biochemical and biological basis. The 'Sonti' fermentation is practised in certain districts of the Madras Presidency. The main organism associated with the process appears to be a hitherto undescribed species of *Rhizopus* provisionally named *Rhizopus Sontii*. It is allied to *R. cambodia*, but its physiological activities are more pronounced. Indeed *R. Sontii* may have a practical future before it as it liquifies and saccharifies cooked rice more rapidly than other well-known organisms, including *Aspergillus oryzae*. This paper is fascinating in its linkage of tradition

with modern problems of biochemistry and mycology, and it shows the great possibilities of advance in standards of nutrition as the result of scientific study of methods of food preparations that are acceptable to a conservative native population. Studies of the species of *Rhizopus* isolated from Chinese yeast cakes such as are used in brewing alcohol from cereal grains in China, Manchoukou and Korea are also being extensively carried out by M. Yamazaki, professor of zymology (*Bull. Utsunomiya Agric. Coll.*, A, 2, No. 6, 1937).

Cyclones in the South Indian Ocean

MISCELLANEOUS PUBLICATIONS of the Royal Alfred Observatory, Mauritius, have in recent years included an annual publication in which an account is given of all the tropical cyclones that have been noted in the last cyclone season in the South Indian Ocean from Cocos Keeling Island across to Madagascar and the adjacent coast of South Africa. Publication No. 16, by N. R. McCurdy, director of the Observatory, which is the seventh of its kind, covers the season 1933-34. The number of depressions of sufficient intensity to be classed as tropical cyclones or hurricanes in that season was eight, which is about the average number; but the weather was more than usually disturbed during the hurricane season, and seven other disturbances are referred to briefly. It is said to have become increasingly evident in recent years with improvements in the synoptic charts, that the formation of cyclones is closely related to the periodic invasions into low latitudes of the cooler air associated with subtropical high-pressure systems. These systems usually move north-eastwards from South Africa but sometimes northwards. In the season under discussion, areas of disturbed weather always developed at the northern limit of the high-pressure wave when the latter was of appreciable intensity, and these sometimes led to the development of a tropical cyclone. Observations with pilot balloons at Mauritius showed that this happened whenever the east or south-east trade winds of the 'high' extended up to 5,000 metres. This is held to be a result of importance in forecasting, in the absence of enough observations from the Indian Ocean to the north of Mauritius to permit of the approach of cyclones to be studied for some days before their arrival near to or over the island itself. None of the storms of this season appears to have been of very outstanding intensity, but some showed interesting features; for example, that of January 26-February 2, which was deflected from its course by the high land of Mauritius, although the highest 'peak' of the island has only an elevation of about 2,700 ft. Another storm in March was broken up into two centres by its encounter with Madagascar, and soon died out.

Absolute Measurements of Sound Intensity

E. N. DA C. ANDRADE and R. C. Parker (*Proc. Roy. Soc.*, A, 159, 507) have measured the amplitude of vibration of smoke particles suspended in a vibrating air column. A theoretical calculation shows that, in the case of fine particles (radius about 0.03μ), this amplitude is very nearly indeed that of the air itself, and this result is confirmed by the fact that particles of different size in the same air column show the same amplitude of motion. The particles were seen and photographed by scattered light: they appeared as well-defined short lines of light. The

apparatus was kept at a constant temperature both to reduce convection and to give generally consistent operation. When the apparatus had been calibrated, it was used to determine the minimum amplitude audible to a number of observers. The end of the tube was allowed to radiate into the open air, and the intensity varied while the observer indicated when the sound passed above and below his threshold of hearing. The observed minimum intensities for audibility were very similar for a number of observers. They corresponded to a pressure variation of 1.2×10^{-3} dynes/cm.² r.m.s. at 410 cycles and 0.9×10^{-3} dynes/cm.² r.m.s. at 646 cycles. The corresponding energy fluxes are 3.4×10^{-8} erg./cm.² sec. and 2.1 erg./cm.² sec.

Lead Borates

A KNOWLEDGE of the system PbO-B₂O₃ is of importance in the manufacture of ceramic glazes and glasses, and a study by well-known methods involving quenching and petrographic examination has been made by R. F. Geller and E. N. Bunting (*J. Res. Nat. Bur. Stand.*, 18, 585; 1937). Four compounds were characterized, namely, 4PbO, B₂O₃ occurring in two forms and melting congruently at 565°; 2PbO, B₂O₃ occurring in two forms and melting incongruently at 497°; 5PbO, 4B₂O₃ melting incongruently at 548°; and PbO, 2B₂O₃ melting congruently at 768°. No evidence of compounds richer in B₂O₃ was obtained, although these have previously been reported. Particular attention was given to the proof that the compound 5PbO, 4B₂O₃ is not the metaborate (PbO, B₂O₃). The eutectic of lowest melting point, 493°, was composed of 88 per cent PbO and 12 per cent B₂O₃. The report also gives the indices of refraction and optical characters of the compounds, and the indices of refraction, coefficients of expansion and softening points of some lead borate glasses.

Isotopes of Potassium

The abundance ratio for the two principal isotopes of potassium, K³⁹/K⁴¹ (the exceedingly rare isotope K⁴⁰ is responsible for part and possibly all the radioactivity) in various animal tissues has been measured by J. H. Yoe and R. T. Hall (*J. Amer. Chem. Soc.*, 59, 869; 1937) by means of the mass spectrograph. Any process which concentrates K⁴¹ will doubtless concentrate K⁴⁰, and as speculations have been made on the possible biological importance of potassium, owing to its radioactivity, it was of interest to see whether the abundance ratio varied in different tissues. The results showed that the ratio for most organs is close to the value found for most plants and minerals and for ocean water. A few tissues, such as the lining of the auricle and the lining of the small intestine, appear to possess an abnormally high concentration of K³⁹, whilst bone marrow is abnormally high in K⁴¹. The atomic weight of potassium was calculated, with the most probable value of the packing fraction and the conversion factor; for most tissues it is 39.094. Since all deviations from this normal value are small, it does not seem probable that potassium in animal tissue could be distinguished from mineral potassium by radioactive measurements as has been suggested by some investigators. The results with bone marrow indicate a possible relationship between the abundance ratio and the age of the animal, and hence with the development of embryonic cells within the organism.

The International Congress of Agriculture

MEETING AT THE HAGUE

THE seventeenth International Congress of Agriculture was held at The Hague on June 16-24. Great Britain was officially represented for the first time for many years, though at recent congresses members of the Women's Institutes and the Horace Plunkett Foundation have been present. There is always a tendency in Great Britain to regard international congresses, other than those of specialists, as somewhat in the nature of 'joy-rides'. Languages undoubtedly present a difficulty that weighs more upon our people than upon Continentals, and this applies more particularly to those informal discussions and personal contacts from which those who participate in the Congress gain most.

The abstention of British representatives of agriculture from this Congress has most probably been due to the feeling that their industry is fundamentally different from the European system, in which peasant farming predominates. However, nowadays nearly all nations have embarked upon policies of control and regulated marketing, about which there is much to be heard from the Continental experiments, which aim like our own at the safeguarding of an industry ill-adapted to hold its own under modern conditions. From every nation one hears the same tale of low prices, of the inability of the farmer to hold his own against the trader or to get his products to the consumer at prices commensurate with those which he receives, and of the drift of men from the land. A 'Green International' is not possible, so diverse are the interests and the organization of the land and the farmers in different countries, but one's domestic policy is more likely to be successful if it is informed of what is going on elsewhere.

From the technical side, Holland is the country most worthy of study by the British farmer; its agriculture is highly accomplished and works under conditions of mixed capitalist exploitation and small holders, analogous to our own. Livestock bulk large in the system and the organization either of registration, disease prevention, advice, even of shows, affords us much to think about. The production of sugar from beet is higher in the Netherlands than in any other country—for the years 1926-29, 4,000 lb. per acre as against 2,500 lb. in Great Britain. Vegetable growing exhibits an exceptionally high general level of efficiency, even if some of our experts need fear no comparison.

It was therefore somewhat of a lost opportunity that British representation at the Hague Congress, except in the women's section, was still so limited. The formal opening was attended by H.R.H. Prince Bernhard and a representative of the Queen, the Prime Minister of the Netherlands and the Minister of Agriculture, the Minister of Agriculture of Italy, the president and secretary general of the International Institute of Agriculture at Rome, and representatives of forty nations in all. In welcoming the Congress, M. Colijn, Prime Minister, made a courageous speech on the necessity of breaking down the trade barriers between nations which have so often been set up in response to the pressure of particular interests. This was followed by a remarkable

demonstration, at which the representatives of one country after another affirmed that the maintenance of peace was the prime necessity for the maintenance of agriculture and indeed of the world's civilization.

Then, as is customary, the Congress resolved itself into its various committees. The first and third sections, dealing with agrarian policy and co-operation respectively, bore perhaps little upon British conditions, though the discussion on the international market for butter was of interest to the Dominions. The second section discussed education and propaganda, and the chief point raised was the importance of economic studies in the agricultural colleges as a means of preparing trustworthy leaders of opinion in these times when so much legislation affecting agriculture is being proposed. The fourth section, on plant production, produced discussions on the improvement of protein yield from light soils and on vernalization, with some reference to the recent clash between the advocates of vernalization and the geneticists in Russia. Of great interest was the account of recent legislation in Germany to restrict the number of varieties of farm crops that can be offered for sale, a restriction dependent upon an organization for testing the productivity of the immense number of varieties that are more or less in cultivation. It was reported, for example, that from the 348 varieties of wheat formerly to be found in Germany, only 11 may now be sold, with a further 34 under trial. The vexed question of assuring to the breeder of a new variety protection analogous to that of a patent was discussed at some length. If legislative control is obtained of the varieties that may be offered for sale, it is possible to secure royalties on the stocks multiplied from the original which has been duly characterized and registered, but while something is thus practicable internally, the situation is complicated by the existence of international trade and the lack of any general system of testing and registration. In the section on livestock production, discussion chiefly turned on the role of vitamins and mineral accessories, and several of the papers presented merit careful consideration.

In the woman's section the chief report had been prepared by Mrs. Haldane, on public health regulations in English villages. The role of the woman in agriculture is obviously much larger in the European countries than in Great Britain, owing to the predominance of peasant farming; hence the greater attention that is being paid to instruction in the domestic economy of the farm.

The Congress was admirably prepared and organized; before the meetings copies were available in French of the reports and of the main communications. It might, however, well be laid down that a speaker whose paper has been printed should not read it at length, particularly in a language in which he is not at home; in some sections the time for discussion was seriously curtailed by this.

The Congress was followed by excursions to the reclamation works of the Zuider Zee, the experiment station at Wageningen, and to farms representative of the milk production and market gardening industries.

The National Physical Laboratory

INSPECTION BY THE GENERAL BOARD

THE annual inspection of the work in progress at the National Physical Laboratory was made on June 22, by the General Board and also by about two thousand visitors, who were received in the High Voltage Laboratory by Sir William Bragg, president of the Royal Society, chairman of the Board, Lord Rayleigh, chairman of the Executive Committee, and Sir Frank Smith, director of the Laboratory. Amongst the numerous exhibits in the eight departments of the Laboratory the following may be mentioned.

A comprehensive investigation into the thermal properties of a number of alloy steels is being made in the Physics Department up to temperatures of the order of 800° C. The thermal and electrical conductivity, specific heat, latent heat at the transformation points, and thermal expansion, are measured *in vacuo*. The specific and latent heats are determined by measuring the rate of rise of temperature of a hollow cylindrical specimen in which an electric heater is embedded. Loss of heat by radiation is avoided by surrounding the specimen with a jacket of low thermal capacity, which can be adjusted always to the same temperature as the specimen. The thermal conductivities of a large variety of materials are also measured in this section, the method generally employed consisting in the determination of the electrical energy required to maintain a known difference of temperature across a specimen of slab or cylindrical form, lateral flow of heat either being annulled by some form of guard system or else determined by a separate experiment.

In another building the apparatus used for the accurate realization of various points on the International Temperature Scale was shown, and the routine testing of various types of thermometers was demonstrated. It should be mentioned here that approximately half a million clinical thermometers have been tested at the Laboratory during the last year.

The radiological work done at the Laboratory can be divided into two sections, one devoted to the precise measurement of the properties and intensities of X-rays and gamma rays and the other to the application of radiography and diffraction methods to the study of the structure of materials. This latter has now become a valuable experimental tool, and typical results obtained by it on electro-deposited, heat-treated and strained metals, tooth-enamel and dentine were shown. A considerable amount of radium has been tested lately, and a valve amplifier apparatus for facilitating this work was demonstrated. The lead equivalents of various building materials to X-rays of different hardness have also been investigated, and the superior performance of barium concrete in this respect was illustrated.

A popular exhibit in the acoustics laboratory—which is at present in process of enlargement—was designed to test the efficacy of various anti-drumming treatments applied to metal panels representative of the bodywork of vehicles. The panel under test is held in a rigid square frame which is attached to a moving-coil loud-speaker movement at each corner

and thereby driven at any desired frequency. The acoustic output is measured over a range of frequencies. The measurement of the absorption coefficient of sheet material was also demonstrated in the reverberation room, and a portable instrument for the measurement of noise, in which the peculiarities of the average human ear in this respect have been copied, was shown.

In the Optics Division, apparatus for measuring the intensity-response function of thermopiles and also the time-constant of this response was demonstrated. In the latter, the thermopile is connected to a condenser which is discharged through a ballistic galvanometer by an adjustable time-switch. Amongst the numerous exhibits here devoted to the measurement of colour a spectrophotometer for opaque surfaces was noted. The feeble intensity available from such a surface is counteracted by using a zonal concave mirror which focuses the light received from the specimen on to a photo-electric cell.

The Electrical Standards Division is now in a strong position with regard to the absolute determination of the ohm, inasmuch as the value finally obtained by the a.c. method devised by Albert Campbell has been found to agree to within 1 part in 100,000 with that obtained by the Lorenz machine. The apparatus used in these refined measurements was exhibited and the precautions necessary to attain the required accuracy were illustrated. Amongst other exhibits in this section was a simple form of apparatus for calibrating audio-frequency oscillators, using 50-cycle a.c. mains as a standard. The 50-cycle wave-form is distorted by passage through a metal rectifier and then mixed in suitable proportions with the oscillator output. The resulting combination is passed through a telephone in series with another metal rectifier, and integral multiples of the mains frequency are revealed by the presence of beats. A new type of quartz ring oscillator which will form the principal unit in a standard clock for the Royal Observatory, Greenwich, was also shown, together with the quartz bars used in a recent experiment, which showed that the frequency of vibration of these bars remains constant to ± 4 parts in 10^{11} irrespective of their orientation in a horizontal plane. This has been cited as being the highest precision ever achieved in a physical measurement.

In the Electrotechnics Building, the standard apparatus for the routine testing of alternating and direct current meters of all kinds was shown. The functioning of the thyatron stroboscope recently developed was illustrated by cathode ray oscillograms of the current in various parts of the operating circuit, and the results of a comprehensive theoretical and experimental investigation into the eddy-current losses in square-section alternating current conductors were also shown here.

The work in the High Voltage Laboratory is mainly carried out with impulsive voltages, and cathode ray oscillograms illustrating the work recently done were exhibited. In addition, the testing of a pin insulator with simultaneous alternating and impulsive voltages

was demonstrated, and the relation between the phase of the impulse and the probability of an ensuing power arc illustrated. The demonstration of high voltage sparks proved, as usual, to be a very popular exhibit.

In the Photometry Building, an exhibit which attracted attention was concerned with street lighting. A cinema film was prepared from a series of photographs of a night street scene and the projected image viewed from a definite position. On recognizing the change from one scene to another, the observer presses a key which operates the shutter of a camera, thereby recording the instantaneous position of the film, and hence the delay in recognition. This has been carried out with various sources of illumination in order to find out if any of them have advantages from this point of view. In this building there were also exhibits illustrating the routine testing of electric lamps, maintenance of photometric standards, and other illumination research. The photo-electric spectrophotometer recently developed was shown in operation: this has materially reduced the time and tedium involved in visual measurements of this nature.

In the Radio Department the chief exhibits, which were shown on the same occasion last year, were a direction-finding radio receiver for use on wavelengths between 8 and 10 metres, a self-checking, direct-reading, frequency-measuring equipment for the range 1-70 megacycles per second, which is based on a standard 1,000-cycle tuning fork, and a number of coils and condensers of very low or adjustable temperature-coefficients of reactance.

The synchronization of a pulse transmitter and receiver, such as are used in the ionosphere research of the Radio Department, where the frequency of the exploring waves may be varied over the range 1-20 megacycles per second, has been effected automatically. The receiver is tuned by means of a small reversible electric motor, suitably geared down, which is controlled, through a system of relays, by currents which depend on the difference in frequency between the transmission and the frequency-change oscillator of the receiver.

An interferometer for routine measurements of block gauges which was exhibited in the Metrology Department has very materially decreased the time occupied by such tests. A series of gauges is wrung radially on to a circular lapped plate which is rotated so that each is viewed successively in light of four monochromatic radiations from a cadmium lamp. By estimating to 1/10th of a fringe for each radiation, the amount by which the path-difference between light reflected from the surfaces of the gauge and the plate differs from an integral number of wave-lengths, and knowing the approximate thickness of the gauge, the true thickness may be determined rapidly and without ambiguity. Amongst the new exhibits in this Department was a comparator sensitive to a millionth of an inch, and a circular dividing table reading to 1 second and accurate to 5 seconds of arc, in which the driving mechanism and the reading mechanism are entirely separate, so that the latter is not subject to wear.

An appliance for measuring the drunkenness (that is, departure from a true helix) of screw threads was shown. A pair of round-nosed feelers attached to a floating carriage register in the vee-groove of the screw at opposite ends of a diameter. Rotation of the screw produces axial movement of the feelers, and any inequalities in the movements of the two feelers is revealed on a dial gauge capable of detecting

errors as small as 0.00005 inch. A horizontal projection machine has just been completed. By using suitable lenses, plate gauges up to 3 inches in length can be projected as a whole to a magnification of 25, the maximum error over any part of this field not exceeding 0.0002 inch, whilst the threads of screw gauges up to 8 inches in diameter, and the teeth of large gear-cutting hobs, can be examined at a magnification of 50. An experimental machine for testing the wearing qualities of gauge steels consists of a lapping table on which three ring-shaped specimens rest. The table and the specimens all rotate slowly about their own axes, thereby reproducing a lapping operation.

The combined fatigue testing machine developed in the Engineering Department was in operation on specimens of cast material for use as crankshafts. The high resistance to fatigue of these materials has emerged from the results so far obtained, and a law has been devised determining the behaviour of cast materials under conditions of combined bending and torsional fatigue stresses. Another exhibit of interest showed the results of fatigue tests under corrosive conditions, and the effect of using protective coatings to combat the deleterious effects thereby obtained on a number of steels. Amongst the exhibits connected with problems of lubrication, the influence of small quantities of water on the lubricating value of a motor-car oil was shown. In a journal-bearing machine, a reduction of seizing temperature from 200° C. to 140° C., and an increase of about 40 per cent in the minimum friction, was obtained, with only 0.05 per cent of water.

In the Metallurgy Department the development of magnesium alloys has continued, and data showing the valuable properties possessed by certain alloys containing aluminium and cerium were illustrated. In the rolling mill, the technique of working these alloys was demonstrated, and some very clean examples of forged and machined work were exhibited. A careful exploration of the delta region of the iron-carbon system has recently been made, using materials of the highest purity *in vacuo*. The results were exhibited in the form of the constitution diagram of this particular region of the iron-carbon system. The iron used in this and other researches is prepared in the Department by reduction of ferric oxide in hydrogen. The vacuum fusion method of determining the oxygen content of steels has been improved in reliability by the removal of gases from the apparatus at 2,200° C., thereby reducing both the correction to be applied and the time taken to carry out a test. The main results of the work which has been done on dental alloys for several years were summed up in a model, which shows the relation between the composition of the alloy and its volume change during setting. The narrow limits within which a satisfactory alloy lies were thus well illustrated. Experiments have been made in this Department on the diffusion of gases through wood. With hydrogen diffusing across the grain, it has been found that the rates vary by as much as 2,500 to 1, depending on the variety of wood under test.

The electron microscope is being developed as an experimental tool, and a magnified image of a very fine wire gauze was exhibited to show some of the possibilities of this instrument.

In the Aerodynamics Department the pitot-traverse method of measuring aerofoil drag appears to be now more widely used, and satisfactory agreement has been obtained between this and balance measurements. The drags of a number of aerofoils

with various surface finishes have been measured in the compressed air tunnel up to a Reynolds number of 24 millions. Similar experiments on a thin aluminium plate with suitably shaped leading and trailing edges have given very good agreement with the theoretical curve for turbulent flow over a flat plate except at low Reynolds numbers, where the experimental curve tends to fall to the theoretical curve for laminar flow. Two other exhibits in this Department were devoted to the investigation of the transition from laminar to turbulent flow along the boundary of an aerofoil, one employing a visual— or photographic—method, and the other a hot-wire method of detection.

In the large 'duplex' wind tunnel the effect of the slipstream from the propellers of a model monoplane on the stability of the model was being studied, the propellers being driven by an internal electric motor. Another exhibit of interest here was concerned with the problem of wing flutter. The aerodynamic forces acting on a wing section subjected to a sinusoidal pitching motion are measured by the aid of a magnetostriction stress recorder. The high-speed tunnel, which operates by induction from the exhaust from the compressed air tunnel, has been employed in the investigation of the behaviour of aerofoils up to speeds of more than 600 miles per hour, where the effects of the compressibility of air attain a pre-dominating importance.

Experiments on the improvement of ships' lifeboats enabling them to avoid shipping seas in rough water were in progress in the William Froude Laboratory, and the results obtained with a model have been confirmed by full-scale trials of a lifeboat of the best design. Tests were also being made in the new tank on a model propeller partially immersed in water, as for a ship in ballast condition. Automatic records of thrust, torque, revolutions, etc., are made at different immersions. By means of a stroboscope, the action of the blades upon the water during emersion and submersion is observed. It should be noted that during 1936, 88 ship designs were tested in this Laboratory, representing 80 per cent of the merchant shipping listed as "under construction" in Great Britain.

University Events

CAMBRIDGE.—Dr. H. J. Bhabha, of Gonville and Caius College, has been awarded an 1851 Exhibition studentship.

The General Board recommends that three additional part-time University lectureships in zoology be established from October 1; that an additional University demonstratorship in zoology be established from October 1, and that a readership in invertebrate zoology be established for one tenure only, and that the General Board be authorized to appoint Dr. C. F. A. Pantin to this post from October 1.

Dr. R. N. Chopra, of Downing College, has been approved for the degree of Sc.D.

At Christ's College, Dr. R. D. Davies, of Gonville and Caius College, has been elected into a research fellowship. Dr. Davies was elected to a Salomons engineering scholarship in 1921, and was placed in Class I of the Mechanical Sciences Tripos in 1922. He is a University demonstrator in engineering and was formerly a captain in the Royal Engineers.

Sir David Chadwick, formerly a scholar of Sidney Sussex College, secretary of the Imperial Economic Committee and of the executive council of the Imperial Agricultural Bureaux, has been elected an honorary fellow of Christ's College.

LONDON.—University postgraduate studentships of the value of £150 for one year have been awarded to W. J. Allum (Imperial College—Royal College of Science), W. J. Arrol (Queen Mary College and Imperial College—Royal College of Science), Elizabeth Carey (University College), J. A. Kitchener (University College), D. McMillan (University College), J. D. Marcantoni (Queen Mary College), Dorothee Metlitzky (University College), A. A. Ruddock (University College, Southampton) and Elizabeth Sweeting (Royal Holloway College).

The University studentship in physiology of the value of £100 has been awarded to J. P. Quilliam (University College) who will carry on physiological research at University College.

O. A. Saunders has been appointed as from October 1 to the Clothworkers' readership in applied thermodynamics tenable at the Imperial College—City and Guilds College. Since 1932 he has been lecturer in applied mathematical physics at the College.

OXFORD.—Sir Farquhar Buzzard, Christ Church, and I. O. Griffith, Brasenose College, have been elected to the Hebdomadal Council.

Dr. A. D. Gardner, University College, has been appointed to the new readership in bacteriology as from October 1. The title of professor has been conferred on Dr. A. D. Gardner. Dr. A. H. T. Robb-Smith has been appointed assistant director of pathology at the Nuffield Institute.

The senior mathematical scholarship for 1937 has been awarded to G. L. Camm of Balliol and New Colleges.

Dr. H. M. Sinclair, Oriel College, has been elected to an official fellowship and tutorship in physiology at Magdalen College. Miss M. G. Adam, senior scholar of Lady Margaret Hall, has been appointed assistant tutor in science at St. Hugh's College. At Christ Church, J. F. Hope Simpson (Balliol College) has been elected to a senior scholarship for work in botany and J. A. Moy-Thomas re-elected to a lectureship (the equivalent of a research fellowship) in zoology.

J. A. Boycott, Brasenose College and Miss E. J. Cockram, Society of Oxford Home-Students, have been granted degrees of M.D. Dr. N. C. Wright (Christ Church), of the Rowett Institute, has been granted the degree of D.Sc. for his work on proteins.

At Queen's College, M. Abercrombie has been elected to a junior research fellowship for work in zoology and E. P. Abraham, New College, to a taberdarship for work in chemistry.

R. Campbell Thompson, Merton College, has been elected Shillito reader in Assyriology in succession to the late Prof. S. Langdon.

ST. ANDREWS.—At a graduation ceremonial to be held on September 28 in connexion with the celebration of the quater-centenary of St. Mary's College, the honorary degree of LL.D. is to be conferred on Sir Leonard Woolley, archaeologist, among others.

The following appointments have recently been made: J. Dewar to be lecturer in chemistry in the United College, St. Andrews; T. G. Cowling to be lecturer in mathematics, and R. E. Stedman to be lecturer in philosophy, both in University College, Dundee.

Science News a Century Ago

The Grand Junction Railway

THE most important addition to the railways of Great Britain in 1837 was the Grand Junction Railway, uniting Birmingham with Liverpool and Manchester. The Bill for the line had been passed in 1833, and in 1834 the directors appointed George Stephenson and Joseph Locke as joint engineers. Stephenson withdrawing in August 1835, Locke became engineer-in-chief, and the line was constructed under his supervision. The opening of the line took place on July 4, 1837, when a train left Newton on the Liverpool and Manchester Railway at 7.0 a.m. and, after stopping at Crewe, Stafford and other places, finally arrived at Birmingham at 11.30 a.m. The distance was $82\frac{1}{2}$ miles. Describing the events of the day, the *Morning Herald* said: "From Wolverhampton to Birmingham a general holiday appeared to be observed and the scene was highly interesting both to the observed and observers. Tents were pitched in several fields, and parties given by the respective tenants in honour of the day. The weather was extremely beautiful, and the freedom from dust which exists on railways is another interesting feature connected with this branch of mechanics." Among the most notable works on the line was the Dutton Viaduct, over the valley of the River Weaver.

Death in the Candle

UNDER this sensational heading the *Lancet* of July 8, 1837, contains the following account of a meeting of the Medico-Botanical Society held on June 28: "Mr. Everett detailed the results of several experiments made with the view of ascertaining the constituents of some 'new composition candles' which have lately been much employed by the public. His attention had been called to the subject by his having detected a strong garlic odour from the burning candles similar to that given out during the combustion of metallic arsenic. He purchased candles from various vendors of them, and, after considerable trouble, discovered a method by which he could collect a large quantity of the condensed smoke given out during their burning. He broke off the bottom of a glass retort with a very long neck, and placed the burning candle under it, the smoke having to traverse the lengthened tube was deposited on its sides. On carefully collecting this matter, and subjecting it to all the most unequivocal tests for arsenic, that metal was in every instance detected. The quantity contained in each candle would, according to the quantity collected by the experimenter, be about two grains; but in consequence of the difficulty in preventing the escape of a large quantity of the smoke, he considered that double that quantity might be fairly inferred to be present. He supposed the makers of the candles used this metal for the purpose of giving the candles a better appearance, and to give them a higher melting point, and this had since been acknowledged to him by a manufacturer of them, as the fact, the arsenic being found an excellent substitute for a small quantity of wax which answered the same purpose. Now, the question was to be decided whether or not this quantity of arsenic burnt in a room was injurious. . . . He (Mr. E.) would say that the vapours of metallic arsenic were fully as if not more noxious than those of sulphuretted hydrogen."

Medical Practitioners in Russia

THE *London Medical Gazette* of July 8, 1837, contains the following account of medical practitioners in Russia at that time:

"There are several classes of practitioners, but the deference paid to each is not in a ratio with their medical, so much as their military or civil rank. The degrees conferred by the universities are the following: Physician, Surgeon-in-Chief; Surgeon-in-Ordinary; Staff Surgeon; and Surgeon's Mate; Hospital Mate; Barber Surgeon; Apothecary. In general practice there is no positive distinction in the labours allotted to the first three ranks. The physician and the surgeon, in most cases, practise indiscriminately all branches of the profession. The physician receives homage from the surgeons, takes precedence as he passes through the wards of the hospital, signs documents and makes valid his rank by several operations. The hospital mates dressed in military uniform, march up and down the wards, half face about and stand to attention, as their superiors command them. The hospital mates and surgeon's mates are completely under military control, although attached to civil institutions. The apothecaries . . . are mere vendors of drugs and preparers of recipes, and their shops are all licensed by Government. . . . The last class is the *Tsirulnik* or barber surgeon, and is a numerous and thriving brotherhood. It falls to their lot to bleed, cup, draw teeth, apply leeches, and perform other little odd jobs of minor consequence. . . . There are no distinct aurists; aural surgery forming part of the practice of ordinary surgeons. There are likewise but few oculists who devote their whole time to diseases of the eye. Many physicians and surgeons include the treatment of these diseases in their general practice. Dentists abound in every street, and their profession is perfectly distinct, and not within the pale of the medical faculty. There are no distinct chiroprudists in Russia."

Schönbein and Faraday

ON July 9, 1837, Schönbein wrote to Faraday, sending him copies of a book containing an account of his researches on iron dedicated by Schönbein to Faraday. He expressed his regret at not being able to visit England for the meeting of the British Association, and asked that a copy of his book might be presented to the Association if such gifts were received.

In the course of his letter, Schönbein said: "The other day I got a letter from Mr. Berzelius, the contents of which relate to my observations on the peculiar state of Iron. The distinguished Chemist, though he does not yet give a decided opinion upon the subject, is inclined to think, that in one notice of yours, published some time ago in the *Phil. Mag.*, which alludes to the observations of Ritter and de la Rive regarding the secondary poles and the electrical state of polar Platina-wires, the true cause of the inactivity of Iron is hinted at. According to the view of Berzelius, Iron performing the function of the positive Electrode undergoes a change with regard to its primitive electrical condition in such a manner as to be turned from a positive electrical body into a negative one. As my views with respect to electrochemical subjects essentially differ from those of Berzelius', I cannot on this account think the ideas of that Philosopher correct. . . ."

Societies and Academies

Dublin

Royal Irish Academy, January 25.

E. J. CONWAY, J. M. O'CONNOR and D. K. O'DONOVAN: Influence of temperature on the activity of the kidney in relation to its influence on oxygen consumption. Expressing the secretory activity as an energy equation—with free passage of urea across the tubular cells—the slope of the oxygen consumption of the animal and that of the activity of the kidney with temperature are identical. On the curve of activity with temperature there appear three main phases similar to those on the oxygen curve, the latter being already described (O'Connor, *Proc. R.I.A.*). The diurnal variations of body temperature in the normal human subject (96.4°–98.6° F. in the subject investigated) also show a temperature effect similar to that on total oxygen consumption, with minimum at 97.2° F., and the two main phases already described for renal activity (Conway) receive a satisfactory metabolic explanation. The lowest energy requirement for the maximum urea secretion was computed on the most general basis of an active secretion process, and found to be of the same order as that derived from the experimental values of the oxygen consumption as given in the general literature.

February 22.

E. J. CONWAY: Structural laws of the mammalian kidney with theoretical derivations. Details of certain structural laws of the mammalian kidney with theoretical derivation were presented. These were already briefly announced in *NATURE* of February 6, and referred to the agreement of the actual relationships with the following theoretical equations:

$$\begin{aligned} n \text{ (number of tubules)} &= W^{0.444} \times \text{a constant.} \\ l \text{ (length of the first convoluted} \\ &\text{tubule)} &= W^{0.222} \times \text{"} \\ g \text{ (diameter of the glomerulus)} &= W^{0.111} \times \text{"} \\ d \text{ (diameter of the first con-} \\ &\text{voluted tubule)} &= W^{0.000} \times \text{"} \end{aligned}$$

Paris

Academy of Sciences, May 10 (*C.R.*, 204, 1377–1448).

ALEXANDRE GUILLIERMOND and ROGER GAUTHIER: The conditions under which neutral red produces the vital coloration of the vacuoles. For most of the fungi studied, the vital coloration of the vacuoles with neutral red is only possible in cells which have their growth arrested: as soon as the cells start growing they are decolorized. *Saprolegnia* and roots of wheat behave differently, and always accumulate neutral red at the commencement of their growth.

JEAN BOSLER and HENRI ROURE: The disappearance of Biéla's comet. In 1867, C. Bruhns pointed out that Biéla's comet in January 1846 passed near the orbit of the Leonids; if the orbits met, this might account for the disappearance of the comet. The author's calculations confirm those of Bruhns.

NICOLAS KRYLOFF and NICOLAS BOGOLIOUBOFF: Probabilities *en chaîne*.

Z. WARASZKIEWICZ: Topologically homogeneous plane curves.

CHI-TAI CHUANG: A generalization of a theorem of Valiron.

ROBERT FORTET: The iteration of certain linear substitutions.

HENRI MILLOUX: The meromorph functions in a circle.

ARNAUD DENJOY: The approximation of certain sums.

DE MIRA FERNANDES: The calculation of the energy of acceleration of a solid body.

LUCIEN MALAVARD and JOSEPH PERES: The boundary wall corrections in elliptical wind chambers.

GUSTAV ANDRÉ MOKRZYCKI: The work required from starting an aeroplane to the point at which it leaves the ground.

JEAN LOUIS DESTOUCHES: The interaction of two corpuscles in relativistic wave mechanics.

JEAN ROUBAUD-VALETTE: The interpretation of the operators employed by Dirac by means of the fundamental magnitudes of hyperspace.

PHILIPPE TONGAS: A new empirical expression for the total heat of superheated steam.

THÉODORE V. IONESCU: A new oscillator with very short waves (microwaves). The apparatus described and illustrated gives an oscillation of wavelength 36 cm.

MME. ARLETTE TOURNAIRE-VASSY: The relative measurement of the absorption coefficients of ozone in the region of the Chappuis bands.

LÉON CAPDECOMME and PIERRE JACQUET: The reflecting power of copper. Polishing by the anodic method gives copper surfaces the reflective power of which is more constant and less alterable than surfaces obtained by the usual mechanical method.

MLLE. WILLY A. LUB: The optical spectrum of actinium. Actinium is the only element the optical spectrum of which is unknown. Starting with lanthanum oxide containing actinium, the wavelengths of seven new lines have been measured which appear to be due to actinium.

F. BARILLET and MLLE. A. CHOISNARD: The evolution of the interfacial tensions in the neighbourhood of saturation.

FRANÇOIS BOURION, E. ROUYER and MLLE. O. HUN: The determination of the individual hydration of the ions.

MLLE. HENRIETTE SCHUHLER: The ultra-violet spectral properties of salicylic acid as a function of the pH.

VICTOR AUGER and MLLE. NINA IVANOFF: The molybdenum blues. A phosphoceruleomolybdic acid.

HALDUN N. TEREM: The corrosion of beryllium bronzes.

GEORGES LAUDE: The formation of ammonia by boiling some proteins with solutions of potash.

ROGER DE LARAMBERGUE: The synthesis of cyanamide by the oxidation, in the presence of ammonia, of some sugars, lævulose, arabinose, mannitol and glycerol.

FRANÇOIS KRAUT: The breccias and conglomerates of the neighbourhood of Rochechouart (Haute-Vienne).

ANTONIO DE MEDEIROS GOUVEA and GEORGES ZBYSZEWSKI: Observations on the Portuguese coast between the mouth of the River Odesseixe and that of Rio Mira.

ROBERT LAFFITTE: Some levels containing Foraminifera of the Cretacean at Aurès (Algeria).

JOSUÉ HEILMANN HOFFET: The Cretacean of Bas-Laos.

LÉVI HERMAN and MME. RENÉE HERMAN-MONTAGNE: The meaning of measurements relating to the quantity of dust or smoke shown at the ground-level.

JEAN CHAZE: The production of choline in the caryopses and seedlings of darnel, in relation with parasitism.

HENRI MARCELET: The presence of a new C_{10} alcohol in the wax extracted from the oil of the fruit of the raspberry.

GEORGES BROOKS: The phosphorescent mineral matter in the bony tissues of the frog (*Rana esculenta*).

Amsterdam

Royal Academy (*Proc.*, 40, No. 5, May 1937).

J. F. SCHOUTEN: The role of electric, photochemical and diffusion phenomena in vision. Quantitative determinations of the change in the sensitivity of the fovea produced by stimulation of a part of the retina by light.

F. A. VENING MEINESZ: The gravity expedition of the Dutch submarine *O16* in the North Atlantic, January 11–March 16, 1937.

W. H. KEESOM, MISS H. VAN DER HORST and K. W. TACONIS: Measurements concerning the volumes of mercury menisci. Determinations carried out by an X-ray method.

W. H. KEESOM and P. H. VAN LAER: (1) Measurements of the latent heat of tin in passing from the supraconductive to the non-supraconductive state at constant temperature. (2) Relaxation phenomena in supraconductivity.

A. A. NIJLAND: Mean light curves of long-period variables. (28) *Z. Ceti*. (29) *U. Persei*. (30) *S. Lyncis*.

H. R. KRUYT and J. OOSTERMAN: Flow potentials on platinum.

J. TER BERG and F. M. JAEGER: The possibility of distinguishing right- and left-handed structures in crystals by means of their Laue patterns.

P. E. VERKADE, J. VAN DER LEE and A. J. S. VAN ALPHEN: Researches on fat metabolism (10). Feeding experiments on dogs with simple saturated triglycerides.

H. A. BROUWER: Metamorphic rocks at Torne Tråsk (Lappland).

K. MAHLER: Arithmetic properties of a class of decimal fractions.

V. LEVIN: Two remarks on van der Corput's generalization of Knopp's inequality.

W. H. ARISZ and J. OUDMAN: (1) Influence of aggregation on the transport of asparagine and caffeine in the tentacles of *Drosera capensis*. (2) Transport of introduced nitrogenous substances in the leaves of *Vallisneria spiralis*.

L. A. H. BOUWMAN: A new species of the genus *Sabinia*.

G. P. FRETTS: The relation of head length and head index of Johannsen and the spurious correlation of Pearson.

Moscow

Academy of Sciences (*C.R.*, 14, No. 5; 1937).

S. FINIKOV: Laplacean suites with two projectively applicable congruences.

A. ANDRONOV and L. PONTRJAGIN: Gross systems.

E. LEONTOVIČ and A. MAYER: Trajectories which determine the qualitative structure and the division of the sphere into trajectories.

L. KANTOROVICH: The sequence of linear operations.

H. HILMY: A property of the minimal ensembles.

S. N. VERNOV: Measurement of cosmic rays in the stratosphere at the magnetic latitude 35° .

A. S. KOMPANEIETZ: Absorption of sound by crystals at high temperatures.

S. A. UKHOLIN: Influence of temperature on the combined spectrum of carbon tetrachloride in the liquid and gaseous states.

P. BAŽULIN: Influence of temperature on the absorption of ultra-sonic waves by benzene and carbon tetrachloride.

P. P. LAZAREFF: Thermic theory of changes in the peripheric visual sensibility due to geophysical causes.

P. P. LAZAREFF and I. A. LOURÉ: Adaptation in peripheral vision in normal and imbecile infants.

K. A. KRAKAU, E. J. MUKHIN and M. S. HEINRICH: Equilibrium diagram of the ternary system Na_2SiO_3 — $PbSiO_2$ — SiO_2 .

S. FRISCH: The 3P_0 — 3P term combination in the arc spectrum of cerium.

V. V. ČELINCEV: Compounds of chinones with HCl , H_3PO_4 , CH_3COOH , and their chlorination.

N. K. PŠENCYN: A new type of iridium compound.

A. V. SOLOVJEV: Electrochemical investigation of the anti-corrosive properties of sodium nitrite.

A. F. SOSEDKO: Geochemical diagram of pegmatites of the principal arcs of mountain chains of Central Asia.

J. LARIONOV and J. M. TOLMAČEV: Chemical composition of cassiterites.

M. GUDLET and E. KARDO-SYSOJEVA: Oxidation of ascorbic acid (vitamin C) in plants.

V. S. SADIKOV: A new method of isolating amino acids, peptides and cyclopeptides from protein hydrolysates.

J. D. POLJAKOV: A new apparatus for measuring the oxygen consumed by small aquatic animals.

Vienna

Academy of Sciences, March 11.

LUDWIG ECKHART: Affine representation and axonometry. A method is given for the construction of the projection of a body in any plane from its ground plan and elevation.

KARL FEDERHOFER: Calculation of the normal modes of vibration of a spherical shell.

ALFONS KLEMENC and WALTER NEUMANN: Exact estimation of a nitric oxide–nitrogen dioxide mixture by the methods of gas analysis.

ERNST STORFER: Precipitation of trithiurea cuprous chloride from its aqueous solution.

F. BILGER, W. HALDEN, E. MAYER-PITSCH and M. PESTEMER: Fatty matter in yeast (5). Quantitative relations in the biological formation of ergosterin.

W. JORDE: Thermal polymerization of styrol.

WALTER HÄUSLMAYER: Chemical development of the markings of butterflies. Wings extracted from the pupa develop markings when placed in tyrosinase. This action of tyrosinase is hindered by uric acid.

MARTHA GEIRINGER: Influence of the central nervous system on the adaptation of the colour of the frog (*Hyla arborea* L.). Severing the nerve connecting the regio chiasmatica to the pituitary destroys the ability of the frog to adapt its colour to its surroundings, while leaving the eyesight unimpaired.

GUSTAV GÖTZINGER: Geological analysis of the Quaternary deposits in the Traun valley region above Gmunden. The hydrographical state of the valley during various periods of recession of the main glacier is determined.

