Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

MM & Co

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME LXXXIV

JULY to OCTOBER, 1910

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

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

Richard Clay and Sons, Limited,
bread street hill, e.c., and
bungay, suffolk.

INDEX.

Abbott (W. J. Lewis), Classification of the British Stone Age and some New and Little-known Horizons and Cultures, 30
Absorption, Radiation and, Prof. Humphreys, 52
Ach (Prof. Narziss), Ueber den Willensakt und das Temperament, 199
Acoustics: the Propagation of Sound in a Fog, C. J. T. Sewell, 62
Adamović (Prof. Lujo), die Vegetationsverhältnisse der Balkanländer (Mosische Länder), 135; aus Bosnien und der Herzegovinia, 395
Adams (Franklin), Prevention of Dew Deposit upon Lens Surfaces, 52
Adhikary (Birendra Bhusan), Preparation of Phenyl-nitromethane by the Interaction of Mercurous Nitrite and Benzyl Chloride, 292
Aëronautics: Experiments on Air Resistance, Dr. T. E. Stanton, 13; Relation of the Wind to Aërial Navigation, Prof. A. L. Rotch, 151; IV. Congrès international d'Aéronautique, 1909, Procès verbaux, Rapports et Mémoires, Prof. G. H. Bryan, F.R.S., 229; Bibliography of Aëronautics, Paul Brockett, Prof. G. H. Bryan, F.R.S., 229; Petite Encyclopédie aéronautique, L. Ventou-Duclaux, Prof. G. H. Bryan, F.R.S., 229; the Encyclopædia of Sports and Games, Prof. G. H. Bryan, F.R.S., 229; Results of the Italian Aëronautical Experiments near Zanzibar during the Last Week of July, 1908, 506
Africa: the Journal of the East Africa and Uganda Natural History Society, Sir H. H. Johnston, G.C.M.G., K.C.B., 80; the Ethnology, Botany, Geology, and Meteorology of German East Africa, Sir H. H. Johnston, G.C.M.G., K.C.B., 106; Science in South Africa, 158; the Ore Deposits of South Africa, J. P. Johnson, 293; Veterinary Research in the Transvaal, 321
Agaric with Sterile Gills, an, W. B. Grove, 531
Agassiz (Col. Georges), Death of, 81
Agriculture: a Manual of Practical Farming, John McLennan, 38; How to Use Nitrate of Soda, 50; Report of the Agricultural Experimental Station, Lafayette, Indiana, 83; Death and Obituary Notice of John B. Carruthers, 114; Life-history and the Means of Controlling the Hop Flea-beetle, W. B. Parker, 117; Fertilising Value of Seaweed, 151; Tobacco produced in India, Mr. and Mrs. Howard, 151; Physiological Effect on the Cow of the Milking Machine, 181; Relation between the Reduction in Area of Wheat in England and the Increased Yield, Mr. Vigor, 182; the Year-book of the Khedivial Agricultural Society, Cairo, 1909, 184; Studies of Egyptian Cotton, Lawrence Ball, 184; the Manufacture of Cane Sugar, Llewellyn Jones and F. I. Scard, 190; Lead Chromate as Insecticides, 212; Recent Agricultural Publications in Great Britain, 219; the Sclerotinia Disease of the Gooseberry, Mr. Salmon, 219; Effect of Overhead Electrical Discharges on Plant Growth, Mr. Priestley, 219; Secondary Effects of Manures on the Soil, Mr. Hall, 219; Physiological Problems of the Stock-breeder, F. H. A. Marshall, 219; Legislation in the West Indies for the Control of Pests and Diseases of Imported Plants, Mr. Ballou, 247; Bacterial Blight in Cotton caused by *Bact. Malvacearum*, Mr. McCall, 247; Outbreak of Blister-blight on Tea in the Darjeeling District in 1908 and 1909, 247; Cause of the Colour of Black Cotton Soil, Mr. Annett, 247; Fruit Experiments, Mr. Howard, 247; the Journal of the South-eastern Agricultural College, Wye, Kent, 253; Beet Sugar Making and its Chemical Control, Y. Nikaido, 424; Recent Investigations on the Cultivation of Rubber, 510; Effect of Heat on Soils, C. Harold Wright, 530; Possibility of Raising Ostriches in the Transvaal, 543; *see also* British Association
Agrogeology: the First International Agrogeological Conference, Dr. E. J. Russell, 157; Russian Soils, Prof. Glinka, 157
Ainslie (Mr.), the Large Corn-stalk-borer, 18
Air, Models of Meteorological Conditions in the Free, 59
Air Resistance, Experiments on, Dr. T. E. Stanton, 13
Airship Flights, 512
Aitken (Dr. John), Did the Tail of Halley's Comet affect the Earth's Atmosphere? 228
Aitken (Mr.), Rediscovery of Brooks's Periodical Comet (1889 V.), 438
Akikũyu, the, of British East Africa, With a Prehistoric People, W. Scoresby Routledge and Katherine Routledge, Sir H. H. Johnston, G.C.M.G., K.C.B., 41
Albrecht (Prof.), the Variation of Latitude, 20
Alcock (Lt.-Col. A., F.R.S.), Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum, 524
Algol's Satellite, Irregularities in the Motion of, Enzo Mora, 472
Allen (Glover M.), Insectivorous Mammal, *Solenodon paradoxus*, of San Domingo, 315
Allen (Mr.), Synthetic Study of Diopside and its Relations to Calcium and Magnesium Metasilicates, 375
Alpine Flowers and Gardens, Painted and Described, G. Flemwell, 37
Alps, Summer Flowers of the High, Somerville Hastings, 37
Alternate-current Theory, the Foundations of, Dr. C. V. Drysdale, Prof. Gisbert Kapp, 6
Ambrecht (Mr.), Change of Colour of Sapphires and other Precious Stones by the Action of Radium, 179
Ameghino (Dr. F.), Human Skulls and Skeletons and Supposed Evidence of Human Work, 402
America: Fossil Vertebrates in the American Museum of Natural History, 12; Glaciers, Goldfields, and Landslides in North America, 76; Recent Work of Geological Surveys, iv., the United States, 121; List of Documents in Spanish Archives relating to the History of the United States which have been Printed or of which Transcripts are Preserved in American Libraries, J. A. Robertson, 238; Selections from American Zoological Work, 547
Ammonia, Coal Tar and, Prof. George Lunge, 166
Amory (Dr. Robert), Death of, 340
Anatomy: the Anatomy and Relationship of the Negro and

Negroid Races, Hunterian Lectures at Royal College of Surgeons, Prof. Arthur Keith, 54; International Congress of Anatomists at Brussels, 252
Anderson (Prof. R. J.), the Temporal Bone in Primates, 550
Animal Romances, Graham Renshaw, 100
Annam, On and Off Duty in, Gabrielle M. Vassal, J. Thomson, 243
Annett (Mr.), Cause of the Colour of Black Cotton Soil, 247
Antarctica: Antarctic Pycnogons, Dr. W. T. Calman, 104; Deutsche Südpolar-Expedition, 1901–3, die Grundproben der Deutschen Südpolar-Expedition, 1901–3, E. Philippi, 167; National Antarctic Expedition, 1901–4, Natural History, vol. v., Zoology and Botany, 205; British Antarctic Expedition, 1907–9, under the Command of Sir E. H. Shackleton, C.V.O., Reports on Scientific Investigations, vol. i., Biology, 205; Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, Sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Botanique-Diatomées, H. Van Heurck, Geologie-Petrographische Untersuchung der Gesteinproben, A. Pelikan, Quelques Plantes Fossiles des Terres Magellaniques, Prof. A. Gilkinet, Oceanographie-les Glaces-Glace de Mer et Banquises, H. Arctowski, Zoologie-Schizopoda and Cumacea, H. J. Hansen, 205; Date of Lieut. Filchner's Antarctic Expedition, 400
Anthropogeography of the Polar Eskimos, Contributions to the Ethnology and, Dr. H. P. Steensby, 443
Anthropology: Collection of Human Bones found on the Site of an Augustinian Friary near the Corn Market, Cambridge, Dr. W. L. Duckworth and W. J. Pocock, 16; Royal Anthropological Institute, 30; Totemism and Exogamy, a Treatise on certain Early Forms of Superstition and Society, Prof. J. G. Frazer, A. E. Crawley, 31; Prehistoric Man, Joseph McCabe, 39; the Position of the Father's Sister in Oceania, Dr. W. H. R. Rivers, 48; the Anatomy and Relationship of the Negro and Negroid Races, Hunterian Lectures at Royal College of Surgeons, Prof. Arthur Keith, 54; Origin of the Fulah or Filani Race, Capt. A. J. N. Tremearne, 82; Antiquities of the Ouachita Valley, Clarence B. Moore, Dr. A. C. Haddon, F.R.S., 129; Colonial Empire of the Phœnicians, Louis Seret, 211; Anthropological Society of Paris, 2[illegible]; the Jesup North Pacific Expedition, the Kwakiutl of Vaucouver Island, Frank Boas, Chukchee Mythology, Waldemar Bogoras, the Yukaghir and the Yukaghirized Tungus, Waldemar Jockelson, Dr. A. C. Haddon, F.R.S., 250; Skull Discovered at Galley Hill, Kent, 270; Filipino Racial Types at Taytay, R. B. Bean and F. S. Planta, 340; Chimariko Tribe of Indians Inhabiting Trinity County, in North California, 370; Discovery in the Neighbourhood of the Pyramid of Sneferu (B.C. 4600) of a Stone Tomb Dating from a Time before the Construction of the Pyramid, Prof. Flinders Petrie, 401; System of "Wireless Telegraphy" in use among the Indian Tribes of the Putumayo River, W. E. Hardenburg, 436; *see also* British Association
Antike Tierwelt, die, Otto Keller, 357
Antoniadi (M.), Subjective Phenomena on Mars, 120; Occultation of η Gemini by the Planet Venus, 196; the Recent Occultation of η Geminorum by Venus, 317; Halley's Comet, 322
Ants, the Prince and his, (Ciondolino), Luigi Bertelli, 138
Arabian Astronomical Instruments, Prof. E. Wiedemann, 472
Archæology: Arthur's Round Table in Glamorgan, Rev. John Griffith, 8; Pit-dwellings in the District of Holderness, Canon Greenwell and R. A. Gatty, 16; Prehistoric Rhodesia, Richard N. Hall, 32; Excavations at the Glastonbury Lake-village, Arthur Bulleid and H. St. George Gray, 82; Processes of Prehistoric Pottery-making, N. W. Thomas and Capt. A. J. N. Tremearne, 116; Date of Narrow Cultivation Terraces, Lynchets, 116; Antiquities of the Ouachita Valley, Clarence B. Moore, Dr. A. C. Haddon, F.R.S., 129; Discovery of the Site of the Famous Cyprian Temple of Aphrodite-Astarte, Dr. Max O. Richter and Dr. K. Koritsky, 149; Death of Prof. A. Michaelis, 210; Neolithic Implements from Bridlington, Mr. Sheppard, 246; Recent Finds made in Rock Shelters once Occupied by Strand Loopers, Dr. L. Péringuey, 262; Classification of the British Stone Age and Some New and Little-known Horizons and Cultures, W. J. Lewis Abbott, 30; Stone-headed Axe from Rennell Island, C. M. Woodford, 314; Model of the Fine Dolmen Situated at Coldrum, in Maidstone Museum, 401; "Tomb of the Double Axes," Dr. A. J. Evans, 401; the Royal Commission on Welsh Monuments, Rev. John Griffith, 404; the Archæological Survey of Nubia, Prof. G. Eliot Smith and Dr. D. E. Derry, 406; Customs at Holy Wells, Zorah Godden, 429; Geological and Archæological Notes on Orangia, J. P. Johnson, 465; Archæological Expedition in Sardis, Prof. Howard C. Butler, 503; Prehistoric Boat Discovered at Brigg in 1886, T. Shepherd, 542
Archbutt (Mr.), Provident Use of Coal, 519
Architecture: Condition of the Leaning Tower of Pisa, 48; the Leaning Tower of Pisa, Prof. A. Batelli, 146; Edward G. Brown, 297; Arthur T. Bolton, 297; Report of Pisa Commission on the Leaning Tower, Prof. William H. Goodyear, 471; Town-planning, A. E. Crawley, 498
Arctica: die Polarwelt und ihre Nachbarländer, O. Nordenskjöld, 236; North Polar Exploration, 245; Expedition Ship *Alabama*, 245
Arctowski (H.), Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9 sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Oceanographie—Les Glaces—Glace de Mer et Banquises, 205
Ardigo (Prof. Robert), an Inconsistent Preliminary Objection against Positivism, 461
Argentina, Catalogo Sistematico y Descriptivo de las Aves de la Republica, Roberto Dabbene, 427
Argentine Biology, Australian and, 186
Arkansas and Louisiana, Archæological and Anthropological Investigations in, Dr. A. C. Haddon, F.R.S., 129
Armstrong (Dr. E. F.), Existing Knowledge with Regard to the Oxydases, 518
Armstrong (Prof.), Crystallographic Examinations of Twenty-nine Derivatives of the *p*-Dihalogenbenzene-sulphonic Acids, 403
Armstrong (Prof.), Impossibility of any Interaction taking Place between Two Substances if Neither was an Electrolyte, 517
Armstrong (Prof. H. E.), Provident Use of Coal, 518
Arnold (Prof. J. O.), Theory of Hardening Carbon Steels, 440; a Fourth Recalescence in Steel, 518
Arnold-Bemrose (H. H.), Derbyshire, 426
d'Arrest's Comet (1910c), Rediscovery of, M. Gonnessiat, 317; Observations of d'Arrest's Comet at the Observatory of Algiers, M. Gonnessiat, 324; M. Baillaud, 324
Arthur's Round Table in Glamorgan, Rev. John Griffith, 8
Ascoli (F. D.), Rivers of Dacca District, 30
Ashworth (Dr. J. H.), Zoology at the British Association, 548
Ashworth (Dr. J. R.), the Temperature Coefficients of the Ferromagnetic Metals, 238
Asia, a Systematic Geography of, G. W. Webb, 426
Asiatic Society of Bengal, 30, 292, 422
Association of Economic Biologists, 156
Association of Technical Institutions, the, 90
Assyriology: Death of Hormuzd Rassam, 400
Astronomy: Halley's Comet, Dr. James Moir, 9; Dr. Wolf, 19; Prof. Seeliger, 19; M. Eginitis, 19, 52; Comas Sola, 19; M. Nordmann, 19; Mr. Leach, 19; Dr. Ebell, 52; Prof. Fowler, 52; Father Iniguez, 52; Herr v. d. Pahlen, 86; Dr. Ristenpart, 86; G. Millochau and H. Godard, 120; Prof. Frost, 152; Mr. Motherwell, 183; Prof. Barnard, 183, 322; Mr. Helmcken, 184; Father Stein, 184; Herr Sykora, 322; Dr. Hartmann, 322; M. Antoniadi, 322; K. Saotome, 322; Drs. Cowell and Crommelin, 322; M. Iwanow, 322; Mr. Merfield, 322; Messrs. Crawford and Meyer, 322; Mr. Slocum, 323; Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19, D. Stenquist and E. Petri, 9; Some Phenomena shown by Halley's Comet after its Passage across the Sun, D. Eginitis, 64; Phenomena presented by the Tail of Halley's Comet during the Passage of May 19 last, H. Deslandres and J. Bosler, 163; Did the Tail of Halley's Comet affect the Earth's Atmosphere? Dr.

John Aitken, 228; Further Observations of Halley's Comet, Michie Smith and John Evershed, 374; C. D. Perrine, 374; Velocities and Accelerations of the Ejecta from Halley's Comet, Profs. Barnard and Lowell, 404; J. Comas Sola, 404; Time of the Solar Transit of Halley's Comet, 472; Death of Prof. G. V. Schiaparelli, 14; Obituary Notice of, 44; Our Astronomical Column, 19, 52, 86, 120, 152, 183, 213, 248, 272, 317, 344, 374, 404, 438, 472, 507, 544; Astronomical Occurrences in July, 19; in August, 120; in September, 272; in October, 438; Ephemeris for Comet 1910a, Prof. Kobold, 19; Prof. Barnard, 19; Observations of Comet 1910a, Dr. Karl Bohlin, 272; Prof. Ricco, 472; Photographs of Morehouse's Comet, Messrs. Hirayama and Toda, 19; the Determination of Position near the Poles, Mr. Hinks, 19; the Variation of Latitude, Prof. Albrecht, 20; New Canals and Lakes on Mars, M. Jonckheere, 20; Subjective Phenomena on Mars, M. Antoniadi, 120; Mars in 1909 as seen at the Lowell Observatory, Prof. Percival Lowell, 172; Water Vapour on Mars, Prof. Campbell, 317; Prof. Frank W. Very, 405; a Suggested Volcanic Origin of Martian Features, Dr. Wilhelm Krebs, 344; International Union for Cooperation in Solar Research, 22; Prof. Arthur Schuster, F.R.S., 463, Death and Obituary Notice of Prof. J. G. Galle, 45; Death of Prof. T. Zona, 46; Death of Dr. Wilhelm Winkler, 47; Prevention of Dew Deposits upon Lens Surfaces, Franklin Adams, 52; a Variable Star as a Time Constant, Prof. Barnard, 52; Radiation and Absorption, Prof. Humphreys, 52; an Interesting Occultation, Arthur Burnett, 73; the Next Total Eclipse of the Sun, Dr. William J. S. Lockyer, 75; the Total Solar Eclipse, May 9, 1910, Dr. William J. S. Lockyer, 113; the Total Solar Eclipse of April 28, 1911, Dr. Pio Emanuelli, 172; Harvard College Observatory, Prof. E. C. Pickering, 86; Photographs of Auroræ, Carl Störmer, 86; Displacement of Spectral Lines at the Sun's Limb, A Perot, 86; the Pressure of Light on Gases, Dr. Lebedew, 86; the Determination of Stellar Radial Velocities, Prof. Frost, 86; Prof. R. W. Wood, 86; the Evolution of Worlds, Prof. Percival Lowell, William E. Rolston, 99; Present Meteoric Displays, W. F. Denning, 105; Death of J. Ellard Gore, 116; the Genesis of Various Lunar Features, M. Puiseux, 120; the Gnomon in Ancient Astronomy, Jules Sagaret, 120; the Leeds Astronomical Society, 120; a Central Bureau for Meteor Observations, 152; the Rotation of Sun-spots, P. Kempf, 152; Large Meteorites, Edmund O. Hovey, 152; the United States Naval Observatory, 152; Measures of Double Stars, Prof. Burnham, 152; Dr. Lau, 317; Mr. Sellors, 507; the Study of Double Stars for Amateurs, G. F. Chambers, 273; Popular Astronomy, Prof. Simon Newcomb, 171; Photographs of Nebulæ, Dr. Ritchey, 183; the Accurate Measurement of Photographs, Prof. E. C. Pickering, 184; Observations of Perseids in 1909, S. Beljawsky, 184; Results from Micrometric Observations of Eros, 1900, Mr. Hinks, 184; Occultation of η Gemini by the Planet Venus, M. Antoniadi, F. Baldet, and F. Quénisset, 196; the Recent Occultation of η Geminorum by Venus, MM. Baldet, Quénisset, and Antoniadi, 317; Occultation of η Geminorum by Venus, July 26, observed at Lyons, J. Guillaume and J. Merlin, 390; Discovery of a Small Planet, presumably New, José Comas Sola, 196; Perseid Meteoric Shower, 1910, W. F. Denning, 204, 248; C. L. Brook, 248; W. H. Steavenson, 248; Miss Warner, 248; D. E. Packer, 248; W. Johnson, 248; E. F. Sawyer, 439; Brilliant Meteor of July 31, Father A. L. Cortie, 204; a New Comet, Rev. J. H. Metcalf, 213; Mr. Burton, 213; Metcalf's Comet, 1910b, 249, 273; M. Guillaume, 249; Dr. Kobold, 249, 344, 507; Prof. Pickering, 344; M. Quénisset, 507; Observations of Metcalf's Comet, J. Guillaume, 261; Observations of the Comet 1910b (Metcalf), August 9, 1910, M. Coggia, 261; Observations of Metcalf's Comet, 1910b, M. Borrelly, 261; M. Schaumasse, 292; Observations of Metcalf's Comet made at the Paris Observatory, J. Chatelu, 261; Properties of the Polar Filaments of the Sun, H. Deslandres, 228; Photographs of Daniel's Comet, 1907d, Prof. Barnard, 249; Precession and the Solar Motion, Prof. Boss, 249; Calcium Vapour in the Sun, C. E. St. John, 249; Observations of Comets, Dr. Max Wolf, 213; Observations of Mercury, G. and V. Fournier, 213; M. Jarry-Desloges, 213; Dispersion of Light in Interstellar Space, Herr Beljawsky, 213; Anomalous Scattering of Light, Dr. Julius, 214; the Spiral Nebula M51 (Canum Venaticorum), Madame Dorothea Isaac Roberts, 214; Supplement to the "Astronomische Nachrichten," 214; the Paris Observatory, M. Baillaud, 272; the Sun's Velocity through Space, Profs. Frost and Kapteyn, 272; Parallax of Fourth-type Stars, Prof. Kapteyn, 273; the Maximum of Mira in 1909, Prof. Nijland, 273; Mr. Ichinohe, 273; Rediscovery of d'Arrest's Comet (1910c), M. Gonnessiat, 317; Observation of the d'Arrest Comet at the Observatory of Algiers, M. Gonnessiat, 324; M. Baillaud, 324; Search-ephemerides for Comets 1889 V. (Brooks) and 1890 VII. (Spitaler), Dr. Bauschinger, 317; F. Hopfner, 317; the Sun-spots of 1909, Dr. E. Guerrieri, 317; the Permanent International Committee for the "Carte du Ciel," 317; Meteors and Bolides, Prof. Guido Cora, 317; History of Navigation, Prof. Marguet, 317; Meteoric Fireballs, Rev. W. F. A. Ellison, 318; Rev. J. C. W. Herschel, 318; a Suspected New Planet, Prof. J. Comas Sola, 344; Definitive Elements for Comet 1852 IV., Adolf Hnatek, 344; the Passage of the Earth through the Tail of the 1861 Comet, R. Baer, 344; the Spectrum of Cyanogen, Comte de Gramont and M. Drecq, 344; Researches on the Colours of Stars, Osten Bergstrand, 344; "Mock Suns," James F. Ronca, 345; "Mock Suns" at Eastbourne, Mrs. A. M. Butler, 374; Astronomy in India, 374; an Oblique Belt on Jupiter, Scriven Bolton, 362; the Distances of Red Stars, Dr. H. Norris Russell, 374; Astronomy: a Handy Manual for Students and Others, Prof. F. W. Dyson, F.R.S., 393; Chats about Astronomy, H. P. Hollis, 393; Observations of Comets, M. Gonnessiat, 404; Mr. Innes, 404; the Solar Physics Observatory, South Kensington, 404; the Determination of Longitude, Dr. Jean Mascart, 404; Transactions of the Astronomical Observatory of Yale University, Parallax Investigations on Thirty-five Selected Stars by Frederick L. Chase, Mason F. Smith, and William L. Elkin, 433; a Bright Meteor, 438; Rediscovery of Brooks's Periodical Comet (1889 V.), 1910d, Messrs. Aitken and Wilson, 438; the Luminosity of Comets, W. L. Dudley, 439; Coloured Stars between the Pole and 60° N. Declination, Herr Krüger, 439; Observations of the Companion of Sirius, Prof. Barnard, 439; a Modified Method for Nadir Observations, R. M. Stewart, 439; a New Micrometer, Dr. Doberck, 439; the Mean Parallax of Tenth-magnitude Stars, Dr. H. E. Lau, 439; Halley Meteors, Prof. David Todd, 439; Announcement of a Nova, Mrs. Fleming, 472; Arabian Astronomical Instruments, Prof. E. Wiedemann, 472; New Ephemerides for Saturn, Uranus, and Neptune, Dr Downing, 472; a Bright Projection on Saturn, M. Maggini, 507; Origin of Cometary Bodies and Saturn's Rings, Dr. Henry Wile, 522; Irregularities in the Motion of Algol's Satellite, Enzo Mora, 472; the Cambridge Observatory, Sir Robert Ball, 472; Prof. Newall, 472; Observations of Neptune's Satellite, Prof. Barnard, 472; Spectrum and Radial Velocity of ϕ Persei, Dr. Ludendorff, 507; Death and Obituary Notice of Thorvald Nicolai Thiele, 503; Comets and Electrons, Prof. Righi, 507; Recent Results in Solar Physics, Prof. Riccò, 507; the Amateur Astronomer, Gideon Riegler, W. E. Rolston, 526; a Brilliant Meteor on October 23, W. F. Denning, 544; J. E. Clark, 544; Simultaneous Photographic Observations of a Remarkable Meteor, Herr Sykora, 544; Two Remarkable Prominences, Dr. F Slocum, 544; the Relations between Solar and Terrestrial Phenomena, Abbé Th. Moreux, 545; Search-ephemerides for Westphal's Comet, 1852 IV., A. Hnatek, 545

Astrophysics: the Pressure of Light on Gases, Dr. Lebedew, 86

Atkins (W. R. G.), Cryoscopic Determination of the Osmotic Pressure in Some Plant Organs, 211

Atlas, an Economic, J. G. Bartholomew, 426

Atlases, a List of Geographical, in the Library of Congress, with Bibliographical Notes, 325

Atmosphäre, Die Temperatur Verhältnisse in der freien, [Ergebnisse der internationalen unbemannter Ballonaufstiege], Dr. Arthur Wagner, E. Gold, 42
Atomic Weights, 207
Atwood (W. W.), Glacial History of the Uinta and Wasatch Mountains, 122
Auerbach (Prof. Felix), Geschichtstafeln der Physik, 457
Auger (V.), Manganate of Sodium and its Hydrates, 64
Augustin (E.), Ueber japanische Seewalzen, 34
Aurorae, Photographs of, Carl Störmer, 86
Australia, Rainfall of Rhodesia and, 187
Australian and Argentine Biology, 186
Austria, Mathematics in, 399
Aviation: Death and Obituary Notice of the Hon. Charles Stewart Rolls, Dr. William J. S. Lockyer, 46; the Art of Aviation, R. W. A. Brewer, Prof. G. H. Bryan, F.R.S., 229; How to Build an Aëroplane, R. Petit, Prof. G. H. Bryan, F.R.S., 229; How to Build a 20-foot Biplane Glider, A. P. Morgan, Prof. G. H. Bryan, F.R.S., 229; Les Aéroplanes, considérations théoriques, P. Raybaud, Prof. G. H. Bryan, F.R.S., 229; Ballons et Aéroplanes, G. Besançon, Prof. G. H. Bryan, F.R.S., 229; L'Aviation, Prof. Paul Painlevé and Prof. Emile Borel, Prof. G. H. Bryan, F.R.S., 229; Navigation in der Luft, Prof. A. Marcuse, Prof. G. H. Bryan, F.R.S., 229; Stabilitié des Aéroplanes, Surface Métacentrique, Prof. M. Brillouin, Prof. G. H. Bryan, F.R.S., 229; Die Seitensteuer der Flugmaschinen, Prof. H. Reissner, Prof. G. H. Bryan, F.R.S., 229; National Fund Airship Flight, 369; Progress of Aviation during the Past Year, 373; Erasmus Darwin Prophesied Advent of Aërial Navigation, 370, Arthur Platt, 397; Death of M. G. Chavez, Flight Across the Alps from Brigue to Domo d'Ossola, 400; Airship Flights, 512

Backe (A.), Researches on *Iso*-Maltol, 64
Backhouse (T. W.), the Colours and Spectrum of Water, 530
Bacon (F.), Heat Insulation, 554
Bacteriology: Results of Sterilisation Experiments on the Cambridge Water, Prof. Sims Woodhead, 63; Effect of Mosquito Larvæ upon Drinking Water, Sir Rupert Boyce and F. C. Lewis, 150; Metropolitan Water Examinations, Dr. Houston, 246; Bacterial Blight in Cotton Caused by *Bact. malvacearum*, Mr. McCall, 247; Veterinary Research in the Transvaal, 321; Bacteriology for Nurses, Isabel McIsaac, 493
Baer (R.), the Passage of the Earth through the Tail of the 1861 Comet, 344;
Bailey (Prof. F. G.), Sensitive Bifilar Seismograph for Recording Undulatory Movements of the Earth's Surface of Short Period, 516
Bailey (L. H.), the Nature-Study Idea, 100
Baillaud (M.), the Paris Observatory, 272; Observation of the d'Arrest Comet at the Observatory of Algiers, 324
Baker (Dr.), a Certain Permutation Group, 514; the Theory of Numbers, 514
Baker (Dr. H. Brereton, F.R.S.), Ionisation of Gases and Chemical Change, Discourse at Royal Institution, 388
Baker (T. Thorne), the Telegraphy of Photographs, Wireless and by Wire, 220; the Telegraphic Transmission of Photographs, 460
Bakerian Lecture at Royal Society: the Pressure of Light against the Source: the Recoil from Light, Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, 139
Balaton, Resultate der Wissenschaftlichen Untersuchungen des, Untersuchungen über die Schwerkraft, R. v. Sterneck; Die Niveaufläche des Balatonsees und die Veränderungen der Schwerkraft auf diesem, Baron L. Eötvös; Erdmagnetische Messungen in Sommer, 1901, L. Steiner; Das Eis Balatonsees, E. v. Cholnoky; Die Tropischen Nymphæen des Hévazsees bei Keszthely, A. Lovassy; Kirchen und Burgen in der Umgebung des Balaton im Mittelalter, R. Bekefi, 299
Baldet (F.), Occultation of η Gemini by the Planet Venus, 196; the Recent Occultation of η Geminorum by Venus, 317
Balkanländer (Mösische Länder), Die Vegetationsverhältnisse der, Prof. Lujo Adamović, 135
Ball (Lawrence), Studies of Egyptian Cotton, 184
Ball (Sir Robert), the Cambridge Observatory, 472
Ball (Robert S., jun.), Static Charge in Bicycle Frame, 9
Ballou (Mr.), Legislation in the West Indies for the Control of Pests and Diseases of Imported Plants, 247
Bancroft (Prof. Wilder D.), on the Photographic Emulsion, 215
Barbour (J.), History of the Discovery of the Chinese Alligator, 341
Barkla (Prof. C. G.), X-Ray Spectra, 139; Homogeneous Radiation, 478
Barling (Prof. Gilbert), Treatment of Cancer, 154
Barlow (Dr. Guy), the Pressure of Light against the Source; the Recoil from Light; Bakerian Lecture at Royal Society, 139
Barnard (Prof.), Ephemeris for Comet 1910*a*, 19; a Variable Star as a Time Constant, 52; Halley's Comet, 183, 322; Photographs of Daniel's Comet, 249; Velocities and Accelerations of the Ejecta from Halley's Comet, 404; Observations of the Companion of Sirius, 439; Observations of Neptune's Satellite, 472
Barnard (H. Clive), the British Isles in Pictures, 238
Barnard (H. O.), Alleged Partiality of Cobras for Music, 49
Barnes (H. T.), Problems of Winter Navigation on the River St. Lawrence, 83
Barnett (S. A.), Lacustrine Culture, 116
Barre (M.), Sulphate of Thorium, 132
Barrett-Hamilton (G. E. H.), a History of British Mammals, 493
Barrois (Prof.), Pre-Cambrian Fauna, 442
Barthel (Dr. Chr.), Methods used in the Examination of Milk and Dairy Products, 69
Bartholomew (J. G.), an Economic Atlas, 426
Bartlett (A. W.), Cause of Serious Loss of Gooseberry Bushes in Cambridgeshire, 402
Bassett (Dr. H.), the Gulf Stream Drift and the Weather of the British Isles, 44
Bateman (H.), Present State of the Theory of Integral Equations, 514
Bateson (Prof., F.R.S.), Sex and Immunity, 549
Bauer (Dr. L. A.), Magnetic Results of the First Cruise of the *Carnegie*, 119; Results of Some Recent Investigations on Magnetic Disturbances, 192; So-called "Sudden Commencements" of Magnetic Storms, 516; Tables of Corrections to the British Admiralty, the German Admiralty, and the United States Hydrographic Department Magnetic Charts of the North Atlantic, 544
Baumes (Georges), Critical Constants of Acetylene and Cyanogen, 98
Bauschinger (Dr.), Search-Ephemerides for Comet 1889, V. Brooks, 317
Bean (R. B.), Filipino Racial Types at Taytay, 340
Bean (W. J.), New Trees and Shrubs, 547
Bean (Mr.), Chimæroid Fishes, 547
Bear, the Black, William H. Wright, 327
Beck (Dr. R.), Lehre von den Erzlagerstätten, 198
Becker (Dr.), Glacial Erosion, 442
Becquerel (Prof. Jean), Constitution of Matter, 506
Becquerel (Paul), the Abiotic Action of Ultra-Violet Rays, and the Hypothesis of the Cosmic Origin of Life, 64
Beebe (Mary Blair and C. William), Our Search for a Wilderness, 525
Bees for Profit and Pleasure, H. Geary, 464
Beet Sugar Making and its Chemical Control, Y. Nikaido, 424
Beilby (Dr.), Provident Use of Coal, 510
Békefi (R.), Resultate der Wissenschaftlichen Untersuchungen des Balaton, Kirchen und Burgen in der Umgebung des Balaton im Mittelalter, 299
Beljawsky (S.), Observations of Perseids in 1909, 184; Dispersion of Light in Interstellar Space, 213
Bell (Dr. Digby), Physical Training, 320
Bengal, Science in, 185
Bengough (G. D.), the Heat Treatment of Brass, 421
Bennett (S. R.), on the Nature, Uses, and Manufacture of Ferro-Silicon, with Special Reference to Possible Danger Arising from its Transport and Storage, 53; Ferro-Silicon, 519
Beresford (Col. C. E. de la Poer), "Byways in the Caucasus," 469
Bergstrand (Östen), Researches on the Colours of Stars, 344
Berlin University, the Centenary of, 480, 496

Bernau (K.), Naturwissenschaftliches Unterrichtswerk für höhere Mädchenschulen, 171
Bertelli (Luigi), the Prince and his Ants (Ciondolino), 138
Berthelot (Daniel), Mechanism of Photo-Chemical Reactions and the Formation of Plant Principles, 196; Photochemical Decomposition of the Alcohols, Aldehydes, Acids, and Ketones, 262
Bertin (E.), Arrest of Steam Ships either by Reversing the Engine or by Allowing to Slow Down by Friction of the Water, 421
Bertrand (Gabriel), Researches on the Constitution of Vicianose, 164
Berwerth (Prof. Friedrich), Meteoric Iron which fell on August 1, 1898, near Quesa, 372
Besançon (G.), Ballons et Aéroplanes, 229
Beyschlag (Prof.), Iron Ores Supplies, 441
Bickerton (W.), "Hunting Birds with the Camera," 402
Bicycle Frame, Static Charge in, Robert S. Ball, jun., 9
Bierry (Henri), Action of the Ultra-Violet Rays upon Certain Carbohydrates, 164
Bio-Chemistry: Effect of an Increased Percentage of Oxygen on the Vitality and Growth of Bacteria, Prof. Benjamin Moore and Dr. Stenhouse Williams, 181
Biology: the Laws of Heredity, G. Archdall Reid, Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S., 1; Alcyonarians Collected by Mr. J. Murray of Sir E. Shackleton's Antarctic Expedition, Prof. J. Arthur Thomson, 29; Science from an Easy Chair, Sir Ray Lankester, K.C.B., F.R.S., 37; Ooze and Irrigation, Rev. Hilderic Friend, 39, 70; A. R. Horwood, 40; the Abiotic Action of Ultra-Violet Rays, and the Hypothesis of the Cosmic Origin of Life, Paul Becquerel, 64; Observations on the Biology of Roridula, Dr R. Marloth, 98; a Theory of Death, M. Mühlmann, 117; Forms of Endogenous Multiplication of *Haemogregarina Sebai*, A. Laveran and A. Pettit, 131; General Biology, Prof. James G. Needham, 137; Anatomy of *Histriobdella homari*, Cresswell Shearer, 150; Parasitic Castration in a Cockerel, Geoffrey Smith, 150; Association of Economic Biologists, 156; Interdependence of Research in So-called "Pure" and "Applied" Science, Prof. G. H. Carpenter, 156; Place of Economic Zoology in the Modern University, Prof. S. J. Hickson, 156; Wild-bird Protection W. E. Collinge, 156; Observations on the Garden Tropæolum, Prof. F. E. Weiss, 157; Animal Pests, Dr. R. Stewart MacDougall, 157; Australian and Argentine Biology, 186; Rinaldo's Polygeneric Theory: a Treatise on the Beginning and End of Life, Joel Rinaldo, 202; British Antarctic Expedition, 1907–9, under the Command of Sir E. H. Shackleton, C.V.O.; Reports on Scientific Investigations vol. i., Biology, 205; Geschichte der biologischen Theorien, Dr. Em. Rádl, 263; the Inherent Law of Life: a New Theory of Life and of Disease, Dr. Franz Kleinschrod, 403; Cytology of the Flagellata, M. Hartmann and C. Chagas, 504; the Biological Laboratories at Woods Hole, Francis B. Sumner, 527; *Proisocrinus ruberrimus*, a New Genus and Species of Stalked Crinoid from the Philippines, A. H. Clark, 547; Collection of Arenaceous Foraminifera obtained by the *Albatross* during her Recent Cruise in the Philippines, J. A. Cushman, 547; Marine Biology, Die Ernährung der Wassertiere und der Stoffhaushalt der Gewasser, Prof. August Pütter, 5; *Leptocephalus nyoproioides* and *L. thorianus*, Johs. Schmidt, 9; Marine Biological Photography, Francis Ward, 10; New Marine Biological Station at Venice, Cal., 81; New Species of Feather-Star (Antedon) from the Adriatic, A. H. Clark, 150; Polychætous Annerlids Dredged off the Californian Coast by the *Albatross* in 1904, J. P. Moore, 246; a Monograph of the Foraminifera of the North Pacific Ocean, J. A. Cushman, 265; Bulletin Trimestrie: Conseil Permanent International pour l'Exploration de la Mer; Résumé des Observations sur le Plankton des Mers Explorées par le Conseil pendant les Années, 1902–8, 394; the Decapod Natantia of the Coasts of Ireland, Stanley M. Kemp, 394; Report of a Survey of the Trawling Grounds on the Coasts of Counties Down, Louth, Meath, and Dublin, E. W. L. Holt, 394
Birds: a History of the Birds of Kent, Norman F. Ticehurst, 241; a History of Birds, W. P. Pycraft, 367
Birge (E. A.), Lake Temperatures, 83
Bishop (Prof. A. L.), Physical and Commercial Geography, 459
Blackman (F. F.), Biochemistry of Respiration, 517
Blair (R.), the Relation of Science to Industry and Commerce, 345
Blanc (M.), Synthesis of Camphoric Acid, 51
Blood-sucking Conorhinus, the, J. D. H., 172
Bloomfield (D.), Do Kittens Kill Mice Instinctively? 436
"Blotched" Tabby Cat, the Origin of the Domestic, H. M. Vickers, 298, 331; R. I. Pocock, 298
Boas (Franz), the Jesup North Pacific Expedition, the Kwakuitl of Vancouver Island, 250
Bogoras (Waldemar), the Jesup North Pacific Expedition, Chukchee Mythology, 250
Bohle (H.), Influence of Uniformity and Contrast on the Amount of Light Required, 422
Bohlin (Dr. Karl), Observations of Comet 1910*a*, 272
Bolides, Meteors and, Prof. Guido Cora, 317
Bolton (Arthur T.), the Leaning Tower of Pisa, 297
Bolton (Scriven), an Oblique Belt on Jupiter, 363
Boltwood (Dr. Bertram B.), Treatment of Storage Cells, 174
Bombay Presidency and Sind, Forest Flora of the, W. A. Talbot, 170
Bone (Prof.), Production of Methane by the Direct Union of Hydrogen with Carbon, 248; Researches upon the Chemical Aspects of Gaseous Combustion during the Past Thirty Years, 517
Bonnerot (S.), Reduction of Oxide of Iron by Solid Carbon, 555
Bonney (the Rev. Prof. T. G., Sc.D., LL.D., F.R.S.), Inaugural Address at the Meeting of the British Association at Sheffield, 274
Books of Science, Forthcoming, 475
Borel (Emile), L'Aviation, 229
Borisov (M.), Quartz in Druses from the Government of Olonetz, 375
Borrelly (M.), Observations of Metcalf's Comet, 1910*d*, 261
Bosler (J.), Phenomena Presented by the Tail of Halley's Comet during the Passage of May 19 last, 163
Boss (Prof.), Precession and the Solar Motion, 249
Botany: the Grasses of Alaska, Prof. F. Lamson-Scribner and E. D. Merrill, 17; New Garden Plants of 1909, 17; Linnean Society 29; Male Sterility in Potatoes, Dr. R. N Salaman, 29; the Plant Cell, its Modifications and Vital Processes, H. A. Haig, 36; Alpine Flowers and Gardens, Painted and Described, G. Flemwell, 37; Summer Flowers of the High Alps, Somerville Hastings, 37; Botanical Resources of Yola Province, Northern Nigeria, Dr. J. M. Dalziel, 50; Flowering Trees, H. F. Macmillan, 55; Indigenous Trees of Southern Rhodesia, C. F. H. Monro, 55; Right- and Left-handedness in Barley, R. H. Compton, 63; New South Wales Linnean Society, 64, 196, 422, 522; Handbook of Flower Pollination, Dr. P. Knuth, 66; "Bulletins of the State Geological and Natural History Survey of Connecticut," Catalogue of Flowering Plants and Ferns 82; Action of Cold and Anæsthetics upon the Leaves of *Angraecum fragrans* and the Green Husks of Vanilla, Edouard Heckel, 98; Observations on the Biology of Roridula, Dr. R. Marloth, 98; a New Italian Orchid, W. Herbert Cox, 104; the Ethnology, Botany, Geology, and Meteorology of German East Africa, Sir H. H. Johnston, G.C.M.G., K.C.B., 106; Lichens, A. N. Danilov, 117; die Vegetationsverhältnisse der Balkanländer (Mösische Länder), Prof. Lujo Adamović, 135; Botany of To-day, G. F. Scott Elliot, 146; the Book of Nature Study, 146; a Text-book of Botany for Students, Amy F. M. Johnson, 146; Systematic Position of the Tropical American Genus Phytelephas, O. F. Cook, 151; Note on Local Coloration of the Cell Wall in Certain Water Plants induced by Manganese Compounds, Prof. H. Molisch, 151; Description of *Haworthia truncata*, Schönl., Dr. Schönland, 158; Experiments to Find out whether the Aërial Parts of Plants absorb Moisture from the Air, Dr. Schönland, 158; Dr. Marloth, 158; Plant Distribution, 160; Formations and Flora-elements in the North-west of Cape Colony, Dr. L. Diels, 160; Botanical Expedition through Western Districts of Cape Colony, Dr. H. H. W. Pear-

son, 160; *Celmisia spectabilis*, Dr. L. Cockayne, 160; Botanical Excursions in Chatham Island, Capt. A. A. Dorrien-Smith, 160; Forest Flora of the Bombay Presidency and Sind, W. A. Talbot, 170; Wild Plants on Waste Land in London, 184; Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Botanique—Diatomées, H. van Heurck, 205; Philippine Leguminosæ, E. D. Merrill, 211; Root Disease of the Cocoa-nut Palm caused by the Fungus *Fomes lucidus*, Mr. Petch, 212; the Action of Vapours on Green Plants, Marcel Mirande, 262; Composition of Carnations with Flexible Stems and Rigid Stems, L. Fondard and F. Gauthie, 292; Photomicrographs of Botanical Studies, 296; the Genus Citrus, A. W. Lushington, 315; White Chicory, 316; Sweet Peas, H. J. Wright, 326; Pansies, Violas, and Violets, Wm. Cuthbertson and R. Hooper Pearson, 326; die Hiede, W. Wagner, 326; Niedere Pflanzen, Dr. R. Timm, 326; das Holz, H. Kottmeier and F. Uhlmann, 326; der Pflanzengarten, seine Anlage und seine Verwerkung, Prof. F. Pfuhl, 326; die Aufzucht und Kultur der Parasitischen Samenpflanzen, Prof. E. Heinricher, 327; Prodromus Floræ Britannicæ, F. N. Williams, 342; Rhododendron producing Double Flowers in its Wild State, Dr. M. Miyoshi, 372; Description of *Dioon spinulosum*, C. J. Chamberlain, 372; a History of Botany, 1860–1900, being a Continuation of Sach's "History of Botany, 1530–1860," Prof. J. Reynolds Green, F.R.S., 391; Vegetationsbilder, Trockensteppen der Kalahari, F. Seiner, Von den Juan Fernandez Inseln, Carl Skottberg, die Schwäbische Alp, Otto Feucht, aus Bosnien und der Herzegovinia, L. Adamović, die Flora von Irland, Prof. T. Johnson, 395; Action of the Ultra-violet Rays upon Plants containing Coumarin, and some Plants the Smell of which is due to the Hydrolysis of Glucosides, M. Pougnet, 421; Plant Formations of East Bolivia, 437; Science in Modern life, Botany, J. M. F. Drummond, 464; Plants obtained in Southern Half of the Island of Saghalien, G. Koidzumi, 470; Conditions of Parasitism in Plants, Dr. W. A. Cannon, 505; Inducing Dependent Nutrition by the Insertion of Prepared Slips into a Host Plant, Dr. D. T. Macdougal, 505; an Agaric with Sterile Gills, W. B. Grove, 531; Death and Obituary Notice of Dr. Melchior Treub, 539; Plants Gathered by Dr. Th. Derbeck on the Shores of the Gulf of Tartary, V. L. Komarov, 542; Botanising in County Kerry, H. S. Thompson, 543; Account of the Genus Scrophularia, Dr. Heinz Stiefelhagen, 543; Flora and Plant Formations of the Kermadec, R. B. Oliver, 543; Distribution of Weeds, 547; a Natural Preventative to the Oak-tree Disease, Paul Vuillemin, 555; the Elective *Rôle* of the Root in the Absorption of Salts, Jean de Rufz de Lavison, 556; *see also* British Association

Boudariat (A.), Occurrence of a Basalt in the Volcanic Cone of Tritriva in Central Madagascar, 376

Bourgeois (R.), the Daily Movement of the Top of the Eiffel Tower, 261; Comparison of Two Astronomical Pendulums with the Aid of Electrical Signals transmitted by a Submarine Cable of Great Length, 456

Bourne (Prof. G. C., M.A., D.Sc., F.R.S.), Opening Address in Section D at the Meeting of the British Association at Sheffield, 378; Hormones in Relation to Inheritance, 462

Bourquelot (Prof.), Biochemical Method of Examination of Vegetable Glucosides Hydrolysed by Emulsin, 354

Bowman (Prof. Isiah), the Economic Geography of Bolivia, 118

Boyce (Sir Rubert W., F.R.S.), Effect of Mosquito Larvæ upon Drinking Water, 150; Health Progress and Administration in the West Indies, 174

Boyle (Dr. R. W.), Absorption and Adsorption with Reference to the Radio-active Emanations, 152

Boys (Prof. C. V., F.R.S.), the Ultra-rapid Kinematograph, 112; Very Viscid Fluid to make Dumb-bell by the Union of the Drops of Two Bubbles, 436

Bragg (Prof.), Nature of the γ Rays, 478

Braun (Prof. Max), a Handbook of Practical Parasitology, 393

Breinl (A.), Life-history of *Trypanosoma lewisi* in the Rat-louse *Haematopinus spinulosus*, 150

Brereton (C. A.), Death of, 340

Breul (Prof. Karl), Students' Life and Work in the University of Cambridge, 461

Brewer (R. W. A.), the Art of Aviation, 229

Brillouin (Prof. M.), Stabilitié des Aéroplanes, Surface métacentrique, 229

Brindley (H. H.), Notes on the Procession of *Cnethocampa pinivora*, 62

Briner (E.), Action of Pressure and Temperature upon Cyanogen, 164

Brion (Dr. G.), Leitfaden zum elektrotechnischen Praktikum, 67

British Antarctic Expedition, 1907–9, under the Command of Sir E. H. Shackleton, C.V.O., Reports on Scientific Investigations, vol. i., Biology, 205

British Association Meeting at Sheffield, 110, 174, 274, 300, 333; S. R. Milner, 174; Inaugural Address by the Rev. Prof. T. G. Bonney, Sc.D., LL.D., F.R.S., President of the Association, 274; Forthcoming Meeting of British Association, Arrangements for Section H, 179; Recent Hittite Discovery, D. G. Hogarth, 318

Section A (*Mathematical and Physical Science*).—Opening Address by Prof. E. W. Hobson, Sc.D., F.R.S., President of the Section, 284; on Positive Rays, Sir J. J. Thomson, 513; Spectrophotometer of the Hüfner Type, Dr. R. A. Houston, 513; New Gyroscopic Apparatus, Prof. A. E. H. Love, 513; a Certain Permutation Group, Dr. Baker, 514; the Theory of Numbers, Lieut.-Colonel Allan Cunningham, 514; Dr. Baker, 514; Initial Motion of Electrified Spheres, Dr. J. W. Nicholson, 514; Need of a Non-Euclidean Bibliography, Dr. Duncan M. Y. Somerville, 514; Present State of the Theory of Integral Equations, H. Bateman, 514; Dr. Hobson, 514; the Theory of Ideals, Prof. J. C. Fields, 514; Number of Electrons in the Atoms, J. A. Crowther, 514; Attractive Constant of a Molecule of a Compound and its Chemical Properties, Dr. R. D. Kleemann, 514; Demonstration of Vacuum-tight Seals between Iron and Glass, Dr. H. J. S. Sand, 514; Complete Apparatus for the Measurement of Sound, Dr. A. G. Webster, 515; the Relation of Spectra to the Periodic Series of the Elements, Prof. W. M. Hicks, 515; Sir Norman Lockyer, 515; Photographic Study of the Mercury Arc *in vacuo*, Dr. S. R. Milner, 515; Apparatus for a Production of Circularly Polarised Light, A. E. Oxley, 515; Principles of Mechanical Flight, Prof. G. H. Bryan, 515; Dugald Clerk, 515; Atmospheric Electricity, Dr. Charles Chree, 515; Existence of a Positive Gradient of Potential during Fine Weather and a Negative Gradient during Wet Weather, Sir Oliver Lodge, 515; Dr. Shaw, 515; Sir J. J. Thomson, 515; a New Instrument, the Variograph, for Measuring Short Waves in Atmospheric Pressure, Dr. W. Schmidt, 516; Records from the Upper Atmosphere Obtained during Passage of the Earth through the Tail of Halley's Comet, Mr. Dines, 516; Vertical Temperature Gradients in Canada in the Winter Months, Mr. Stupart, 516; Results of an Investigation into the Effect of Radiation on H, the Height, and *Te*, the Temperature, of the Advective Region, Mr. Gold, 516; Sensitive Bifilar Seismograph for Recording Undulatory Movements of the Earth's Surface of Short Period, Prof. F. G. Bailey, 516; a Successful Attempt to Simplify the Long-range Spectrograph to Make it Suitable for Industrial Investigations concerning Metals, Alloys, &c., Prof. C. Féry, 516; Magnetic Field Produced by the Motion of a Charged Condenser through Space, W. F. G. Swann, 516; Results of Experiments on the Secondary Radiation from Carbon at Low Temperatures when Bombarded by the α Rays from Polonium, V. E. Pound, 516; Resolution of the Spectral Lines of Mercury by a High-grade Echelon Spectroscope, Prof. McLennan and N. Macallum, 516; Active Deposit Obtained when the Emanation from Actinium is Allowed to Diffuse Freely between Two Parallel Plates Placed about 2 Millimetres apart over the Actinium Salt, the Plates being Maintained at a Difference of Potential of 250 volts, W. T. Kennedy, 516; Recoil of Radium B from Radium A, Drs. W. Makower and S. Russ and E. J. Evans, 516; Stars and their Temperatures, Sir Norman Lockyer, 516; So-called "Sudden Commencements" of Magnetic Storms, Dr. Bauer, 516; Dr. Chree, 516

Section B (*Chemistry*).—Opening Address by J. E. Stead, F.R.S., F.I.C. F.C.S., President of the Section, 302; Researches upon the Chemical Aspects of Gaseous Combustion during the Past Thirty Years, Prof. Bone, 517; Combustion, Sir J. J. Thomson, 517; Velocity of Sound not a Constant Quantity, Sir Oliver Lodge, 517; Explosion of Hydrogen and Chlorine by Light, Prof. H. B. Dixon, 517; Impossibility of any Interaction Taking Place between Two Substances if Neither was an Electrolyte, Prof. Armstrong, 517; Molecular Weight of Radium Emanation, Sir Wm. Ramsay and Dr. R. W. Gray, 517; Biochemistry of Respiration, F. F. Blackman, 517; Existing Knowledge with Regard to the Oxydases, Dr. E. F. Armstrong, 518; a Fourth Recalescence in Steel, Prof. J. O. Arnold, 518; Dr. C. H. Carpenter, 518; Mr. Stead, 518; Allotropy or Transmutation, Prof. H. M. Howe, 518; Closing and Welding of Blow-holes in Steel Ingots, Prof. H. M. Howe, 518; Mr. Stead, 518; Provident Use of Coal, Prof. H. E. Armstrong, 518; Prof. A. Smithells, 519; Dr. Beilby, 519; Mr. Archbutt, 519; Properties of a Series of Steels with Varying Carbon Contents, Prof. McWilliam, 519; Crystalline Structure of Iron at High Temperatures, Dr. Rosenhain, 519; Ferro-silicon, Dr. S. M. Copeman, 519; Dr. Wilson Hake, 519; S. R. Bennett, 519; Corrosion of Iron and Steel, Dr. J. N. Friend, 519; Influence of Heat Treatment on the Corrosion, Solubility, and Solution Pressures of Steel, C. Chappell and F. Hodson, 519; Relative Instability of the Trimethylene Ring, Dr. J. F. Thorpe, 519; Elimination of a Carbethoxyl Group during the Closing of the Five-membered Ring, A. D. Mitchell and Dr. J. F. Thorpe, 519; Molecular Association in Water, W. E. S. Turner and C. J. Peddle, 519; Affinities of the Halogen Elements, W. E. S. Turner, 519; Molecular Complexity of Nitrosoamines, W. E. S. Turner and E. W. Merry, 520; Action of Metals upon Alcohols, Dr. F. M. Perkin, 520

Sub-Section of B (*Agricultural Sub-Section*).—Opening Address by A. D. Hall, M.A., F.R.S., Chairman of the Sub-section, 309

Section C (*Geology*).—Opening Address by Prof. A. P. Coleman, M.A., Ph.D., F.R.S., President of the Section, the History of the "Canadian Shield," 333; Graptolitic Zones from the Salopian Beds of the Cautly District, Sedburgh, Miss G. R. Whatney and Miss E. G. Welch, 520; the Concealed Coalfield of Notts, Derby, and Yorkshire, Prof. P. F. Kendall, 520; the Shelly Moraine of the Sefström Glacier, Spitsbergen, G. W. Lamplugh, 520

Section D (*Zoology*).—Opening Address by Prof. G. C. Bourne, M.A., D.Sc., F.R.S., President of the Section, 378; Hormones in Relation to Inheritance, Gilbert C. Bourne, 462; Zoology at the British Association, Dr. J. H. Ashworth, 548; Coral Snakes and Peacocks, Dr. H. F. Gadow, F.R.S., 548; Coccidia and Coccidiosis in Birds, Dr. H. B. Fantham, 548; the Formation and Arrangement of the Opercular Chætae of Sabellaria, Arnold T. Watson, 549; the Anatomy and Physiology of *Calma glaucoides*, T. J. Evans, 549; Sex and Immunity, Geoffrey Smith, 549; Prof. Bateson, F.R.S., 549; Prof. Hartog, 549; the Colours of Insect Larvæ, Prof. Walter Garstang, 549; Mr. Doncaster, 550; Insect Coloration, Mark L. Sykes, 550; G. Story, 550; the Biology of Teleost and Elasmobranch Eggs, Dr. W. J. Dakin, 550; Semination in the Sanderling, Prof. C. J. Patten, 550; Anatomical Adaptations in Seals to Aquatic Life, Dr. H. W. Marett Tims, 550; the Temporal Bone in Primates, Prof. R. J. Anderson, 550; the Oxford Anthropometrical Laboratory, Dr. E. Schuster, 550; the Relation of Regeneration and Developmental Processes, Dr. J. W. Jenkinson, 550

Section E (*Geography*).—Opening Address by A. J. Herbertson, M.A., Ph.D., Professor of Geography in the University of Oxford, President of the Section, Geography and Some of its Present Needs, 383; Origin of Some of the More Characteristic Features of the Topography of Northern Nigeria, Dr. J. D. Falconer, 551; Prince Charles Foreland, Spitsbergen, Dr. W. S. Bruce, 551; Plans for a Second Scottish National Antarctic Expedition, Dr. W. S. Bruce, 551; Voyage of the *Nimrod* from Sydney to Monte Video, Captain J. K. Davis, 551; Metallurgical Industries in Relation to the Rocks of the District, Prof. A. McWilliam, 552; Importance to Sheffield of the Unoxidised Iron Ores of Leicestershire and Lincolnshire, Prof. Kendall, 552; the Humber during the Human Period, T. Sheppard, 552; Journey Across South America from Bogotá to Manáos, Dr. Hamilton Rice, 552; Geography of British Cotton-growing, J. Howard Reed, 552; Journey from India through Gilgit, Hanza, across the Pamirs, and thence by Chinese Turkestan, Mongolia, and Siberia to the Trans-Siberian Railway, Lieutenant P. T. Etherton, 552; New Globe-map of the World, William Wilson, 552; Midlothian District, James Cossar, 552; Underground Waters of the Castleton District of Derbyshire, H. Brodrick, 552

Section G (*Engineering*).—Opening Address by Prof. W. E. Dalby, M.A., M.Inst.C.E., President of the Section, British Railways, Some Facts and a Few Problems, 407; the Testing of Lathe Tool Steels, Prof. Ripper, 553; Third Report of the Committee on Gaseous Explosions, 553; Radiation from Open Flames in the Laboratory, Prof. Callendar, 553; Radiation from Gases in a Closed Combustion Chamber, Prof. Hopkinson, 553; the Ignition of Gases by Adiabatic Compression, Prof. Dixon, 553; Captain Sankey, 553; New Method of Testing the Cutting Quality of Files, Prof. Ripper, 553; Electrification of the London, Brighton, and South Coast Railway between Victoria and London Bridge, P. Dawson, 553; Use of an Accelerometer in the Measurement of Road Resistance and Horse-power, H. E. Wimperis, 553; Cyclical Changes of Temperature in a Gas-engine Cylinder near the Walls, Prof. Coker, 553; Principles of Mechanical Flight, Prof. Bryan, 554; Optical Determination of Stress, Prof. Coker, 554; Measurement of the Air Supply to a Gas-engine Cylinder, Prof. Dalby, 554; Heat Insulation, F. Bacon, 554; a New Method of Producing High-tension Electrical Discharges, Prof. E. Wilson and W. H. Wilson, 554; Machine for Testing Rubber by Means of its Mechanical Hysteresis, Prof. Schwartz, 554; Utilisation of Solar Radiation, Wind Power, and other Intermittent Natural Sources of Energy, Prof. Fessenden, 554; Experimental Investigation of the Strength of Thick Cylinders, Mr. Cook, 554

Section H (*Anthropology*).—Opening Address by W. Crooke, B.A., President of the Section, 414

Section I (*Physiology*).—Opening Address by Prof. A. B. Macallum, M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., President of the Section, 444

Section K (*Botany*).—Opening Address by Prof. James W. H. Trail, M.A., M.D., F.R.S., President of the Section, 452

Section L (*Educational Science*).—Opening Address by Principal H. A. Miers, M.A., D.Sc., F.R.S., President of the Section, 480; the Relation of Science to Industry and Commerce, R. Blair, 345

British Fossils 101

British Isles, the Gulf Stream Drift and the Weather of the, Dr. H. Bassett, 44

British Isles in Pictures, the, H. Clive Barnard, 238

British Mammals, a History of, G. E. H. Barrett-Hamilton, 493

British Marine Zoology, Prof. E. W. MacBride, F.R.S., 252, 330, 396, 462; Prof. W. A. Herdman, F.R.S., 329, 396, 462; Dr. Wm. J. Dakin, 396

British Medical Association in London, the, 153

British Museum: Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History), Prof. J. W. Gregory, F.R.S., 8; Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History), 266; Guide to Mr.

Worthington Smith's Drawings of Field and Cultivated Mushrooms and Poisonous or Worthless Fungi often Mistaken for Mushrooms, Exhibited in the Department of Botany, British Museum (Natural History), 361; Mineral Specimens Acquired by British Museum, 467; Handbook to the Ethnographical Collection, 536
British Pharmaceutical Conference, the, 156
British Rainfall, 1909, Dr. Hugh Robert Mill, 523
British Section of the Brussels Exhibition, the, Dr. F. Mollwo Perkin, 398
Brizard (L.), Ionisation of Gases in Presence of Chemical Reactions, 151
Brockett (Paul), Bibliography of Aëronautics, 229
Brodrick (H.), Underground Waters of the Castleton District of Derbyshire, 552
Broglie (Maurice de), Exclusive Presence in the Gases Evolved from some Hydrogenated Flames of Ions altogether Analogous to those Produced by Röntgen Rays, 64; Ionisation of Gases in Presence of Chemical Reactions, 151
Brook (C. L.), the Perseid Meteoric Shower, 248
Brooke (T. F.), Cause of Serious Loss of Gooseberry Bushes in Cambridgeshire, 402
Brooks (A. H.), Mineral Resources of Alaska, 511
Brooks's Comet, 1889 V, Search-ephemeris for, Dr. Bauschinger, 317
Brooks's Periodical Comet (1889 V), Rediscovery of, Messrs. Aitken and Wilson, 438
Broom (Dr. R.), Relationship of the South African Fossil Reptiles to those Found in other Parts of the World, 158; Relationship of Permian Reptiles of North America to those of South, 402
Brown (Edward G.), the Leaning Tower of Pisa, 297
Brown (H. Y. L.), the Tanami Goldfield in Central Australia, 182
Brown (J. Coggin), a Lisu Jew's Harp, 422
Brown (Sidney G.), Modern Submarine Telegraphy, Discourse at Royal Institution, 23
Bruce (Dr. James), Practical Chemistry, 360
Bruce (Dr. J. Mitchell), Important Additions to Medical Knowledge, 154
Bruce (Dr. W. S.), Prince Charles Foreland, Spitsbergen, 551; Plans for a Second Scottish National Antarctic Expedition, 551
Brückner (Prof. E.), les Variations périodiques des Glaciers, 17
Brunetti (E.), Protest against Unnecessary Subdivision and Splitting in the Culicidæ, 407
Brussels, International Congress of Anatomists at, 252
Brussels Exhibition, the British Section of the, Dr. F. Mollwo Perkin, 398
Bryan (Prof. G. H., F.R.S.), the Art of Aviation, R. W. A. Brewer, 229; How to Build an Aëroplane, R. Petit, 229; How to Build a 20-foot Biplane Glider, A. P. Morgan, 229; les Aéroplanes, considérations théoriques, P. Raybaud, 229; Ballons et Aéroplanes, G. Besançon, 229; l'Aviation, Prof. Paul Painlevé and Prof. Emile Borel, 229; Navigation in der Luft, Prof. A. Marcuse, 229; Stabilitié des Aéroplanes, Surface métacentrique, Prof. M. Brillouin, 229; die Seitensteuer der Flugmaschinen, Prof. H. Reissner, 229; VI. Congrès international d'Aéronautique, 1909, Procès verbaux, Rapports et Mémoires, 229; Bibliography of Aëronautics, Paul Brockett, 229; Petite Encyclopédie aëronautique, L. Ventou-Duclaux, 229; the Encyclopædia of Sports and Games, 229; Principles of Mechanical Flight, 515, 554
Bryozoa, Catalogue of the Fossil, in the Department of Geology, British Museum (Natural History), Prof. J. W. Gregory, F.R.S., 8
Buchanan (Miss F.), the Relative Size of the Heart in Different Groups of Animals, 148
Buchanan (J. Y., F.R.S.), Colour of the Sea, 87
Buckland (J.), Traffic in Feathers and the Need for Legislation, 117
Buenos Aires, the International Scientific Congress at, Prof. C. D. Perrine, 509
Building: Chimney Design, 213; Facilities Provided at the Brussels Exhibition for the Beginning and Rapid Spread of Fire, 272
Bulleid (Arthur), Excavations at the Glastonbury Lake-village, 82
Bullen (Rev. R. Ashington), a Meteorological Phenomenon, 429
Burial Customs in Egypt, Early, Prof. G. Elliot Smith, F.R.S., 461, 529; Prof. W. M. Flinder Petrie, F.R.S., 494
Burnet (Arthur), an Interesting Occultation, 73
Burnham (Prof.), Measures of Double Stars, 152
Burr (Dr. Malcolm), a Synopsis of the Orthoptera of Western Europe, 39
Burt (F. P.), Relative Atomic Weights of Nitrogen and Sulphur, 62
Burton (F. M.), Pwdre Ser, 40
Burton (Mr.), A New Comet, 213
Bury (H.), the Denudation of the Western End of the Weald, 29
Büsgen (Dr. M.), Distinguishing Characters of the Trees in the German Cameroons, 546
Bush Calendar, a, Amy E. Mack, 464
Busignies (M.), Some Ethylenic Cyclic Derivatives (Ether Oxides) and their Bromine Derivatives, 324
Butler (Mrs. A. M.), "Mock Suns" at Eastbourne, 374
Butler (Bert S.), Areal Geology, 76
Butler (Prof. Howard C.), Archæology Expedition in Sardis, 503

Calcium Vapour in the Sun, C. E. St. John, 249
Calculus Elements of the Differential and Integral, Prof. A. E. H. Love, F.R.S., 136
Calendar, Reforms of the, Prof. Förster, 368
California Earthquake of April 18, 1906, the, vol. ii., the Mechanics of the Earthquake, Harry F. Reid, Prof. John Milne, F.R.S., 165
Calkins (Mr.), Ore Deposits of the Cœur l'Alène District, Idaho, 122
Callendar (Prof.), Radiation from Open Flames in the Laboratory, 553
Callendar (Prof. H. L.), the Radio-balance, 195
Calman (Dr. W. T.), Antarctic Pycnogons, 104
Calmette (Prof.), Special Susceptibility of Children of Tuberculous Parents, 508
Cambier (R.), Abiotic Action of Ultra-Violet Rays of Chemical Origin, 164
Cambridge County Geographies, Nottinghamshire, Dr. H. H. Swinnerton; Lanarkshire, Frederick Mort, 527
Cambridge Observatory, the, Sir Robert Ball, 472; Prof. Newall, 472
Cambridge Philosophical Society, 62
Cambridge Pocket Diary for the Academical Year 1910–11, 527
Cambridge, Students' Life and Work in the University of, Prof. Karl Breul, 461
Campbell (A. G.), Natural Features of the Australian Grampians, 271
Campbell (M. R.), Contributions to Economic Geology, part ii., Coal and Lignite, 511
Campbell (Norman R.), the Nomenclature of Radioactivity, 203
Campbell (Prof.), Water Vapour on Mars, 317
Canada, Medical Education in the United States and, Abraham Flexner, 332
Cancer: the Progress of Cancer Research, 126; the International Cancer Conference at Paris, 545
Cannon (Dr. W. A.), Conditions of Parasitism in Plants, 505
Cape Town, Royal Society of South Africa, 98, 132, 262, 422
Cardoso (Ettore), Critical Constants of Acetylene and Cyanogen, 98
Carey (W. M.), a First Book of Physical Geography, 426
Carnation Year Book, 1910, the, 460
Carpenter (Dr.), Theory of Hardening Carbon Steels, 440; a Fourth Recalescence in Steel, 518
Carpenter (Prof. G. H.), Interdependence of Research in So-called "Pure" and "Applied" Science, 156
Carruthers (John B.), Death and Obituary Notice of, 114
Carslaw (Prof. H. S.), Plane Trigonometry, 136; Gauss and Non-Euclidean Geometry, 362
"Carte du Ciel," the Permanent International Committee for the, 317
Carter (F. W.), Electrification of Railways, 155

Cat, the Origin of the Domestic "Blotched" Tabby, H. M. Vickers, 298, 331; R. I. Pocock, 298
Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History), 266
Caucasus, Byways in the, Col. C. E. de la Poer Beresford, 469
Causal Geology, Prof. E. H. Schwarz, Prof. Grenville A. J. Cole, 397
Cavolini (Filippo), Centenary of Death of, 313, 500
Cemento Armato, Le Prove dei Materiali da Construzione e le Construzione in, Guilo Revere, 358
Cemento Armato e la sua applicazione practica, Il, Cesare Presenti, 358
Centenary of Berlin University, the, 496
Centenary of Death of Filippo Cavolini, the, 313, 500
Centre of Gravity of Annual Statistics, A. Marshall, 104
Césaro (G.), Galactite a Mixture of Natrolite and Scolezite, 376
Chagas (C.), Nova tripanosomiaze humana, 142; Cytology of the Flagellata, 504
Chamberlain (C. J.), Description of *Dioon spinulosum*, 372
Chamberlain (R. T.), the Gases in Rocks, 376
Chambers (G. F.), the Study of Double Stars for Amateurs, 273
Chandler (Prof. Charles Frederick), Testimonial to, 403
Chapman (C. M.), Rust-preventing Properties of Protective Coatings for Structural Steel, 272
Chapman (F.), Silurian Fossils of the South Yarrow District, 401
Chapman (Dr. H. G.), the Study of the Precipitins, 522
Chappell (C.), Influence of Heat Treatment on the Corrosion, Solubility, and Solution Pressures of Steel, 519
Charpy (G.), Reduction of Oxide of Iron by Solid Carbon, 555
Chase (Frederick L.), Parallax Investigations on Thirty-five Selected Stars, 433
Chatelu (J.), Observations of Metcalf's Comet Made at the Paris Observatory, 261
Chaudhuri (B. L.), Triacanthus weberi, 422
Chavez (M. G.), Death of, 400
Chemistry: Death of Dr. W. H. Seaman, 14; Death and Obituary Notice of C. H. Greville Williams, F.R.S., 14; Molecular Weights of Helium, Neon, Krypton, and Xenon, H. E. Watson, 18; Death of Prof. Hugo Erdman, 46; Synthesis of Camphoric Acid, M. Blanc and Dr. J. F. Thorpe, 51; Tinctorial Chemistry, Ancient and Modern, Prof. Walter M. Gardner, 56; Method for the Quantitative Estimation of Hydrocyanic Acid in Vegetable and Animal Tissues, Prof. A. D. Waller, 60; Spontaneous Crystallisation and the Melting- and Freezing-point Curves of Mixtures of Two Substances which form Mixed Crystals and possess a Minimum or Eutectic Freezing-point, F. Isaac, 61; Relative Atomic Weights of Nitrogen and Sulphur, F. P. Burt and F. L. Usher, 62; Comparative Toxicity of Theobromine and Caffeine as Measured by their Direct Effects upon the Contractility of Isolated Muscle, V. H. Veley and Prof. A. D. Waller, 62; Results of Sterilisation Experiments on the Cambridge Water, Prof. Sims Woodhead, 63; Action of Iron and its Oxides at a Red Heat, on Carbonic Oxide, Armand Gautier and P. Clausmann, 64; Manganate of Sodium and its Hydrates, V. Auger, 64; Researches on *iso*-Maltol, A. Backe, 64; a History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D., with Sanskrit Texts, &c., Prof. Praphulla Chandra Ray, 68; Methods Used in the Examination of Milk and Dairy Products, Dr. Chr. Barthel, 69; Electrolytic Conductivity of Non-aqueous Solutions at Low Temperatures, P. Walden, 84; Specific Volumes of Solutions of Tetrapropylammonium Chloride, J. W. M'David, 97; Action of Cold and Anæsthetics upon the Leaves of Angraecum fragrans and the Green Husks of Vanilla, Edouard Heckel, 98; Toxic Qualities of Certain Salts towards Green Leaves, L. Maquenne and E. Demoussy, 131; the Action of Vapours on Green Plants, Marcel Mirande, 262; Critical Constants of Acetylene and Cyanogen, Ettore Cardoso and Georges Baumes, 98; Action of Pressure and Temperature upon Cyanogen, E. Briner and A. Wroczynski, 164; Technical Methods of Chemical Analysis, Prof. George Lunge, 101; Cordite, 109; Examination of the Atmosphere at Various Altitudes for Oxides of Nitrogen and Ozone, Messrs. Hayhurst and Pring, 119; Rectilinear Diameter of Oxygen, E. Mathias and H. Kamerlingh Onnes, 131; Action of Ultra-Violet Rays on Gelatine, A. Tian, 131; Action of the Ultra-Violet Rays upon Certain Carbohydrates, Henri Bierry, Victor Henri, and Albert Ranc, 164; Abiotic Action of Ultra-Violet Rays of Chemical Origin, E. Tassilly and R. Cambier, 164; Action of the Ultra-Violet Rays upon Plants containing Coumarind, Some Plants the Smell of which is due to the Hydrolysis of Glucosides, M. Pougnet, 421; New Researches on the Sterilisation of Large Quantities of Water by the Ultra-Violet Rays, Victor Henri, A. Helbronner, and Max de Recklinghausen, 556; Sulphate of Thorium, M. Barre, 132; Absorption of Iodine by Solid Bodies, Marcel Guichard, 132; Ionisation of Gases in presence of Chemical Reactions, Messrs. de Broglie and L. Brizard, 151; Note on Local Coloration of the Cell Wall in Certain Water Plants induced by Manganese Compounds, Prof. H. Molisch, 151; Aluminium Nitride, its Preparation and Fusion, Daffy Wolk, 164; Decomposition of Steam by the Brush Discharge, Miroslaw Kernbaum, 164; Researches on the Constitution of Vicianose, Gabriel Bertrand and G. Weisweiller, 164; Colours Arising in Colourless Solutions of Coloured Bodies at the Moment of the Solidification of the Colourless Solvent, D. Gernez, 164; Observations on Callose, L. Mangin, 164; Relations between Callose and Fungose, C. Tanret, 228; Electrical Resistance of the Alkali Metals, L. Hackspill, 164; Coal, Tar, and Ammonia, Prof. George Lunge, 166; the Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches, Prof. George Lunge, 166; Chimica Generale e Applicata all' Industria, Prof. Ettore Molinari, 170; Death of Oscar Guttmann, 179; the Chemical Significance of Crystal Structure, Prof. William J. Pope, F.R.S., at Royal Institution, 187; Action of Mixtures of Carbon Monoxide and Hydrogen, or of Carbon Dioxide and Hydrogen, upon the Oxides of Iron, A. Gautier and P. Clausmann, 196; Catalytic Preparation of Alkyl-aryl Ethers, Paul Sabatier and A. Mailhe, 196; Evolution of Heat in a Mixture of Radium and a Phosphorescent Salt, William Duane, 196; Relations between White Phosphorus, Red Phosphorus, and Pyromorphic Phosphorus, Pierre Jolibois, 196; Catalytic Reactions in the Wet Way based on the Use of Aluminium Sulphate, J. B. Senderens, 196; Mechanism of Photochemical Reactions and the Formation of Plant Principles, Daniel Berthelot and Henry Gaudechon, 196; the Constants of Nature, Part v., a Recalculation of the Atomic Weights, Frank Wigglesworth Clarke, 207; Determination of Atomic Weights, Theodore W. Richards and Hobart Hurd Willard, 207; the Harvard Determination of Atomic Weights between 1870 and 1910, Theodore W. Richards, 207; Methods used in Precise Chemical Investigation, Theodore W. Richards, 207; Changes taking Place during the Storage of Butter, 212; Development of the Leblanc Process for the Manufacture of Soda, Sir William Ramsay, 213; New Process for producing Protective Metallic Coatings, M. U. Schoop, 218; Lehmann's Anisotropic Liquids, G. Friedel and F. Grandjean, 228; Preparation of Pure Arbutine, H. Hérissey, 228; Determinations of the Effects of Atmospheres of Various Vapours on the Volt-ampere "Characteristic Curves" of the Carbon Copper Arc, M. Kimura and K. Yamamoto, 248; Solubility of Ether in Water, Y. Osaka, 248; Production of Methane by the Direct Union of Hydrogen with Carbon, Prof. Bone and Dr. H. F. Coward, 248; Photochemical Decomposition of the Alcohols, Aldehydes, Acids, and Ketones, Daniel Berthelot and Henry Gaudechon, 262; the Rectilinear Diameter of Oxygen, E. Mathias and H. Kamerlingh Onnes, 262; a First Year's Course of Inorganic Chemistry, G. F. Hood, 266; a Manual of Elementary Practical Chemistry for Use in the Laboratory, P. W. Oscroft and R. P. Shea, 266; Catalytic Preparation of the Phenolic Oxides and the Diphenylenic Oxides, Paul Sabatier and A. Mailhe, 292; Preparation of Phenylnitro-methane by the Interaction of Mercurous Nitrite and Benzyl Chloride, Panchanan Neogi and Birendra Bhusan Adhikary, 292; a Manual of Dyeing, Prof. E. Knecht, C. Rawson, and Dr. R. Loewenthal, 295;

Death of Dr. Charles Fahlberg, 313; Alleged Allotropy of Lead, E. Cohen and K. Inouye, 316; Some Ethylenic Cyclic Derivatives (Ether Oxides) and their Bromine Derivatives, M. Busignies, 324; New Researches on Bitter Wines and the Acrylic Fermentation of Glycerol, E. Voisenet, 324; Lead and Zinc Pigments, Dr. C. D. Holley, Dr. A. P. Laurie, 325; Chemistry for Photographers, Chas. F. Townsend, 327; Preparation of Acrolein, J. B. Senderens, 356; Soft Crystals and the Measurement of their Indices of Refraction, Paul Gaubert, 356; A.B.C. Five Figure Logarithms and Tables for Chemists, including Electrochemical Equivalents, Analytical Factors, Gas Reduction Tables, and other Tables useful in Chemical Laboratories, C. J. Woodward, 360; Practical Chemistry, Dr. James Bruce and Harry Harper, 360; Qualitative Analysis, E. J. Lewis, 360; Outlines of Organic Chemistry, Dr. F. J. Moore, 360; the Calculations of General Chemistry, with Definitions, Explanations, and Problems, Prof. William J. Hale, 360; Death of Dr. Charles A. Goessmann, 370; Ionisation of Gases and Chemical Change, Dr. H. Brereton Baker, F.R.S., at Royal Institution, 388; Chemistry of the Sugars, J. S. Hepburn, 403; Testimonial to Prof. Charles Frederick Chandler, 403; Annual Report of the Government Laboratory, 405; Beet Sugar Making and its Chemical Control, Y. Nikaido, 424; Complexity of Tellurium, W. R. Flint, 438; Analytical Chemistry, Prof. F. P. Treadwell, 461; Recent Work on Colloidal Solutions, Prof. Paterno, 471; Organic Compounds of Tetravalent Tellurium, Charles Lederer, 488; Action of Quinones and their Sulphonic Derivatives on the Photographic Images formed by Silver Salts, A. and L. Lumière and M. Seyewetz, 488; World's Consumption of Nitrate, 502; the Study of the Precipitins, Dr. H. G. Chapman, 522; Leitfaden der graphischen Chemie, Dr. R. Kremann, 525; Abhandlungen Jean Rey's, über die Ursache der Gewichtszunahme von Zinn und Blei beim Verkalten, Ernst Ichenhäuser and Max Speter, 527; Luminous Paint, R. G. Durrant, 530; Absorption of Helium in Salts and Minerals, Prof. A. Piutti, 543; Batteries with Antimony and Antimony Selenides, H. Pelabon, 555; Reduction of Oxide of Iron by Solid Carbon, G. Charpy and S. Bonnerot, 555; Presence of a Small Quantity of Carbon Monoxide in the Air of Coal Mines, P. Mahler and J. Denet, 555; *see also* British Association
Cheshire and Liverpool Bay, the Vertebrate Fauna of, 175
Chick (Harriette), Process of Disinfection by Chemical Agencies and Hot Water, 469
Cholera and its Control, 239
Cholnoky (E. v.), Resultate der Wissenschaftlichen Untersuchungen des Balaton, das Eis Balatonsees, 299
Chree (Dr. Charles), Atmospheric Electricity, 515; So-called "Sudden Commencements" of Magnetic Storms, 516
Christian Topography of Cosmas Indicopleustes, the, 133
Christy (Miller), a History of the Mineral Waters and Medicinal Springs of the County of Essex, 361
Chronology: Reforms of the Calendar, Prof. Förster, 368
Chronometry: Suggested Bill making Greenwich Time Compulsory in Paris, 81; Greenwich Watch and Chronometer Trials, 210; Comparison of Two Astronomical Pendulums with the Aid of Electrical Signals Transmitted by a Submarine Cable of Great Length, R. Bourgeois, 456
Church Congress, Heredity at the, 431; Dr. G. E. Shuttleworth, 431; Mrs. Pinsent, 431; Bishop of Ripon, 431; W. C. D. Whetham, 431
Churches, Lightning and the, Alfred Hands, 238
Chwolson (O. D.), Traité de Physique, 65
Clark (A. H.), New Species of Feather-star (Antedon) from the Adriatic, 150; *Proisocrinus ruberrimus*, a New Genus and Species of Stalked Crinoid from the Philippines, 547
Clark (F. H.), American Engine-houses and their Appliances, 155
Clark (J. E.), a Brilliant Meteor on October 23, 544
Clark (John Willis), Death of, 468; Obituary Notice of, Dr. Sidney F. Harmer, F.R.S., 501
Clarke (Frank Wigglesworth), the Constants of Nature, Part v., a Recalculation of the Atomic Weights, 207
Clausmann (P.), Action of Iron and its Oxides, at a Red Heat, on Carbonic Acid, 64; Action of Mixtures of Carbon Monoxide and Hydrogen, or of Carbon Dioxide and Hydrogen, upon the Oxides of Iron, 196
Clement (J. K.), Measurements of the Heat Transmitted through a Steel Tube of $1\frac{1}{4}$-inch External Diameter, with Walls $\frac{1}{8}$-inch Thick, from Steam Outside to Water Inside running through the Tube, 18
Clerk (Dugald), Principles of Mechanical Flight, 515
Climates, Reports on, 377
Clutterbuck (W. J.), Great Lu-Chu Island, 180
Coal, Increase in Germany's Imports of British, 248
Coal Mining, First Steps in, Alexander Forbes, 492
Coal Tar and Ammonia, Prof. George Lunge, 166
Cobbett (Dr.), "Grouse Disease," 48; Absence of Tubercle Bacilli from Old Tuberculous Lesions, 63
Cockayne (Dr. L.), *Celmisia spectabilis*, 160
Cockburn (Sir John), Growth of Sanitary Science, 313
Cockerell (Prof. T. D. A.), Bees of the Genus Nomia, 49; Plant-remains from the Cretaceous of Mesa Verde, 89; the Fur Trade, 428
Cocos-Keeling Atoll, 432; Dr. F. Wood-Jones, 528; the Reviewer, 529
Coe (H. I.), Manganese in Cast Iron and the Volume Changes during Cooling, 440
Coggia (M.), Observations of the Comet 1910*d* (Metcalf, August 9, 1910), 261
Cohen (E.), Alleged Allotropy of Lead, 316
Coker (Prof.), Cyclical Changes of Temperature in a Gas-engine Cylinder near the Walls, 553; Optical Determination of Stress, 554
Cole (Prof. Grenville A. J.), Causal Geology, Prof. E. H. Schwarz, 397
Coleman (Prof. A. P., M.A., Ph.D., F.R.S.), Opening Address in Section C at the Meeting of the British Association at Sheffield, the History of the "Canadian Shield," 333; Various Subdivisions of the Pre-Cambrian Rocks, 443
Colgate (Mr.), Crystallographic Examination of Twenty-nine Derivatives of the *p*-Dihalogenbenzenesulphonic Acids, 403
Collin (Eugène), Nature of the Wick of a Punic Lamp, 132
Collinge (W. E.), Wild-bird Protection, 156
Coloration in the Animal Kingdom, Concealing, Gerald H. Thayer, 532
Colour: Colour of the Sea, J. Y. Buchanan, F.R.S., 87; A Manual of Dyeing, Prof. E. Knecht, C. Rawson, and Dr. R. Loewenthal, 295; the Colours and Spectrum of Water, T. W. Backhouse, 530
Colour-blindness, Tests for, Dr. F. W. Edridge-Green, 495; the Reviewer, 495
Colour-blindness and Colour-perception, Dr. F. W. Edridge-Green, 263
Colour-vision, R. M. Deeley, 267
Colour-vision at the Ends of the Spectrum, on, Rt. Hon. Lord Rayleigh, O.M., F.R.S., 204
Colour-vision, Tests for, 208; Commander D. Wilson-Barker, 363
Coloured Stars between the Pole and 60° N. Declination, Herr Krüger, 439
Colver-Glauert (E.), Sulphurous Acid as an Etching Agent for Metallographic Work, 440
Comets: Halley's Comet, Dr. James Moir, 9; Dr. Wolf, 19; Prof. Seeliger, 19; M. Eginitis, 19, 52; Comas Sola, 19; M. Nordmann, 19; Mr. Leach, 19; Dr. Ebell, 52; Prof. Fowler, 52; Father Iniguez, 52; Herr v. d. Pahlen, 86; Dr. Ristenpart, 86; G. Millochau and H. Godard, 120; Prof. Frost, 152; Mr. Motherwell, 183; Prof. Barnard, 188, 322; Mr. Helmcken, 184; Father Stein, 184; Herr Sykora, 322; Dr. Hartmann, 322; M. Antoniadi, 322; K. Saotome, 322; Drs. Cowell and Crommelin, 322; M. Iwanow, 322; Mr. Merfield, 322; Messrs. Crawford and Meyer, 322; Mr. Slocum, 323; Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19, D. Stenquist and E. Petri, 9; Further Observations of Halley's Comet, Michie Smith and John Evershed, 374; C. D. Perrine, 374; Velocities and Accelerations of the

Ejecta from Halley's Comet, Profs. Barnard and Lowell, 404; J. Comas Sola, 404; Time of the Solar Transit of Halley's Comet, 472; Photographs of Morehouse's Comet, Messrs. Hirayama and Toda, 19; Ephemeris for Comet 1910*a*, Prof. Kobold, 19; Prof. Barnard, 19; Observations of Comet 1910*a*, Dr. Karl Bohlin, 272; Prof. Ricco, 472; a New Comet, Rev. J. H. Metcalf, 213; Mr. Burton, 213; Metcalf's Comet, 1910*b*, 249, 273; M. Guillaume, 249; Dr. Kobold, 249, 344, 507; Prof. Pickering, 344; M. Quénisset, 507; Observations of Comets, Dr. Max Wolf, 213; Photographs of Daniel's Comet 1907*d*, Prof. Barnard, 249; Rediscovery of D'Arrest's Comet (1910*c*), M. Gonnessiat, 317; Observation of the D'Arrest Comet at the Observatory of Algiers, M. Gonnessiat, 324; M. Baillaud, 324; Search-Ephemerides for Comets 1889 V. (Brooks) and 1890 VII. (Spitaler), Dr. Bauschinger, 317; F. Hopfer, 317; Rediscovery of Brooks's Periodical Comet (1889 V.), Messrs. Aitken and Wilson, 438; Definitive Elements for Comet 1852 IV., Adolf Hnatek, 344; Search-Ephemerides for Westphal's Comet, 1852 IV., A. Hnatek, 545; the Passage of the Earth through the Tail of the 1861 Comet, R. Baer, 344; Observations of Comets, M. Gonnessiat, 404; Mr. Innes, 404; the Luminosity of Comets, W. L. Dudley, 439; Comets and Electrons, Prof. Righi, 507
Compton (R. H.), Accident in Heredity, 63; Right- and Left-handedness in Barley, 63
Concealing Coloration in the Animal Kingdom, Gerald H. Thayer, 532
Concrete, a Concise Treatise on Reinforced, C. F. Marsh, 358
Concrete-Steel Construction, Prof. Emil Mörsch, 358
Conference, the International Cancer, at Paris, 545
Conference on Tuberculosis, the Ninth International, 507
Congress, Library of, a List of Geographical Atlases in the Library of Congress, with Bibliographical Notes, 325
Congresses: the First International Congress of Entomology, 214; the Fifth International Congress of Photography, 215; International Congress of Anatomists at Brussels, 252; the International Zoological Congress at Graz (August 15–20, 1910), 318; the Third International Congress of School Hygiene at Paris, August 2–7, 1910, 320; International Congress of Pharmacy, 354; the Geological Congress at Stockholm, 440; the International Congress of Radiology and Electricity, 478; the International Scientific Congress at Buenos Aires, Prof. C. D. Perrine, 509
Conklin (Prof.), Power of Regulation in Echinoderm Eggs, 319
Conorhinus, the Blood-sucking, J. D. H., 172
Conseil (E.), Properties of the Serum of Convalescents and Animals Cured of Exanthematic Typhus, 456
Consumption, the Crusade against, 374
Cook (Mr.), Experimental Investigation of the Strength of Thick Cylinders, 554
Cook (O. F.), Systematic Position of the Tropical American Genus Phytelephas, 151
Copeman (Dr. S. M., F.R.S.), on the Nature, Uses, and Manufacture of Ferro-Silicon, with Special Reference to Possible Danger arising from its Transport and Storage, 53; Ferro-Silicon, 519
Coquillett (D.), Type-species of North American Genera of Diptera, 547
Cora (Prof. Guido), Meteors and Bolides, 317
Coral and Atolls, F. Wood-Jones, 432
Cordite, 109
Core (Prof. T. H.), Death of, 47
Cornu (F.), "Hydrogelen im Mineralreiche," 375
Cortie (Father A. L.), Brilliant Meteor of July 31, 204
Cosmas Indicopleustes, the Christian Topography of, 133
Cosmogony: Scientific Papers, Sir George Howard Darwin, K.C.B., F.R.S., 235
Cossar (James), Midlothian District, 552
Cotton (L. A.), Ore-deposits of Borah Creek, New England, N.S.W., 422
Coward (Dr. H. F.), Production of Methane by the Direct Union of Hydrogen with Carbon, 248
Coward (T. A.), the Mammals and Birds of Cheshire, 175; the Reptiles and Amphibians of Cheshire, 175
Cowell (Dr.), Halley's Comet, 322
Cox (Harry W.), Death of, 47
Cox (W. Herbert), a New Italian Orchid, 104
Crampton (Prof.), Distribution of Species of Partula, 319
Crawford (Mr.), Halley's Comet, 322
Crawley (A. E.), Totemism and Exogamy: a Treatise on Certain Early Forms of Superstition and Society, Prof. J. G. Frazer, 31; Town-planning, 498
Cretaceous Plants, Studies on the Structure and Affinities of, Dr. Marie C. Stopes and Prof. K. Fujii, 129
Cromer (Lord), Value of Research in Medicine, 541
Crommelin (Dr.), Halley's Comet, 322
Crooke (W., B.A.), Opening Address in Section H at the Meeting of the British Association at Sheffield, 414
Cross (Dr. W.), the Natural Classification of Igneous Rocks, 29
Crowther (J. A.), Scattering of Homogeneous β Rays and the Number of Electrons in the Atom, 61; Number of Electrons in the Atoms, 514
Crustacea: New Species of Amphipod Crustacean, G. C. Embody, 149; Guide to the Crustacea, Arachnida, Onychophora, and Myriopoda Exhibited in the Department of Zoology, British Museum (Natural History), 171; Amphipod Crustaceans of Bermuda and the West Indies, Dr. W. B. Kunkel, 180; Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum, Lt.-Col. A. Alcock, F.R.S., 524
Crystallography: the Chemical Significance of Crystal Structure, Prof. William J. Pope, F.R.S., at Royal Institution, 187; Crystallographic Examinations of Twenty-nine Derivatives of the *p*-dihalogenbenzenesulphonic Acids, Prof. Armstrong and Messrs. Colgate and Rodd, 403
Cunningham (Lieut.-Colonel Allan), the Theory of Numbers, 514
Curie (Madame), Isolation of Pure Radium, 313; Metallic Radium, 356; Isolation of Metallic Radium, 478
Curve Tracing and Curve Analysis, A. P. Trotter, 40
Cushman (J. A.), a Monograph of the Foraminifera of the North Pacific Ocean, 265; Collection of Arenaceous Foraminifera obtained by the *Albatross* during her Recent Cruise in the Philippines, 547
Customs at Holy Wells, Zorah Godden, 429
Cuthbertson (Wm.), Pansies, Violas, and Violets, 326
Cyanogen, the Spectrum of, Comte de Gramont and M. Drecq, 344
Cytology: the Plant Cell, its Modifications and Vital Processes, H. A. Haig, 36

Dabbene (Roberto), Catalogo Sistematico y Descriptivo de las Aves de la Republica Argentina, 427
Dakin (Dr. Wm. J.), British Marine Zoology, 396; the Biology of Teleost and Elasmobranch Eggs, 550
Dakyns (John Roche), Death of, 468
Dalby (Prof. W. E., M.A., M.Inst.C.E.), Opening Address in Section G at the Meeting of the British Association at Sheffield: British Railways: Some Facts and a Few Problems, 407; Measurement of the Air Supply to a Gas-engine Cylinder, 554
Dalgliesh (G.), Limitations of Species and Races of the Yellow-necked Field-mouse, 180
Dallimore (W.), Tree Plantations in Inverness-shire, 470
Daly (Dr. R. A.), Average Chemical Compositions of Igneous-rock Types, 376; Origin of Augite-Andesite, 376; Pre-Cambrian Fauna, 442
Dalziel (Dr. J. M.), Botanical Resources of Yola Province, Northern Nigeria, 50
Daniel's Comet 1907*d*, Photographs of, Prof. Barnard, 249
Danilov (A. N.), Lichens, 117
Darboux (M.), Measurements of the Exact Volume of the Kilogram of Water, 456
Darling (Dr. S. T.), Factors in the Transmission and Prevention of Malaria in the Panama Canal Zone, 401
Darton (Mr.), the Laramie Basin in South-Eastern Wyoming, 121
Darwin (Erasmus), on Flying Machines, 370; Arthur Platt, 397
Darwin (Sir George Howard, K.C.B., F.R.S.), Elementaire Theorie der Getijden—Getij-Constanten in den Indische Archipel, Dr. J. P. van der Stork, 144; Scientific Papers, 235

Davenport (C. B.), Inheritance of Characteristics in Domestic Fowl, 253
Davis (Dr. J. Ainsworth), Science in Modern Life, Zoology, 464
Davis (Captain J. K.), Voyage of the *Nimrod* from Sydney to Monte Video, 551
Dawson (P.), Electrification of the London, Brighton, and South Coast Railway between Victoria and London Bridge, 553
Debierne (A.), Atomic Weight of the Radium Emanation, 63; Isolation of Pure Radium, 313; Metallic Radium, 356
Dechy (Dr. von), Glacial Erosion, 442
Dee as a Wildfowl Resort, the, John A. Dockray, 175
Deeley (R. M.), Colour-vision, 267
Definite Proportions, the Law of, 364
Deimler (T.), Physiologische Studien im Hochgebirge, Versuche über den repiratonschen Stoffwechsel im Hochgebirge, 369
Demeny (M.), Physical Training, 320
Demoussy (E.), Toxic Qualities of Certain Salts towards Green Leaves, 131
den Broeck (Ernest van), Conditions of Effective Filtration of the Underground Waters in Certain Chalk Formations, 422
Dendy (Prof. A.), Structure, Development, and Morphological Interpretation of the Pineal Organs and Adjacent Parts of the Brain in the Tuatara (*Sphenodon punctatus*), 61
Denet (J.), Presence of a Small Quantity of Carbon Monoxide in the Air of Coal Mines, 555
Denning (W. F.), Present Meteoric Displays, 105; Perseid Meteoric Shower, 1910, 204; the Perseid Meteoric Shower, 248; Fireball of September 2, 364; a Brilliant Meteor on October 23, 544
der Stork (Dr. J. P. van), Elementaire Theorie der Getijden—Getij-Constanten in den Indische Anchipel, 144
Derbyshire, H. H. Arnold-Bemrose, 426
Derjugin (K.), Fauna of the Kola Fjord, 505
Derry (Dr. D. E.), the Archæological Survey of Nubia, 406
Desalme (J.), Theory of Development, 215
Desch (Dr. C. H.), Some Common Defects occurring in Alloys, 421
Deslandres (H.), Phenomena Presented by the Tail of Halley's Comet during the Passage of May 19 last, 163; Properties of the Polar Filaments of the Sun, 228
Determination of Position near the Poles, Mr. Hinks, 19
Deutsche Südpolar-Expedition, 1901–3, die Grundproben der Deutschen Südpolar-Expedition, 1901–3, E. Philippi, 167
Deville (E.), Photo-surveying in Canada, 215
Devon and Dorset Coast, the South, Sidney Heath, 138
Devonshire, F. A. Knight and Louie M. Dutton, 426
Dew Deposit upon Lens Surfaces, Prevention of, Franklin Adams, 52
Dickins (F. Victor), the New School of Japan, Founded for the Purpose of Making the Use of the Newly Invented Letters, 7
Diels (Dr. L.), Formations and Flora-elements in the North-west of Cape Colony, 160
Diener (Prof. C.), Marine Lower Triassic Formations of the Himalayas, 159; Fauna of the Traumatocrinus Limestone of Painkhanda, 159
Digby (W. P.), Tests of the Electrical Conductivity of the Water, 373
Diller (J. S.), the Taylorsville Region at the North End of the Sierra Nevada in California, 121
Dines (Mr.), Records from the Upper Atmosphere Obtained during Passage of the Earth through the Tail of Halley's Comet, 516
Disease, House-flies and, Dr. C. Gordon Hewitt, 73
Distant Lands, H. J. Mackinder, 426
Distribution of Weeds, 547
Dixon (Prof. H. B.), Explosion of Hydrogen and Chlorine by Light, 517; the Ignition of Gases by Adiabatic Compression, 553
Dixon (W. E.), Action of Potash Salts taken by the Mouth, 63
Doberck (Dr.), a New Micrometer, 439
Dockray (John A.), the Dee as a Wildfowl Resort, 175
Doflein (Prof. Franz), Tierbau und Tierleben in ihrem Zusammen hang betractet, 538
Dominici (Dr.), Radium Treatment, 153
Doncaster (Mr.), the Colours of Insect Larvæ, 550
Donkey Hybrid, an Interesting, R. I. Pocock, 329
Donkin (Dr. H. B.), Some Aspects of Heredity in Relation to Mind, Harveian Oration at Royal College of Physicians, 541
Dorrien-Smith (Capt. A. A.), Botanical Excursions in Chatham Island, 160
Dorset, A. L. Salmon, 426
Dorset Coast, the South Devon and, Sidney Heath, 138
Double Stars, Measures of, Prof. Burnham, 152; Dr. Lau, 317; Mr. Sellors, 507
Douvillé (Henri), Formation of the Loam of the Plateaux, 555
Downing (Dr.), New Ephemerides for Saturn, Uranus, and Neptune, 472
Doyen (M.), Use of Thermo-electric Baths without Alteration of Normal Tissue, 98
Drecq (M.), the Spectrum of Cyanogen, 344
Driesch (Hans), Zwei Vorträge zur Naturphilosophie, 294
Drummond (J. M. F.), Science in Modern Life, Botany, 464
Drysdale (Dr. C. V.), the Foundations of Alternate-current Theory, 6
Du Sablon (Leclerc), the Ascent of Sap, 98
du Toit (A. L.), Evolution of the River System of Griqualand West, 158
Duane (William), Evolution of Heat in a Mixture of Radium and a Phosphorescent Salt, 196; the Energy of the Radium Rays, 262; Arrangement for Registering Photographically the Number of α Particles Emitted by a Radio-active Substance, 316
Duckworth (Dr. W. L.), Collection of Human Bones Found on the Site of an Augustinian Friary near the Corn Market, Cambridge, 16
Dudley (W. L.), Luminosity of Comets, 439
Dueñas (E. T.), the Provinces of Tayacaja, Angaræs, and Huancavelica, 217
Dufferin (Lord), Letters from High Latitudes, being Some Account of a Voyage in 1856 in the Schooner-yacht *Foam* to Iceland, Jan Mayen, and Spitzbergen, 202
Duggar (Prof. B. M.), Fungous Diseases of Plants, 233
Durrant (R. G.), Luminous Paint, 530
Düsseldorf, the International Congress at, 20
Dutch Meteorological Work in the East, 159
Dutton (Louie M.), Devonshire, 426
Dyeing, a Manual of, Prof. E. Knecht, C. Rawson, and Dr. R. Loewenthal, 295
Dynamics: Innsbrucker Föhnstudien, iv., Weitere Beiträge zur Dynamik der Föhns, Dr. H. v. Ficker, 368
Dyson (Prof. F. W., F.R.S.), Astronomy, a Handy Manual for Students and Others, 393

Eagle (Albert), Practical Spectroscopy, 159
Eardley-Wilmot (S.), Indian State Forestry, 56
Earth, the Passage of the, through the Tail of the 1861 Comet, R. Baer, 344
Earthquakes: Earthquake in Sicily, 15; the California Earthquake of April 18, 1906, vol. ii., the Mechanics of the Earthquake, Harry F. Reid, Prof. John Milne, F.R.S., 165; the Jamaica Earthquake, Sir D. Morris, K.C.M.G., 239
Eastbourne, "Mock Suns" at, Mrs. A. M. Butler, 374
Ebell (Dr.), Halley's Comet, 52
Eccles (Dr. W. H.), Energy Relations of Certain Detectors used in Wireless Telegraphy, 195
Eclipses: the Next Total Eclipse of the Sun, Dr. William J. S. Lockyer, 75; the Total Solar Eclipse, May 9, 1910, Dr. William J. S. Lockyer, 113; the Total Solar Eclipse of April 28, 1911, Dr. Pio Emanuelli, 172
Economic Biologists, Association of, 156
Edible and Poisonous Fungi, 361
Edinburgh Royal Society, 30, 97, 227
Edridge-Green (Dr. F. W.), Relation of Light Perception to Colour Perception, 62; Colour-blindness and Colour-perception, 263; Tests for Colour-blindness, 495
Edser (E.), Light and Sound, W. S. Franklin and Barry Macnutt, 103
Education: Death of R. Russell, 14; the Association of Technical Institutions, 90; Examinations for Evening Students, 90; Trade Schools and Trade Preparatory

Schools, 90; the Position of University Education in Great Britain, W. Runciman, 91; Suggestions for the Consideration of Teachers and Others Concerned in the Work of Public Elementary Schools, 220; Broad Lines in Science Teaching, 264; the Third International Congress of School Hygiene at Paris, August 2–7, 1910, 320; Uniformity of Method in Medical Inspection, Dr. James Kerr, 320; Open-air Schools, Dr. Newfert, 320; Dr. Mumford, 320; Physical Training, Dr. Digby Bell, 320; M. Demeny, 320; Discovery of a Trustworthy Mathematical Formula which shall Determine the State of Nutrition of a Child in Relation to Physical Measurements, Prof. Guttman, 320; Fatigue in School Children, Dr. Janala, 320; Inattention, Prof. Schuyten, 320; the Reform of Oxford University, 331; Medical Education in the United States and Canada, Abraham Flexner, 332; Opening of the Medical Session, 479; *see also* British Association

Edwards (C. A.), Theory of Hardening Carbon Steels, 440

Eggar (W. D.), a Manual of Geometry, 138

Eginitis (Prof. D.), Halley's Comet, 19, 52; Some Phenomena shown by Halley's Comet after its Passage Across the Sun, 64

Egypt: the Year-book of the Khedivial Agricultural Society, Cairo, 1909, 184; Studies of Egyptian Cotton, Lawrence Ball, 184

Egyptology: the Funeral Papyrus of Ioniya, Edouard Naville, 237; Early Burial Customs in Egypt, Prof. G. Elliot Smith, F.R.S., 461, 529; Prof. W. M. Flinders Petrie, F.R.S., 494

Ehrenhaft (Dr. F.), Ultra-microscopic Method of Measuring the Electric Charges carried by Small Particles, 182

Elderton (W. Palin), Mortality of the Tuberculous in Relation to Sanatorium Treatment, 371

Electricity: the Foundations of Alternate-current Theory, Dr. C. V. Drysdale, Prof. Gisbert Kapp, 6; Static Charge in Bicycle Frame, Robert S. Ball, jun., 9; Leitfaden zum elektrotechnischen Praktikum, Dr. G. Brion, Prof. Gisbert Kapp, 67; Experimental Study of Fulgurites, Prof. R. W. Wood, 70; Electrical Discharge Figures, Prof. W. Lermantoff, 72; Prof. Alfred W. Porter, 73; Distribution of Power from the Niagara Falls, 84; Notes on the Electric Smelting of Iron and Steel, Dr. W. F. Smeeth, 103; Renewal of Sulphated Storage Cells, J. O. Hamilton, 118; Treatment of Storage Cells, Dr. Bertram B. Boltwood, 174; Ultra-microscopic Method of Measuring the Electric Charges carried by Small Particles, Dr. F. Ehrenhaft, 182; Energy Relations of Certain Detectors used in Wireless Telegraphy, Dr. W. H. Eccles, 195; Lightning and the Churches, Alfred Hands, 238; Determinations of the Effects of Atmospheres of Various Vapours on the Volt-ampere "Characteristic Curves" of the Carbon Copper Arc, M. Kimura and K. Yamamoto, 248; Electrical and other Properties of Sand, Charles E. S. Phillips at Royal Institution, 255; Tests of the Electrical Conductivity of the Water, W. P. Digby, 373; the International Congress of Radiology and Electricity, 478; New Electric Generating Station at the Northampton Polytechnic Institute, 544

Elemental Weight Accurately a Function of the Volution of Best Space-symmetry Ratios, H. Newman Howard, 71, 239

Elkin (William L.), Parallax Investigations on Thirty-five Selected Stars, 433

Elliot (G. F. Scott), Botany of To-day, 146

Ellis (T. S.), Winding Course of the River Wye, 83

Ellison (Rev. W. F. A.), Meteoric Fireballs, 318

Emanuelli (Dr. Pio), the Total Solar Eclipse of April 28, 1911, 172

Embody (G. C.), New Species of Amphipod Crustacea, 149

Embryology: Die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere, Prof. A. A. W. Hubrecht, 134; Development of Aphysia punctata, A. M. Carr Saunders and Margaret Poole, 504

Emerson (Dr. F. V.), Manual of Physical Geography, 201

Engeln (O. D. von), a Laboratory Manual of Physical Geography, 201

Engineering: Relative Merits of the Various Oil- and Air-cooling Devices, R. D. Gifford, 18; Measurements of the Heat Transmitted through a Steel Tube of $1\frac{1}{4}$-inch External Diameter, with Walls $\frac{1}{8}$-inch thick, from Steam Outside to Water Inside running through the tube, J. K. Clément and C. M. Garland, 18; Rules for Internal-combustion Engines for Marine Purposes, 18; the Design and Construction of Internal Combustion Engines, Hugo Güldner, 197; Diesel Oil Engine Fitted to Three Fairly Large Vessels, 506; Novel Features Possessed by a Set of Internal-combustion Engines, 506; Diversity of Published Results of Compressive Tests on Cubes of Concrete, 19; a Concise Treatise on Reinforced Concrete, C. F. Marsh, 358; Concrete-steel Construction, Prof. Emil Mörsch, 358; Il Cemento Armato e la sua applicazione practica, Cesare Presenti, 358; Le Prove dei Materiali da Construzione e le Construzione in Cemento Armato, Giulio Revere, 358; New Armoured Concrete Viaduct at Rotterdam, 373; the International Congress at Düsseldorf, 20; Floating Dock for the Brazilian Government, 84; Aërial-propeller Testing Plant at Vickers' Works, 85; Aëroplanes fitted with the Gnome Rotary Engine, 119; the Institution of Mechanical Engineers, 154; Running-shed Practice, Cecil W. Paget, 155; Handling Locomotives at Terminals, F. M. White, 155; American Engine-houses and their Appliances, F. H. Clark, 155; Arrangements of the Pennsylvania Railroad at East Altoona, W. Forsyth, 155; Pooling System, H. H. Vaughan, 155; Tooth Gearing, J. D. Stevens, 155; Interchangeable Involute Gearing, Wilfrid Lewis, 155; Electrification of Railways, F. W. Carter, 155; Comparison between Systems Employing Series Wound, Continuous-electricity Train-equipments and the Single-phase System, H. M. Hobart, 155; Extended Distribution of Electricity for Industrial Purposes, G. Westinghouse, 155; Development of Apparatus for Higher Voltage Direct-current, W. B. Potter, 155; Electrification of Trunk Lines, L. R. Pomeroy, 155; the Maintenance and Administration of Roads, 160; Systems of Road Administration, L. W. Page, 162; Death of Oscar Guttman, 179; Caissons for the New Foundations of the Quebec Bridge, 183; Hydroplane *Miranda IV.*, Sir John Thornycroft, 183; International Road Congress, 213; Torpedo-boat Destroyers for Brazilian Government, 248; Rust-preventing Properties of Protective Coatings for Structural Steel, C.M. Chapman, 272; die Kraftmaschinen, C. Schütze, 295; Death of C. A. Brereton, 340; Tests of the Electrical Conductivity of the Water, W. P. Digby, 373; Science in Modern Life, vol. vi., Engineering, J. W. French, 395; Photograph of Submarine "D 1," 403; Progress of the Great Barren Jack Dam in Australia, 403; Arrest of Steam Ships either by Reversing the Engine or by Allowing to Slow Down by Friction of the Water, E. Bertin, 421; the Perfilograph, Augustus Mercau, 434; Trials of H.M. Second-class Cruiser *Bristol*, 438; Portsmouth Water Works, 471; the White Star Liner *Olympic*, 544; *see also* British Association

Entomology: the Giant Moth-borer, J. J. Quelch, 17; the Clover Root-borer, Mr. Webster, 18; the Large Corn-stalk-borer, Mr. Ainslie, 18; a Synopsis of the Orthoptera of Western Europe, Dr. Malcolm Burr, 39; Death of Prof. Cyrus Thomas, 47; Bees of the Genus Nomia, Prof. T. D. A. Cockerell, 49; Gipsy Moth Parasite Laboratory, 49; Parasites of the Sugar-Cane Borer (*Sphenophorus obscurus*, 50; Notes on the Procession of *Cnethocampa pinivora*, H. H. Brindley, 62; House-flies and Disease, Dr. C. Gordon Hewitt, 73; the House-fly, Musca domestica Linnaeus: a Study of its Structure, Development, Bionomics, and Economy, Dr. C. Gordon Hewitt, 202; Ticks and other Blood-sucking Arthropoda of Jamaica, R. Newstead, 83; Determinate Evolution in the Colour-pattern of "Lady-beetles," R. H. Johnson, 116; Life-history and the Means of Controlling the Hop Flea-beetle, W. B. Parker, 117; Catalogue of British Hymenoptera of the Family Chalcidæ, Claude Morley, 138; the Blood-sucking Conorhinus, J. D. H., 172; the Genus Synthemis (Neuroptera: Odonata), R. J. Tillyard, 196; New Species of Carabidæ, T. G. Sloane, 196; the First International Congress of Entomology, 214; New Spider, *Erigone capra*, Dr. A. R. Jackson, 246; a Bomberx Preying on the Glossina of Dahomey, E. Rouband, 292; Experiments with Silkworms, R. Inoue, 371; New Genera and Species of Culicidæ, F. V. Theobald, 407; Protest against Unnecessary Subdivision and Splitting in the Culicidæ, E. Brunette, 407; the Death-dealing Insects and their

Story, C. Conyers Morrell, 526; Type-species of North American Genera of Diptera, D. Coquillett, 547
Eötvös (Baron L.), Resultate der Wissenschaftlichen Untersuchungen des Balaton, Die Niveaufläche des Balatonsees und die Veranderungen der Schwerkraft auf diesem, 299
Epiphyses, Fractures and Separated, A. J. Walton, Frank Romer, 361
Erdman (Prof. Hugo), Death of, 46
Ernährung der Wassertiere und der Stoffhaushalt der Gewasser, Die, Prof. August Pütter, 5
Eros, Results from Micrometric Observations of, 1900, Mr. Hinks, 181
Erzlagerstätten, Lehre von den, Dr. R. Beck, 198
Eskimos, Contributions to the Ethnology and Anthropogeography of the Polar, Dr. H. P. Steensby, 443
Essex, a History of the Mineral Waters and Medicinal Springs of the County of, Miller Christy and May Thresh, 361
Etherton (Lieut. P T.), Journey from India through Gilgit, Hanza, across the Pamirs, and thence by Chinese Turkestan, Mongolia, and Siberia to the Trans-Siberian Railway, 552
Ethnography: the Castes and Tribes of Southern India, Edgar Thurston and K. Rangachari, 365; Handbook to the Ethnographical Collections, 536
Ethnology: the Takelma Language, F. Sapir, 16; With a Prehistoric People: the Akikuyu of British East Africa, W. Scoresby Routledge and Katherine Routledge, Sir H. H. Johnston, G.C.M.B., K.C.B., 41; Death of Prof. Cyrus Thomas, 47; Notes on the Origin of the Hausas, Capt. A. J. N. Tremearne, 58; Customs and Folk-lore of the Natives of the Upper Yukon, Alaska, Capt. F. Schmitter, 81; Notes on Some Bushmen, Dr. L. Péringuey, 98; the Ethnology, Botany, Geology, and Meteorology of German East Africa, Sir H. H. Johnston, G.C.M.G., K.C.B., 106; Lacustrine Culture, S. A. Barnett, 116; Mundari Poetry, Father J. Hoffmann, 185; Unknown Region in New Guinea's Inhabitants, Dr. H. A. Lorentz, 269; the Machyengas, W. C. Farabee, 314; Contributions to the Ethnology and Anthropogeography of the Polar Eskimos, Dr. H. P. Steensby, 443; the Melanesians of British New Guinea, Dr. C. G. Seligmann, S. H. Ray, 499
Eugenics: "Nature and Nurture," Prof. Karl Pearson, 149
Evans (Dr. A. J.), "Tomb of the Double Axes," 401
Evans (E. J.), Recoil of Radium B from Radium A, 516
Evans (Dr. J. W.), An Earthquake Model, 29; Model to Illustrate the Movements along the Line of the San Andreas Fault during the Recent Californian Earthquake, 442; Pre-Cambrian Fauna, 442
Evans (T. J.), the Anatomy and Physiology of Calma glaucoides, 549
Evershed (John), Further Observations of Halley's Comet, 374
Evolution: the Evolution of Worlds, Prof. Percival Lowell, William E. Rolston, 99; Determinate Evolution in the Colour-pattern of "Lady-beetles," R. H. Johnson, 116
Ewart (Prof. J. C., F.R.S.), Lord Morton's Quagga Hybrid and Origin of Horses, 328, 494
Ewen (Donald), Shrinkage of Antimony-lead Alloys and of the Aluminium Zinc Alloys during and after Solidification, 421
Exogamy, Totemism and, a Treatise on Certain Early Forms of Superstition and Society, Prof. J. G. Frazer, A. E. Crawley, 3
Explosives: Cordite, 109
Extinct Monsters and Creatures of Other Days, Rev. H. N. Hutchinson, 459

Fabry (Prof. E.), Problèmes et Exercices de Mathématiques générales, 8
Fahlberg (Dr. Charles), Death of, 313
Falconer (Dr. J. D.), Origin of some of the More Characteristic Features of the Topography of Northern Nigeria, 551
Fantham (Dr. H. B.), Coccidia and Coccidiosis in Birds, 548
Farabee (W. C.), the Machyengas, 314
Farmer (Dr. R. C.), Gas-calculator Designed by, 51
Farming, a Manual of Practical, John McLennan, 38
Feather Element, an Undescribed, Fredk. J. Stubbs, 329; W. P. Pycroft, 436; Prof. R. V. Lendenfeld, 436
Fermat's Theorem, Dr. H. C. Pocklington, F.R.S., 531
Fermor (H. Leigh), Memoirs of the Geological Survey in India, the Manganese-ore Deposits of India, 128; Various Subdivisions of the Pre-Cambrian Rocks, 443
Fernow (Bernard E.), the Care of Trees in Lawn, Street, and Park, 423
Ferrar (H. T.), Creation of an Artificial Water-table in Egypt, 343
Ferro-silicon, on the Nature, Uses, and Manufacture of, with Special Reference to Possible Danger arising from its Transport and Storage, Dr. S. M. Copeman, F.R.S., S. R. Bennett and Dr. H. Wilson Hake, Prof. A. McWilliam, 53
Féry (Prof. C.), Spectrograph with a Prism having Spherical Faces so designed that the Image of the Slit is in Focus on the Photographic Plate, 343; a Successful Attempt to Simplify the Long-range Spectrograph to Make it Suitable for Industrial Investigations concerning Metals, Alloys, &c., 516
Fessenden (Prof.), Utilisation of Solar Radiation, Wind Power, and other Intermittent Natural Sources of Energy, 554
Feucht (Otto), die schwäbische Alp, 395
Ficker (Dr. H. v.), Innsbrucker Föhnstudien, iv., Weitere Beiträge zur Dynamik der Föhns, 368
Fields (Prof. J. C.), the Theory of Ideals, 514
Figee (Dr. S.), Royal Magnetical and Meteorological Observatory at Batavia, Report on Cloud-observations at Batavia made during the International Cloud-year 1896–7 and Subsequent Years, 249
Filchner (Lieut.), Date of Antarctic Expedition, 400
Fire Tests with Textiles, 364; Leonard Parry, 429
Fireball of September 2, Edmund J. Webb, 363; W. F. Denning, 364
Fireballs, Meteoric, Rev. W. F. A. Ellison, 318; Rev. J. C. W. Herschel, 318
Fischer (Prof. Theobald), Death of, 400
Fisheries: Science in Modern Life, Science and the Sea Fisheries, Dr. J. Travis Jenkins, 464; the Lancashire Sea-fisheries Laboratory, 548; Measurements of some 55,000 Plaice from the District, James Johnstone, 548
Fishes: Life-history and Habits of the Salmon, Sea-trout, Trout, and other Fresh-water Fish, P. D. Malloch, 168; the Fishes of Cheshire and Liverpool Bay, James Johnstone, 175; Movements of Turbot and Plaice, 341
Fishing: Norwegian and other Fish Tales, Bradnock Hall, 69
Fleig (C.), Experimental Ocular Action of the Dust on Tarred Roads, 456
Fleming (Mrs.), Announcement of a Nova, 472
Flemwell (G.), Alpine Flowers and Gardens, Painted and Described, 37
Flexner (Abraham), Medical Education in the United States and Canada, 332
Flint (W. R.), Complexity of Tellurium, 438
Floquet (Paul), Comparison of the Different Methods of Measuring the Dielectric Current, 390
Flower Pollination, Handbook of, Dr. P. Knuth, 66
Föhns, Innsbrucker Föhnstudien, iv., Weitere Beiträge zur Dynamik der, Dr. H. v. Ficker, 368
Folk-lore: Luck of the Horse-shoe, Dr. A. Smythe-Palmer, 180; Strange Myth of Theseus and the Minotaur, Andrew Lang, 246
Fondard (L.), Composition of Carnations with Flexible Stems and Rigid Stems, 292
Foot (Constance M.). Insect Wonderland, 464
Foraminifera of the North Pacific Ocean, a Monograph of the, J. A. Cushman, 265
Forbes (Alexander), First Steps in Coal Mining, 492
Forest Flora of the Bombay Presidency and Sind, W. A. Talbot, 170
Forestry: *Berrya ammonilla* and *Pterocarpus macrocarpus*, 55; Best Season for Coppice Fellings of Teak, R. S. Hole, 56; Dipterocarp Trees in the Philippine Forests, H. N. Whitford, 56; Indian State Forestry, S. Eardley-Wilmot, 56; Selection of Seed, Dr. N. Sylven, 56; Beech Forests in Sweden, E. Wibeck, 56; the Jequié Manicoba Rubber Tree, R. Thomson, 56; Pine Forests of the Landes, J. H. Ricard, 84; Schlich's Manual of Forestry, Sir Wm.

Schlich, K.C.I.E., F.R.S., 137; Protection of Timber against White Ants, 342; Results of Trials in Inverness-shire with Belgian System of Tree Planting on Turfs, Sir John Stirling-Maxwell, 372; Tree Plantations in Inverness-shire, W. Dallimore, 470; New Type of Resin Collector, J. S. Woolsey, jun., 402; State Nurseries and Plantations in New Zealand, 505; Trees and Timbers, 546; Distinguishing Characters of the Trees in the German Cameroons, Dr. M. Büsgen, 546; Fissibility of some Indian Woods, R. S. Troup, 547; Prospects of the Match Industry in the Indian Empire, R. S. Troup, 547; New Trees and Shrubs, W. J. Bean, 547
Förster (Prof.), Reforms of the Calendar, 368
Forsyth (W.), Arrangements of the Pennsylvania Railroad at East Altoona, 155
Fossil Plants, Some Recent Studies of, 473
Fossil Plants: a Text-book for Students of Botany and Geology, Prof. A. C. Seward, F.R.S., 490
Fossil Vertebrates in the American Museum of Natural History, 12
Fossils: British Fossils, 101; Leitfossilien, ein Hilfsbuch zum Bestimmen von Versteinerungen bei geologischen Arbeiten in der Sammlung und im Felde, Prof. Georg Zürich, 200
Fournier (E. E.), Wonders of Physical Science, 168
Fournier (G. and V.), Observations of Mercury, 213
Fowler (Prof.), Halley's Comet, 52
Fraas (Dr. E.), Skeletons of Plesiosaurians from the Upper Lias of Holzmaden, 82
Fractured and Separated Epiphyses, A. J. Walton, Frank Romer, 361
Frankland (W. B.), Theories of Parallelism, an Historical Critique, 169
Franklin (W. S.), Light and Sound, 103
Fraser (Dr. F. W. D.), Death of, 468
Frazer (Prof. J. G.), Totemism and Exogamy, a Treatise on Certain Early Forms of Superstition and Society, 31
French (J. W.), Science in Modern Life, vol. vi., Engineering, 395
Freytags (Gustav), Kultur- und Geschichtspsycologie, Dr. Georg Schridde, 294
Friedal (G.), Lehmann's Anisotropic Liquids, 228
Friend (Rev. Hilderic), Ooze and Irrigation, 39, 70; the Habits of Worms, 397
Friend (H.), Wild Flowers and How to Identify Them, 460
Friend (Dr. J. N.), Corrosion of Iron and Steel, 510
Fritsche (Dr. H.), die Saecularen Aenderungen der Erdmagnetischen Elemente, 373
Frohawk (W.), Feeding Habits of the Razor-bill, 378
Frost (Prof.), the Determination of Stellar Radial Velocities, 86; Halley's Comet, 152; the Sun's Velocity through Space, 272
Fuchs (R. F.), Physiologische Studien im Hochgebirge: Versuche über den repiratorischen Stoffwechsel im Hochgebirge, 369
Fuel and Refractory Materials, Prof. A. H. Sexton, Prof. A. McWilliam, 392
Fugger (Prof. E.), Newly Discovered Ice-cave near Obertraum, 469
Fujii (Prof. K.), Studies on the Structure and Affinities of Cretaceous Plants, 129
Fulgurites, Experimental Study of, Prof. R. W. Wood, 70
Funeral Papyrus of Iouiya, the, Edouard Naville, 237
Fungi: Edible and Poisonous Fungi, 361; Guide to Mr. Worthington Smith's Drawings of Field and Cultivated Mushrooms and Poisonous or Worthless Fungi often Mistaken for Mushrooms, Exhibited in the Department of Botany, British Museum (Natural History), 361
Fungous Diseases of Plants, Prof. B. M. Duggar, Prof. E. S. Salmon, 233
Fur Trade, the, Prof. T. D. A, Cockerell, 428

Gadow (Dr. H.), Nature and Meaning of the Colours of Birds, 378
Gadow (Dr. H. F., F.R.S.), Coral Snakes and Peacocks, 548
Galitzin Seismograph, the, 219
Galle (Prof. J. G.), Death and Obituary Notice of, 45
Gallé (Dr. P. H.), Wind and Current Observations, 343
Gardening: the Educational Value of the School Garden, 220; the Calendar of Garden Operations, 266; the Carnation Year-book, 1910, 460; Gardening Difficulties Solved, 460; Leitfaden für gärtnerische Pflanzenzuchtung, M. Löbner, 460; Wild Flowers and How to Identify Them, H. Friend, 460
Gardner (Prof. Walter M.), Tinctorial Chemistry, Ancient and Modern, 56
Garland (C. M.), Measurements of the Heat Transmitted through a Steel Tube of $1\frac{1}{4}$-inch External Diameter, with Walls $\frac{1}{8}$-inch thick, from Steam Outside to Water Inside Running through the Tube, 18
Garstang (Prof. Walter), the Colours of Insect Larvæ, 549
Gases, Ionisation of, and Chemical Change, Dr. H. Brereton Baker, F.R.S., at Royal Institution, 388
Gases, the Pressure of Light on, Dr. Lebedew, 86
Gatty (R. A.), Pit-dwellings in the District of Holderness, 16
Gaubert (Paul), Soft Crystals and the Measurement of their Indices of Refraction, 356
Gaudechon (Henry), Mechanism of Photochemical Reactions and the Formation of Plant Principles, 196; Photochemical Decomposition of the Alcohols, Aldehydes, Acids, and Ketones, 262
Gaupp (Prof.), Affinities of the Mammalia as Deduced by the Study of the Skull, 319
Gauss and Non-Euclidean Geometry, Prof. H. S. Carslaw, 362
Gauthie (F.), Composition of Carnation with Flexible Stems and Rigid Stems, 292
Gautier (Armand), Action of Iron and its Oxides, at a Red Heat, on Carbonic Acid, 64; Action of Mixtures of Carbon Monoxide and Hydrogen, or of Carbon Dioxide and Hydrogen, upon the Oxides of Iron, 196
Geary (H.), Bees for Profit and Pleasure, 464
Geer (Prof. de), the Geochronology of the Last 12,000 Years, 440
Geiger (Dr. H.), Properties of the α Particles Sent Out by Radio-active Substances, 213
η Geminorum, the Recent Occultation of, by Venus, MM. Baldet, Quénisset, and Antoniadi, 317
Genth (Dr. Frederick A., jun.), Death of, 370
Geodesy: Death of Prof. A. P. Sokoloff, 46; Probable Exactness of Different Evaluations of the Altitude of Lake Chad, C. H. Lallemand, 64
Geography: Rivers of Dacca District, F. D. Ascoli, 30; the Economic Geography of Bolivia, Prof. Isiah Bowman, 118; Across Yunnan, Archibald Little, 177; Great Lu-Chu Island, W. J. Clutterbuck, 180; Trans-Himalaya, Dr. Felix Oswald, 180; Manual of Physical Geography, Dr. F. V. Emerson, 201; a Laboratory Manual of Physical Geography, Prof. R. S. Tarr and O. D. von Engeln, 201; Letters from High Latitudes, being some Account of a Voyage in 1856 in the Schooner-yacht *Foam* to Iceland, Jan Mayen, and Spitzbergen, Lord Dufferin, 202; Coast of Southern Peru and the Pampas West of the Andes, V. F. Marsters, 217; the British Isles in Pictures, H. Clive Barnard, 238; On and Off Duty in Annam, Gabrielle M. Vassal, J. Thomson, 243; Documents scientifiques de la Mission Tilho (1906–9), Sir H. H. Johnston, G.C.M.G., K.C.B., 244; Lake Edward, Ruwenzori, and the Uganda-Congo Frontier, 267; Death of Prof. Pedroso, 313; Library of Congress, a List of Geographical Atlases in the Library of Congress, with Bibliographical Notes, 325; Exploration of the Region Westward from Davis Inlet to George River, Prof. MacMillan, 340; Home-work Atlas of Maps in Black and White, 395; Death of Prof. Theobald Fischer, 400; Distant Lands, H. J. Mackinder, 426; a First Book of Physical Geography, W. M. Carey, 426; a Physiographical Introduction to Geography, Prof. A. J. Herbertson, 426; an Economic Atlas, J. G. Bartholomew, 426; Devonshire, F. A. Knight and Louie M. Dutton, 426; Dorset, A. L. Salmon, 426; Derbyshire, H. H. Arnold-Bemrose, 426; a Systematic Geography of Asia, G. W. Webb, 426; Physical and Commercial Geography, Profs. H. E. Gregory, A. G. Keller, and A. L. Bishop, 450; Exploration in Western Labrador, Prof. Raymond McFarland, 468; Land of the Incas, Sir Clements R. Markham, K.C.B., F.R.S., 470; Royal Scottish Geographical Society's Medal Awards, 502; Recent Norwegian Explorations in Spitzbergen, 503; Exploration in

China, A. de C. Sowerby, 504; Elementary Regional Geography, Great Britain and Ireland, J. B. Reynolds, 527; Cambridge County Geographies, Nottinghamshire, Dr. H. H. Swinnerton, Lanarkshire, Frederick Mort, 527; *see also* British Association
Geology: "Les Variations périodiques des Glaciers," Prof. E. Brückner and E. Muret, 17; the International Congress at Düsseldorf, 20; Geological Society, 29; Natural Classification of Igneous Rocks, Dr. W. Cross, 29; the Denudation of the Western End of the Weald, H. Bury, 29; the Yakutat Bay Region, Alaska, Ralph S. Tarr, 76; Areal Geology, R. S. Tarr and Bert S. Butler, 76; the Geology and Ore Deposits of Goldfield Nevada, F. L. Ransome, 76; Landslides in the San Juan Mountains, Colorado, including a Consideration of their Causes and Classification, E. Howe, 76; on a Theory that a Connection between Africa and South America Persisted into the Tertiary, Dr. A. E. Ortmann, 89; the Ethnology, Botany, Geology, and Meteorology of German East Africa, Sir H. H. Johnston, G.C.M.G., K.C.B., 106; Recent Work of Geological Surveys, IV.: the United States, 121; the Laramie Basin in South-eastern Wyoming, Messrs. Darton and Siebenthal, 121; the Taylorsville Region at the North End of the Sierra Nevada in California, J. S. Diller, 121; Western Arizona, W. T. Lee, 121; the "Manzano Group," W. T. Lee, 121; Glacial History of the Uinta and Wasatch Mountains, W. W. Atwood, 122; the Guadalupian Fauna of New Mexico, G. H. Girty, 122; Ore Deposits of the Cœur d'Alène District, Idaho, Messrs. Ransome and Calkins, 122; Pioneer Work in Southern Oregon, G. A. Waring, 122; History of the Salton Sea, W. C. Mendenhall, 122; Memoirs of the Geological Survey in India: the Manganese Ore Deposits of India, H. Leigh Fermor, 128; Extinct Geyser of Waimangu, New Zealand, 148; Evolution of the River System of Griqualand West, A. L. du Toit, 158; the Tanami Goldfield in Central Australia, H. Y. L. Brown, 182; Lehre von den Erzlagerstätten, Dr. R. Beck, 198; Leitfossilien: ein Hilfsbuch zum Bestimmen von Versteinerungen bei geologischen Arbeiten in der Sammlung und im Felde, Prof. Georg Gürich, 200; Expédition Antarctique Belge, Résultats du Voyage du s.y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Geologie-Petrographische Untersuchung der Gesteins proben, A. Pelikan, 205; Die Polarwelt und ihre Nachbarländer, O. Nordenskjöld, 236; Note on "Verneuk Pan," Dr. A. W. Rogers, 262; Analyses of Rocks and Minerals made in the Laboratory of the U.S. Geological Survey during 1880–1908, 271; the Ore Deposits of South Africa, J. P. Johnson, 293; the Geology of Ore Deposits, H. H. Thomas and D. A. MacAlister, 293; Death of Prof. William H. Niles, 370, 468; Stagnant Glaciers, G. W. Lamplugh, F.R.S., 297; Causal Geology, Prof. E. H. L. Schwarz, Prof. Grenville A. J. Cole, 397; Conditions of Effective Filtration of the Underground Waters in certain Chalk Formations, Ernest van den Broeck and E. A. Martel, 422; Geology, Prof. J. W. Gregory, 426; Tectonic Development of the Armenian Highlands, Dr. Felix Oswald, 437; the Geological Congress at Stockholm, 440; the Geochronology of the Last 12,000 Years, Prof. de Geer, 440; Influence of Applied Geology and the Mining Industry upon the Economic Development of the World, Prof. Van Hise, 441; Iron Ore Supplies, M. Lindman, 441; Prof. Sjögren, 441; Prof. Beyschlag, 441; M. de Launay, 441; Prof. J. F. Kemp, 441; Prof. J. W. Richards, 441; Glacial Erosion, Prof. Penck, 441; Prof. Högbom, 441; Prof. Wahnschaffe, 441; Prof. Reusch, 441; Dr. Becker, 442; Dr. Nordenskjold, 442; Prof. Salomon, 442; Dr. von Dechy, 442; Prof. Wahnschaffe, 442; Prof. Heim, 442; Prof. Högbom, 442; Prof. E. Stolley, 442; Prof. Reusch, 442; Prof. Penck, 442; Pre-Cambrian Fauna, Prof. Barrois, 442; Dr. Sederholm, 442; Prof. Rothpletz, 442; Dr. J. W. Evans, 442; Dr. R. A. Daly, 442; Profs. Sollas and Steinmann, 442; Prof. Walther, 442; Model to Illustrate the Movements along the Line of the San Andreas Fault during the Recent Californian Earthquake, Dr. Evans, 442; the Fracture Systems of the Earth's Crust, Prof. Hobbs, 442; Advance of Glaciers in Alaska as a Result of Earthquake Shaking, Prof Tarr, 442; Pre-Cambrian Geology, 442; Various Sub-divisions of the Pre-Cambrian Rocks, W. G. Miller, 442; Prof. Coleman, 443; Dr. Sederholm, 443; Prof. Van Hise, 443; Mr. Fermor, 443; Geological and Archæological Notes on Orangia, J. P. Johnson, 465; Death of John Roche Dakyns, 468; Newly Discovered Ice-cave near Obertraun, Prof. E. Fugger, 469; United States Geological Survey, Contributions to Economic Geology, part ii, Coal and Lignite, M. R. Campbell, 511; the Ketchikan and Wrangell Mining Districts, Alaska, F. E. Wright and C. W. Wright, 511; Mineral Resources of the Kotsina-Chitina Region, Alaska, F. H. Moffit and A. G. Maddren, 511; Mineral Resources of Alaska, A. H. Brooks, 511; Contributions to Economic Geology, part i, Metals and Non-metals except Fuels, C. W. Hayes and W. Lindgren, 511; Papers on the Conservation of Mineral Resources, 511; Formation of the Loam of the Plateaux, Henri Douvillé, 555; *see also* British Association
Geometry: a First Course in Analytical Geometry, Plane and Solid, with Numerous Examples, C. N. Schmall, 136; a Manual of Geometry, W. D. Eggar, 138; Elementary Projective Geometry, A. G. Pickford, 136; Theories of Parallelism: an Historical Critique, W. B. Frankland, 169; the Early History of Non-Euclidean Geometry, D. M. Y. Sommerville, 172; Gauss and Non-Euclidean Geometry, Prof. H. S. Carslaw, 362
Geophysics: Scientific Papers, Sir George Howard Darwin, K.C.B., F.R.S., 235
Gernez (D.), Colours Arising in Colourless Solutions of Coloured Bodies at the Moment of the Solidification of the Colourless Solvent, 164
Ghose (A.), Manganese-ore Deposits of the Sandur State, 406
Gibson (H.), Dew-ponds on the Thorpe Downs, Berkshire, 246
Gifford (R. D.), Relative Merits of the Various Oil- and Air-cooling Devices, 18
Gilkinet (Prof. A.), Expédition Antarctique Belge, Résultats du Voyage du s.y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Quelques Plantes Fossiles des Magellaniques, 205
Girty (G. H.), the Guadalupian Fauna of New Mexico, 122
Glaciers, Stagnant, G. W. Lamplugh, F.R.S., 297
Glamorgan, Arthur's Round Table in, Rev. John Griffith, 8
Glasgow Institute of Metals, 421
Glinka (Prof.), Russian Soils, 157
Gnomon in Ancient Astronomy, the, Jules Sagaret, 120
Godard (H.), Halley's Comet, 120
Godden (Zorah), Customs at Holy Wells, 429
Godwin-Austen (Lieut.-Col. H. H.), Land and Fresh-water Mollusca of India, 427
Goessmann (Dr. Charles A.), Death of, 370
Goetz (Rev. E.), Rainfall of Rhodesia, 187
Gold (E.), Die Temperatur Verhältnisse in der freien Atmosphäre [Ergebnisse der internationalen unbemannter Ballonaufstiege], Dr. Arthur Wagner, 42; Royal Magnetical and Meteorological Observatory at Batavia, Report on Cloud-observations at Batavia made during the International Cloud-year 1896–187 and Subsequent Years, Dr. S. Figee, 249; Volocità e Direzione delle Correnti Aeree alle diverse Altitudini Determinate a Mezzo dei Palloni-Sonde e Pilote, Dr. G. Pericle, 249; Tables for the Reduction of Meteorological Observations, Dr. G. C. Simpson, 326; Results of an Investigation into the Effect of Radiation on H the Height and *Te* the Temperature of the Advective Region, 516
Gomery (A. de Gerlache de), Expédition Antarctique Belge, Résultats du Voyage du s.y. *Belgica* en 1897–8–9, sous le Commandement de, 205
Gonder (Dr. R.), Development of Piroplasma parvum (Protozoa) in the Various Organs of Cattle, 132
Gonnessiat (M.), Rediscovery of D'Arrest Comet (1910*c*), 317; Observation of the D'Arrest Comet at the Observatory of Algiers, 324; Observations of Comets, 404
Goodhart (Dr. J. F.), Chronic Constipation, 153
Goodyear (Prof. William H.), Report of Pisa Commission on the Leaning Tower, 471
Gore (J. Ellard), Death of, 116
Gorzawsky (H.), Die Familien der Primnoiden, Muricriden und Acanthogorgüden, 34
Göttingen Royal Society of Sciences, 390, 556
Government Laboratory, Annual Report of the, 405
Gramont (Comte de), the Spectrum of Cyanogen, 344

Grandjean (F.), Lehmann's Anisotropic Liquids, 228
Graphischen Chemie, Leitfaden der, Dr. R. Kremann, 525
Gray (H. St. George), Excavations at the Glastonbury Lake-village, 82
Gray (R. C.), Magnetism of the Copper-Manganese-Tin Alloys under Varying Thermal Treatment, 97
Gray (Dr. Robert Whytlaw), Density of the Radium Emanation, 98; Molecular Weight of Radium Emanation, 517
Graz, the International Zoological Congress at, (August 15–20, 1910), 318
Great Britain, the Position of University Education in, 91
Great Britain and Ireland, Elementary Regional Geography, J. B. Reynolds, 527
Greek and Roman Methods of Painting: Some Comments on the Statements made by Pliny and Vitruvius about Wall and Panel Painting, Dr. A. P. Laurie, 265
Green (Prof. J. Reynolds, F.R.S.), a History of Botany, 1860–1900, being a Continuation of Sach's "History of Botany, 1530–1860," 391
Greenwell (Canon), Pit-dwellings in the District of Holderness, 16
Greenwich Watch and Chronometer Trials, 210
Gregory (Prof. H. E.), Physical and Commercial Geography, 459
Gregory (Prof. J. W., F.R.S.), Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History), 8; Geology, 426
Gregory (W. K.), the Orders of Mammals, 216
Griffith (Rev. John), Royal Commission on Welsh Monuments, 404; Arthur's Round Table in Glamorgan, 8
Griffiths (B. Millard), Pwdre Ser, 73
Grouse and Grouse Moors, Charles Malcolm and Aymer Maxwell, 466
Grove (W. B.), Pwdre Ser, 73; an Agaric with Sterile Gills, 531
Grundproben der Deutschen Südpolar-expedition, 1901–3, die, E. Philippi, 167
Grüneisen (Dr. E.), Thermal Expansion of Metals, 403
Guerrieri (Dr. E.), the Sun-spots of 1909, 317
Guertler (Dr. W.), Metallographie, ein ausführliches Lehr- und Handbuch der Konstitution, und der physikalischen, chemischen und technischen Eigenschaften der Metalle und metallischen Legierungen, 200
Guichard (Marcel), Absorption of Iodine by Solid Bodies, 132
Guillaume (J.), Metcalf's Comet, 1910*b*, 249; Observations of Metcalf's Comet, 261; Occultation of η Geminorum by Venus, July 26, Observed at Lyons, 390
Guillemard (H.), Observations on Animal Calorimetry made on Mt. Blanc, 456
Güldner (Hugo), the Design and Construction of Internal Combustion Engines, 197
Gulf Stream Drift and the Weather of the British Isles, the, Dr. H. Bassett, 44
Günther (Dr. A. C.), Description of Collection of Fishes made in the Indian Ocean and South Pacific by Andrew Garrett, 402
Gürich (Prof. Georg), Leitfossilien, ein Hilfsbuch zum Bestimmen von Versteinerungen bei geologischen Arbeiten in der Sammlung und im Felde, 200
Guttmann (Oscar), Death of, 179
Guttmann (Prof.), Discovery of a Trustworthy Mathematical Formula which shall Determine the State of Nutrition of a Child in Relation to Physical Measurements, 320

Hackspill (L.), Electrical Resistance of the Alkali Metals, 164
Haddon (Dr. A. C., F.R.S.), Antiquities of the Ouachita Valley, Clarence B. Moore, 129; the Jesup North Pacific Expedition, the Kwakiutl of Vancouver Island, Frank Boas, Chukchee Mythology, Waldemar Bogoras, the Yukaghir and the Yukaghirized Tungus, Waldemar Jockelson, 250
Hague (A.), Influence of Silicon on the Properties of Pure Cast Iron, 440
Hahn (Dr.), Magnetic Deflection of β Rays, 478
Haig (H. A.), the Plant Cell, its Modifications and Vital Processes, 36
Hake (Dr. H. Wilson), on the Nature, Uses, and Manufacture of Ferro-silicon, with Special Reference to Possible Danger arising from its Transport and Storage, 53; Ferro-silicon, 519
Hale (Prof. William J.), the Calculations of General Chemistry, with Definitions, Explanations, and Problems, 360
Hall (A. D., M.A., F.R.S.), Secondary Effects of Manures on the Soil, 219; Opening Address in Sub-section of B at the Meeting of the British Association at Sheffield, 309
Hall (Bradnock), Norwegian and other Fish Tales, 69
Hall (Richard N.), Prehistoric Rhodesia, 32
Halley's Comet, Dr. James Moir, 9; Dr. Wolf, 19; Prof. Seeliger, 19; M. Eginitis, 19, 52; Comas Sola, 19; M. Nordmann, 19; Mr. Leach, 19; Dr. Ebell, 52; Prof. Fowler, 52; Father Iniguez, 52; Herr v. d. Pahlen, 86; Dr. Ristenpart, 86; G. Millochau and H. Godard, 120; Prof. Frost, 152; Mr. Motherwell, 183, Prof. Barnard, 183, 322; Mr. Helmcken, 184; Father Stein, 184; Herr Sykora, 322; Dr. Hartmann, 322; M. Antonidi, 322; K. Saotome, 322; Drs. Cowell and Crommelin, 322; N. Iwanow, 322; Mr. Merfield, 322; Messrs. Crawford and Meyer, 322; Mr. Slocum, 323; Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19, D. Stenquist and E. Petri, 9; Further Observations of Halley's Comet, Michie Smith and John Evershed, 374; C. D. Perrine, 374; Velocities and Accelerations of the Ejecta from Halley's Comet, Profs. Barnard and Lowell, 404; J. Comas Sola, 404; Time of the Solar Transit of Halley's Comet, 472
Halley Meteors, Prof. David Todd, 439
Hamilton (J. O.), Renewal of Sulphated Storage Cells, 118
Hands (Alfred), Lightning and the Churches, 238
Hann (Dr. J.), Meteorology of Peru, 377
Hansen (H. J.), Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Zoologie-Schizopoda and Cumacea, 205
Happiness, the Science of, Dr. H. S. Williams, 202
Hardenburg (W. E.), System of "Wireless Telegraphy" in Use among the Indian Tribes of the Putumayo River, 436
Harley (Rev. Robert, F.R.S.), Death of, 148; Obituary Notice of, 210
Harmer (Dr. Sidney F., F.R.S.), Death and Obituary Notice of John Willis Clark, 501
Harper (Harry), Practical Chemistry, 360
Harrison (Frank), Our Teeth, 237
Hart (Dr. D. Berry), Validity of the Mendelian Theory, 228
Hartert (Dr.), Nomenclature of some British Birds, 504
Hartmann (Dr.), Halley's Comet, 322
Hartmann (M.), Cytology of the Flagellata, 504
Hartog (Prof.), Sex and Immunity, 549
Harvard College Observatory, Prof. E. C. Pickering, 86
Hastings (Somerville), Summer Flowers of the High Alps, 37
Hausas, Notes on the Origin of the, Capt. A. J. N. Tremearne, 58
Hayes (C. W.), Contributions to Economic Geology, Part i., Metals and Non-metals except Fuels, 511
Hayhurst (Mr.), Examination of the Atmosphere at various Altitudes for Oxides of Nitrogen and Ozone, 119
Health Progress and Administration in the West Indies, Sir Rubert W. Boyce, F.R.S., 174
Heat: the Temperature Coefficients of the Ferromagnetic Metals, Dr. J. R. Ashworth, 238
Heath (Sidney), the South Devon and Dorset Coast, 138
Heawood (Edward), the Uganda-Congo Boundary, 531
Heckel (Edouard), Action of Cold and Anæsthetics upon the Leaves of *Angraecum fragrans* and the Green Husks of Vanilla, 98
Hegels Asthetik im Verhaltnis zu Schiller, A. Lewkowitz, 294
Heim (Prof.), Glacial Erosion, 442
Heinricher (Prof. E.), die Aufzucht und Kultur der Parasitischen Samenpflanzen, 327
Helbronner (A.), New Researches on the Sterilisation of Large Quantities of Water by the Ultra-violet Rays, 556
Hellmann (Prof.), Results of the Exposure of Thermometers in Windows and in Screens, 17–8; Climate of Berlin, 377
Helmcken (Mr.), Halley's Comet, 183

Helmholtz, eine Zeitschrift für die exakten Wissenschaften mit besonderer Berücksichtigung ihrer Anwendung, 237
Hemsalech (G. A.), Relative Duration of the Lines of the Spectrum emitted by Magnesium in the Electric Spark, 556
Henri (Victor), Action of the Ultra-violet Rays upon Certain Carbohydrates, 164; New Researches on the Sterilisation of Large Quantities of Water by the Ultra-violet Rays, 556
Hens, How to Keep, for Profit, C. S. Valentine, 138
Hepburn (J. S.), Chemistry of the Sugars, 403
Herbertson (A. J., M.A., Ph.D., Professor of Geography in the University of Oxford), Opening Address in Section E at the Meeting of the British Association at Sheffield, Geography and some of its Present Needs, 383; a Physiographical Introduction to Geography, 426
Herdman (Prof. W. A., F.R.S.), British Marine Zoology, 329, 396, 462
Heredity: the Laws of Heredity, G. Archdall Reid, Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S., 1; Determination of the Chief Correlations between Collaterals in the Case of a Simple Mendelian Population Mating at Random, E. C. Snow, 61; Accident in Heredity, F. J. M. Stratton and R. H. Compton, 63; Validity of the Mendelian Theory, Dr. D. Berry Hart, 228; Chromosomes and Heredity, Prof. T. H. Morgan, 246; Inheritance of Characteristics in Domestic Fowl, C. B. Davenport, 253; Heredity at the Church Congress, 431; Dr. G. E. Shuttleworth, 431; Mrs. Pinsent, 431; Bishop of Ripon, 431; W. C. D. Whetham, 431; Hormones in Relation to Inheritance, Prof. Gilbert C. Bourne, F.R.S., 462; Some Aspects of Heredity in Relation to Mind, Harveian Oration at Royal College of Physicians, Dr. H. B. Donkin, 541
Hérissey (Prof. H.), Preparation of Pure Arbutine, 228; Chemical Method of Obtaining the True Glucoside Arbutin, 354
Herrick (Prof. F. H.), Instinct and Intelligence in Birds, 378
Herschel (Rev. J. C. W.), Meteoric Fireballs, 318
Hertwig (Prof. R.), Lehrbuch der Zoologie, 234
Hesse (Prof. Richard), Tierbau und Tierleben in ihrem Zusammenhang betractet, i., der Tierkörper als selbstandigen organismus, 538
Heurck (H. Van), Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Botanique-Diatomées, 205
Hewitt (Dr. C. Gordon), House-flies and Disease, 73; the House-fly, *Musca domestica*, Linnæus, a Study of its Structure, Development, Bionomics, and Economy, 202
Hewitt (J.), the Zoological Region of South Africa, 542
Hewlett (Prof. R. T.), Standardisation of Disinfectants, 156
Heysinger (Dr. Isaac W.), Spirit and Matter before the Bar of Modern Science, 36
Hicks (Prof. W. M.), the Relation of Spectra to the Periodic Series of the Elements, 515
Hickson (Prof. S. J.), Place of Economic Zoology in the Modern University, 156
Hiede, die, W. Wagner, 326
Hilbert (Prof. David), Bolyai Prize Awarded to, 541
Hildebrand (Mr.), Fish-fauna of the Chicago District, 547
Hill (Leonard, F.R.S.), Physiologische Studien im Hochgebirge, Versuche über den repiratorischen Stoffwechsel im Hochgebirge, R. F. Fuchs and T. Deimler, 369
Hillebrand (W. F.), Analyse der Silikat- und Karbonatgesteine, 425; the Analysis of Silicate and Carbonate Rocks, 425
Hilpert (S.), Sulphurous Acid as an Etching Agent for Metallographic Work, 440; Preparation of Magnetic Oxides of Iron from Aqueous Solutions, 440.
Himalaya, Peaks and Glaciers of Nun Kun, a Record of Pioneer-exploration and Mountaineering in the Punjab, Fanny Bullock Workman and Dr. W. H. Workman, Sir T. H. Holland, K.C.I.E., F.R.S., 78
Hindle (E.), Life-history of *Trypanosoma lewisi* in the Rat-louse *Haematopinus spinulosus*, 150
Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D., with Sanskrit Texts, &c., a History of, Prof. Praphulla Chandra Ray, 68
Hinks (Mr.), the Determination of Position near the Poles, 19; Results from Micrometric Observations of Eros, 1900, 184
Hinterlechner (Dr.), Eruptive Rocks of the Bohemian Eisengebirge, 377
Hirayama (Mr.), Photographs of Morehouse's Comet, 19
Hise (Prof. van), Influence of Applied Geology and the Mining Industry upon the Economic Development of the World, 440; Various Sub-divisions of the Pre-Cambrian Rocks, 443
Hittite Discovery, Recent, D. G. Hogarth, 318
Hnatek (Adolf), Definitive Elements for Comet 1852 IV., 344; Search-Ephemerides for Westphal's Comet 1852 IV., 545
Hobart (H. M.), Comparison between Systems Employing Series Wound, Continuous-electricity Train-equipments and the Single-phase System, 155
Hobbs (Prof.), the Fracture Systems of the Earth's Crust, 442
Hobson (Prof. E. W., Sc.D., F.R.S.), Opening Address in Section A at the Meeting of the British Association at Sheffield, 284; Present State of the Theory of Integral Equations, 514
Hodges (Dr. A. P.), Uganda Sleeping-sickness Camps, 315
Hodson (F.), Influence of Heat Treatment on the Corrosion, Solubility, and Solution Pressures of Steel, 519
Hoffmann (Father J.), Mundari Poetry, 185
Hogarth (D. G.), Recent Hittite Discovery, 318
Högbom (Prof.), Glacial Erosion, 441, 442
Hole (R. S.), Best Season for Coppice Fellings of Teak, 56
Holland (Sir T. H., K.C.I.E., F.R.S.), Peaks and Glaciers of Nun Kun: a Record of Pioneer-exploration and Mountaineering in the Punjab Himalaya, Fanny Bullock Workman and Dr. W. H. Workman, 78
Holley (Dr. C. D.), Lead and Zinc Pigments, 325
Hollis (E.), European Hedgehog, 437
Hollis (H. P.), Chats about Astronomy, 393
Holt (E. W. L.), Report of a Survey of the Trawling Grounds on the Coasts of Counties Down, Louth, Meath, and Dublin, 394
Holy Wells, Customs at, Zorah Godden, 429
Holz, Das, H. Kottmeier and F. Uhlmann, 326
Honda (Kotaro), the Law of Variation of the Coefficient of Specific Magnetisation of the Elements of Heating, 324
Hood (G. F.), a First Year's Course of Inorganic Chemistry, 266
Hooper (D.), Medicinal Lizards, 30
Hopfer (F.), Search-Ephemerides for Comet 1890 VII., Spitaler, 317
Hopkinson (Prof.), Radiation from Gases in a Closed Combustion Chamber, 553
Hormones in Relation to Inheritance, Prof. Gilbert C. Bourne, F.R.S., 462
Horses, Lord Morton's Quagga Hybrid and Origin of Dun, Prof. James Wilson, 328, 494; Prof. J. C. Ewart, F.R.S., 328, 494
Horwood (A. R.), Ooze and Irrigation, 40
Hosseus (Dr. C. C.), Cultivation in Dalmatia of the Spineless Variety of Cactus, 372
House-flies and Disease, Dr. C. Gordon Hewitt, 73
House-fly, *Musca domestica*, Linnæus: a Study of its Structure, Development, Bionomics, and Economy, Dr. C. Gordon Hewitt, 202
Houston (Dr.), Results of the Chemical and Bacteriological Examination of London Waters, 212; Metropolitan Water Examinations, 246
Houston (Dr. R. A.), Spectrophotometer of the Hüfner Type, 513
Houstoun (R. A.), Aqueous Solutions of Ferrous Ammonium Sulphate Form a Good Filter for Stopping Heat Rays, 182
Hovey (Edmund O.), Large Meteorites, 152
Howard (H. Newman), Elemental Weight Accurately a Function of the Volution of Best Space-symmetry Ratios, 71, 239
Howard (Mr. and Mrs.), Tobacco produced in India, 151
Howard (Mr.), Fruit Experiments, 247
Howe (E.), Landslides in the San Juan Mountains, Colorado, including a Consideration of their Causes and Classification, 76

Howe (Prof. H. M.), Allotropy or Transmutation, 518; Closing and Welding of Blow-holes in Steel Ingots, 518
Hubbard (Dr. J. C.), Curious Visual Phenomenon Resulting from Stimulation of the Macular Region of the Retina, 148
Hubrecht (Prof. A. A. W.), die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere, 134
Hudson (O. F.), the Heat Treatment of Brass, 421
Hughes (Prof. T. McKenny, F.R.S.), Pwdre Ser, 171, 462
Hull (A. F. Basset), Description of a Fossil Chiton (Mollusca) from North-west Tasmania, 522
Hume (M.), Psychism, 103
Humphreys (Prof.), Radiation and Absorption, 52
Hunterian Lectures at Royal College of Surgeons: the Anatomy and Relationship of the Negro and Negroid Races, Prof. Arthur Keith, 54
Hutchinson (Rev. H. N.), Extinct Monsters and Creatures of Other Days, 459
Huygens (Christiaan), Œuvres Complètes de, 491
Hybridisation: the Origin of the Domestic "Blotched" Tabby Cat, H. M. Vickers, 298, 331; R. J. Pocock, 298; Lord Morton's Quagga Hybrid and Origin of Dun Horses, Prof. James Wilson, 328, 494; Prof. J. C. Ewart, F.R.S., 328, 494; an Interesting Donkey Hybrid, R. J. Pocock, 329
Hydrography: the Gulf Stream Drift and the Weather of the British Isles, Dr. H. Bassett, 44; Hydrographical Work Carried on by the Marine Biological Station at San Diego, G. F. McEwen, 82; Colour of the Sea, J. Y. Buchanan, F.R.S., 87; Elementaire Theorie der Getijden-Getij-Constanten in den Indische Archipel, Dr. J. P. van der Stok, Sir G. H. Darwen, F.R.S., 144; Admiralty Surveys for the Year, 1909, 342
Hydrology: Problems of Winter Navigation on the River St. Lawrence, H. T. Barnes, 83; Lake Temperatures, E. A. Birge, 83; Winding Course of the River Wye, T. S. Ellis, 83; Creation of an Artificial Water-table in Egypt, H. T. Ferrar, 343
Hygiene: the Sterilisation of Liquids by Light of very Short Wave-length, Prof. Theodore Lyman, 71; the Third International Congress of School Hygiene at Paris, August 2–7, 1910, 320; Uniformity of Method in Medical Inspection, Dr. James Kerr, 320; Open-air Schools, Dr. Neufert, 320; Dr. Mumford, 320; Physical Training, Dr. Digby Bell, 320; M. Demeny, 320; Discovery of a Trustworthy Mathematical Formula which shall Determine the State of Nutrition of a Child in Relation to Physical Measurements, Prof. Guttmann, 320; Fatigue in School Children, Dr. Janale, 320; "Inattention," Prof. Schuyten, 320; Modern Methods of Water Purification, Dr. D. M. Tomory, 437; the Process of Disinfection by Chemical Agencies and Hot Water, Harriette Chick, 469
Hymenoptera of the Family Chalcidæ, Catalogue of British, Claude Morley, 138

Ichenhäuser (Ernst), Abhandlungen Jean Rey's, über die Ursache der Gewichtszunahme von Zinn und Blei beim Verkalken, 527
Ichinohe (Mr.), the Maximum of Mira in 1909, 273
Ichthyology: Relative Sizes of the Otoliths in Various Species and Groups of Bony Fishes, Col. C. E. Shepherd, 270; Description of Collection of Fishes made in the Indian Ocean and South Pacific by Andrew Garrett, Dr. A. C. Günther, 402; Triacanthus Urberi, sp. Nor. B. L. Chaudhuri, 422; Chimæroid Fishes, Messrs. Bean and Weed, 547; Fish-fauna of the Chicago District, Messrs. Meek and Hildebrand, 547
Imms (A. D.), the Habits and Distribution of Scutigera in India, 429
India: Smallpox and Vaccination in British India, Major S. P. James, 5; Reference Libraries in India, 85; Memoirs of the Geological Survey in India: the Manganese-ore Deposits of India, H. Leigh Fermor, 128; Indian Palæontology, 159; Forest Flora of the Bombay Presidency and Sind, W. A. Talbot, 170; on the Meteorological Evidence for Supposed Changes of Climate in India, Dr. Gilbert T. Walker, F.R.S., Dr. William J. S. Lockyer, 178; Science in Bengal, 185; Malaria Prophylaxis in India, 240; Astronomy in India, 374; the Castes and Tribes of Southern India, Edgar Thurston and K. Rangachari, 365; Manganese-ore Deposits of the Sandur State, A. Ghose, 406; Zoological Work in India, 406; Land and Fresh-water Mollusca of India, Lieut.-Col. H. H. Godwin-Austen, 427; the Habits and Distribution of Scutigera in India, A. D. Imms, 429; Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum, Lieut.-Col. A. Alcock, F.R.S., 524
Iniguez (Father), Halley's Comet, 52
Innes (Mr.), Observations of Comets, 404
Inoue (R.), Experiments with Silkworms, 371
Inouye (K.), Alleged Allotropy of Lead, 316
Insect Wonderland, Constance M. Foot, 464
Insects, Jack's, Edward Selous, 427
Insects, the Death-dealing, and their Story, C. Conyers Morrell, 526
Institute of Metals, the Journal of the, 89
Institution of Mechanical Engineers, the, 154
Internal Combustion Engines, the Design and Construction of, Hugo Güldner, 197
International Agrogeological Conference, the First, Dr. E. J. Russell, 157
International Cancer Conference at Paris, the, 545
International Congress at Düsseldorf, the, 20
International Congress of Ornithologists, the Fifth, 53
International Union for Cooperation in Solar Research, 22
Ionisation of Gases and Chemical Change, Dr. H. Brereton Baker, F.R.S., at Royal Institution, 388
Ioniya, the Funeral Papyrus of, Edouard Naville, 237
Ireland, Great Britain and, Elementary Regional Geography, J. B. Reynolds, 527
Iron and Steel, Notes on the Electric Smelting of, Dr. W. F. Smeeth, 103
Iron and Steel Institute, the Autumn Meeting of the, 440
Irrigation, Ooze and, Rev. Hilderic Friend, 39, 70; A. R. Horwood, 40
Isaac (F.), Spontaneous Crystallisation and the Melting- and Freezing-point Curves of Mixtures of Two Substances which form Mixed Crystals and Possess a Minimum or Eutectic Freezing-point, 61
Iwanow (M.), Halley's Comet, 322

Jackson (Dr. A. R.), New Spider, *Erigone capra*, 246
Jacot (E.), Effect of the Electric Discharge on Water Vapour, 262
Jacquerod (A.), Application of the Principle of Archimides to the Exact Determination of Gaseous Densities, 556
Jamaica Earthquake, the, Sir D. Morris, K.C.M.G., 239
James (Major S. P.), Smallpox and Vaccination in British India, 5
James (William), Death and Obituary Notice of, 268
Janala (Dr.), Fatigue in School Children, 320
Japan: the New School of Japan, Founded for the Purpose of Making the Use of the Newly Invented Letters, F. Victor Dickins, 7; Korean Peninsula an Integral Part of Japanese Territory, 313
Japan-British Exhibition, Science at the, 125
Jarry-Desloges (M.), Observations of Mercury, 213
Jeffrey (Dr. E. C.), Remains of a Triassic Forest in Arizona, 247; Fossil Remains of a Conifer, 247
Jenkins (J. T.), Pelagic Sealing, 115
Jenkins (Dr. J. Travis), Science in Modern Life, Science and the Sea Fisheries, 464
Jenkinson (Dr. J. W.), the Relation of Regeneration and Developmental Processes, 550
Jensen (Dr. H. I.), Distribution, Origin, and Relationships of Alkaline Rocks, 376
Jerrold (Walter), Shakespeareland, 138
Jesup North Pacific Expedition, the, the Kwakiutl of Vancouver Island, Frank Boas, Chukchee Mythology, Waldemar Bogoras, the Yukaghir and the Yukaghirized Tungus, Waldemar Jockelson, Dr. A. C. Haddon, F.R.S., 250
Jochamowitz (A.), Mineral Resources of Apurimac, 217
Jockelson (Waldemar), the Jesup North Pacific Expedition, the Yukaghir and the Yukaghirized Tungus, 250
John (C. von), Eruptive Rocks of the Bohemian Eisengebirge, 377
Johnson (Amy F. M.), a Text-book of Botany for Students, 146

Johnson (F.), Effect of Silver, Bismuth, and Aluminium on the Mechanical Properties of "Tough-pitch" Copper containing Arsenic, 421
Johnson (J. P.), the Ore Deposits of South Africa, 293; Geological and Archæological Notes on Orangia, 465
Johnson (R. H.), Determinate Evolution in the Colour-pattern of "Lady-beetles," 116
Johnson (Prof. T.), die Flora von Irland, 395; an Irish Pteridosperm, 531
Johnson (W.), the Perseid Meteoric Shower, 248
Johnston (Sir H. H., G.C.M.G., K.C.B.), With a Prehistoric People, the Akikũyu of British East Africa, W. Scoresby Routledge and Katherine Routledge, 41; the Journal of the East Africa and Uganda Natural History Society, 80; the Ethnology, Botany, Geology, and Meteorology of German East Africa, 106; Documents scientifiques de la Mission Tilho (1906–9), 244
Johnston-Lavis (Dr.), Occurrence of a Basalt in the Volcanic Cone of Tritriva in Central Madagascar, 376
Johnstone (James), the Fishes of Cheshire and Liverpool Bay, 175; Measurements of some 55,000 Plaice, 548
Jolibois (Pierre), Relations between White Phosphorus, Red Phosphorus, and Pyromorphic Phosphorus, 196
Jonckheere (M.), New Canals and Lakes on Mars, 20
Jones (Llewellyn), the Manufacture of Cane Sugar, 199
Jordan (Dr. A. C.), Röntgen-ray Diagnosis, 153
Julius (Dr.), Anomalous Scattering of Light, 214
Jupiter, an Oblique Belt on, Scriven Bolton, 362

Kammerer (Dr. Paul), Colour-physiology, 319
Kapp (Prof. Gisbert), the Foundations of Alternate-current Theory, Dr. C. V. Drysdale, 6; Leitfaden zum elektrotechnischen Praktikum, Dr. G. Brion, 67
Kapteyn (Prof.), the Sun's Velocity through Space, 272; Parallax of Fourth-type Stars, 273
Kearney (Dr. T. H.), Date Gardens of the Jerid, 247
Keeling (B. F. E.), Temperature of "Invar" Wire, 272
Keith (Prof. Arthur), the Anatomy and Relationship of the Negro and Negroid Races, Hunterian Lectures at Royal College of Surgeons, 54; Illustrated Guide to the Museum of the Royal College of Surgeons, England, 296
Keller (Prof. A. G.), Physical and Commercial Geography, 459
Keller (Otto), die Antike Tierwelt, 357
Kelvin (Lord), Statue of, 340
Kemp (Prof. J. F.), Iron Ores Supplies, 441
Kemp (Stanley M.), the Decapod Natantia of the Coasts of Ireland, 394
Kempf (P.), the Rotation of Sun-spots, 152
Kendall (Prof. P. F.), the Concealed Coalfield of Notts, Derby, and Yorkshire, 520; Importance to Sheffield of the Unoxidised Iron Ores of Leicestershire and Lincolnshire, 552
Kennedy (W. T.), Active Deposit Obtained when the Emanation from Actinium is Allowed to Diffuse Freely between Two Parallel Plates Placed about 2 millimetres apart over the Actinium Salt, the Plates being Maintained at a Difference of Potential of 250 volts, 516
Kent, a History of the Birds of, Norman F. Ticehurst, 241
Kernbaum (Miroslaw), Decomposition of Steam by the Brush Discharge, 164
Kerr (Prof. Graham), Presence of a Posterior Vena Cava in Polypterus, 341
Kerr (Dr. James), Uniformity of Method in Medical Inspection, 320
Kershaw (J. A.), Remains of Subfossil Emeus and Marsupials from King Island, Bass Strait, 186; Existing Species of Wombats, 186
Kimura (M.), Determinations of the Effects of Atmospheres of Various Vapours on the Volt-ampere "Characteristic Curves" of the Carbon Copper Arc, 248
Kinematograph, the Ultra-rapid, Prof. C. V. Boys, F.R.S., 112
Kingzett (C. T.), the Rideal-Walker Test, 156
Kleemann (Dr. R. D.), Attractive Constant of a Molecule of a Compound and its Chemical Properties, 514
Kleinschrod (Dr. Franz), the Inherent Law of Life, a New Theory of Life and of Disease, 493
Knecht (Prof. E.), a Manual of Dyeing, 295
Knight (F. A.), Devonshire, 426
Knudsen (Dr. M.), Absolute Manometer for the Measurement of Gas Pressures not Greater than a Few Thousandths of a Millimetre of Mercury, 471
Knuth (Dr. P.), Handbook of Flower Pollination, 66
Kobold (Prof.), Ephemeris for Comet 1910*a*, 19; Metcalf's Comet 1910*b*, 249, 344, 507
Koidzumi (G.), Plants Obtained in Southern Half of the Island of Saghalien, 470
Kolowrat (Léon), the β Rays of Radium at its Minimum Activity, 356
Komarov (V. L.), Plants Gathered by Dr. Th. Derbeck on the Shores of the Gulf of Tartary, 542
Koritsky (Dr. K.), Discovery of the Site of the Famous Cyprian Temple of Aphrodite-Astarte, 149
Kossel (Prof. Albrecht), Nobel Prize Awarded to, 540
Kottmeier (H.), das Holz, 326
Kraft: das ist animalische, mechanische, soziale Energien und deren Bedeutung für die Machtentfaltung der Staaten, Prof. Dr. E. Reyer, 103
Kraftmaschinen, die, C. Schütze, 295
Krebs (Dr. Wilhelm), a Suggested Volcanic Origin of Martian Features, 344
Kreman (Dr. R.), Leitfaden der Graphischen Chemie, 525
Kremer (Dr. E.), Non-periodical Variations of Rainfall and Famines in German East Africa, 343
Kretschmer (F.), the "Kalksitikatfelse" near Mährisch-Schönberg in the Sudetic, 377
Krüger (Herr), Coloured Stars between the Pole and 60° N. Declination, 439
Kudu, the Spotted, R. Lydekker, F.R.S., 396
Kükenthal (Prof. W.), Japanische Alcyonaceen, 34; die Familien der Primnoiden, Muriceiden, und Acanthogorgüden, 34; die Familien der Plexauriden Chrysogorgüden und Melitodiden, 34
Kunkel (Dr. W. B.), Amphipod Crustaceans of Bermuda and the West Indies, 180

Laboratories: Annual Report of the Government Laboratory, 405; the Biological Laboratories at Woods Hole, Francis B. Sumner, 527; Unemployed Laboratory Assistants, G. E. Reiss, 462
Laby (Prof. T. H.), Tables of Constants of Ionisation and of Radio-activity, 316
Lacroix (A.), Minerals Formed by the Action of Sea-water upon Roman Metallic Objects found off the Coast of Mahdia, Tunis, 164
Lallemand (Ch.), Probable Exactness of Different Evaluations of the Altitude of Lake Chad, 64
Lamplugh (G. W., F.R.S.), Stagnant Glaciers, 297; the Shelly Moraine of the Sefström Glacier, Spitsbergen, 520
Lamson-Scribner (Prof. F.), the Grasses of Alaska, 17
Lanarkshire, Frederick Mort, 527
Lancashire Sea-fisheries Laboratory, the, 548
Landouzy (Prof.), Influence of Predisposition and Heredity, 508
Landscape Beautiful, the, F. A. Waugh, 464
Lane (Arbuthnot), Operative Treatment of Simple Fractures, 153
Lang (Andrew), Strange Myth of Theseus and the Minotaur, 246
Langevin (P.), Electric and Magnetic Double Refraction, 262
Langton (John), Death of, 340
Lankester (Sir Ray, K.C.B., F.R.S.), Science from an Easy Chair, 37
Larsen (Mr.), Synthetic Study of Diopside and its Relations to Calcium and Magnesium Metasilicates, 375; New Views on Quartz, 375
Latitude, the Variation of, Prof. Albrecht, 20
Lau (Dr.), Measures of Double Stars, 317; the Mean Parallax of Tenth Magnitude Stars, 439
Launay (M. de), Iron Ore Supplies, 441
Laurie (Dr. A. P.), Greek and Roman Methods of Painting, Some Comments on the Statements made by Pliny and Vitruvius about Wall and Panel Painting, 265; Lead and Zinc Pigments, Dr. C. D. Holley, 325
Laveran (A.), Forms of Endogenous Multiplication of *Haemogregarina sebai*, 131; an Epidemic Disease in Trout, 228; Treatment of Different Trypanosomiases by Arsenic and Antimony Emetic, 456

Lavison (Jean de Rufz de), the Elective *Rôle* of the Root in the Absorption of Salts, 556
Law of Definite Proportions, the, C. E., 364
Leach (Mr.), Halley's Comet, 19
Lead and Zinc Pigments, Dr. C. D. Holley, Dr. A. P. Laurie, 325
Leaf (Cecil H.), Death of, 468
Leaning Tower of Pisa, the, Prof. A. Batelli, 146; Edward G. Brown, 297; Arthur T. Bolton, 297
Lebedew (Dr.), the Pressure of Light on Gases, 86
Lebon (Ernest), Prof. Emile Picard, "Savant du Jour," 119
Lederer (Charles), Organic Compounds of Tetravalent Tellurium, 488
Lee (W. T.), Western Arizona, 121; the "Manzano" Group, 121
Leeds Astronomical Society, the, 120
Leger (Mr.), Establishment of the Constitution of the Aloins, 354
Lendenfell (Prof. R. v.), an Undescribed Feather-element, 436
Lermantoff (Prof. W.), Electrical Discharge Figures, 72
Lessings Briefwechsel mit Mendelssohn und Nicolai über das Trauerspiel, Prof. Dr. Robert Petsch, 294
Lévy (Prof. Maurice), Death of, 468; Obituary Notice of, 502
Lewis (E. J.), Qualitative Analysis, 360
Lewis (F. C.), Effect of Mosquito Larvæ upon Drinking Water, 150
Lewis (Francis J.), Plant Remains in the Scottish Peat Mosses, 227
Lewis (T.), Separating Power of a Telescope, 266
Lewis (Prof. W. J., F.R.S.), Wiltshireite, a New Mineral, 203
Lewis (Wilfrid), Interchangeable Involute Gearing, 155
Lewkowitz (A.), Hegels Asthetik im Verhaltnis zu Schiller, 294
Leyden (Prof. Ernst von), Death of, 468
Life, the Inherent Law of, a New Theory of Life and of Disease, Dr. Franz Kleinschrod, 493
Light: the Sterilisation of Liquids by Light of Very Short Wave-length, Prof. Theodore Lyman, 71; the Pressure of Light on Gases, Dr. Lebedew, 86; Light and Sound, W. S. Franklin and Barry Macnutt, E. Edser, 103; the Pressure of Light against the Source, the Recoil from Light, Bakerian Lecture at Royal Society, Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, 139; Dispersion of Light in Interstellar Space, Herr Beljawsky, 213; Anomalous Scattering of Light, Dr. Julius, 214; Light Visible and Invisible, Silvanus P. Thompson, F.R.S., 395
Lightning and the Churches, Alfred Hands, 238
Lindgren (W.), Contributions to Economic Geology, Part i., Metals and Non-metals except Fuels, 511
Lindman (M.), Iron Ore Supplies, 441
Linnean Society, 29
Linnean Society, New South Wales, 64, 196, 422, 522
Little (Archibald), Across Yunnan, 177
Lloyd (Dr. R. E.), Variation in Indian Rats, 407
Löbner (M.), Leitfaden für gärtnerische Pflanzenzuchtung, 460
Lockyer (Sir Norman), the Relation of Spectra to the Periodic Series of the Elements, 515; Stars and their Temperatures, 516
Lockyer (Dr. William J. S.), Death and Obituary Notice of the Hon. Charles Stewart Rolls, 46; the Next Total Eclipse of the Sun, 75; the Total Solar Eclipse of May 9, 1910, 113; on the Meteorological Evidence for supposed Changes of Climate in India, Dr. Gilbert T. Walker, F.R.S., 178
Lodge (Sir Oliver, F.R.S.), the Newer Spiritualism, Frank Podmore, 489; Existence of a Positive Gradient of Potential during Fine Weather and a Negative Gradient during Wet Weather, 515; Velocity of Sound not a Constant Quantity, 517
Loewenthal (Dr. R.), a Manual of Dyeing, 295
Logie (J.), Aqueous Solutions of Ferrous Ammonium Sulphate Form a Good Filter for Stopping Heat Rays, 182
London, the British Medical Association in, 153
London, Wild Plants on Waste Land in, 184
Longitude, the Determination of, Dr. Jean Mascart, 404
Lönnberg (Dr. Einar), Teeth of Very Young White Whales (*Delphinapterus leucas*), 270
Loomis (F.), Complete Skeleton of a New Species of the Camel-like Genus Stenomylus from the Harrison Beds of Nebraska, 89
Lorentz (Dr. H. A.), Inhabitants of Unknown Region in New Guinea, 269
Lovassy (A.), Resultate der Wissenschaftlichen Untersuchungen des Balaton, die Tropischen Nymphæen des Hévezsees bei Keszthely, 299
Love (Prof. A. E. H., F.R.S.), Elements of the Differential and Integral Calculus, 136; New Gyroscopic Apparatus, 513
Lowell (Prof. Percival), the Evolution of Worlds, 99; Mars in 1909 as Seen at the Lowell Observatory, 172; Velocities and Accelerations of the Ejecta from Halley's Comet, 404
Ludendorff (Dr.), Spectrum and Radial Velocity of ϕ Persei, 507
Lühe (Dr. M.), a Handbook of Practical Parasitology, 393
Lull (Prof. R. S.), Evolution of the Horned Dinosaurs, 89; Relation of Embryology and Vertebrate Palæontology, 211
Lumière (A. and L.), Various Gelatine-hardening Agents, 216; Action of Quinones and their Sulphonic Derivatives on the Photographic Images Formed by Silver Salts, 488
Luminosity of Comets, W. L. Dudley, 439
Luminous Paint, R. G. Durrant, 530
Lunge (Prof. George), Technical Methods of Chemical Analysis, 101; Coal Tar and Ammonia, 166; the Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches, 166
Lushington (A. W.), the Genus Citrus, 315
Lussana (Prof. S.), Coefficients of Compressibility and of Dilation with Temperature of Certain Pure Metals and Alloys, 118
Lydekker (R., F.R.S.), the Spotted Kudu, 396
Lyman (Prof. Theodore), the Sterilisation of Liquids by Light of Very Short Wave-length, 71

Maas (O.), Japanische Medusen, 34
McAdie (A.), Diversity of Systems of Notation in Meteorology, 506
MacAlister (D. A.), the Geology of Ore Deposits, 293
Macallum (Prof. A. B., M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S.), Opening Address in Section I at the Meeting of the British Association at Sheffield, 444
Macallum (N.), Resolution of the Spectral Lines of Mercury by a High-grade Echelon Spectroscope, 516
MacBride (Prof. E. W., F.R.S.), British Marine Zoology, 252, 330, 396, 462
McCabe (Joseph), Prehistoric Man, 39
McCall (Mr.), Bacterial Blight in Cotton caused by *Bact. Malvacearum*, 247
M'David (J. W. M.), Specific Volumes of Solutions of Tetrapropylammonium Chloride, 97
Macdougal (Dr. D. T.), Inducing Dependent Nutrition by the Insertion of Prepared Slips into a Host Plant, 505
MacDougall (Dr. R. Stewart), Animal Pests, 157
McEwen (G. F.), Hydrographical Work carried on by the Marine Biological Station at San Diego, 82
McFarland (Prof. Raymond), Exploration in Western Labrador, 468
M'Ilroy (Dr. A. Louise), Development of the Germ Cells in the Mammalian Ovary, 97
McIsaac (Isabel), Bacteriology for Nurses, 493
Mack (Amy E.), a Bush Calendar, 464
Mackinder (H. J.), Distant Lands, 426
McLennan (John), a Manual of Practical Farming, 38
McLennan (Prof.), Resolution of the Spectral Lines of Mercury by a High-grade Echelon Spectroscope, 516
Macmillan (H. F.), Flowering Trees, 55
Macnutt (Barry), Light and Sound, 103
McWilliam (Prof. A.), on the Nature, Uses, and Manufacture of Ferro-silicon, with Special Reference to Possible Danger arising from its Transport and Storage, Dr. S. M. Copeman, F.R.S., S. R. Bennett, and Dr. H. Wilson Hake, 53; la Métallographie Microscopique, Louis Révillon, 295; Fuel and Refractory Materials, Prof. A. H. Sexton, 392; Properties of a Series of Steels

with Varying Carbon Contents, 519; Metallurgical Industries in Relation to the Rocks of the District, 552
Maddren (A. G.), Mineral Resources of the Kotsina-Chitina Region, Alaska, 511
Maggini (M.), a Bright Projection on Saturn, 507
Magnetism: Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19, D. Stenquist and E. Petri, 9; Magnetism of the Copper-manganese-tin Alloys under Varying Thermal Treatment, A. D. Ross and R. C. Gray, 97; Magnetic Results of the First Cruise of the *Carnegie*, Dr. L. A. Bauer and W. J. Peters, 119; die secularen Arnderungen der Erdmagnetischen elemente, Dr. H. Fritsche, 373; Results of some Recent Investigations on Magnetic Disturbances, Dr. L. A. Bauer, 192; Magnetic Survey of Sardinia, Prof. L. Palazzo, 437; Liste der Observatoires Magnétiques et des Observatoires Séismologiques, E. Merlin and O. Somville, 460; Tables of Corrections to the British Admiralty, the German Admiralty, and the United States Hydrographic Department, Magnetic Charts of the North Atlantic, Dr. L. A. Bauer and W. J. Peters, 544
Mahler (P.), Presence of a Small Quantity of Carbon Monoxide in the Air of Coal Mines, 555
Mailhe (A.), Catalytic Preparations of Alkyl-aryl Ethers, 196; Catalytic Preparation of the Phenolic Oxides and the Diphenylenic Oxides, 292
Makower (Dr. W.), Recoil of Radium B from Radium A, 516
Malaria Prophylaxis in India, 240
Malclès (Louis), Appearance of Certain Dielectric Anomalies by Changing the State of the Insulating Medium, 64
Malcolm (Charles), Grouse and Grouse Moors, 466
Malloch (P. D.), Life-history and Habits of the Salmon, Sea-trout, Trout, and other Fresh-water Fish, 168
Mammalia: the Mammals and Birds of Cheshire, T. A. Coward and C. Oldham, 175; the Orders of Mammals, W. K. Gregory, 216; Life-histories of Northern Mammals, an Account of the Mammals of Manitoba, Ernest Thompson Seton, 423; a History of British Mammals, G. E. H. Barrett-Hamilton, 493
Man and Nature on Tidal Waters, Arthur H. Patterson, 100
Manchester Literary and Philosophical Society, 521
Manganese-ore Deposits of India, the, H. Leigh Fermor, 128
Manganese-ore Deposits of the Sandur State, A. Ghose, 406
Mangin (L.), Observations on Callose, 164
Mantegazza (Prof. Paolo), Death of, 270
Maps, Home-work Atlas of, in Black and White, 395
Maquenne (L.), Toxic Qualities of Certain Salts towards Green Leaves, 131
Marconi (Mr.), Wireless Messages from a Distance of 3500 Miles, 400; Wireless Telegraphic Messages Transmitted between Clifden (Galway) and Buenos Aires, 435
Marcuse (Prof. A.), Navigation in der Luft, 229
Marguet (Prof.), History of Navigation, 317
Marine Biology: die Ernährung der Wassertiere und der Stoffhaushalt der Gewasser, Prof. August Pütter, 5; *Leptocephalus hyoproroides* and *L. thorianus*, Johs. Schmidt, 9; Marine Biological Photography, Francis Ward, 10; New Marine Biological Station at Venice, Cal., 81; New Species of Feather-star (Antedon) from the Adriatic, A. H. Clark, 150; Polychætous Annelids Dredged off the Californian Coast by the *Albatross* in 1904, J. P. Moore, 246; a Monograph of the Foraminifera of the North Pacific Ocean, J. A. Cushman, 265; the Decapod Natantia of the Coasts of Ireland, Stanley M. Kemp, 394; Report of a Survey of the Trawling Grounds on the Coasts of Counties Down, Louth, Meath, and Dublin, E. W. L. Holt, 394; Bulletin Trimestrie, Conseil Permanent International pour l'Exploration de la Mer, Résumé des Observations sur le Plankton des Mers explorées par le Conseil pendant les Années 1902–8, 394
Marine Zoology, British, Prof. E. W. MacBride, F.R.S., 252, 330, 396, 462; Prof. W. A. Herdman, F.R.S., 329, 396, 462; Dr. Wm. J. Dakin, 396
Markham (Sir Clements K., K.C.B., F.R.S.), Land of the Incas, 470
Marloth (Dr. R.), Observations on the Biology of Roridula, 98; Experiments to Find Out whether the Aerial Parts of Plants absorb Moisture from the Air, 158
Mars: New Canals and Lakes on, M. Jonckheere, 20; Subjective Phenomenon on Mars, M. Antoniadi, 120; Mars in 1909 as Seen at the Lowell Observatory, Prof. Percival Lowell, 172; Water Vapour on Mars, Prof. Campbell, 317; Prof. Frank W. Very, 495; a Suggested Volcanic Origin of Martian Features, Dr. Wilhelm Krebs, 344
Marsh (C. F.), a Concise Treatise on Reinforced Concrete, 358
Marsh (Prof. Howard), Medicine and Biology, 48
Marshall (A.), Centre of Gravity of Annual Statistics, 104
Marshall (F. H. A.), Physiological Problems of the Stock-breeder, 219
Marsters (V. F.), Coast of Southern Peru and the Pampas West of the Andes, 217
Martel (E. A.), Conditions of Effective Filtration of the Underground Waters in Certain Chalk Formations, 422
Mascart (Dr. Jean), the Determination of Longitude, 404
Massol (G.), Vibration of a Tuning Fork, 228
Mathematics: Problèmes et Exercises de Mathématiques générales, Prof. E. Fabry, 8; Curve Tracing and Curve Analysis, A. P. Trotter, 40; Savants du Jour, Prof. Emile Picard, Ernest Lebon, 119; Elements of the Differential and Integral Calculus, Prof. A. E. H. Love, F.R.S., 136; Plane Trigonometry, Prof. H. S. Carslaw, 136; Elementary Projective Geometry, A. G. Pickford, 136; a First Course in Analytical Geometry, Plane and Solid, with Numerous Examples, C. N. Schmall, 136; a Manual of Geometry, W. D. Eggar, 138; Death of Rev. Robert Harley, F.R.S., 148; Obituary Notice of, 210; Theories of Parallelism, an Historical Critique, W. B. Frankland, 169; the Early History of Non-Euclidean Geometry, D. M. Y. Sommerville, 172; Gauss and Non-Euclidean Geometry, Prof. H. S. Carslaw, 362; the Bicentenary of Thomas Simpson, Edgar C. Smith, 254; Factorisable Continuants, Dr. T. Muir, 262; Death of Eugène Rouché, 339; Mathematics in Austria, 399; Œuvres complètes de Christiaan Huygens, 491; Death of Prof. Maurice Levy, 468; Obituary Notice of, 502; Fermat's Theorem, Dr. H. C. Pocklington, F.R.S., 531; Bólyai Prize Awarded to Prof. David Hilbert, 541; *see also* British Association
Mathias (E.), Rectilinear Diameter of Oxygen, 131, 262
Maxwell (Aymer), Grouse and Grouse Moors, 466
Mechanical Engineers, the Institution of, 154
Medicine: Medicine and Biology, Prof. Howard Marsh, 48; Special Screening against Mosquitoes, Dr. H. W. Thomas, 48; Annual Report for 1908 of the Chief Medical Officer of the Board of Education, 57; Action of Potash Salts taken by the Mouth, W. E. Dixon, 63; the British Medical Association in London, 153; Radiology and Medical Electricity, Sir J. J. Thomson, F.R.S., 153; Röntgen-ray Diagnosis, Dr. H. Orton and Dr. A. C. Jordan, 153; Operative Treatment of Simple Fractures, Arbuthnot Lane, 153; Chronic Constipation, Dr. J. F. Goodhart, 153; Radium Treatment, Drs. Dominici and Wickham, 153; Treatment of Cancer, Prof. Gilbert Barling, 154; Important Additions to Medical Knowledge, Dr. J. Mitchell Bruce, 154; Recent Advances in our Knowledge of Tropical Diseases, Dr. John L. Todd, 181; Death of Prof. Paolo Mantegazza, 270; Medical Education in the United States and Canada, Abraham Flexner, 332; the Municipal Control of Tuberculosis, 353; Preventive Medicine in School Life, 353; Disease Carriers, 353; a Handbook of Practical Parasitology, Prof. Max Braun and Dr. M. Lühe, 393; Use of X-Ray in the Diagnosis of Pulmonary Tuberculosis, Dr. C. L. Minor, 436; Death of Prof. Ernst von Leyden, 468; Opening of the Medical Session, 479; a Guide for Medicine and Surgery, Compiled for Nurses, Sydney Welham, 526; Nobel Prize Awarded to Prof. Albrecht Kossel, 540; Value of Research in Medicine, Lord Cromer, 541
Meek (Mr.), Fish-fauna of the Chicago District, 547
Melanesians of British New Guinea, the, Dr. C. G. Seligmann, S. H. Ray, 499
Mendel (Gregor), Memorial to, 435
Mendenhall (W. C.), History of the Salton Sea, 122
Mental Diseases, a Text-book of, Prof. Eugenio Tanzi, 458
Menzies (A. W. C.), Static Method for Determining the

Vapour Pressures of Solids and Liquids, and the Vapour Pressures of Mercury, 97
Mercantile Marine, Sight Tests in the, 537
Mercau (Augustus), the Perfilograph, 434
Mercury, Observations of, G. and V. Fournier, 213; M. Jarry-Desloges, 213
Merfield (Mr.), Halley's Comet, 322
Merlin (E.), Liste des Observatoires Magnétiques et des Observatoires Séismologiques, 460
Merlin (J.), Occultation of η Geminorum by Venus, July 26, Observed at Lyons, 390
Merrill (E. D.), the Grasses of Alaska, 17; Philippine Leguminosæ, 211
Merrill (G. P.), Averages of Analyses of Stony Meteorites, 376
Merry (E. W.), Molecular Complexity of Nitrosoamines, 520
Metallography: Metallografia applicata ai Prodotti Siderurgici, Umberto Savoia, 39; Lo Zinco, Prof. R. Musu-Boy, 39; Metallographie, ein ausführliches Lehr- und Handbuch der Konstitution, und der physikalischen, chemischen und technischen Eigenschaften der Metalle und metallischen Legierungen, Dr. W. Guertler, 200; la Métallographie Microscopique, Louis Révillon, A. McWilliam, 295; Metallography as an Aid to the Brass Founder, H. S. Primrose, 421
Metallurgy: the International Congress at Düsseldorf, 20; on the Nature, Uses, and Manufacture of Ferro-silicon, with Special Reference to Possible Danger arising from its Transport and Storage, Dr. S. M. Copeman, F.R.S., S. R. Bennett, and Dr. H. Wilson Hake, Prof. A. McWilliam, 53; Nature of Intermetallic Compounds, Dr. T. Slater Price, 83; the Journal of the Institute of Metals, 89; Elastic Breakdown of Non-ferrous Metals, A. C. M. Smith, 89; Magnetism of the Copper-manganese-tin Alloys under Varying Thermal Treatment, A. D. Ross and R. C. Gray, 97; Notes on the Electric Smelting of Iron and Steel, Dr. W. F. Smeeth, 103; New Process for Producing Protective Metallic Coatings, M. U. Schoop, 218; New Alloy Duralumin, 313; Shrinkage of Antimony-lead Alloys and of the Aluminium-zinc Alloys during and after Solidification, Donald Ewen and Prof. T. Turner, 421; Effect of Silver, Bismuth, and Aluminium on the Mechanical Properties of "Tough-pitch" Copper containing Arsenic, F. Johnson, 421; Magnetic Alloys Formed from Non-magnetic Materials, A. D. Ross, 421; the Heat Treatment of Brass, G. D. Bengough and O. F. Hudson, 421; Some Common Defects occurring in Alloys, Dr. C. H. Desch, 421; the Autumn Meeting of the Iron and Steel Institute, 440; Theory of Hardening Carbon Steels, C. A. Edwards, 440; Prof. Arnold, 440; Dr. Carpenter, 440; Prof. Turner, 440; Influence of Silicon on the Properties of Pure Cast Iron, A. Hague and Prof. T. Turner, 440; Manganese in Cast Iron and the Volume Changes during Cooling, H. I. Coe, 440; Sulphurous Acid as an Etching Agent for Metallographic Work, S. Helpert and E. Colvert Glauert, 440; Preparation of Magnetic Oxides of Iron from Aqueous Solutions, S. Hilpert, 440
Metals, the Temperature Coefficients of the Ferromagnetic, Dr. J. R. Ashworth, 238
Metcalf (Rev. J. H.), a New Comet, 213
Metcalf's Comet 1910*b*, 249, 273; M. Guillaume, 249; Dr. Kobold, 249, 344, 507; Prof. Pickering, 344; M. Quénisset, 507; Observations of, J. Guillaume, 261; M. Coggia, 261; M. Borrelly, 261; M. Schaumasse, 292; Observations of, at the Paris Observatory, J. Chatelu, 261
Meteorites: Large Meteorites, Edmund O. Hovey, 152; Meteoric Iron which Fell on August 1, 1898, near Quesa, Prof. Friedrich Berwerth, 372
Meteorology: Results of the Exposure of Thermometers in Windows and in Screens, Prof. Hellman, 17-8; die Temperatur Verhältnisse in der freien Atmosphäre [Ergebnisse der internationalen unbemannter Ballonaufstiege], Dr. Arthur Wagner, E. Gold, 42; the Gulf Stream Drift and the Weather of the British Isles, Dr. H. Bassett, 44; Meteorological Chart of North Atlantic for July, 50; Meteorological Charts of the North Atlantic and North Pacific Oceans for September, and of the South Atlantic and South Pacific for September–November, 1910, 247; Meteorological Chart of the North Atlantic and Mediterranean for September, 316; Meteorological Chart of the North Atlantic Ocean for November, Prof. W. L. Moore, 543; Two Notable Typhoons which Crossed the Philippine Archipelago during November, 50; Weather for the Five Weeks ending July 9, 50; July Weather, 148; Weather for Week ending August 27, 271; Weather, June 25 to September 3, 316; Models of Meteorological Conditions in the Free Air, 59; Centre of Gravity of Annual Statistics, A. Marshall, 104; the Ethnology, Botany, Geology, and Meteorology of German East Africa, Sir H. H. Johnstone, G.C.M.G., K.C.B., 106; Examination of the Atmosphere at Various Altitudes for Oxides of Nitrogen and Ozone, Messrs. Hayhurst and Pring, 119; Meteorological Conditions Prevailing before the South-west Monsoon of 1910, Dr. Walker, 118; Comparison of the Barometers of the Various Meteorological Institutes, 118; Reports of Meteorological Observatories, 123; the Meteorological Service of Canada (1906), 123; Toronto Observatory (1907), 123; Bombay and Alibag Observatories (1909), 123; Helwan Observatory (1909), 123; Royal Prussian Meteorologcial Institute (1909), 124; the Deutsche Seewarte (1909), 124; the Sonnblick Observatory (1909), 124; Norwegian Meteorological Institute (1909), 124; the Southport Meteorological Observatory (1909), 124; Falmouth Observatory (1909), 124; Observatory Department of the National Physical Laboratory (1909), 124; Koninklijk Nederlandsch Meteorologisch Instituut, No. 105, Oceanographische en Meteorologische Waarnemingen bij Kaap Guardafui, 159; Regenwaarnemingen in Nederlandsch-Indie, 159; on the Meteorological Evidence for Supposed Changes of Climate in India, Dr. Gilbert T. Walker, F.R.S., Dr. William J. S. Lockyer, 178; Rainfall of Rhodesia and Australia, 187; Rainfall of Rhodesia, Rev. E. Goetz, 187; Dew-ponds on the Thorpe Downs, Berkshire, H. Gibson, 240; Royal Magnetical and Meteorological Observatory at Batavia, Report on Cloud-observations at Batavia made during the International Cloud-year 1896–7 and Subsequent Years, Dr. S. Figee, E. Gold, 249; Velocità e Direzione delle Correnti Aeree alle diverse Altitudini Determinate a Mezzo dei Palloni-Sonde e Piloti, Dr. G. Pericle, E. Gold, 249; Diurnal Variation of Level at Kimberley, Dr. J. R. Sutton, 262; Report of Meteorological Committee for the Year ending March 31, 271; Meteorology, Practical and Applied, Sir John Moore, 293; Monsoon Conditions Prevailing during June and July, 316; Tables for the Reduction of Meteorological Observations, Dr. G. C. Simpson, E. Gold, 326; Non-periodical Variations of Rainfall and Famines in German East Africa, Dr. E. Kremer, 343; Wind and Current Observations, Dr. P. H. Gallé, 343; Innsbrucker Föhnstudien, iv., Weitere Beiträge zur Dynamik der Föhns, Dr. H. v. Ficker, 368; Great Tropical Storm of October, 1909, 372; Average Rainfall Map and Isohyets of New South Wales, 373; Reports on Climates, 377; Meteorology of Peru, Dr. J. Hann, 377; Climate of the Lower Guinea Coast and Hinterland, Dr. R. Sieglerschmidt, 377; Climate of Berlin, Prof. G. Hellmann, 377; Rainfall of Northern Spain and Portugal, Dr. W. Semmelhack, 377; Australian Commonwealth Bureau of Meteorology, 402; a Meteorological Phenomenon, Rev. R. Ashington Bullen, 429; the Summer Season, 435; Vegetation and Rainfall, Dr. A. Morrison, 437; Application of the Method of Correlation to Investigations of the Connection between Meteorological Elements at Different Places, Dr. T. Okada, 470; Daily Variation of Wind and the Displacement of the Air at Nagasaki, Y. Tsuiji, 471; Diversity of Systems of Notation in Meteorology, A. McAdie, 506; Meteorological Outlook in South Africa, 506; British Rainfall, 1909, Dr. Hugh Robert Mill, 523; Cloud-burst in the Island of Ischia, 541; Snowfall in the Transvaal, H. E. Wood, 543; Bremen Meteorological Year-book, 1909, 546; Liverpool Observatory (1909), 546; Royal Alfred Observatory, Mauritius (1909), 546; Transvaal Meteorological Department (1908–9), 546; Deutsche überseeische meteorologische Beobachtungen, 546
Meteors: Present Meteoric Displays, W. F. Denning, 105; a Central Bureau for Meteor Observations, 152; Observations of Perseids in 1909, S. Beljawsky, 184; Perseid Meteoric Shower, 1910, W. F. Denning, 204;

Brilliant Meteor of July 31, Father A. L. Cortie, 204; the Perseid Meteoric Shower, Mr. Denning, 248; C. L. Brook, 248; W. H. Stevenson, 248; Miss Warner, 248; Dr. E. Packer, 248; W. Johnson, 248; the Perseid Shower, 1910, E. F. Sawyer, 439; Meteors and Bolides, Prof. Guido Cora, 317; Meteoric Fireballs, Rev. W. F. A. Ellison, 318; Prof. J. C. W. Herschel, 318; Fireball on September 2, Edmund J. Webb, 363; W. F. Denning, 364; a Bright Meteor, 438; Halley Meteors, Prof. David Todd, 439; a Brilliant Meteor on October 23, W. F. Denning, 544; J. E. Clark, 544; Simultaneous Photographic Observations of a Remarkable Meteor, Herr Sykora, 544
Metzograph Grained Screen, the, 182
Meyer (Mr.), Halley's Comet, 322
Meyrick (E., F.R.S.), Revision of Australian Tortricina, 64
Michaelis (Prof. A.), Death of, 210
Micrometer, a New, Dr. Doberck, 439
Micrometric Observations of Eros, Results from, 1900, Mr. Hinks, 184
Microscopy: Royal Microscopical Society, 29
Microtome, New Large, 470
Miers (Principal H. A., M.A., D.Sc., F.R.S.), Opening Address in Section L at the Meeting of the British Association at Sheffield, 480
Milk, Methods Used in the Examination of, and Dairy Products, Dr. Chr. Barthel, 69
Mill (Dr. Hugh Robert), British Rainfall, 1909, 523
Miller (W. G.), Various Subdivisions of the Pre-Cambrian Rocks, 443
Millochau (G.), Halley's Comet, 120
Milne (Prof. John, F.R.S.), the California Earthquake of April 18, 1906, vol. ii., the Mechanics of the Earthquake, Harry F. Reid, 165
Milner (Dr. S. R.), the Sheffield Meeting of the British Association, 174; Photographic Study of the Mercury Arc *in vacuo*, 515
Minakata (Kumagusu), a Singular Mammal called "Orocoma," 40
Minchin (Prof. E. A.), Nova tripansomiaze humana, C. Chagas, 142
Mineral Waters and Medicinal Springs of the County of Essex, a History of the, Miller Christy and May Thresh, 361
Mineralogy: Leitfaden der Mineralogie, Prof. Julius Ruska, 38; Minerals Formed by the Action of Sea-water upon Roman Metallic Objects Found off the Coast of Mahdia, Tunis, A. Lacroix, 164; Wiltshireite, a New Mineral, Prof. W. J. Lewis, F.R.S., 203; the Mineral Survey of Peru, 217; Mineral Resources of Apurimac, A. Jochamowitz, 217; the Provinces of Tayacaja, Angaráes, and Huancavelica, E. T. Dueñas, 217; Occurrences of Antimony Ores throughout Peru, E. Weckwarth, 217; the Ratio between Uranium and Radium in Minerals, Alex. S. Russell, 238; Electrical and Other Properties of Sand, Charles E. S. Phillips at Royal Institution, 255; the Ratio between Uranium and Radium in Minerals, Frederick Soddy, F.R.S., 296; Relations of Uralite and Other Secondary Amphiboles to their Parent Minerals, Dr. A. Wilmore, 372; Ore-deposits of Borah Creek, New England, N.S.W., L. A. Cotton, 422
Minerals: Mineral Specimens acquired by British Museum, 467; United States Geological Survey, Contributions to Economic Geology, Part ii., Coal and Lignite, M. R. Campbell, 511; the Ketchikan and Wrangell Mining Districts, Alaska, F. E. Wright and C. W. Wright, 511; Mineral Resources of the Kotsina-Chitina Region, Alaska, F. H. Moffit and A. G. Maddren, 511; Mineral Resources of Alaska, A. H. Brooks, 511; Contributions to Economic Geology, Part i., Metals and Non-metals except Fuels, C. W. Hayes and W. Lindgren, 511; Papers on the Conservation of Mineral Resources, 511
Mining: the International Congress at Düsseldorf, 20; Memoirs of the Geological Survey in India, the Manganese-ore Deposits of India, H. Leigh Fermor, 128; Tanami Goldfield in Central Australia, H. Y. L. Brown, 182; Mining Operations in the State of South Australia, 342; Death of A. H. Stokes, 468; First Steps in Coal Mining, Alexander Forbes, 492; Manganese-ore Deposits of the Sandur State, A. Ghose, 406
Minor (Dr. C. L.), Use of X-rays in the Diagnosis of Pulmonary Tuberculosis, 436
Mira, the Maximum of, in 1909, Prof. Nijland, 273; Mr. Ichinohe, 273
Mirande (Marcel), Action of Vapours on Green Plants, 262
Mitchell (A. D.), Elimination of a Carbethoxyl Group during the Closing of the Five-membered Ring, 519
Mitton (G. E.), the Thames, 138
Miyoshi (Dr. M.), Rhododendron producing Double Flowers in its Wild State, 372
"Mock Suns," James F. Ronca, 345
"Mock Suns" at Eastbourne, Mrs. A. M. Butler, 374
Moffit (F. H.), Mineral Resources of the Kotsina-Chitina Region, Alaska, 511
Moir (Dr. James), Halley's Comet, 9
Moir (J. Reid), Discovery of Worked Flints beneath Undisturbed Deposits of Crag in the Neighbourhood of Ipswich, 503
Moir (Dr. T.), Absorption Spectrum of Oxygen and a New Law of Spectra, 98
Molinari (Prof. Ettore), Chimica Generale e Applicata all' Industria, 170
Molisch (Prof. H.), Note on Local Coloration of the Cell Wall in Certain Water Plants induced by Manganese Compounds, 151
Mollusca, Land and Fresh-water, of India, Lieut.-Col. H. H. Godwin-Austen, 427
Monro (C. F. H.), Indigenous Trees of Southern Rhodesia, 55
Moodie (Dr. R. L.), Alimentary Canal of a Branchiosaurian Salamander from the Carboniferous Shales of Mazon Creek, 17
Moon: the Genesis of Various Lunar Features, M. Puiseux, 120
Moore (Dr. Benjamin), Effect of an Increased Percentage of Oxygen on the Vitality and Growth of Bacteria, 181
Moore (Clarence B.), Antiquities of the Ouachita Valley, 129
Moore (Dr. F. J.), Outlines of Organic Chemistry, 360
Moore (Sir John), Meteorology, Practical and Applied, 293
Moore (J. P.), Polychætous Annelids Dredged off the Californian Coast by the *Albatross* in 1904, 246
Moore (Prof. W. L.), Meteorological Chart of the North Atlantic Ocean for November, 543
Mora (Enzo), Irregularities in the Motion of Algol's Satellite, 472
Morbology: Smallpox and Vaccination in British India, Major S. P. James, 5; Sleeping Sickness, Colonel Seely, 16; Sleeping Sickness in Europeans, 469; Uganda Sleeping-sickness Camps, Dr. A. P. Hodges, 315; the Tuberculosis Conference and Exhibition, 22; Mortality of the Tuberculous in Relation to Sanatorium Treatment, W. Palin Elderton and S. J. Perry, 371; the Crusade against Consumption, 374; the Ninth International Conference on Tuberculosis, 507; Influence of Predisposition and Heredity, Prof. Landouzy, 508; Special Susceptibility of Children of Tuberculous Parents, Prof. Calmette, 508; M. Piery, 508; Analysis of 232 Fatal Cases of Tuberculosis, Dr. Nathan Raw, 508; Importance of Predisposition, Dr. C. Theodore Williams, 508; Action of Sunlight and High Altitudes, Dr. Hermann von Schrötter, 509; Grouse Disease, Drs. Cobbett and Graham Smith, 48; House-flies and Disease, Dr. C. Gordon Hewitt, 73; the Progress of Cancer Research, 126; the International Cancer Conference at Paris, 545; *Anaplasma marginale*, a New Genus and Species of the Protozoa, Dr. A. Theiler, 132; Development of *Piroplasma parvum* (Protozoa) in the Various Organs of Cattle, Dr. R. Gonder, 132; Nova tripanosomiaze humana, C. Chagas, Prof. E. A. Minchin, 142; Original Source and Spread of Bubonic Plague, H. B. Wood, 149; Treatment of Trypanosomiasis of Man and Animals, 150; Health, Progress and Administration in the West Indies, Sir Rubert W. Boyce, F.R.S., 174; an Epidemic Disease in Trout, A. Laveran and A. Pettit, 228; Cholera and its Control, 239; Malaria Prophylaxis in India, 240; Prevention of Malaria, Dr. Malcolm Watson, 340; Factors in the Transmission and Prevention of Malaria in the Panama Canal Zone, Dr. S. T. Darling, 401; Etiology of Beriberi, 401; Death of Cecil H. Leaf, 468; Trypanosome Found in the Blood of a Patient in

Sumatra, Dr. C. Elders, 504; Recent Investigations on Pellagra, Dr. Louis Sambon, 538
Morehouse's Comet, Photographs of, Messrs. Hirayama and Toda, 19
Moreux (Abbé Th.), the Relations between Solar and Terrestrial Phenomena, 545
Morgan (A. P.), How to Build a 20-foot Biplane Glider, 229
Morgan (Prof. T. H.), Chromosomes and Heredity, 246
Morley (Claude), Catalogue of British Hymenoptera of the Family Chalcidæ, 138
Morphology: Glandular Structures Supposed to Form Part of the Postate Gland in Rats and Guinea Pigs, Dr. Walker, 82; Morphology of the Manus in *Platanista gangetica*, Sir William Turner, 97; the Thyroid Body and Related Structures, F. D. Thompson, 181; Presence of a Posterior Vena Cava in Polypterus, Prof. Graham Kerr, 341
Morrell (C. Conyers), the Death-dealing Insects and their Story, 526
Morris (Sir D., K.C.M.G.), the Jamaica Earthquake, 239
Morrison (Dr. A.), Vegetation and Rainfall, 437
Mörsch (Prof. Emil), Concrete-steel Construction, 358
Morse (H. W.), Evaporation from a Solid Sphere, 51
Mort (Frederick), Lanarkshire, 527
Moser (Dr. Fanny), Japanische Ctenophoren, 34
Mosquitoes, Special Screening against, Dr. H. W. Thomas, 48
Motherwell (Mr.), Halley's Comet, 183
Mountaineering: Peaks and Glaciers of Nun Kun, a Record of Pioneer-exploration and Mountaineering in the Punjab Himalaya, Fanny Bullock Workman and Dr. W. H. Workman, Sir T. H. Holland, K.C.I.E., F.R.S., 78
Mühlmann (M.), a Theory of Death, 117
Muir (Dr. T.), Factorisable Continuants, 262
Mumford (Dr.), Open-air Schools, 320
Münsterberg (Prof. Hugo), Psychotherapy, 458
Muret (E.), les Variations périodiques des Glaciers, 17
Museums: Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History), Prof. J. W. Gregory, F.R.S., 8; Guide to the Crustacea, Arachnida, Onychophora, and Myriopoda Exhibited in the Department of Zoology, British Museum (Natural History), 171; Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History), 266; Guide to Mr. Worthington Smith's Drawings of Field and Cultivated Mushrooms and Poisonous or Worthless Fungi often Mistaken for Mushrooms, Exhibited in the Department of Botany, British Museum (Natural History), 361; Handbook to the Ethnographical Collection, 536; Fossil Vertebrates in the American Museum of Natural History, 12; Illustrated Guide to the Museum of the Royal College of Surgeons, England, Prof. Arthur Keith, 296; Important Accessions to Hull Museum, 314; Report of the Madras Government Museum, 370
Music: a Lisu Jew's Harp, J. Coggin Brown, 422
Musu-Boy (Prof. R.), Lo Zinco, 39
Mycology: Bacteria in their Relation to Plant Pathology, Prof. M. C. Potter, 18; Destructive Action of Fungi and Bacteria, Prof. Potter, 181; Fungous Diseases of Plants, Prof. B. M. Duggar, Prof. E. S. Salmon, 233; Annual Foray of the Mycological Section of the Yorkshire Naturalists' Union, 400; Cause of Serious loss of Gooseberry Bushes in Cambridgeshire, T. F. Brooke and A. W. Bartlett, 402

Nadir Observations, a Modified Method for, R. M. Stewart, 439
Nagelschmidt (Dr. Franz), Thermal Effects Produced by High-frequency Currents, Address at Royal Society of Medicine, 542
Natural History: Early Developmental History of the Canadian Oyster, Dr. J. Stafford, 17; Linnean Society, 29; a Singular Mammal called "Orocoma," Kumagusu Minakata, 40; Pwdre Ser, F. M. Burton, 40; W. B. Grove and B. Millard Griffiths, 73; C. Fitzhugh Talman, 73; Prof. Frank Schlesinger, 105; Geo. H. Pethybridge, 139; Prof. T. McKenny Hughes, F.R.S., 171, 462; Revision of Australian Tortricina, E. Meyrick, F.R.S., 64; New South Wales Linnean Society, 64, 196, 422, 522; the Journal of the East Africa and Uganda Natural History Society, Sir H. H. Johnston, G.C.M.G., K.C.B., 80; Death of Col. Georges Agassiz, 81; the Nature-study Idea, L. H. Bailey, 100; Man and Nature on Tidal Waters, Arthur H. Patterson, 100; Tommy's Adventures in Natureland, Sir Digby Pigott, C.B., 100; Animal Romances, Graham Renshaw, 100; Pelagic Sealing, J. T. Jenkins, 115; Method Employed in American Museum of Natural History for Mounting Skins of Large Mammals, 117; Traffic in Feathers and the Need for Legislation, J. Buckland, 117; Short History of the Academy of Natural Sciences of Philadelphia, 119; the Prince and his Ants (Ciondolino), Luigi Bertelli, 138; the Book of Nature Study, 146; Tillers of the Ground, Dr. Marion I. Newbigin, 168; Threads in the Web of Life, Margaret R. Thomson and Prof. J. Arthur Thomson, 168; Naturwissenschaftliches Unterrichtswerk für höhere Mädchenschulen, Dr. K. Smalian and K. Bermau, 171; Limitations of Species and Races of the Yellow-necked Field-mouse, G. Dalgliesh, 180; National Antarctic Expedition, 1901–4, Natural History, vol. v., Zoology and Botany, 206; Date Gardens of the Jerid, Dr. T. H. Kearney, 247; Natural Features of the Australian Grampians, A. G. Campbell, 271; Centenary of Death of Filippo Cavolini, 313, 500; "Schools" of Caa'ing Whales, *Globicephalus meles*, in the Faroes, 315; the Black Bear, William H. Wright, 327; History of the Discovery of the Chinese Alligator, T. Barbour, 341; die Antike Tierwelt, Otto Keller, 357; Flower Gardens upon Vacant Land, 369; Additional Protected Area for Birds in East Sussex, 371; Cultivation in Dalmatia of the Spineless Variety of Cactus, Dr. C. C. Hosseus, 372; the Habits of Worms, Rev. Hilderic Friend, 397; Hunting Birds with the Camera, W. Bickerton, 402; Revisional Notes on Carabidæ (Coleoptera), T. G. Sloane, 422; Jack's Insects, Edward Selous, 427; the Fur Trade, Prof. T. D. A. Cockerell, 428; Monument to Gregor Mendel, 435; Science in Modern Life, Botany, J. M. F. Drummond, Zoology, Prof. J. R. Ainsworth Davis, Science and the Sea Fisheries, Dr. J. Travis Jenkins, 464; a Bush Calendar, Amy E. Mack, 464; Nature Studies by Night and Day, F. C. Snell, 464; Insect Wonderland, Constance M. Foot, 464; the Landscape Beautiful, F. A. Waugh, 464; Bees for Profit and Pleasure, H. Geary, 464; Grouse and Grouse Moors, Charles Malcolm and Aymer Maxwell, 466; Life and Sport on the Norfolk Broads in the Golden Days, Oliver G. Ready, 466; Fauna of the Kola Fjord, K. Derjugen, 505; Our Search for a Wilderness, Mary Blair Beebe and C. William Beebe, 525; Concealing Coloration in the Animal Kingdom, Gerald H. Thayer, 532
Navigation, History of, Prof. Marguet, 317
Naville (Edouard), the Funeral Papyrus of Ioniya, 237
Nebula M51 (Canum Venaticorum), the Spiral, Madame Dorothea Isaac Roberts, 214
Nebulæ, Photographs of, Dr. Ritchey, 183
Needham (Prof. James G.), General Biology, 137
Negro and Negroid Races, the Anatomy and Relationship of the, Hunterian Lectures at Royal College of Surgeons, Prof. Arthur Keith, 54
Neogi (Panchanan), Preparation of Phenyl-nitro-methane by the Interaction of Mercurous Nitrite and Benzyl Chloride, 292
Neptune, New Ephemerides for Saturn, Uranus, and, Dr. Downing, 472
Neptune's Satellite, Observations of, Prof. Barnard, 472
Neufert (Dr.), Open-air Schools, 320
Neumann (Prof. F. von), Death of, 245
Neurology: Cutaneous Innervation of the Lumbo-sacral Region in the Dog, Dr. Ferruccio Rossi, 315; Death of Prof. Fulgence Raymond, 435
New South Wales Linnean Society, 64, 196, 422, 522
Newall (Prof.), the Cambridge Observatory, 472
Newbigin (Dr. Marion I.), Tillers of the Ground, 168
Newcomb (Prof. Simon), Popular Astronomy, 171
Newstead (R.), Ticks and other Blood-sucking Arthropoda of Jamaica, 83
Nicholson (Dr. J. W.), Initial Motion of Electrified Spheres, 514
Nicol (J.), X-Ray Spectra, 139

Nicolle (Charles), Properties of the Serum of Convalescents and Animals Cured of Exanthematic Typhus, 456
Niedere Pflanzen, Dr. R. Timm, 326
Nijland (Prof.), the Maximum of Mira in 1909, 273
Nikaido (Y.), Beet Sugar Making and its Chemical Control, 424
Niles (Prof. William H.), Death of, 370, 468
Nomenclature of Radio-activity, the, Norman R. Campbell, 203
Nordenskjöld (Dr. O.), die Polarwelt und ihre Nachbarländer, 236; Glacial Erosion, 442
Nordmann (M.), Halley's Comet, 19
Norfolk Broads, Life and Sport on the, in the Golden Days, Oliver G. Ready, 466
Norwegian and Other Fish Tales, Bradnock Hall, 69
Nottinghamshire, Dr. H. H. Swinnerton, 527
Nowikoff (Dr. M.), Structure, Development, and Significance of the Parietal Eye of Saurians, 469
Nubia, the Archæological Survey of, Prof. G. Elliot Smith and Dr. D. E. Derry, 406

Observatories: Harvard College Observatory, Prof. E. C. Pickering, 86; Reports of Meteorological Observatories, 123; the United States Naval Observatory, 152; Mars in 1909 as Seen at the Lowell Observatory, Prof. Percival Lowell, 172; the Paris Observatory, M. Baillaud, 272; the Solar Physics Observatory, South Kensington, 404; Transactions of the Astronomical Observatory of Yale University, Parallax Investigations on Thirty-five Selected Stars by Frederick L. Chase, Mason F. Smith, and William L. Elkin, 433; Liste des Observatoires Magnétiques et des Observatoires Séismologiques, E. Merlin and O. Somville, 460; the Cambridge Observatory, Sir Robert Ball, 472; Prof. Newall, 472; Bremen "Meteorological Year-book," 1909, 546; Liverpool Observatory (1909), 546; Royal Albert Observatory, Mauritius (1909), 546; Transvaal Meteorological Department (1908–9), 546; Deutsche überseeische meteorologische Beobachtungen, 546
Oceanography: Report of the Danish Oceanographic Expedition, 116; Deep-sea Observations in the North Atlantic made by the *Michael Sars* Expedition, 149; Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Oceanographie—les Glaces—Glace de Mer et Banquises, H. Arctowski, 205
Occultation, an Interesting, Arthur Burnet, 73
Odontology: Our Teeth, R. Denison Pedley and Frank Harrison, 237
Okada (Dr. T.), Application of the Method of Correlation to Investigations of the Connection between Meteorological Elements at Different Places, 470
Oldham (C.), the Mammals and Birds of Cheshire, 175; the Reptiles and Amphibians of Cheshire, 175
Oliver (R. B.), Flora and Plant Formations of the Kermadec, 543
Olivier (Dr. Louis), Death of, 245; Obituary Notice of, 269
Onnes (H. Kamerlingh), Rectilinear Diameter of Oxygen, 131, 262
Ooze and Irrigation, Rev. Hilderic Friend, 39, 70; A. R. Horwood, 40
Ophthalmology: Experimental Ocular Action of the Dust on Tarred Roads, H. Truc and C. Fleig, 456
Optics: Relation of Light-perception to Colour Perception, Dr. F. W. Edridge-Green, 62; Instruments optiques d'Observation et de Mesure, Jules Raibaud, 68; the Pressure of Light against the Source, the Recoil from Light, Bakerian Lecture at Royal Society, Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, 139; Curious Visual Phenomenon Resulting from Stimulation of the Macular Region of the Retina, Dr. J. C. Hubbard, 148; Colour Vision at the Ends of the Spectrum, Rt. Hon. Lord Rayleigh, O.M., F.R.S., 204; Tests for Colour Vision, 208; Commander D. Wilson-Barker, 363; Colour-blindness and Colour-perception, Dr. F. W. Edridge-Green, 263; Colour-vision, R. M. Deeley, 267; Tests for Colour-blindness Dr. F. W. Edridge-Green, 495; the Reviewer, 495; Sight Tests in the Mercantile Marine, 537; Influence of Uniformity and Contrast on the Amount of Light Required, H. Bohle, 422; the Thomas Young Oration at the Optical Society, Prof. R. W. Wood, 443
Orangia, Geological and Archæological Notes on, J. P. Johnson, 465
Orationes et Epistolæ Cantabrigienses (1876–1909), Dr. John Edwin Sandys, Dr. R. Y. Tyrrell, 35
Orchid, a New Italian, W. Herbert Cox, 104
Ore Deposits, the Geology of, H. H. Thomas and D. A. MacAlister, 293
Ore Deposits of South Africa, the, J. P. Johnson, 293
Ore Deposits, Structure and Distribution of, 198
Ornithology: the Fifth International Congress of Ornithologists, 53; Polyglot List of Birds in Turki, Manchu, and Chinese, Dr. E. D. Ross, 186; Playing-grounds and Nests of the Yellow-spotted Bower-bird (*Chlamydodera guttala*), F. L. Whitlock, 186; a History of the Birds of Kent, Norman F. Ticehurst, 241; an Undescribed Feather Element, Fredk. J. Stubbs, 329; W. P. Pycraft, 436; Prof. R. V. Lendenfeld, 436; Death of William Earl Dodge Scott, 340; a History of Birds, W. P. Pycraft, 367; Bird Notes, 378; Nature and Meaning of the Colours of Birds, Dr. H. Gadow, 378; Feeding Habits of the Razor-bill, W. Frohawk, 378; Instinct and Intelligence in Birds, Prof. F. H. Herrick, 378; Catalogo Sistematico y Descriptivo de las Aves de la Republica Argentina, Roberto Dabbene, 427; Report of Migration Committee for 1908–9, 469; Nomenclature of Some British Birds, Dr. Hartert, 504
"Orocoma," a Singular Mammal called, Kumagusu Minokata, 40
Orthoptera of Western Europe, a Synopsis of the, Dr. Malcolm Burr, 39
Ortmann (Dr. A. E.), on a Theory that a Connection between Africa and South America Persisted into the Tertiary, 89
Orton (Dr. H.), Röntgen-ray Diagnosis, 153
Osaka (Y.), Solubility of Ether in Water, 248
Oscroft (P. W.), a Manual of Elementary Practical Chemistry for Use in the Laboratory, 266
Oswald (Dr. Felix), Trans-Himalaya, 180; Tectonic Development of the Armenian Highlands, 437
Ouachita Valley, Antiquities of the, Clarence B. Moore, Dr. A. C. Haddon, F.R.S., 129
Oxford University, the Reform of, 331
Oxley (A. E.), Apparatus for a Production of Circularly Polarised Light, 515

Packer (Dr. E.), the Perseid Meteoric Shower, 248
Page (L. W.), Systems of Road Administration, 162
Paget (Cecil W.), Running-shed Practice, 155
Pahlen (Herr v. d.), Halley's Comet, 86
Painlevé (Prof. Paul), l'Aviation, 229
Paint, Luminous, R. G. Durrant, 530
Painting, Greek and Roman Methods of, Some Comments on the Statements Made by Pliny and Vitruvius about Wall and Panel Painting, Dr. A. P. Laurie, 265
Palæobotany: Plant-remains from the Cretaceous of Mesa Verde, Prof. T. D. A. Cockerell, 89; Studies on the Structure and Affinities of Cretaceous Plants, Dr. Marie C. Stopes and Prof. K. Fujii, 129; Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9 sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Quelques Plantes Fossiles des Magellaniques, Prof. A. Gilkinet, 205; Plant Remains in the Scottish Peat Mosses, Francis J. Lewis, 227; Remains of a Triassic Forest in Arizona, Dr. E. C. Jeffrey, 247; Fossil Remains of a Conifer, Dr. E. C. Jeffrey, 247; Some Recent Studies of Fossil Plants, 473; Fossil Plants, a Text-book for Students of Botany and Geology, Prof. A. C. Seward, F.R.S., 490; the Relation of Palæobotany to Plant-phylogeny, Prof. Penhallow, 505; Ancient Plants, being a Simple Account of the Past Vegetation of the Earth and of the Recent Important Discoveries made in this Realm of Nature Study, Dr. Marie C. Stopes, 523; an Irish Pteridosperm, Prof. T. Johnson, 531
Palæontographical Society, 101
Palæontology: Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History), Prof. J. W. Gregory, F.R.S., 8; Fossil Vertebrates

in the American Museum of Natural History, 12; Alimentary Canal of a Branchiosaurian Salamandar from the Carboniferous Shales of Mazon Creek, Dr. R. L. Moodie, 17; Remains of the Gigantic Extinct Australian Marsupial Diprotodon, 49; New Model of the Skull and Mandible of the Gigantic Extinct Lemur, *Megaladapis insignis*, from Madagascar, 49; Skeletons of Plesiosaurians from the Upper Lias of Holzmaden, Dr. E. Fraas, 82; Evolution of the Horned Dinosaurs, R. S. Lull, 89; Complete Skeleton of a New Species of the Camel-like Genus Stenomylus from the Harrison Beds of Nebraska, F. Loomis, 89; Relationship of the South African Fossil Reptiles to those Found in other Parts of the World, Dr. Broom, 158; Indian Palæontology, 159; Marine Lower Triassic Formations of the Himalayas, Prof. C. Diener, 159; Fauna of the Traumatocrinus Limestone of Painkhanda, Prof. C. Diener, 159; Devonian Faunas of the Northern Shan States, F. R. Cowper Reed, 159; Relation of Embryology and Vertebrate Palæontology, Prof. R. S. Lull, 211; Local Races of the Musk-ox, Dr. K. Wanderer, 211; Existence in Belgian Caverns of Layers containing Remains of Arctic Rodents, A. Rutot, 315; Cambrian Fossils from the Bhabeh Rocks of Spiti, F. R. C. Reed, 342; Eyes of Trilobites, Prof. C. D. Walcott, 371; Silurian Fossils of the South Yarra District, F. Chapman, 401; Human Skulls and Skeletons and Supposed Evidence of Human Work, Dr. F. Ameghino, 402; Cetacean Remains from the Superficial Deposits of Canada, G. H. Perkins, 371; Relationship of Permian Reptiles of North America to those of South, Dr. R. Broom, 402; Extinct Monsters and Creatures of Other Days, Rev. H. N. Hutchinson, 459; Discovery of a Skeleton of Diprotodon in the Smithton District, H. H. Scott, 469; Discovery of Worked Flints beneath Undisturbed Deposits of Crag in the Neighbourhood of Ipswich, J. Reid Moir, 503; Description of a Fossil Chiton (Mollusca) from North-west Tasmania, A. F. Basset Hull, 522; New Genera and Species of Mammals from the Indian Siwaliks, G. E. Pilgrim, 542

Palazzo (Prof. L.), Magnetic Survey of Sardinia, 437

Pansies, Violas, and Violets, 326

Parallelism, Theories of, an Historical Critique, W. B. Frankland, 169

Parasitischen Samenpflanzen, die Aufzucht und Kultur der, Prof. E. Heinricher, 327

Parasitology: Development of *Trypanosoma lewisi* in the Rat-flea (*Ceratophyllus fasciatus*), Dr. N. H. Swellengrebel and C. Strickland, 63; Nova tripanosomiaze humana, C. Chagas, Prof. E. A. Minchin, 142; Life-history of *Trypanosoma lewisi* in the Rat-louse, *Haematopinus spinulosus*, A. Brienl and E. Hindle, 150; a Handbook of Practical Parasitology, Prof. Max Braun and Dr. M. Lühe, 393; Trypanosome Found in the Blood of a Patient in Sumatra, 504

Paris: Paris Academy of Sciences, 63, 98, 131, 163, 196, 228, 261, 292, 324, 356, 390, 421, 456, 488, 555; the Paris Observatory, M. Baillaud, 272; the Third International Congress of School Hygiene at Paris, August 2–7, 1910, 320; the International Cancer Conference at, 545

Parker (W. B.), Life-history and the Means of Controlling the Hop Flea-beetle, 117

Parry (Leonard), Fire Tests with Textiles, 429

Paterno (Prof.), Recent Work on Colloidal Solutions, 471

Pathology: Death of Prof. von Recklinghausen, 339

Patten (Prof. C. J.), Semination in the Sanderling, 550

Patterson (Arthur H.), Man and Nature on Tidal Waters, 100

Pearson (Dr. H. H. W.), Botanical Expedition through Western Districts of Cape Colony, 160

Pearson (Prof. Karl), Nature and Nurture, 149

Pearson (R. Hooper), Pansies, Violas, and Violets, 326

Peddie (Prof. W.), Continuous and Stable Isothermal Change of State, 30

Peddle (C. J.), Molecular Association in Water, 519

Pedley (R. Denison), Our Teeth, 237

Pedroso (Prof.), Death of, 313

Peile (Dr. John), Death and Obituary Notice of, 467; a Correction, the Writer of the Article, 496

Pelabon (H.), Batteries with Antimony and Antimony Selinides, 555

Pelikan (A.), Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Geologie—Petrographische Untersuchung der Gesteinproben, 205

Pellagra, Recent Investigations on, Dr. Louis Sambon, 538

Pelseneer (Prof.), Occurrence of Hermaphroditism in Lamellibranchs, 319

Penck (Prof.), Glacial Erosion, 441, 442

Penhallow (Prof.), the Relation of Palæobotany to Plant-phylogeny, 505

Perfilograph, the, Augustus Mercau, 434

Pericle (Dr. G.), Velocità e Direzione delle Corrente Aeree alle diverse Altitudini Determinate a Mezzo dei Palloni-Sonde e Pilote, 249

Péringuey (Dr. L.), Notes on some Bushmen, 98; Recent Finds Made in Rock Shelters once Occupied by Strand Loopers, 262

Perkin (Dr. F. Mollwo), the British Section of the Brussels Exhibition, 398; Action of Metals upon Alcohols, 520

Perkins (G. H.), Cetacean Remains from the Superficial Deposits of Canada, 371

Perot (A.), Displacement of Spectral Lines at the Sun's Limb, 86

Perrine (Prof. C. D.), Further Observations of Halley's Comet, 374; the International Scientific Congress at Buenos Aires, 509

Perry (S. J.), Mortality of the Tuberculous in Relation to Sanatorium Treatment, 371

ϕ Persei, Spectrum and Radial Velocity of, Dr. Ludendorff, 507

Perseid Meteoric Shower, 1910, W. F. Denning, 204, 248; C. L. Brook, 248; W. H. Steavenson, 248; Miss Warner, 248; Dr. E. Packer, 248; W. Johnson, 248; E. F. Sawyer, 420

Perseids, Observations of, in 1909, S. Beljawsky, 184

Peru, the Mineral Survey of, 217

Petch (Mr.), Root Disease of the Cocoa-nut Palm caused by the Fungus *Fomes lucidus*, 212

Peters (W. J.), Magnetic Results of the First Cruise of the *Carnegie*, 119; Tables of Corrections to the British Admiralty, the German Admiralty, and the United States Hydrographic Department Magnetic Charts of the North Atlantic, 544

Pethybridge (Geo. H.), Pwdre Ser, 139

Petit (R.), How to Build an Aëroplane, 229

Petri (E.), Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19, 9

Petrie (Prof. Flinders), Discovery in the Neighbourhood of the Pyramid of Sneferu (B.C. 4600) of a Stone Tomb Dating from a Time before the Construction of the Pyramid, 401; Early Burial Customs in Egypt, 494

Petrology: Recent Papers on Petrology, 375; Measurement of Extinction Angles in Thin Section, F. E. Wright, 375; Synthetic Study of Diopside and its Relations to Calcium and Magnesium Metasilicates, Messrs. Allen, White, Wright, and Larsen, 375; New Views on Quartz, Messrs. Wright and Larsen, 375; Quartz in Druses from the Government of Olonetz, M. Borisov, 375; Binary Systems of Alumina with Silica, Lime, and Magnesia, Messrs. Shepherd, Rankin, and Wright, 375; Molecule Corresponding to Soda-anorthite in a Felspar from Linosa, Messrs. Washington and Wright, 375; Hydrogelen im Mineralreiche, F. Cornu, 375; Galactite, a Mixture of Natrolite and Scolezite, G. Césaro, 376; Average Chemical Compositions of Igneous-rock Types, R. A. Daly, 376; Averages of Analyses of Stony Meteorites, G. P. Merrill, 376; the Gases in Rocks, R. T. Chamberlin, 376; Origin of Augite-andesite, R. A. Daly, 376; Distribution, Origin, and Relationships of Alkaline Rocks, Dr. H. I. Jenson, 376; Occurrence of a Basalt in the Volcanic Cone of Tritriva in Central Madagascar, A. Boudariat and Dr. Johnston-Lavis, 376; Ordovician Rhyolites of Nant Ffrancon, Carnarvonshire, C. B. Travis, 376; the "Kalksilekatfelse" near Mährisch-Schönberg in the Sudetic, F. Kretschmer, 377; Eruptive Rocks of the Bohemian Eisengebirge, Dr. Hinterlechner and C. von John, 377; Analyse der Silikat- und Karbonatgesteine, W. F. Hillebrand, 425; the Analysis of Silicate and Carbonate Rocks, W. F. Hillebrand, 425

Petsch (Prof. Dr. Robert), Lessings Briefwechsel mit Mendelssohn und Nicolai über das Trauerspiel, 294
Pettit (A.), Forms of Endogenous Multiplication of *Haemogregarina sebai*, 131; an Epidemic Disease in Trout, 228
Pflanzengarten, der, seine Anlage und seine Verwerkung, Prof. F. Pfuhl, 326
Pfuhl (Prof. F.), der Pflanzengarten, seine Anlage und seine Verwerkung, 326
Pharmacy: the British Pharmaceutical Conference, 156; Pharmaceutical Research, F. Ransom, 156; Standardisation of Disinfectants, Prof. Sims Woodhead and Dr. C. Ponder, 156; Prof. R. T. Hewlett, 156; the Rideal-Walker Test, C. T. Kingzett and R. C. Woodcock, 156; Modification of Mendeléeff's Classification of the Elements, J. F. Tocher, 156; Water Analysis, J. E. Purvis, 156; International Congress of Pharmacy, 354; Analytical Methods, 354; Sale of Proprietary Disinfectants, 354; Biochemical Method of Examination of Vegetable Glucosides Hydrolysed by Emulsion, Prof. Bourquelot, 354; Chemical Method of Obtaining the True Glucoside Arbutin, Prof. Herissey, 355; Establishment of the Constitution of the Aloins, Mr. Leger, 355,
Philippi (E.), die Grundproben der Deutschen Südpolar Expedition, 1901–3, 167
Phillips (Charles E. S.), Electrical and other Properties of Sand, Discourse at Royal Institution, 255
Philology: the New School of Japan, Founded for the Purpose of Making the Use of the Newly Invented Letters, F. Victor Dickins, 7; Death and Obituary Notice of Dr. John Peile, 467; a Correction, the Writer of the Article, 496
Philosophies, Prof. Ronald Ross, F.R.S., C.B., 493
Philosophy: Gustav Freytags Kultur- und Geschichtspsychologie, Dr. Georg Schridde, 294; Lessings Briefwechsel mit Mendelssohn und Nicolai über das Trauerspiel, Prof. Dr. Robert Petsch, 294; Hegels Ästhetik im Verhältnis zu Schiller, A. Lewkowitz, 294; Über Christian Wolff's Ontologie, Hans Pichler, 294; Zwei Vorträge zur Naturphilosophie, Hans Driesch, 294; an Inconsistent Preliminary Objection against Positivism, Prof. Robert Ardigo, 461
Photography: Marine Biological Photography, Francis Ward, 10; Photographs of Auroræ, Carl Störmer, 86; the Ultra-rapid Kinematograph, Prof. C. V. Boys, F.R.S., 112; the Accurate Measurement of Photographs, Prof. E. C. Pickering, 184; the Fifth International Congress of Photography, 215; Photo-surveying in Canada, E. Deville, 215; on the Photographic Emulsion, Prof. Wilder D. Bancroft, 215; Theory of Development, J. Desalme, 215; Measuring the True Opacity or Obstructive Power of Photographic Plates, F. F. Renwick, 215; How to take Photographs with Infra-red and Ultra-violet Lights, Prof. R. W. Wood, 215; Various Gelatine-hardening Agents, A. and L. Lumière and A. Seyewetz, 216; the Telegraphy of Photographs, Wireless and by Wire, T. Thorne Baker, 220; the Telegraphic Transmission of Photographs, T. Thorne Baker, 460; the Royal Photographic Society's Exhibition, 273; Photomicrographs of Botanical Studies, 296; the Photographic Annual, 1910–1, 296; Chemistry for Photographers, Chas. F. Townsend, 327
Physics: Variation of Young's Modulus under an Electric Current, Dr. H. Walker, 30; Continuous and Stable Isothermal Change of State, Prof. W. Peddie, 30; Death of Prof. T. H. Core, 47; Evaporation from a Solid Sphere, H. W. Morse, 51; Gas-calculator Designed by Dr. R. C. Farmer, 51; Determination of the Ratio of Mass to Weight, L. Southerns, 62; Appearance of Certain Dielectric Anomalies by Changing the State of the Insulating Medium, Louis Malclès, 64; Exclusive Presence in the Gases Evolved from some Hydrogenated Flames of Ions altogether Analogous to those Produced by Rontgen Rays, Maurice de Broglie, 64; Traité de Physique, O. D. Chwolson, 65; Instruments optiques d'Observation et de Mesure, Jules Raibaud, 68; Elemental Weight Accurately a Function of the Volution of Best Space-symmetry Ratios, H. Newman Howard, 71, 239; Determination of Vertical Motion of Air, during Balloon Ascents, 84; Novel Technical Thermometer, Messrs. Townson and Mercer, 84; Colour of the Sea, J. Y. Buchanan, F.R.S., 87; Static Method for Determining the Vapour Pressures of Solids and Liquids, and the Vapour Pressures of Mercury, Prof. Alex. Smith and A. W. C. Menzies, 97; the Ascent of Sap, Leclerc Du Sablon, 98; Sap-rising Forces in Living Wood, E. Reinders, 181; Light and Sound, W. S. Franklin and Barry Macnutt, E. Edser, 103; Coefficients of Compressibility and of Dilation with Temperature of Certain Pure Metals and Alloys, Prof. S. Lussana, 118; the Pressure of Light against the Source, the Recoil from Light, Bakerian Lecture at Royal Society, Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, 139; Wonders of Physical Science, E. E. Fournier, 168; Aqueous Solutions of Ferrous Ammonium Sulphate Form a Good Filter for Stopping Heat Rays, R. A. Houstoun and J. Logie, 182; Ultra-microscopic Method of Measuring the Electric Charges Carried by Small Particles, Dr. F. Ohrenhaft, 182; Physical Society, 195; the Convection of Heat from a Body Cooled by a Stream of Fluid, Dr. A. Russell, 195; Hysteresis Loops and Lissajous's Figures, and on the Energy Wasted in a Hysteresis Loop, Prof. S. P. Thompson, 195; Cryoscopic Determination of the Osmotic Pressures in some Plant Organs, W. R. G. Atkins, 211; Duddell Oscillographs, 212; Vibration of a Tuning Fork, Gabriel Sizes and G. Massol, 228; the Temperature Coefficients of the Ferromagnetic Metals, Dr. J. R. Ashworth, 238; the Daily Movement of the Top of the Eiffel Tower, R. Bourgeois, 261; Diurnal Variation of Level at Kimberley, Dr. J. R. Sutton, 262; Electric and Magnetic Double Refraction, P. Langevin, 262; Effect of the Electric Discharge on Water Vapour, E. Jacot, 262; Temperature of "Invar" Wire, B. F. E. Keeling, 272; the Law of Variation of the Coefficient of Specific Magnetisation of the Elements of Heating, Kotaro Honda, 324; Spectrograph with a Prism having Spherical Faces so Designed that the Image of the Slit is in Focus on the Photographic Plate, M. C. Féry, 343; New Form of Calorimeter, 343; the Law of Definite Proportions, C. E., 364; Comparison of the Different Methods of Measuring the Dielectric Constant, Paul Floquet, 390; Thermal Expansion of Metals, Dr. E. Grüneisen, 403; Very Viscid Fluid to make Dumb-bell by the Union of the Drops of Two Bubbles, C. G. Thorp, 436; Prof. C. V. Boys, 436; Measurements of the Exact Volume of the Kilogram of Water, M. Darboux, 456; Geschichtstafeln der Physik, Prof. Felix Auerbach, 457; Death of Maurice Lévy, 468; Obituary Notice of, 502; Absolute Manometer for the Measurement of Gas Pressures not Greater than a Few Thousandths of a Millimetre of Mercury, Dr. M. Knudsen, 471; Constitution of Matter, Prof. Jean Becquerel, 506; Method for Preventing the Tarnishing of Silver-on-glass Parabolic Mirrors, T. Thorp, 521; Velocity of Negative Ions in Hydrogen at Atmospheric Pressure, A. M. Tyndall, 531; Law of Resistance to Crushing of Cylindrical Bodies as a Function of their Dimensions, F. Robin, 555; Application of the Principle of Archimides to the Exact Determination of Gaseous Densities, A. Jacquerod and M. Turpaïan, 556; *see also* British Association
Physiographical Introduction to Geography, a, Prof. A. J. Herbertson, 426
Physiology: Structure, Development, and Morphological Interpretation of the Pineal organs and adjacent parts of the Brain in the Tuatara Sphenadon punctatus), Prof. A. Dendy, 61; Comparative Toxicity of Theobromine and Caffeine as Measured by their Direct Effects upon the Contractility of Isolated Muscle, V. H. Veley and Prof. A. D. Waller, 62; Development of the Germ Cells in the Mammalian Ovary, Dr. A. Louise M'Ilroy, 97; Handbuch der vergleichenden Physiologie, 102; Die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere, Prof. A. A. W. Hubrecht, 134; the Relative Size of the Heart in different Groups of Animals, Miss F. Buchanan, 148; Colour Vision at the Ends of the Spectrum, Rt. Hon. Lord Rayleigh, O.M., F.R.S., 204; Tests for Colour Vision, 208; Commander D. Wilson-Barker, 363; Colour-Blindness and Colour-Perception, Dr. F. W. Edridge-Green, 263; Colour-vision, R. M. Deeley, 267; Tests for Colour-Blindness, Dr. F. W. Edridge-Green, 495; the Reviewer, 495; Sight Tests in the Mercantile Marine, 537; Death and Obituary Notice

of William James, 268; Death of Dr. Robert Amory, 340; Physiologische Studien im Hochgebirge: Versuche über den repiratorischen Stoffwechsel im Hochgebirge, R. F. Fuchs and T. Deimler, Leonard Hill, F.R.S., 369; Observations on Animal Calorimetry made on Mt. Blanc, H. Guillemard and G. Regnier, 456; Death of Dr. F. W. D. Fraser, 468; Death of Dr. Sydney Ringer, F.R.S., 502; Obituary Notice of, 540; Plant Physiology, Anatomy, and Morphology of the Leaves and Inflorescences of Welwitschia mirabilis, M. G. Sykes, 62; *see also* British Association.
Picard (Prof. Emile), "Savants du Jour," Ernest Lebon, 119
Pichler (Hans), Über Christian Wolff's Ontologie, 294
Pickering (Prof. E. C.), Harvard College Observatory, 86; the Accurate Measurement of Photographs, 184
Pickering (Prof.), Metcalf's Comet, 1910*b*, 344
Pickford (A. G.), Elementary Projective Geometry, 136
Piery (M.), Special Susceptibility of Children of Tuberculous Parents, 508
Pigott (Sir Digby, C.B.), Tommy's Adventures in Natureland, 100
Pilgrim (G. E.), New Genera and Species of Mammals from the Indian Siwaliks, 542
Pinsent (Mrs.), Heredity at the Church Congress, 431
Pisa, the Leaning Tower of, Prof. A. Batelli, 146; Edward G. Brown, 297; Arthur T. Bolton, 297
Piutti (Prof. A.), Absorption of Helium in Salts and Minerals, 543
Planetology: the Evolution of Worlds, Prof. Percival Lowell, William E. Rolston, 99
Planets: New Canals and Lakes on Mars, M. Jonckheere, 20; Subjective Phenomena on Mars, M. Antoniadi, 120; Mars in 1909 as seen at the Lowell Observatory, Prof. Percival Lowell, 172; Water Vapour on Mars, Prof. Campbell, 317; Prof. Frank W. Very, 495; a Suggested Volcanic Origin of Martian Features, Dr. Wilhelm Krebs, 344; Observations of Mercury, G. and J. Fournier, 213; M. Jarry-Desloges, 213; Occultations of η Gemini by the Planet Venus, MM. Baldet, Quénisset, and Antoniadi, 196; the Recent Occultation of η Geminorum by Venus, MM. Baldet, Quénisset, and Antoniadi, 317; a Suspected New Planet, Prof. J. Comas Sola, 344; an Oblique Belt of Jupiter, Scriven Bolton, 362; Observations of Neptune's Satellite, Prof. Barnard, 472; New Ephemerides for Saturn, Uranus, and Neptune, Dr. Downing, 472; a Bright Projection on Saturn, M. Maggini, 507
Plant Cell, the, its Modifications and Vital Processes, H. A. Haig, 36
Plant Physiology: Anatomy and Morphology of the Leaves and Inflorescences of *Welwitschia mirabilis*, M. G. Sykes, 62
Planta (F. S.), Filipino Racial Types at Taytay, 340
Plants, Ancient, being a Simple Account of the Past Vegetation of the Earth and the Recent Important Discoveries made in this Realm of Nature-Study, Dr. Marie C. Stopes, 523
Plants, Fungous Diseases of, Prof. B. M. Duggar, Prof. E. S. Salmon, 233
Platt (Arthur), Erasmus Darwin on Flying Machines, 397
Pocklington (Dr. H. C., F.R.S.), Fermat's Theorem, 531
Pocock (R. I.), the Origin of the "Blotched" Domestic Tabby Cat, 298; an Interesting Donkey Hybrid, 329
Pocock (W. J.), Collection of Human Bones Found on the Site of an Augustinian Friary near the Corn Market, Cambridge, 16
Podmore (Frank), the Newer Spiritualism, 489
Polarwelt, die, und ihre Nachbarländer, O. Nordenskjöld, 236
Political Economy: Death of Prof. F. von Neumann, 245
Pomeroy (L. R.), Electrification of Trunk Lines, 155
Ponder (Dr. C.), Standardisation of Disinfectants, 156
Poole (Margaret), Development of *Aphysia punctata*, 504
Pope (Prof. William J., F.R.S.), the Chemical Significance of Crystal Structure, Lecture at Royal Institution, 187
Porter (Prof. Alfred W.), Electrical Discharge Figures, 72
Positivism, an Inconsistent Preliminary Objection against, Prof. Robert Ardigo, 461
Potter (Prof.), Destructive Action of Fungi and Bacteria, 181
Potter (Prof. M. C.), Bacteria in their Relation to Plant Pathology, 18
Potter (W. B.), Development of Apparatus for Higher Voltage Direct-current, 155
Pougnet (M.), Action of the Ultra-violet Rays upon Plants containing Coumarin, and Some Plants the Smell of which is Due to the Hydrolysis of Glucosides, 421
Poultry: How to Keep Hens for Profit, C. S. Valentine, 138; Inheritance of Characteristics in Domestic Fowl, C. B. Davenport, 253
Pound (V. E.), Results of Experiments on the Secondary Radiation from Carbon at Low Temperatures when Bombarded by the α-Rays from Polonium, 516
Poynting (Prof. J. H., F.R.S.), the Pressure of Light against the Source, the Recoil from Light, Bakerian Lecture at Royal Society, 139
Precession and the Solar Motion, Prof. Boss, 249
Prehistoric Man, Joseph McCabe, 39
Prehistoric Rhodesia, Richard N. Hall, 32
Presenti (Cesare), Il Cemento Armato e la sua applicazione practica, 358
Price (Dr. T. Slater), Nature of Intermetallic Compounds, 83
Priestley (Mr.), Effect of Overhead Electrical Discharges on Plant Growth, 219
Primrose (H. S.), Metallography as an Aid to the Brass Founder, 421
Pring (Mr.), Examination of the Atmosphere at Various Altitudes for Oxides of Nitrogen and Ozone, 119
Proceedings of the Imperial Malaria Conference held at Simla in October, 1909, 240
Prominences, Two Remarkable, Dr. F. Slocum, 544
Protozoology: *Anaplasma marginale*, a New Genus and Species of the Protozoa, Dr. A. Theiler, 132; Development of *Piroplasma parvum* (Protozoa) in the Various Organs of Cattle, Dr. R. Gonder, 132
Psychiatry: a Text-book of Mental Diseases, Prof. Eugenio Tanzi, 458
Psychism, M. Hume, 103
Psychology: Spirit and Matter before the Bar of Modern Science, Dr. Isaac W. Heysinger, 36; Ueber den Willensakt und das Temperament, Prof. Narziss Ach, 199; Death and Obituary Notice of William James, 268; Do Kittens Kill Mice Instinctively? R. M. Yerkes and D. Bloomfield, 436; the Newer Spiritualism, Frank Podmore, Sir Oliver Lodge, F.R.S., 489
Psychotherapy, Prof. Hugo Münsterberg, 458
Pteridosperm, an Irish, Prof. T. Johnson, 531
Puisseux (M.), the Genesis of Various Lunar Features, 120
Punic Lamp, Nature of the Wick of, Eugène Collin, 132
Purvis (J. E.), Water Analysis, 156
Pütter (Prof. August), die Ernährung der Wassertiere und der Stoffhaushalt der Gewasser, 5
Pwdre Ser, F. M. Burton, 40; W. B. Grove and B. Millard Griffiths, 73; C. Fitzhugh Talman, 73; Prof. Frank Schlesinger, 105; Geo. H. Pethybridge, 139; Prof. T. McKenny Hughes, F.R.S., 174, 462
Pycnogons, Antarctic, Dr. W. T. Calman, 104
Pycraft (W. P.), a History of Birds, 367; an Undescribed Feather-Element, 436

Quelch (J. J.), the Giant Moth-borer, 17
Quénisset (F.), Occultation of η Gemini by the Planet Venus, 196; the Recent Occultation of η Geminorum by Venus, 317; Metcalf's Comet, 507

Radiation and Absorption, Prof. Humphreys, 52
Radiography: Death of Harry W. Cox, 47; Scattering of Homogeneous β-rays, and the Number of Electrons in the Atom, J. A. Crowther, 61; Atomic Weight of the Radium Emanation, A. Debierne, 63; Density of the Radium Emanation, Sir William Ramsay and Robert Whytlaw Gray, 98; Radium Treatment, Drs. Dominici and Wickham, 153; Change of Colour of Sapphires and other Precious Stones by the Action of Radium, Mr. Ambrecht, 179; the Ratio between Uranium and Radium in Minerals, Alex. S. Russell, 238; the Energy of the Radium Rays, William Duane, 262; Isolation of Pure Radium, Madame Curie and M. Debierne, 313; Metallic

Radium, Madame P. Curie and A. Debierne, 356; the β-rays of Radium at its Minimum Activity, Léon Kolowrat, 356; an Attempt to Determine the Supposed Change in Weight Accompanying the Radio-active Disintegration of Radium, Dr. Bertram D. Steele, 428; Radium Standards and Nomenclature, Prof. E. Rutherford, F.R.S., 430; Isolation of Metallic Radium, Mme. Curie, 478; X-ray Spectra, Prof. C. G. Barkla and J. Nicol, 139; Röntgen-ray Diagnosis, Dr. H. Orton and Dr. A. C. Jordan, 153; Use of X-ray in the Diagnosis of Pulmonary Tuberculosis, Dr. C. L. Minor, 436; Absorption and Adsorption with Reference to the Radio-active Emanations, Dr. R. W. Boyle, 152; Radiology and Medical Electricity, Sir J. J. Thomson, F.R.S., 153; the Radio-balance, Prof. H. L. Callender, 195; the Nomenclature of Radio-activity, Norman R. Campbell, 203; Properties of the α-particles Sent Out by Radio-active Substances, Dr. H. Geiger, 213; Radio-active Projections, Louis Wertenstein, 261–2; Tables of Constants of Ionisation and of Radio-activity, Prof. T. H. Laby, 316; Arrangement for Registering Photographically the Number of α-particles Emitted by a Radio-active Substance, W. Duane, 316; Nature of the γ-rays, Prof. Bragg, 478; Homogeneous Radiation, Prof. Barkla, 478; Magnetic Deflection of β-rays, Dr. Hahn, 478

Radiology and Electricity, the International Congress of, 478

Radium: the Ratio between Uranium and Radium in Minerals, Alex. S. Russell, 238; Frederick Soddy, F.R.S., 296; Radium Standards and Nomenclature, Prof. E. Rutherford, F.R.S., 436; *see also* Radiography

Rádl (Dr. Em.), Geschichte der Biologischen Theorem, 263

Raibaud (Jules), Instruments optiques d'Observation et de Mesure, 68

Rainfall, British, 1909, Dr. Hugh Robert Mill, 523

Rainfall of Rhodesia and Australia, 187

Ramsay (Sir William, K.C.B., F.R.S.), Density of the Radium Emanation, 98; Development of the Leblanc Process for the Manufacture of Soda, 213; Molecular Weight of Radium Emanation, 517

Ranc (Albert), Action of the Ultra-violet Rays upon Certain Carbohydrates, 164

Rangachari (K.), the Castes and Tribes of Southern India, 365

Rankin (Mr.), Binary Systems of Alumina with Silica, Lime, and Magnesia, 375

Ransom (F.), Pharmaceutical Research, 156

Ransome (F. L.), the Geology and Ore Deposits of Goldfield, Nevada, 76; Ore Deposits of the Cœur d'Alène District, Idaho, 122

Rassam (Hormuzd), Death of, 400

Raw (Dr. Nathan), Analysis of 232 Fatal Cases of Tuberculosis, 508

Rawson (C.), a Manual of Dyeing, 295

Ray (Prof. Praphulla Chandra), a History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century, A.D., with Sanskrit Texts, &c., 68

Ray (S. H.), the Melanesians of British New Guinea, Dr. C. G. Seligmann, 499

Raybaud (P.), les Aéroplanes, considérations théoriques, 229

Rayleigh (Rt. Hon. Lord, O.M., F.R.S.), on Colour Vision at the Ends of the Spectrum, 204

Raymond (Prof. Fulgence), Death of, 435

Ready (Oliver G.), Life and Sport on the Norfolk Broads in the Golden Days, 466

Recklinghausen (Friedrich von), Death of, 339

Recklinghausen (Max de), New Researches on the Sterilisation of Large Quantities of Water by the Ultra-violet Rays, 556

Reed (F. R. Cowper), Devonian Faunas of the Northern Shan States, 159; Cambrian Fossils from the Bhabeh Rocks of Spiti, 342

Reed (J. Howard), Geography of British Cotton-growing, 552

Regnier (G.), Observations on Animal Calorimetry made on Mt. Blanc, 456

Reid (G. Archdall), the Laws of Heredity, 1

Reid (Harry F.), the California Earthquake of April 18, 1906, Vol. ii., the Mechanics of the Earthquake, 165

Reinders (E.), Sap-raising Forces in Living Wood, 181

Reiss (G. E.), Unemployed Laboratory Assistants, 462

Reissner (Prof. H.), die Seitensteuer der Flugmaschinen, 229

Remnants of the Past, 89

Renshaw (Graham), Animal Romances, 100

Renwick (F. F.), Measuring the True Opacity or Obstructive Power of Photographic Plates, 215

Reptiles and Amphibians of Cheshire, the, T. A. Coward and C. Oldham, 175

Respiration: Physiologische Studien im Hochgebirge: Versuche über den respiratorischen Stoffwechsel in Hochgebirge, R. F. Fuchs and T. Deimler, Leonard Hill, F.R.S., 369

Reusch (Prof.), Glacial Erosion, 441, 442

Revere (Guilo), le Prove dei Materiali da Construzione e le Construzione in Cemento Armato, 358

REVIEWS AND OUR BOOKSHELF.

The Laws of Heredity, G. Archdall Reid, Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S., 1

Die Ernährung der Wassertiere und der Stoffhaushalt der Gewasser, Prof. August-Pütter, 5

Smallpox and Vaccination in British India, Major S. P. James, 5

The Foundations of Alternate Current Theory, Dr. C. V. Drysdale, Prof. Gisbert Kapp, 6

The New School of Japan, Founded for the Purpose of Making the Use of the Newly Invented Letters, F. Victor Dickins, 7

Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History), Prof. J. W. Gregory, F.R.S., 8

Problèmes et Exercices de Mathématiques générales, Prof. E. Fabry, 8

Fossil Vertebrates in the American Museum of Natural History, 12

Totemism and Exogamy: a Treatise on Certain Early Forms of Superstition and Society, Prof. J. G. Frazer, A. E. Crawley, 31

Prehistoric Rhodesia, Richard N. Hall, 32

Beiträge zur Naturgeschichte Ostasiens, Japanische Alcyonaceen, Prof. W. Kükenthal, Die Familien der Primnoiden, Muriceiden, und Acanthogorgiiden, Prof. W. Kükenthal, H. Gorzawsky; Die Familien der Plexauriden Chrysogorgiiden und Melitodiden, Prof. W. Kükenthal; Athecata und Plumularidæ, E. Stechow; Japanische Antipatharien, E. Silberfeld; Japanische Medusen, O. Maas; Japanische Actinien, Dr. A. Wassilieff; Japanische Ctenophoren, Dr. Fanny Moser; Uber japanische Seewalzen, E. Augustin, 34

Orationes et Epistolæ Cantabrigienses, Dr. John Edwin Sandys, Dr. R. Y. Tyrrell, 35

Spirit and Matter before the Bar of Modern Science, Dr. Isaac W. Heysinger, 36

The Plant Cell, its Modifications and Vital Processes, H. A. Haig, 36

Science from an Easy Chair, Sir Ray Lankester, K.C.B., F.R.S., 37

Alpine Flowers and Gardens, Painted and Described, G. Flemwell, 37

Summer Flowers of the High Alps, Somerville Hastings, 37

A Manual of Practical Farming, John McLennan, 38

Leitfaden der Mineralogie, Prof. Julius Ruska, 38

A Synopsis of the Orthoptera of Western Europe, Dr. Malcolm Burr, 39

Prehistoric Man, Joseph McCabe, 39

Metallografia applicata ai Prodotti Siderurgici, Umberto Savoia, 39

Lo Zinco, Prof. R. Musu-Boy, 39

With a Prehistoric People, the Akikūyu of British East Africa, W. Scoresby Routledge and Katherine Routledge, Sir H. H. Johnston, G.C.M.G., K.C.B., 41

Die Temperatur Verhältnisse in der freien Atmosphäre [Engebnisse der internationalen unbemannter Ballonaufstiege], Dr. Arthur Wagner, E. Gold, 42

On the Nature, Uses, and Manufacture of Ferro-silicon, with Special Reference to possible danger arising from its Transport and Storage, Dr. S. M. Copeman, F.R.S., S. R. Bennett, Dr. H. Wilson Hake, Prof. A. McWilliam, 53

Traité de Physique, O. D. Chivolson, 65
Handbook of Flower Pollination, Dr. P. Knuth, 66
Leitfaden zum elektrotechnischen Praktikum, Dr. G. Brion, Prof. Gisbert Kapp, 67
A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D., with Sanskrit Texts, Prof. Praphulla Chandra Ray, 68
Instruments optiques d'Observation et de Mesure, Jules Raibaud, 68
Methods used in the Examination of Milk and Dairy Products, Dr. Chr. Barthel, 69
Norwegian and other Fish Tales, Bradnock Hall, 69
The Yakutat Bay Region, Alaska: Physiography and Glacial Geology, Ralph S. Tarr; Areal Geology, R. S. Tarr, Bert S. Butler, 76
The Geology and Ore Deposits of Goldfield, Nevada, F. L. Ransome, 76
Landslides in the San Juan Mountains, Colorado, including a Consideration of their Causes and their Classification, E. Howe, 76
Peaks and Glaciers of Nun Kun: a Record of Pioneer Exploration and Mountaineering in the Punjab Himalaya, Fanny Bullock Workman, Dr. W. H. Workman, Sir T. H. Holland, K.C.I.E., F.R.S., 78
The Journal of the East Africa and Uganda Natural History Society, Sir H. H. Johnston, G.C.M.G., K.C.B., 80
The Evolution of Worlds, Prof. Percival Lowell, William E. Rolston, 99
The Nature-study Idea, L. H. Bailey, 100
Man and Nature on Tidal Waters, Arthur H. Patterson, 100
Tommy's Adventures in Natureland, Sir Digby Pigott, C.B., 100
Animal Romances, Graham Renshaw, 100
Technical Methods of Chemical Analysis, Prof. George Lunge, 101
Palæontographical Society, 101
Handbuch der vergleichenden Physiologie, 102
Light and Sound, W. S. Franklin and Barry Macnutt, E. Edser, 103
Kraft: das ist animalische, mechanische, soziale Energien und deren Bedeutung für die Machtenfaltung der Staaten, Prof. Dr. E. Reyer, 103
Soziale Mächte: als Ergänzung der Arbeit über "Kraft," Prof. Dr. E. Reyer, 103
Notes on the Electric Smelting of Iron and Steel, Dr. W. F. Smeeth, 103
Psychism, M. Hume, 103
Mitteilungen aus den Deutschen Schutzgebieten, &c., Sir H. H. Johnston, G.C.M.G., K.C.B., 106
The Manganese-ore Deposits of India, H. Leigh Fermor, 128
Studies on the Structures and Affinities of Cretaceous Plants, Dr. Marie C. Stopes and Prof. K. Fujii, 129
Antiquities of the Ouachita Valley, Clarence B. Moore, Dr. A. C. Haddon, F.R.S., 129
The Christian Topography of Cosmas Indicopleustes, 133
Die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere, Prof. A. A. W. Hubrecht, 134
Die Vegetationsverhältnisse der Balkanländer (Mösische Länder), Prof. Lugo Adamović, 135
Elements of the Differential and Integral Calculus, Prof. A. E. H. Love, F.R.S., 136
Plane Trigonometry, Prof. H. S. Carslaw, 136
Elementary Projective Geometry, A. G. Pickford, 136
A First Course in Analytical Geometry, Plane and Solid, C. N. Schmall, 136
Schlich's Manual of Forestry, Sir Wm. Schlich, K.C.I.E., F.R.S., 137
General Biology, Prof. James G. Needham, 137
Catalogue of British Hymenoptera of the Family Chalcididæ, Claude Morley, 138
How to Keep Hens for Profit, C. S. Valentine, 138
The Prince and his Ants (Ciondolenn), Luigi Bertelli, 138
The Thames, G. E. Mitton, 138
Windsor Castle, Edward Thomas, 138
A Manual of Geometry, W. D. Eggar, 138
Shakespeareland, Walter Jerrold, 138
The South Devon and Dorset Coast, Sidney Heath, 138
Nova tripanosomiaze humana, C. Chagas, Prof. E. A. Minchin, 142
Elementaire Theorie der Getijeden—Getij-Constanten in den Indische Archipel, Dr. J. P. van der Stok, Sir G. H. Bryan, F.R.S., 144
Botany of To-day, G. F. Scott Elliot, 146
The Book of Nature Study, 146
A Text-book of Botany for Students, with Directions for Practical Work, Amy F. M. Johnson, 146
Comptes rendus de la première Conference internationale agrogéologique, Dr. E. J. Russell, 157
Koninklijk Nederlandsch Meteorologisch Institut, Oceanographische en Meteorologische Waarnemingen bij Kaap Guardafui, 159
Regenwaarnemingen in Nederlandsch-Indie, Dertigste Jaargang, 1908, 159
The California Earthquake of April 18, 1906, Harry F. Reid, Prof. John Milne, F.R.S., 165
Coal Tar and Ammonia, Prof. George Lunge, 166
The Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches, Prof. George Lunge, 166
Deutsche Südpolar-Expedition, 1901–3, die Grundproben der Deutschen Südpolar-Expedition, 1901–3, E. Philippi, 167
Wonders of Physical Science, E. E. Fournier, 168
Tillers of the Ground, Dr. Marion I. Newbigin, 168
Threads in the Web of Life, Margaret R. Thomson and Prof. J. Arthur Thomson, 168
Life-history and Habits of the Salmon, Sea-trout, Trout, and other Fresh-water Fish, P. D. Malloch, 168
Theories of Parallelism, an Historical Critique, W. B. Frankland, 169
Forest Flora of the Bombay Presidency and Sind, W. A. Talbot, 170
Chimica Generale e Applicata all' Industria, Prof. Ettore Molinau, 170
Guide to the Crustacea, Arachnida, Onychophora, and Myriopoda Exhibited in the Department of Zoology, British Museum (Natural History), 171
Popular Astronomy, Prof. Simon Newcomb, 171
Naturwissenschaftliches Unterrichtswerk für höhere Mädchenschulen, Dr. K. Smalian and K. Bermau, 171
Health, Progress and Administration in the West Indies, Sir Rubert W. Boyce, F.R.S., 174
The Vertebrate Fauna of Cheshire and Liverpool Bay, the Mammals and Birds of Cheshire, T. A. Coward and C. Oldham, the Dee as a Wildfowl Resort, John A. Dockray, the Reptiles and Amphibians of Cheshire, T. A. Coward and C. Oldham, the Fishes of Cheshire and Liverpool Bay, James Johnstone, 175
Across Yunnan, Archibald Little, 177
On the Meteorological Evidence for Supposed Change of Climate in India, Dr. Gilbert T. Walker, F.R.S., Dr. William J. S. Lockyer, 178
The Year-book of the Khedivial Agricultural Society, Cairo, 184
The Design and Construction of Internal Combustion Engines, Hugo Güldner, 197
Lehre von den Erzlagerstätten, Dr. R. Beck, 198
The Manufacture of Cane Sugar, Llewellyn Jones and F. I. Scard, 199
Ueber den Willensakt und das Temperament: eine experimentelle Untersuchung, Prof. Narziss Ach, 199
Leitfossilien: ein Hilfsbuch zum Bestimmen von Versteinerungen bei geologischen Arbeiten in der Sammlung und im Felde, Prof Georg Gürich, 200
Metallographie: ein ausführliches Lehr- und Handbuch der Konstitution, und die physikalischen, chemischen, und technischen Eigenschaften der Metalle und metallischen Legierungen, Dr. W. Guertler, 200
Manual of Physical Geography, Dr. F. V. Emerson, 201
A Laboratory Manual of Physical Geography, Prof. R. S. Tarr and O. D. von Engeln, 201
The House-fly, *Musca domestica*, Linnæus: a Study of its Structure, Development, Bionomics, and Economy, Dr. C. Gordon Hewitt, 202
The Science of Happiness, Dr. H. S. Williams, 202
Rinaldo's Polygeneric Theory: a Treatise on the Beginning and End of Life, Joel Rinaldo, 202
Letters from High Latitudes, being Some Account of a Voyage in 1856 in the Schooner-yacht *Foam* to Iceland, Jan Mayen, and Spitzbergen, Lord Dufferin, 202
National Antarctic Expedition, 1901–4, Zoology and Botany, 205
British Antarctic Expedition, 1907–9, under the Command

of Sir E. H. Shackleton, C.V.O., Reports on the Scientific Investigations, Biology, 205
Expédition Antarctique Belge, Résultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Botanique—Diatomés, H. van Heurck; Geologie—Petrographische Untersuchung der Gesteinproben, A. Pelikan; Quelques Plantes Fossiles des Terres Magellaniques, Prof. A. Gilkinet; Oceanographie—les Glaces—Glace de Mer et Banquises, H. Arctowski; Zoologie—Schizopoda and Cumacea, H. J. Hansen, 205
The Constants of Nature, a Recalculation of Atomic Weights, Frank Wigglesworth Clark, 207
Determinations of Atomic Weights, Theodore W. Richards and Hobart Hurd Willard, 207
The Harvard Determinations of Atomic Weights between 1870 and 1910, Theodore W. Richards, 207
Methods Used in Precise Chemical Investigations, Theodore W. Richards, 207
The Orders of Mammals, W. K. Gregory, 216
The Art of Aviation, R. W. A. Brewer, Prof. G. H. Bryan, F.R.S., 229
How to Build an Aeroplane, R. Petit, Prof. G. H. Bryan, F.R.S., 229
How to Build a 20-foot Biplane Glider, A. P. Morgan, Prof. G. H. Bryan, F.R.S., 229
Les Aéroplanes, considérations théoriques, P. Raybaud, Prof. G. H. Bryan, F.R.S., 229
Ballons et Aéroplanes, G. Besançon, Prof. G. F. Bryan, F.R.S., 229
L'Aviation, Prof. Paul Painlevé and Prof. Emilé Borel, Prof. G. H. Bryan, F.R.S., 229
Navigation in der Luft, Prof. A. Marcuse, Prof. G. H. Bryan, F.R.S., 229
Stabilité des Aéroplanes, surface métacentrique, Prof. M. Brillouin, Prof. G. H. Bryan, F.R.S., 229
Die Seitensteuer der Flugmaschinen, Prof. H. Reissner, Prof. G. H. Bryan, F.R.S., 229
IV. Congrès international d'Aéronautique, 1909, Prof. G. H. Bryan, F.R.S., 229
Bibliography of Aëronautics, Paul Brockett, Prof. G. H. Bryan, F.R.S., 229
Petite Encyclopédie aéronautique, L. Ventou-Duclaux, Prof. G. H. Bryan, F.R.S., 229
The Encyclopædia of Sports and Games, Prof. G. H. Bryan, F.R.S., 229
Fungous Diseases of Plants, Prof. B. M. Duggar, Prof. E. S. Salmon, 233
Lehrbuch der Zoologie, Prof. R. Hertwig, 234
Scientific Papers, Sir George Howard Darwin, K.C.B., F.R.S., 235
Die Polarwelt und ihre Nachbarländer, O. Nordenskjöld, 236
Our Teeth, R. Denison Pedley and Frank Harrison, 237
The Funeral Papyrus of Iouiya, Edouard Naville, 237
Helmholtz, eine Zeitschrift für die exakten Wissenschaften mit besonderer Berücksichtigung ihrer Anwendungen, 237
List of Documents in Spanish Archives relating to the History of the United States, which have been Printed, of which Transcripts are Preserved in American Libraries, J. A. Robertson, 238
Lightning and the Churches, Alfred Hands, 238
The British Isles in Pictures, H. Clive Barnard, 238
A History of the Birds of Kent, Norman F. Ticehurst, 241
On and Off Duty in Annam, Gabrielle M. Vassal, J. Thomson, 243
Documents scientifiques de la Mission Tilho, Sir H. H. Johnston, G.C.M.G., K.C.B., 244
Royal Magnetical and Meteorological Observatory at Batavia, Report on Cloud-observations at Batavia Made during the International Cloud-year 1896–7 and Subsequent Years, Dr. S. Figee, E. Gold, 249
Velocità e Direzione delle Correnti Aeree alle diverse Altitudini Determinate a Mezzo dei Palloni-Sonde e Piloti, Dr. G. Pericle, E. Gold, 249
The Jesup North Pacific Expedition, the Kwakiutl of Vancouver Island, Franz Boas; Chukchee Mythology, Waldemar Bogoras, the Yukaghir and the Yukaghirized Tungus, Waldemar Jochelson, Dr. A. C. Haddon, F.R.S., 250
Inheritance of Characteristics in Domestic Fowl, C. B. Davenport, 253
The Journal of the South-eastern Agricultural College, Wye, 253
Colour-blindness and Colour-perception, Dr. F. W. Edridge-Green, 263
Geschichte der biologischen Theorien, Dr. Em. Rádl, 263
Broad Lines in Science Teaching, 264
Greek and Roman Methods of Painting: Some Comments on the Statements Made by Pliny and Vitruvius about Wall and Panel Painting, Dr. A. P. Laurie, 265
A Monograph of the Foraminifera of the North Pacific Ocean, J. A. Cushman, 265
A First Year's Course of Inorganic Chemistry, G. F. Hood, 266
A Manual of Elementary Practical Chemistry for Use in the Laboratory, P. W. Oscroft and R. P. Shea, 266
Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History), 266
The Calendar of Gardening Operations, 266
The Ore Deposits of South Africa, J. P. Johnston, 293
The Geology of Ore Deposits, H. H. Thomas, D. A. MacAlister, 293
Meteorology, Practical and Applied, Sir John Moore, 293
Gustav Freytag's Kultur- und Geschichtspsychologie, Dr. Georg Schridde, 294
Lessing's Briefwechsel mit Mendelssohn und Nicolai über das Trauerspiel, Prof. Dr. Robert Petsch, 294
Hegel's Asthetik im Verhältnis zu Schiller, A. Lewkowitz, 294
Uber Christian Wolff's Ontologie, Hans Pichler, 294
Zwei Vorträge zur Naturphilosophie, Hans Driesch, 294
A Manual of Dyeing, Prof. E. Knecht, C. Rawson, Dr. R. Loewenthal, 295
La Métallographie Microscopique, Louis Révillon, A. McWilliam, 295
Die Kraftmaschinen, C. Schütze, 295
Photomicrographs of Botanical Studies, 296
Illustrated Guide to the Museum of the Royal College of Surgeons, England, Prof. Arthur Keith, 296
The Photographic Annual, 1910–11, 296
Resultate der Wissenschaftlichen Untersuchungen des Balaton, Untersuchungen über die Schwerkraft, R. v. Sterneck; die Niveaufläche des Balatonsees und die Veränderungen der Schwerkraft auf diesem, Baron L. Eötvös; Erdmagnetische Messungen in Sommer 1901, L. Steiner; das Eis Balatonsees, E. V. Cholnoky; die Tropischen Nymphæen des Hevizsees bei Keszthely, A. Lovassy; Kirchen und Burgen in der Umgebung des Balaton im Mittelalter, R. Békefi, 299
Library of Congress, a List of Geographical Atlases in the Library of Congress, with Bibliographical Notes, 325
Lead and Zinc Pigments, Dr. C. D. Holley, Dr. A. P. Laurie, 325
Tables for the Reduction of Meteorological Observations, Dr. G. C. Simpson, E. Gold, 326
Sweet Peas, H. J. Wright, 326
Pansies, Violas, and Violets, Wm. Cuthbertson, J.P., R. Hooper Pearson, 326
Die Hiede, W. Wagner, 326
Niedere Pflanzen, Dr. R. Timm, 326
Das Holz, H. Kottmeier and F. Uhlmann, 326
Der Pflanzengarten, seine Anlage und seine Verwerkung, Prof. F. Pfuhl, 326
The Black Bear, William H. Wright, 327
Chemistry for Photographers, Chas. F. Townsend, 327
Die Aufzucht und Kultur der Parasitischen Samenpflanzen, Prof. E. Heinricher, 327
Medical Education in the United States and Canada, Abraham Flexner, 332
Die Antike Tierwelt, Otto Keller, 357
A Concise Treatise on Reinforced Concrete, C. F. Marsh, 358
Concrete-steel Construction, Prof. Emil Mörsch, 358
Il Cemento Armato e la sua Applicazione practica, Cesare Presenti, 358
Le prove dei Materiali da Costruzione e le Costruzioni in Cemento Armato, Guilio Revere, 358
Practical Chemistry, Dr. James Bruce and Harry Harper, 360

Qualitative Analysis, E. J. Lewis, 360
Outlines of Organic Chemistry, Dr. F. J. Moore, 360
The Calculations of General Chemistry, with Definitions, Explanations, and Problems, Prof. William J. Hale, 360
A.B.C. Five Figure Logarithms and Tables for Chemists, including Electrochemical Equivalents, Analytical Factors, Gas Reduction Tables, and other Tables useful in Chemical Laboratories, C. J. Woodward, 360
A History of the Mineral Waters and Medicinal Springs of Essex, Miller Christy and Miss May Thresh, 361
Edible and Poisonous Fungi, 361
Guide to Mr. Worthington Smith's Drawings of Field and Cultivated Mushrooms, and Poisonous or Worthless Fungi often Mistaken for Mushrooms, Exhibited in the Department of Botany, British Museum (Natural History), 361
Fractures and Separated Epiphyses, A. J. Walton, Frank Romer, 361
The Castes and Tribes of Southern India, Edgar Thurston and K. Rangachari, 365
A History of Birds, W. P. Pycraft, 367
Innsbrucker Föhnstudien, IV., Weitere Beiträge zur Dynamik der Föhns, Dr. H. v. Ficker, 368
Physiologische Studien im Hochgebirge: Versuche über den Repiratorischen Stoffwechsel im Hochgebirge, R. F. Fuchs and T. Deimler, Leonard Hill, F.R.S., 369
A History of Botany, 1860–1900, being a Continuation of Sachs "History of Botany, 1530–1860," Prof. J. Reynolds Green, F.R.S., 391
Fuel and Refractory Materials, Prof. A. H. Sexton, Prof. A. McWilliam, 392
A Handbook of Practical Parasitology, Prof. Max Braun and Dr. M. Lühe, 393
Astronomy, a Handy Manual for Students and Others, Prof. F. W. Dyson, F.R.S., 393
Chats about Astronomy, H. P. Hollis, 393
Bulletin Trimestrie: Conseil Permanent International pour l'Exploration de la Mer, Résumé des Observations sur le Plankton des Mers explorées par le Conseil pendant les Années, 394
The Decapod Natantia of the Coasts of Ireland, Stanley M. Kemp, 394
Report of a Survey of the Trawling Grounds on the Coasts of Counties Down, Louth, Meath, and Dublin, E. W. L. Holt, 394
Science in Modern Life, Engineering, J. W. French, 395
Vegetationsbilder, Trockensteppen der Kalahari, F. Seiner; von den Juan Fernandez Inseln, Carl Skottberg; die Schwäbische Alp, Otto Feucht; Aus Bosnien und der Herzegovina, L. Adamović; die Flora von Irland, Prof. T. Johnson, 395
Light Visible and Invisible, Silvanus P. Thompson, F.R.S., 395
A Home-work Atlas of Maps in Black and White, 395
Causal Geology, Prof. E. H. L. Schwartz, Prof. Grenville A. J. Cole, 397
Manganese-ore Deposits of the Sandur State, A. Ghose, 406
Life-histories of Northern Animals: an Account of the Mammals of Manitoba, Ernest Thompson Seton, 423
The Care of Trees in Lawn, Street, and Park, Bernard E. Fernow, 423
Beet Sugar Making and its Chemical Control, Y. Nikaido, 424
Analyse der Silikat- und Karbonatgesteine, W. F. Hildebrand, 425
The Analysis of Silicate and Carbonate Rocks, W. F. Hildebrand, 425
Distant Lands, H. J. Mackinder, 426
A First Book of Physical Geography, W. M. Carey, 426
A Physiographical Introduction to Geography, Prof. A. J. Herbertson, 426
Geology, Prof. J. W. Gregory, 426
An Economic Atlas, J. G. Bartholomew, 426
Devonshire, F. A. Knight and Louie M. Dutton, 426
Dorset, A. L. Salmon, 426
Derbyshire, H. H. Arnold-Bemrose, 426
A Systematic Geography of Asia, G. W. Webb, 426
Catálogo Sistemático y Descriptivo de las Aves de la República Argentina, Roberto Dabbene, 427
Land and Fresh-water Mollusca of India, Lieut.-Col. H. H. Godwin-Austen, 427
Jack's Insects, Edward Selous, 427
Corals and Atolls, F. Wood-Jones, 432
Transactions of the Astronomical Observatory of Yale University, Parallax Investigations on Thirty-five Selected Stars, by Frederic L. Chase Mason, F. Smith, and William L. Elkin, 433
Contributions to the Ethnology and Anthropogeography of the Polar Eskimos, Dr. H. P. Steensby, 443
Geschichtstafeln der Physik, Prof. Felix Auerbach, 457
A Text-book of Mental Diseases, Prof. Eugenio Tanzi, 458
Psychotherapy, Prof. Hugo Münsterberg, 458
Physical and Commercial Geography, Profs. H. E. Gregory, A. G. Keller, and A. L. Bishop, 459
Extinct Monsters and Creatures of other Days: a Popular Account of some of the Larger Forms of Ancient Animal Life, Rev. H. N. Hutchinson, 459
The Carnation Year Book, 1910, 460
Gardening Difficulties Solved, 460
Leitfaden für Gärtnerische Pflanzenzuchtung, M. Löbner, 460
Wild Flowers and How to Identify Them, H. Friend, 460
The Telegraphic Transmission of Photographs, T. Thorne Baker, 460
Liste des Observatoires Magnétiques et des Observatoires Séismologiques, E. Merlin and O. Somville, 460
An Inconsistent Preliminary Objection against Positivism, Prof. Robert Ardigo, 461
Analytical Chemistry, Prof. F. P. Treadwell, 461
Students' Life and Work in the University of Cambridge, Prof. Karl Breul, 461
Science in Modern Life, Botany, J. M. F. Drummond, Zoology, Prof. J. R. Ainsworth Davis, Science and the Sea Fisheries, Dr. J. Travis Jenkins, 464
A Bush Calendar, Amy E. Mack, 464
Nature Studies by Night and Day, F. C. Snell, 464
Insect Wonderland, Constance M. Foot, 464
The Landscape Beautiful, F. A. Waugh, 464
Bees for Profit and Pleasure, H. Geary, 464
The Geology and Archæology of Orangia, J. P. Johnson, 465
Grouse and Grouse Moors, George Malcolm and Aymer Maxwell, 466
Life and Sport on the Norfolk Broads in the Golden Days, Oliver G. Ready, 466
The Newer Spiritualism, Frank Podmore, Sir Oliver Lodge, F.R.S., 489
Fossil Plants: a Text-book for Students of Botany and Geology, Prof. A. C. Seward, F.R.S., 490
Œuvres Complètes de Christiaan Huygens, 491
First Steps in Coal Mining, Alexander Forbes, 492
A History of British Mammals, G. E. H. Barrett-Hamilton, 493
Bacteriology for Nurses, Isabel McIsaac, 493
The Inherent Law of Life: a New Theory of Life and Disease, Dr. Franz Kleinschrod, 493
Philosophies, Prof. Ronald Ross, F.R.S., C.B., 493
The Melanesians of British New Guinea, Dr. C. G. Seligmann, S. H. Ray, 499
United States Geological Survey: Contributions to Economic Geology, 1907, Part ii., Coal and Lignite, M. R. Campbell, 511
The Ketchikan and Wrangell Mining Districts, Alaska, F. E. Wright and C. W. Wright, 511
Mineral Resources of the Kotsina-Chitina Region, Alaska, F. H. Moffit and A. G. Maddren, 511
Mineral Resources of Alaska, A. H. Brooks, 511
Contributions to Economic Geology, 1908, Part i., Metals and Non-Metals except Fuels, C. W. Hayes and W. Lindgren, 511
Papers on the Conservation of Mineral Resources, 511
Ancient Plants: being a Simple Account of the Past Vegetation of the Earth and of the Recent Important Discoveries made in this Realm of Nature Study, Dr. Marie C. Stopes, 523
British Rainfall, 1909, Dr. Hugh Robert Mill, 523
Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum, Lieut.-Col. A. Alcock, F.R.S., 524

Our Search for a Wilderness, Mary Blair Beebe and C. William Beebe, 525
Leitfaden der Graphischen Chemie, Dr. R. Kremann, 525
The Amateur Astronomer, Gideon Riegler, W. E. Rolston, 526
A Guide for Medicine and Surgery Compiled for Nurses, Sydney Welkam, 526
The Death-dealing Insects and their Story, C. Conyers Morrell, 526
Abhandlungen Jean Rey's über die Ursache der Gewichtszunahme von Zinn und Blei bein Verkalken, Ernst Ichenhäuser and Max Speter, 527
Elementary Regional Geography, Great Britain and Ireland, J. B. Reynolds, 527
Cambridge County Geographies, Nottinghamshire, Dr. H. H. Swinnerton, 527
Lanarkshire, Frederick Mort, 527
Cambridge Pocket Diary for the Academical Year 1910–11, 527
Concealing Coloration in the Animal Kingdom, Gerald H. Thayer, 532
Handbook to the Ethnographical Collections, 536
Tierbau und Tierleben in Ihren Zusammenhaug Betrachtet, Prof. R. Hesse and Prof. Franz Doflein, 538

Révillon (Louis), la Mètallographie Microscopique, 295
Rey's (Jean), Abhandlungen über die Ursache der Gewichtszunahme von Zinn und Blei beim Verkalken, Ernst Ichenhäuser and Max Speter, 527
Reyer (Prof. Dr. E.), Kraft: das ist animalische mechanische, soziale Energien und deren Bedeutung für die Machtenfaltung der Staaten, 103; Soziale Mächte: als Ergänzung der Arbeit über "Kraft," 103
Reynolds (J. B.), Elementary Regional Geography, Great Britain and Ireland, 527
Rhodesia and Australia, Rainfall of, 187
Rhodesia, Prehistoric, Richard N. Hall, 32
Ricard (J. H.), Pine Forests of the Landes, 84
Ricco (Prof.), Observations of Comet 1910*a*, 472; Recent Results in Solar Physics, 507
Rice (Dr. Hamilton), Journey across South America from Bogota to Manaos, 552
Richards (Prof. J. W.), Iron Ores Supplies, 441
Richards (Theodore W.), Determination of Atomic Weights, 207; the Harvard Determination of Atomic Weights between 1870 and 1910, 207; Methods used in Precise Chemical Investigation, 207
Richter (Dr. Max O.), Discovery of the Site of the Famous Cyprian Temple of Aphrodite-Astarte, 149
Riegler (Gideon), the Amateur Astronomer, 526
Righi (Prof.), Comets and Electrons, 507
Rinaldo (Joel), Rinaldo's Polygeneric Theory: a Treatise on the Beginning and End of Life, 202
Ringer (Dr. Sydney, F.R.S.), Death of, 502; Obituary Notice of, 540
Ripon (Bishop of), Heredity at the Church Congress, 431
Ripper (Prof.), New Method of Testing the Cutting Quality of Files, 553; the Testing of Lathe Tool Steels, 553
Ristenpart (Dr.), Halley's Comet, 86
Ritchey (Dr.), Photographs of Nebulæ, 183
Rivers (Dr. W. H. R.), the Position of the Father's Sister in Oceania, 48
Roads: the Maintenance and Administration of Roads, 160; Systems of Road Administration, L. W. Page, 162
Roberts (Madame Dorothea Isaac), the Spiral Nebula M51 (Canum Venaticorum), 214
Robertson (J. A.), List of Documents in Spanish Archives relating to the History of the United States which have been printed, or of which Transcripts are preserved in American Libraries, 238
Robin (F.), Law of Resistance to Crushing of Cylindrical Bodies as a Function of their Dimensions, 555
Rodd (Mr.), Crystallographic Examination of Twenty-nine Derivatives of the p-halogenbenzenesulphonic Acids, 403
Rogers (Dr. A. W.), Note on "Verneuk Pan," 262
Rolls (the Hon. Charles Stewart), Death and Obituary Notice of, Dr. William J. S. Lockyer, 46
Rolston (William E.), the Evolution of Worlds, Prof. Percival Lowell, 99; the Amateur Astronomer, Gideon Riegler, 526
Roman Methods of Painting, Greek and, Some Comments on the Statements made by Pliny and Vitruvius about Wall and Panel Painting, Dr. A. P. Laurie, 265
Romer (Frank), Fractures and Separated Epiphyses, A. J. Walton, 361
Ronca (James F.), "Mock Suns," 345
Rosenhain (Dr.), Crystalline Structure of Iron at High Temperatures, 519
Ross (A. D.), New Method of Differentiating between overlapping orders in Mapping Grating Spectra, 30; Magnetism of the Copper-manganese-tin Alloys under Varying Thermal Treatment, 97; Magnetic Alloys formed from Non-Magnetic Materials, 421
Ross (Dr. E. D.), Polyglot List of Birds in Turki, Manchu, and Chinese, 186
Ross (Prof. Ronald, F.R.S., C.B.), Philosophies, 403
Rossi (Dr. Ferruccio), Cutaneous Innervation of the Lumbo-sacral Region in the Dog, 315
Rotch (Prof. A. L.), Relation of the Wind to Aerial Navigation, 151
Rothpletz (Prof. A.), Cause of the Californian Earthquake of 1906, 342; Pre-Cambrian Fauna, 442
Roubaud (E.), a Bombex preying on the Glossina of Dahomey, 292
Rouché (Eugène), Death of, 339
Routledge (W. Scoresby and Katherine), With a Prehistoric People, the Akikũyu of British East Africa, 41
Royal Anthropological Institute, 30
Royal College of Physicians, Harveian Oration at, Some Aspects of Heredity in Relation to Mind, Dr. H. B. Donkin, 541
Royal College of Surgeons, Hunterian Lectures at: the Anatomy and Relationship of the Negro and Negroid Races, Prof. Arthur Keith, 54; Illustrated Guide to the Museum of the Royal College of Surgeons, England, Prof. Arthur Keith, 296
Royal Commission on Welsh Monuments, the, Rev. John Griffith, 404
Royal Institution: Modern Submarine Telegraphy, Sidney G. Brown at, 23; the Chemical Significance of Crystal Structure, Prof. William J. Pope, F.R.S., 187; Electrical and other Properties of Sand, Charles E. S. Phillips, 255; Ionisation of Gases and Chemical Change, Dr. H. Brereton Baker, F.R.S., 388
Royal Magnetical and Meteorological Observatory at Batavia: Report on Cloud-Observations at Batavia, made during the International Cloud-year, 1896–1897, and Subsequent Years, Dr. S. Figee, E. Gold, 249
Royal Microscopical Society, 29
Royal Photographic Society's Exhibition, the, 273
Royal Sanitary Institute, 353
Royal Scottish Geographical Society's Medal Awards, 502
Royal Society, 60; Bakerian Lecture at, the Pressure of Light against the Source, the Recoil from Light, Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, 139
Royal Society, Edinburgh, 30, 97, 227
Royal Society of Medicine: Thermal Effects produced by High-frequency Currents, Dr. Franz Nagelschmidt, 542
Royal Society of Sciences, Göttingen, 390, 556
Royal Society of South Africa, Cape Town, 98, 132, 262, 422
Royal Statistical Society: the Tabulation of Vital Statistics, Dr. T. H. C. Stevenson at, 130
Rubber, Recent Investigations on the Cultivation of, 510
Runciman (W.), Position of University Education in Great Britain, 91
Ruska (Prof. Julius), Leitfaden der Mineralogie, 38
Russ (Dr. S.), Recoil of Radium B from Radium A, 516
Russell (Dr. A.), the Convection of Heat from a Body Cooled by a Stream of Fluid, 195
Russell (Alex. S.), the Ratio between Uranium and Radium in Minerals, 238
Russell (Dr. E. J.), the First International Agrogeological Conference, 157
Russell (Dr. H. Norris), the Distances of Red Stars, 374
Russell (R.), Death of, 14
Rutherford (Prof. E., F.R.S.), Radium Standards and Nomenclature, 430
Rutot (A.), Existence in Belgian Caverns of Layers containing Remains of Arctic Rodents, 315

Sabatier (Paul), Catalytic Preparation of Alkyl-Aryl Ethers, 196; Catalytic Preparation of the Phenolic Oxides and the Diphenylenic Oxides, 292
Sagaret (Jules), the Gnomon in Ancient Astronomy, 120
St. John (C.), Practical Spectroscopy, 159
St. John (C. E.), Calcium Vapour in the Sun, 249
Salaman (Dr. R. N.), Male Sterility in Potatoes, 29
Salmon (A. L.), Dorset, 426
Salmon (Prof. E. S.), the Sclerotinia Disease of the Gooseberry, 219; Fungous Diseases of Plants, Prof. B. M. Dugger, 233
Salmon, Sea-trout, Trout, and other Fresh-water Fish, Life-history and Habits of the, P. D. Malloch, 168
Salomon (Prof.), Glacial Erosion, 442
Sambon (Dr. Louis), Recent Investigations on Pellagra, 538
Sand (Dr. H. J. S.), Demonstration of Vacuum-tight Seals between Iron and Glass, 514
Sand, Electrical and other Properties of, Charles E. S. Phillips at Royal Institution, 255
Sandys (Dr. John Edwin), Orationes et Epistolæ Cantabrigienses (1876–1909), 35
Sanitation: Growth of Sanitary Science, Sir John Cockburn, 313; Royal Sanitary Institute, 353; Control of Foods, 354; Sewage Disposal, 354
Sankey (Captain), the Ignition of Gases by Adiabatic Compression, 553
Saotome (K.), Halley's Comet, 322
Sapir (E.), the Takelma Language, 16
Saturn, a Bright Projection on, M. Maggini, 507
Saturn, Uranus, and Neptune, New Ephemerides for, Dr. Downing, 472
Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere, Prof. A. A. W. Hubrecht, 134
Saunders (A. M. Carr), Development of *Aphysia punctata*, 504
Savoia (Umberto), Metallografia applicata ai Prodotti Siderurgici, 39
Sawyer (E. F.), the Perseid Shower, 439
Seard (F. I.), the Manufacture of Cane Sugar, 199
Schaumasse (M.), Observations of the Metcalf Comet, 292
Schiaparelli (Prof. G. V.), Death of, 14; Obituary Notice of, 44
Schlesinger (Prof. Frank), Pwdre Ser, 105
Schlich (Sir Wm., K.C.I.E., F.R.S.), Schlich's Manual of Forestry, 137
Schmall (C. N.), a First Course in Analytical Geometry, Plane and Solid, with Numerous Examples, 136
Schmidt (Johs.), *Leptocephalus hyoproroides* and *L. thorianus*, 9
Schmidt (Dr. W.), a New Instrument, the Variograph, for Measuring Short Waves in Atmospheric Pressures, 516
Schmitter (Capt. F.), Customs and Folk-lore of the Natives of the Upper Yukon, Alaska, 81
Scholes (J. W.), Separating Power of a Telescope, 266
Schönland (Dr.), Description of *Haworthia truncata*, Schönl., 158; Experiments to Find Out whether the Aërial Parts of Plants Absorb Moisture from the Air, 158
School Children, Medical Inspection of, 57
School Hygiene, the Third International Congress of, at Paris, August 2–7, 1910, 320
Schoop (M. U.), New Process for Producing Protective Metallic Coatings, 218
Schridde (Dr. Georg), Gustav Freytags Kultur- und Geschichtspsychologie, 294
Schrötter (Dr. Hermann von), Action of Sunlight and High Altitudes, 509
Schuster (Prof. Arthur, F.R.S.), the International Union for Cooperation in Solar Research, 463
Schuster (Dr. E.), the Oxford Anthropometrical Laboratory, 550
Schütze (C.), die Kraftmaschinen, 295
Schutzgebieten, Mitteilungen aus den Deutschen, Sir H. H. Johnston, G.C.M.G., K.C.B., 106
Schuyten (Prof.), Inattention, 320
Schwartz (Prof.), Machine for Testing Rubber by Means of its Mechanical Hysteresis, 554
Schwarz (Prof. E. H.), Causal Geology, 307
Science: Science from an Easy Chair, Sir Ray Lankester, K.C.B., F.R.S., 37; Science at the Japan-British Exhibition, 125; Science in South Africa, 158; Science in Bengal, 185; Helmholtz, eine Zeitschrift für die exakten Wissenschaften mit besonderer Berücksichtigung ihrer Anwendung, 237; Death of Dr. Louis Olivier, 245; Obituary Notice of, 269; Broad Lines in Science Teaching, 264; Science in Modern Life, vol. vi., Engineering, J. W. French, 395; Forthcoming Books of Science, 475; the International Scientific Congress at Buenos Aires, Prof. C. D. Perrine, 509
Scott (H. H.), Discovery of a Skeleton of Diprotodon in the Smithton District, 469
Scott (William Earl Dodge), Death of, 340
Scutigera, the Habits and Distribution of, in India, A. D. Imms, 429
Sea, Colour of the, J. Y. Buchanan, F.R.S., 87
Seaman (Dr. W. H.), Death of, 14
Sederholm (Dr.), Pre-Cambrian Fauna, 442; Various Subdivisions of the Pre-Cambrian Rocks, 443
Seeliger (Prof.), Halley's Comet, 19
Seely (Colonel), Sleeping Sickness, 16
Seiner (F.), Trockensteppen der Kalahari, 395
Seismology: an Earthquake Model, Dr. J. W. Evans, 29; the California Earthquake of April 18, 1906, vol. ii., the Mechanics of the Earthquake, Harry F. Reid, Prof. John Milne, F.R.S., 165; Cause of the Californian Earthquake of 1906, Prof. A. Rothpletz, 342; The Galitzin Seismograph, 219; the Jamaica Earthquake, Sir D. Morris, K.C.M.G., 239; Liste des Observatoires Magnétiques et des Observatoires Séismologiques, E. Merlin and O. Somville, 460; *see also* Earthquakes
Seligmann (Dr. C. G.), the Melanesians of British New Guinea, 499
Sellors (Mr.), Measures of Double Stars, 507
Selous (Edward), Jack's Insects, 427
Semmelhack (Dr. W.), Rainfall of Northern Spain and Portugal, 377
Senderens (J. B.), Catalytic Reactions in the Wet Way Based on the Use of Aluminium Sulphate, 196; Preparation of Acrolein, 356
Separating Power of a Telescope, J. W. Scholes, 266; T. Lewis, 266
Seret (Louis), Colonial Empire of the Phœnicians, 211
Serotherapy: Properties of the Serum of Convalescents and Animals Cured of Exanthematic Typhus, Charles Nicolle and E. Conseil, 456
Seton (Ernest Thompson), Life-histories of Northern Mammals, an Account of the Mammals of Manitoba, 423
Seward (Prof. A. C., F.R.S.), Fossil Plants, a Text-book for Students of Botany and Geology, 490
Sewell (C. J. T.), the Propagation of Sound in a Fog, 62
Sexton (Prof. A. H.), Fuel and Refractory Materials, 392
Seyewetz (A.), Various Gelatine-hardening Agents, 216; Action of Quinones and their Sulphonic Derivatives on the Photographic Images Formed by Silver Salts, 488
Shackleton (Sir E. H., C.V.O.), British Antarctic Expedition, 1907–9, under the Command of, Reports on Scientific Investigations, vol. i., Biology, 205
Shakespeareland, Walter Jerrold, 138
Shaw (Dr.), Existence of a Positive Gradient of Potential during Fine Weather and a Negative Gradient during Wet Weather, 515
Shea (R. P.), a Manual of Elementary Practical Chemistry for Use in the Laboratory, 266
Shearer (Cresswell), Anatomy of *Histriobdella homari*, 150
Sheffield, British Association Meeting at, 110, 174, 274, 300, 333; S. R. Milner, 174; *see* British Association
Shepherd (Col. C. E.), Relative Sizes of the Otoliths in Various Species and Groups of Bony Fishes, 270
Shepherd (Mr.), Binary Systems of Alumina with Silica, Lime, and Magnesia, 375
Sheppard (T.), Prehistoric Boat Discovered at Brigg in 1886, 542
Sheppard (Mr.), Neolithic Implements from Bridlington, 246
Sheppard (T.), the Humber during the Human Period, 552
Shuttleworth (Dr. G. E.), Heredity at the Church Congress, 431
Siderurgici, Metallografia applicata ai Proditti, Umberto Savoia, 39
Siebenthal (Mr.), the Laramie Basin in South-eastern Wyoming, 121
Sieglerschmidt (Dr. R.), Climate of the Lower Guinea Coast and Hinterland, 377
Sight Tests in the Mercantile Marine, 537

Silberfeld (E.), Japanische Antipatharien, 34
Silicate and Carbonate Rocks, the Analysis of, W. F. Hillebrand, 425
Silikat- und Karbonatgesteine, Analyse der, W. F. Hillebrand, 425
Simpson (Dr. G. C.), Tables for the Reduction of Meteorological Observations, 326
Simpson (Thomas), the Bicentenary of, Edgar C. Smith, 254
Sirius, Observations of the Companion of, Prof. Barnard, 430
Sizes (Gabriel), Vibration of a Tuning Fork, 228
Sjögren (Prof.), Iron Ores Supplies, 441
Skottberg (Carl), Von den Juan Fernandez Inseln, 395
Sloane (T. G.), New Species of Carabidæ, 196; Revisional Notes on Carabidæ (Coleoptera), 422
Slocum (Dr. F.), Halley's Comet, 322; Two Remarkable Prominences, 544
Smalian (Dr. K.), Naturwissenschaftliches Unterrichtswerk für höhere Mädchenschulen, 171
Smallpox and Vaccination in British India, Major S. P. James, 5
Smeeth (Dr. W. F.), Notes on the Electric Smelting of Iron and Steel, 103
Smith (Prof. Alex), Static Method for Determining the Vapour Pressures of Solids and Liquids, and the Vapour Pressures of Mercury, 97
Smith (A. C. M.), Elastic Breakdown of Non-ferrous Metals, 89
Smith (Edgar C.), the Bicentenary of Thomas Simpson, 254
Smith (Geoffrey), Parasitic Castration in a Cockerell, 150; Sex and Immunity, 549
Smith (Prof. G. Elliot, F.R.S.), the Archæological Survey of Nubia, 406; Early Burial Customs in Egypt, 461, 529
Smith (Dr. Graham), "Grouse Disease," 48
Smith (Mason F.), Parallax Investigations on Thirty-five Selected Stars, 433
Smith (Michie), Further Observations of Halley's Comet, 374
Smithells (Prof. A.), Provident Use of Coal, 519
Smythe-Palmer (Dr. A.), Luck of the Horse-shoe, 180
Snell (F. C.), Nature Studies by Night and Day, 464
Snow (E. C.), Determination of the Chief Correlations between Collaterals in the Case of a Simple Mendelian Population Mating at Random, 61
Soddy (Frederick, F.R.S.), the Ratio between Uranium and Radium in Minerals, 296
Soils, Effect of Heat on, C. Harold Wright, 530
Sokoloff (Prof. A. P.), Death of, 46
Sola (Prof. Jose Comas), Halley's Comet, 19; Discovery of a Small Planet, presumably New, 196; a Suspected New Planet, 344; Velocities and Accelerations of the Ejecta from Halley's Comet, 404
Solar Eclipse, May 9, 1910, the Total, Dr. William J. S. Lockyer, 113
Solar Eclipse of April 28, 1911, the Total, Dr. Pio Emanuelli, 172
Solar Motion, Precession and the, Prof. Boss, 249
Solar Physics, Recent Results in, Prof. Ricco, 507
Solar Physics Observatory, South Kensington, 404
Solar Research, International Union for Cooperation in, 22; Prof. Arthur Schuster, F.R.S., 463
Solar and Terrestrial Phenomena, the Relations between, Abbe Th. Moreux, 545
Sollas (Prof.), Pre-Cambrian Fauna, 442
Sommerville (Dr. D. M. Y.), the Early History of Non-Euclidean Geometry, 172; Need of a Non-Euclidean Bibliography, 514
Somville (O.), Liste des Observatoires Magnétiques et des Observatoires Séismologiques, 460
Sound, Light and, W. S. Franklin and Barry Macnutt, E. Edser, 103
Southerns (L.), Determination of the Ratio of Mass to Weight, 62
Southwell (T.), Capture of a large Female Saw-fish (*Pristis cuspidata*) on the Ceylon Pearl-banks, 49
Sowerby (A. de C.), Exploration in China, 504
Soziale Mächte: als Ergänzung der Arbeit über "Kraft," Prof. Dr. E. Reyer, 103
Spanish Archives, List of Documents in, relating to the History of the United States which have been printed, or of which Transcripts are preserved in American Libraries, J. A. Robertson, 238
Spectroscopy, Practical, Albert Eagle, 159; C. St. John, 160
Spectrum Analysis: New Method of Differentiating between overlapping orders in Mapping Grating Spectra, A. D. Ross, 30; Displacement of Spectral Lines at the Sun's Limb, A. Perot, 86; Absorption Spectrum of Oxygen and a New Law of Spectra, Dr. T. Moir, 98; X-ray Spectra, Prof. C. G. Barkla and J. Nicol, 139; on Colour Vision at the Ends of the Spectrum, Rt. Hon. Lord Rayleigh, O.M., F.R.S., 204; the Spectrum of Cyanogen, Comte de Gramont and M. Drecq, 344; Spectrum and Radial Velocity of ϕ Persei, Dr. Ludendorff, 507; the Colours and Spectrum of Water, T. W. Backhouse, 530; Relative Duration of the Lines of the Spectrum emitted by Magnesium in the Electric Spark, G. A. Hemsalech, 556
Spencer (Baldwin), Remains of Subfossil Emeus and Marsupials from King Island, Bass Strait, 186; Existing Species of Wombats, 186
Speter (Max), Abhandlungen Jean Rey's, über die Ursache der Gewichtszunahme von Zinn und Blei beim Verkalken, 527
Spirit and Matter before the Bar of Modern Science, Dr. Isaac W. Heysinger, 36
Spiritualism, the Newer, Frank Podmore, Sir Oliver Lodge, F.R.S., 489
Spitaler, Comet 1890 VII., Search-ephemerides for, F. Hopfer, 317
Sports and Games, the Encyclopædia of, Prof. G. H. Bryan, F.R.S., 229
Stafford (Dr. J.), Early Developmental History of the Canadian Oyster, 17
Stagnant Glaciers, G. W. Lamplugh, F.R.S., 297
Stanton (Dr. T. E.), Experiments on Air Resistance, 13
Stars: a Variable Star as a Time Constant, Prof. Barnard, 52; the Determination of Stellar Radial Velocities, Prof. Frost, 86; Prof. R. W. Wood, 86; Measures of Double Stars, Prof. Burnham, 152; Dr. Lau, 317; Mr. Sellors, 507; the Study of Double Stars for Amateurs, G. F. Chambers, 273; Parallax of Fourth-type Stars, Prof. Kapteyn, 273; the Maximum of Mira in 1909, Prof. Nijland, 273; Mr. Ichinohe, 273; Results from Micrometric Observations of Eros, 1900, Mr. Hinks, 184; Occultation of η Gemini by the Planet Venus, MM. Baldet, Quénisset and Antoniadi, 196; the Recent Occultation of η Geminorum by Venus, MM. Baldet, Quénisset, and Antoniadi, 317; Researches on the Colours of Stars, Osten Bergstrand, 344; the Distances of Red Stars, Dr. H. Norris Russell, 371; Transactions of the Astronomical Observatory of Yale University, Parallax Investigations on Thirty-five Selected Stars, by Frederick L. Chase, Mason F. Smith, and William L. Elkin, 433; Coloured Stars between the Pole and 60° N. Declination, Herr Krüger, 439; Observations of the Companion of Sirius, Prof. Barnard, 439; the Mean Parallax of Tenth-magnitude Stars, Dr. H. E. Lau, 439; Announcement of a Nova, Mrs. Fleming, 472; Spectrum and Radial Velocity of ϕ Persei, Dr. Ludendorff, 507
Static Charge in Bicycle Frame, Robert S. Ball, jun., 9
Statistics: Centre of Gravity of Annual Statistics, A. Marshall, 104; the Tabulation of Vital Statistics, Dr. T. H. C. Stevenson at Royal Statistical Society, 130; Relation between the Reduction in Area of Wheat in England and the Increased Yield, Mr. Vigor, 182
Stead (J. E., F.R.S., F.I.C., F.C.S.), Opening Address in Section B at the Meeting of the British Association at Sheffield, 302; a Fourth Recalescence in Steel, 518; Closing and Welding of Blow-holes in Steel Ingots, 518
Steavenson (W. H.), the Perseid Meteoric Shower, 248
Stechow (E.), Athecata und Plumularidæ, 34
Steel, Notes on the Electric Smelting of Iron and, Dr. W. F. Smeeth, 103
Steele (Dr. Bertram D.), an Attempt to Determine the Supposed Change in Weight accompanying the Radioactive Disintegration of Radium, 428
Steensby (Dr. H. P.), Contributions to the Ethnology and Anthropogeography of the Polar Eskimos, 443
Stein (Father), Halley's Comet, 183
Steiner (L.), Resultate der Wissenschaftlichen Untersuch-

ungen des Balaton, Erdmagnetische Messungen in Sommer 1901, 299
Steinmann (Prof.), Pre-Cambrian Fauna, 442
Stenquist (D.), Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19, 9
Sterilisation of Liquids by Light of very Short Wave-length, the, Prof. Theodore Lyman, 71
Sterneck (R. v.), Resultate der Wissenschaftlichen Untersuchungen des Balaton, Untersuchungen über die Schwerkraft, 299
Stevens (J. D.), Tooth Gearing, 155
Stevenson (Dr. T. H. C.), the Tabulation of Vital Statistics, Paper at Royal Statistical Society, 130
Stewart (R. M.), a Modified Method for Nadir Observations, 439
Stiefelhagen (Dr. Heinz), Account of the Genus Scrophularia, 543
Stirling-Maxwell (Sir John), Results of Trials in Inverness-shire with Belgian System of Tree Planting on Turfs, 372
Stockholm, the Geological Congress at, 440
Stokes (A. H.) Death of, 468
Stolley (Prof. E.), Glacial Erosion, 442
Stopes (Dr. Marie C.), Studies on the Structure and Affinities of Cretaceous Plants, 129; Ancient Plants: being a Simple Account of the Past Vegetation of the Earth and the Recent Important Discoveries made in this Realm of Nature Study, 523
Storage Cells, Treatment of, Dr. Bertram B. Boltwood, 174
Störmer (Carl), Photographs of Auroræ, 86
Story (G.), Insect Coloration, 550
Stratton (F. J. M.), Accident in Heredity, 63
Strickland (C.), Development of *Trypanosoma lewisi* in the Rat Flea (*Ceratophyllus fasciatus*), 63
Stupart (Mr.), Vertical Temperature Gradients in Canada in the Winter Months, 516
Submarine Telegraphy, Modern, Sidney G. Brown at Royal Institution, 23
Sugar, the Manufacture of Cane, Llewellyn Jones and F. I. Scard, 199
Sulphuric Acid and Alkali, the Manufacture of, with the Collateral Branches, Prof. George Lunge, 166
Sumner (Francis B.), the Biological Laboratories at Woods Hole, 527
Sun: the Next Total Eclipse of the, Dr. William J. S. Lockyer, 75; Displacement of Spectral Lines at the Sun's Limb, A. Perot, 86; Calcium Vapour in the Sun, C. E. St. John, 249; the Sun's Velocity through Space, Profs. Frost and Kapteyn, 272
Sun-spots, the Rotation of, P. Kempf, 152
Sun-spots of 1909, the, Dr. E. Guerrieri, 317
Surgery: Operative Treatment of Simple Fractures, Arbuthnot Lane, 153; Illustrated Guide to the Museum of the Royal College of Surgeons, England, Prof. Arthur Keith, 296; Death of John Langton, 340; Fractures and Separated Epiphyses, A. J. Walton, Frank Romer, 361; a Guide for Medicine and Surgery, Compiled for Nurses, Sydney Welham, 526; Collection of Books and Manuscripts from Lhasa, Lieut.-Colonel L. A. Waddell, 542
Sutton (Dr. J. R.), Diurnal Variation of Level at Kimberley, 262
Swann (W. F. G.), Magnetic Field Produced by the Motion of a Charged Condenser through Space, 516
Sweet Peas, H. J. Wright, 326
Swellengrebel (Dr. N. H.), Development of *Trypanosoma lewisi* in the Rat Flea (*Ceratophyllus fasciatus*), 63
Swinnerton (Dr. H. H.), Nottinghamshire, 527
Sykes (M. G.), Anatomy and Morphology of the Leaves and Inflorescences of *Welwitchia mirabilis*, 62
Sykes (Mark L.), Insect Coloration, 550
Sykora (Herr), Halley's Comet, 322; Simultaneous Photographic Observations of a Remarkable Meteor, 544
Sylven (Dr. N.), Selection of Seed, 56
Sylviculture: the Care of Trees in Lawn, Street, and Park, Bernard E. Fernow, 423

Tabulation of Vital Statistics, the, Dr. T. H. C. Stevenson at Royal Statistical Society, 130
Talbot (A. N.), Tests made on Timber Beams, 152
Talbot (W. A.), Forest Flora of the Bombay Presidency and Sind, 170
Talman (C. Fitzhugh), Pwdre Ser, 73
Tanret (C.), Relations between Callose and Fungose, 228
Tanzi (Prof. Eugenio), a Text-book of Mental Diseases, 458
Tarr (Prof. Ralph S.), the Yakutat Bay Region, Alaska, 76; Areal Geology, 76; a Laboratory Manual of Physical Geography, 201; Advance of Glaciers in Alaska as a Result of Earthquake Shaking, 442
Tassilly (E.), Abiotic Action of Ultra-violet Rays of Chemical Origin, 164
Technical Institutions, the Association of, 90
Technical Methods of Chemical Analysis, Prof. George Lunge, 101
Teeth, Our, R. Denison Pedley and Frank Harrison, 237
Telegraphy: Modern Submarine Telegraphy, Sidney G. Brown at Royal Institution, 23; the Telegraphy of Photographs, Wireless and by Wire, T. Thorne Baker, 220; the Telegraphic Transmission of Photographs, T. Thorne Baker, 460; New Direct Wire Connecting Montreal with the Bamfield Creek Cable Station Completed, 246; Energy Relations of Certain Detectors used in Wireless Telegraphy, Dr. W. H. Eccles, 195; Mr. Marconi obtains Wireless Messages a Distance of 3500 Miles, 400; Wireless Telegraphic Messages Transmitted between Clifden (Galway) and Buenos Aires, Mr. Marconi, 435
Telephony: Novel Type of Submarine Telephone Cable from Dover to Cape Grisnez, 81
Telescope, Separating Power of a, J. W. Scholes, 206; T. Lewis, 266
Temperatur Verhältnisse in der freien Atmosphäre, die, [Ergebnisse der internationalen unbemannter Ballonaufstiege], Dr. Arthur Wagner, E. Gold, 42
Terrestrial Phenomena, the Relations between Solar and, Abbe Th. Moreux, 545
Textiles, Fire Tests with, 364; Leonard Parry, 429
Thames, the, G. E. Mitton, 138
Thayer (Gerald H.), Coloration in the Animal Kingdom, 532
Theiler (Dr. A.), *Anaplasma marginale*, a New Genus and Species of the Protozoa, 132
Theobald (F. V.), New Genera and Species of Culicidæ, 407
Therapeutics: Use of Thermo-electric Baths without Alteration of Normal Tissue, M. Doyen, 98; Treatment of Different Trypanosomiases by Arsenic and Antimony Emetic, A. Laveran, 456; Death of Dr. Sidney Ringer, 502; Obituary Notice of, 540; Thermal Effects produced by High-frequency Currents, Dr. Franz Nagelschmidt at Royal Society of Medicine, 542
Thiele (Theobald Nicolai), Death and Obituary Notice of, 503
Thiselton-Dyer (Sir W. T., K.C.M.G., F.R.S.), the Laws of Heredity, G. Archdall Reid, 1
Thomas (Prof. Cyrus), Death of, 47
Thomas (Edward), Windsor Castle, 138
Thomas (H. H.), the Geology of Ore Deposits, 293
Thomas (N. W.), Processes of Prehistoric Pottery-making, 116
Thomas (Dr. W. H.), Special Screening against Mosquitoes, 48
Thompson (F. D.), the Thyroid Body and Related Structures, 181
Thompson (H. S.), Botanising in County Kerry, 543
Thompson (Prof. S. P., F.R.S.), Hysteresis Loops and Lissajous's Figures, and on the Energy Wasted in a Hysteresis Loop, 195; Light Visible and Invisible, 305
Thomson (J.), On and Off Duty in Annam, Gabrielle M. Vassal, 243
Thomson (Prof. J. Arthur), Alcyonarians Collected by Mr. J. Murray of Sir E. Shackleton's Antarctic Expedition, 29; Threads in the Web of Life, 168
Thomson (Sir J. J., F.R.S.), Radiology and Medical Electricity, 153; on Positive Rays, 513; Existence of a Positive Gradient of Potential during Fine Weather and a Negative Gradient during Wet Weather, 515; Combustion, 517
Thomson (Margaret R.), Threads in the Web of Life, 168
Thomson (R.), the Jequié Manicoba Rubber Tree, 56
Thornycroft (Sir John), Hydroplane Miranda IV., 183

Thorp (C. G.), Very Viscid Fluid to make Dumb-bell by the Union of the Drops of Two Bubbles, 436
Thorp (T.), Method for Preventing the Tarnishing of Silver-on-Glass Parabolic Mirrors, 521
Thorpe (Dr. J. F.), Synthesis of Camphoric Acid, 51; Relative Instability of the Trimethylene Ring, 519; Elimination of a Carbethoxyl Group during the Closing of the Five-membered Ring, 519
Threads in the Web of Life, Margaret R. Thomson and Prof. J. Arthur Thomson, 168
Thresh (May), a History of the Mineral Waters and Medicinal Springs of the County of Essex, 361
Thurston (Edgar), the Castes and Tribes of Southern India, 365
Tiam (A.), Action of Ultra-violet Rays on Gelatine, 131
Ticehurst (Norman F.), a History of the Birds of Kent, 241
Tidal Researches, Dr. J. P. van der Stok, Sir G. H. Darwin, F.R.S., 144
Tierbau und Tierleben in ihrem Zusammenhang betrachtet, Prof. R. Hesse and Prof. Franz Doflein, 1; Der Tierkörper als selbständigen organismus, Prof. Richard Hesse, 538
Tilho, Documents scientifiques de la Mission (1906–9), Sir H. H. Johnston, G.C.M.G., K.C.B., 244
Tillers of the Ground, Dr. Marion I. Newbigin, 168
Tillyard (R. J.), the Genus Synthemis (Neuroptera: Odonata), 196
Timber Beams, Tests made on, A. N. Talbot, 152
Time Constant, A Variable Star as a, Prof. Barnard, 52
Timm (Dr. R.), Niedere Pflanzen, 326
Tims (Dr. H. W. Marett), Anatomical Adaptations in Seals to Aquatic Life, 550
Tinctorial Chemistry, Ancient and Modern, Prof. Walter M. Gardner, 56
Tocher (J. F.), Modification of Mendeléeff's Classification of the Elements, 156
Toda (Mr.), Photographs of Morehouse's Comet, 19
Todd (Prof. David), Halley Meteors, 439
Todd (Dr. John L.), Recent Advances in our Knowledge of Tropical Diseases, 181
Tommy's Adventures in Natureland, Sir Digby Pigott, C.B., 100
Tomory (Dr. D. M.), Modern Methods of Water Purification, 437
Topography, the Christian, of Cosmas Indicopleustes, 133
Totemism and Exogamy: a Treatise on Certain Early Forms of Superstition and Society, Prof. J. G. Frazer, A. E. Crawley, 31
Town-planning, A. E. Crawley, 498
Townsend (Chas. F.), Chemistry for Photographers, 327
Townson and Mercer (Messrs.), Novel Technical Thermometer, 84
Toxicology: Death of Dr. Frederick A. Genth, jun., 370
Trail (Prof. James W. H., M.A., M.D., F.R.S.), Opening Address in Section K at the Meeting of the British Association at Sheffield, 452
Transvaal, Veterinary Research in the, 321
Travis (C. B.), Ordovican Rhyolites of Nant Ffrancon, Carnarvonshire, 376
Treadwell (Prof. F. P.), Analytical Chemistry, 461
Trees, the Care of, in Lawn, Street, and Park, Bernard E. Fernow, 423
Trees and Timbers, 546
Tremearne (Capt. A. J. N.), Notes on the Origin of the Hausas, 58; Origin of the Fulah or Filani Race, 82; Processes of Prehistoric Pottery-making, 116
Treub (Dr. Melchior), Death and Obituary Notice of, 539
Trigonometry, Plane, Prof H. S. Carslaw, 136
Trophoblast and the Early Development of Mammals, 134
Trotter (A. P.), Curve Tracing and Curve Analysis, 40
Troup (R. S.), Fissibility of some Indian Woods, 547; Prospects of the Match Industry in the Indian Empire, 547
True (H.), Experimental Ocular Action of the Dust on Tarred Roads, 456
Tsuiji (Y.), Daily Variation of Wind and the Displacement of the Air at Nagasaki, 471
Tuberculosis: The Tuberculosis Conference and Exhibition, 22; Absence of Tubercle Bacilli from old Tuberculous Lesion, Dr. Cobbett, 63; the Crusade against Consumption, 574; the Ninth International Conference on Tuberculosis, 507; Influence of Predisposition and Heredity, Prof. Landouzy, 508; Special Susceptibility of Children of Tuberculous Parents, Prof. Calmette, 508; M. Piery, 508; Analysis of 232 Fatal Cases of Tuberculosis, Dr. Nathan Raw, 508; Importance of Predisposition, Dr. C. Theodore Williams, 508; Action of Sunlight and High Altitudes, Dr. Hermann von Schrötter, 509
Turner (Prof. T.), Shrinkage of Antimony-lead Alloys and of the Aluminium-zinc Alloys during and after Solidification, 421; Influence of Silicon on the Properties of Pure Cast Iron, 440; Theory of Hardening Carbon Steels, 440
Turner (Sir William), Morphology of the Manus in *Platanista gangetica*, 97
Turner (W. E. S.), Molecular Association in Water, 519; Affinities of the Halogen Elements, 519; Molecular Complexity of Nitrosoamines, 520
Turpaian (M.), Application of the Principle of Archimides to the Exact Determination of Gaseous Densities, 556
Tyndall (A. M.), Velocity of Negative Ions in Hydrogen at Atmospheric Pressure, 531
Tyrrell (Dr. R. Y.), Orationes et Epistolae Cantabrigienses (1876–1909), Dr. John Edwin Sandys, 35

Uganda-Congo Boundary, the, Edward Heawood, 531; the Writer of the Article, 531
Uganda-Congo Frontier, Lake Edward, Ruwenzori, and the, 267
Uhlmann (F.), das Holz, 326
Unemployed Laboratory Assistants, G. E. Reiss, 462
United States, Recent Work of Geological Surveys, IV., the, 121
United States Naval Observatory, the, 152
United States and Canada, Medical Education in the, Abraham Flexner, 332
Universities: University and Educational Intelligence, 28, 60, 96, 130, 163, 194, 226, 261, 291, 323, 355, 389, 420, 455, 487, 521, 554; the Position of University Education in Great Britain, 91; the Reform of Oxford University, 331; Students' Life and Work in the University of Cambridge, Prof. Karl Breul, 461; Death of J. W. Clark, 468; Obituary Notice of, Dr. Sidney F. Harmer, F.R.S., 501; the Centenary of Berlin University, 480, 496
Uranium and Radium in Minerals, the Ratio between, Alex. S. Russell, 238; Frederick Soddy, F.R.S., 296
Uranus, and Neptune, New Ephemerides for Saturn, Dr. Downing, 472
Usher (F. L.), Relative Atomic Weights of Nitrogen and Sulphur, 62

Vaccination, Smallpox and, in British India, Major S. P. James, 5
Valentine (C. S.), How to Keep Hens for Profit, 138
Vassal (Gabrielle M.), On and Off Duty in Annam, 243
Vaughan (H. H.), Pooling System, 155
Vegetationsbilder, Trockensteppen der Kalahari, F. Seiner; von den Juan Fernandez Inseln, Carl Skottberg; die schwäbische Alp, Otto Feucht; aus Bosnien und der Herzegovinia, L. Adamovič; die Flora von Irland, Prof. T. Johnson, 395
Vegetationsverhältnisse der Balkanländer (Mösische Länder), die, Prof. Lujo Adamovič, 135
Veley (V. H.), Comparative Toxicity of Theobromine and Caffeine as Measured by their Direct Effects upon the Contractibility of Isolated Muscle, 62
Velocity of Negative Ions in Hydrogen at Atmospheric Pressure, A. M. Tyndall, 531
Ventou-Duclaux (L.), Petite Encyclopédie aéronautique, 229
Venus, the Recent Occultation of ε Geminorum by, MM. Baldet, Quénisset, and Antoniadi, 317
Vergleichenden Physiologie, Handbuch der, 102
Very (Prof. Frank W.), Water Vapour on Mars, 405
Veterinary Research in the Transvaal, 321
Vickers (H. M.), the Origin of the "Blotched" Domestic Tabby Cat, 208, 331
Vigor (Mr.), Relation between the Reduction in Area of Wheat in England and the Increased Yield, 182
Voisenet (E.), New Researches on Bitter Wines and the Acrylic Fermentation of Glycerol, 324
Volcanoes: New Crater in Eruption near Dormant Geyser of Waimangu, 115

Vuillemin (Paul), a Natural Preventative to the Oak-tree Disease, 555

Waddell (Lieut.-Colonel L. A.), Collection of Books and Manuscripts from Lhasa, 542
Wagner (Dr. Arthur), die Temperatur Verhältnisse in der freien Atmosphäre [Ergebnisse der internationalen unbemannter Ballonaufstiege], 42
Wagner (W.), die Hiede, 326
Wahnschaffe (Prof.), Glacial Erosion, 441, 442
Walcott (Prof. C. D.), Eyes of Trilobites, 371
Walden (P.), Electrolytic Conductivity of Non-aqueous Solutions at Low Temperatures, 84
Walker (Dr.), Glandular Structures Supposed to Form Part of the Postate Gland in Rats and Guinea-pigs, 82
Walker (Dr. Gilbert T., F.R.S.), Meteorological Conditions prevailing before the South-west Monsoon of 1910, 118; on the Meteorological Evidence for Supposed Changes of Climate in India, 178
Walker (Dr. H.), Variation of Young's Modulus under an Electric Current, 30
Waller (Prof. A. D.), Method for the Quantitative Estimation of Hydrocyanic Acid in Vegetable and Animal Tissues, 60; Comparative Toxicity of Theobromine and Caffeine as Measured by their Direct Effects upon the Contractility of Isolated Muscle, 62
Walther (Prof.), Pre-Cambrian Fauna, 442
Walton (A. J.), Fractures and Separated Epiphyses, 361
Wanderer (Dr. K.), Local Races of the Musk-ox, 211
Ward (Francis), Marine Biological Photography, 10
Waring (G. A.), Pioneer Work in Southern Oregon, 122
Warner (Miss), the Perseid Meteoric Shower, 248
Washington (Mr.), Molecule Corresponding to Soda-anorthite in a Felspar from Linosa, 375
Wassertiere, die Ernährung der, und der Stoffhaushalt der Gewasser, Prof. August Pütter, 5
Wassilieff (Dr. A.), Japanische Actinien, 34
Water: Results of the Chemical and Bacteriological Examination of London Waters, Dr. Houston, 212; Metropolitan Water Examinations, Dr. Houston, 246; the Colours and Spectrum of Water, T. W. Backhouse, 530
Water Vapour on Mars, Prof. Campbell, 317; Prof. Frank W. Very, 495
Watson (Arnold T.), the Formation and Arrangement of the Opercular Chætae of Sabellaria, 549
Watson (H. E.), Molecular Weights of Helium, Neon, Krypton, and Xenon, 18
Watson (Dr. Malcolm), Prevention of Malaria, 340
Waugh (F. A.), the Landscape Beautiful, 464
Webb (Edmund J.), Fireball of September 2, 363
Webb (G. W.), a Systematic Geography of Asia, 426
Webster (Dr. A. G.), Complete Apparatus for the Measurement of Sound, 515
Webster (Mr.), the Clover Root-borer, 18
Weckworth (E.), Occurrences of Antimony Ores throughout Peru, 217
Weed (Mr.), Chimæroid Fishes, 547
Weeds, Distribution of, 547
Weiss (Prof. F. E.), Observations on the Garden Tropæolum, 157
Weisweiller (G.), Researches on the Constitution of Vicianose, 164
Welch (Miss E. G.), Graptolitic Zones from the Salopian Beds of the Caulty District, Sedburgh, 520
Welham (Sydney), a Guide for Medicine and Surgery, Compiled for Nurses, 526
Welsh Monuments, Royal Commission on, Rev. John Griffith, 404
Wertenstein (Louis), Radio-active Projections, 261–2
West Indies, Health Progress and Administration in the, Sir Rubert W. Boyce, F.R.S., 174
Westinghouse (G.), Extended Distribution of Electricity for Industrial Purposes, 155
Westphal's Comet, 1852 IV., Search-ephemerides for, A. Hnatek, 545
Whatney (Miss G. R.), Graptolitic Zones from the Salopian Beds of the Caulty District, Sedburgh, 520
Whetham (W. C. D.), Heredity at the Church Congress, 431
White (F. M.), Handling Locomotives at Terminals, 155
White (Mr.), Synthetic Study of Diopside and its Relations to Calcium and Magnesium Metasilicates, 375
Whitford (H. N.), Dipterocarp Trees in the Philippine Forests, 56
Whitlock (F. L.), Playing-grounds and Nests of the Yellow-spotted Bower-bird (*Chlamydodera guttata*), 186
Wibeck (E.), Beech Forests in Sweden, 56
Wickham (Dr.), Radium Treatment, 153
Wiedemann (Prof. E.), Arabian Astronomical Instruments, 472
Wild Plants on Waste Land in London, 184
Wilde (Dr. Henry), Origin of Cometary Bodies and Saturn's Rings, 522
Wilderness, Our Search for a, Mary Blair Beebe and C. William Beebe, 525
Willard (Hobart Hurd), Determination of Atomic Weights, 207
Willensakt und das Temperament, Ueber den, Prof. Narziss Ach, 199
Williams (C. H. Greville, F.R.S.), Death and Obituary Notice of, 14
Williams (Dr. C. Theodore), Importance of Predisposition, 508
Williams (F. N.), *Prodromus Florae Britannicae*, 342
Williams (Dr. H. S.), the Science of Happiness, 202
Williams (Dr. Stenhouse), Effect of an Increased Percentage of Oxygen on the Vitality and Growth of Bacteria, 181
Wilmore (Dr. A.), Relations of Uralite and other Secondary Amphiboles to their Parent Minerals, 372
Wilson (Prof. E., and W. H.), a New Method of Producing High-tension Electrical Discharges, 554
Wilson (Prof. James), Lord Morton's Quagga Hybrid and Origin of Dun Horses, 328, 494
Wilson (William), New Globe-map of the World, 552
Wilson (Mr.), Rediscovery of Brooks's Periodical Comet (1889 V), 1910*d*, 438
Wilson-Barker (Commander D.), Tests for Colour-vision, 363
Wiltshireite, a New Mineral, Prof. W. J. Lewis, F.R.S., 203
Wimperis (H. E.), Use of an Accelerometer in the Measurement of Road Resistance and Horse-power, 553
Windsor Castle, Edward Thomas, 138
Winkler (Dr. Wilhelm), Death of, 47
Wirbeltiere, die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der, Prof. A. A. W. Hubrecht, 134
Wireless Telegraphy: Energy Relations of Certain Detectors Used in Wireless Telegraphy, Dr. W. H. Eccles, 195; Wireless Messages a Distance of 3500 Miles, Mr. Marconi, 400; Wireless Telegraphic Messages Transmitted between Clifden (Galway) and Buenos Aires, Mr. Marconi, 435
Wolf (Dr. Max), Halley's Comet, 19; Observations of Comets, 213
Wolff's (Christian) Ontologie, uber, Hans Pichler, 294
Wolk (Daffy), Aluminium Nitride, its Preparation and Fusion, 164
Wood (H. B.), Original Source and Spread of Bubonic Plague, 149
Wood (H. E.), Snowfall in the Transvaal, 543
Wood (Prof. R. W.), Experimental Study of Fulgurites, 70; the Determination of Stellar Radial Velocities, 86; How to Take Photographs with Infra-red and Ultra-violet Lights, 215; the Thomas Young Oration at the Optical Society, 443
Wood-Jones (Dr. F.), Coral and Atolls, 432; the Cocos-Keeling Atoll, 528
Woodcock (R. C.), the Rideal-Walker Test, 156
Woodford (C. M.), Stone-headed Axe from Rennell Island, 314
Woodhead (Prof. Sims), Results of Sterilisation Experiments on Cambridge Water, 63; Standardisation of Disinfectants, 156
Woods Hole, the Biological Laboratories at, Francis B. Sumner, 527
Woodward (C. J.), A.B.C. Five Figure Logarithms and Tables for Chemists, including Electrochemical Equivalents, Analytical Factors, Gas Reduction Tables, and other Tables Useful in Chemical Laboratories, 360

Woolsey (J. S., jun.), New Type of Resin Collector, 402
Workman (Fanny Bullock, and Dr. W. H.), Peaks and Glaciers of Nun Kun, a Record of Pioneer-exploration and Mountaineering in the Punjab Himalaya, 78
Worlds, the Evolution of, Prof. Percival Lowell, William E. Rolston, 99
Worms, the Habits of, Rev. Hilderic Friend, 397
Wright (C. Harold), Effect of Heat on Soils, 530
Wright (C. W.), the Ketchiwan and Wrangell Mining Districts, Alaska, 511
Wright (F. E.), Measurement of Extinction Angles in Thin Section, 375; Synthetic Study of Diopside and its Relations to Calcium and Magnesium Metasilicates, 375; New Views on Quartz, 375; Binary Systems of Alumina with Silica, Lime, and Magnesia, 375; Molecule corresponding to Soda-anorthite in a Felspar from Linosa, 375; the Ketchiwan and Wrangell Mining Districts, Alaska, 511
Wright (H. J.), Sweet Peas, 326
Wright (William H.), the Black Bear, 327
Wroczynski (A.), Action of Pressure and Temperature upon Cyanogen, 164
Wye, Kent, the Journal of the South-eastern Agricultural College, 253

X-Ray Spectra, Prof. C. G. Barkla and J. Nicol, 139

Yale University, Transactions of the Astronomical Observatory of, Parallax Investigations on Thirty-five Selected Stars by Frederick L. Chase, Mason F. Smith, and William L. Elkin, 433
Yamamoto (K.), Determination of the Effects of Atmospheres of Various Vapours on the Volt-ampere "Characteristic Curves" of the Carbon Copper Arc, 248
Yerkes (R. M.), Do Kittens Kill Mice Instinctively? 436
Young, the Thomas, Oration at the Optical Society, Prof. R. W. Wood, 443
Yunnan, Across, Archibald Little, 177

Zinc Pigments, Lead and, Dr. C. D. Holley, Dr. A. P. Laurie, 325
Zinco, Lo, Prof. R. Musu-Boy, 39
Zona (Prof. T.), Death of, 46
Zoology: Medicinal Lizards, D. Hooper, 30; Beiträge zur Naturgeschichte Ostasiens, Japanische Alcyonaceen, Prof. W. Kükenthal, die Familien der Primnoiden, Muriceiden, und Acanthogorgiiden, Prof. W. Kükenthal and H. Gorzawsky, die Familien der Plexauriden Chrysogorgiiden und Melitodiden, Prof. W. Kükenthal, Athecata und Plumularidæ, E. Stechow, Japanische Antipatharien, E. Silberfeld, Japanische Medusen, O. Maas, Japanische Actinien, Dr. A. Wassilieff, Japanische Ctenophoren, Dr. Fanny Moser, Uber japanische Seewalzen, E. Augustin, 34; Capture of a Large Female Saw-fish (*Pristis cuspidata*) on the Ceylon Pearl-banks, T. Southwell, 49; Alleged Partiality of Cobras for Music, H. O. Barnard, 49; Antarctic Pycnogons, Dr. W. T. Calman, 104; Guide to the Crustacea, Arachnida, Onychophora and Myriopoda exhibited in the Department of Zoology, British Museum (Natural History), 171; the Vertebrate Fauna of Cheshire and Liverpool Bay, vol. i., the Mammals and Birds of Cheshire, T. A. Coward and C. Oldham, vol. ii., the Dee as a Wildfowl Resort, John A. Dockray, the Reptiles and Amphibians of Cheshire, T. A. Coward and C. Oldham, the Fishes of Cheshire and Liverpool Bay, James Johnstone, 175; Remains of Subfossil Emeus and Marsupials from King Island, Bass Strait, Baldwin Spencer and J. A. Kershaw, 186; Existing Species of Wombats, Baldwin Spencer and J. A. Kershaw, 186; a Monograph of Sea Snakes, 186; Expédition Antarctique Belge, Resultats du Voyage du S.Y. *Belgica* en 1897–8–9, sous le Commandement de A. de Gerlache de Gomery, Rapports scientifiques, Zoologie—Schizopoda and Cumacea, H. J. Hansen, 205; Local Races of the Musk-ox, Dr. K. Wanderer, 211; the Orders of Mammals, W. K. Gregory, 216; Lehrbuch der Zoologie, Prof. R. Hertwig, 234; British Marine Zoology, Prof. E. W. MacBride, F.R.S., 252, 330, 396, 462; Prof. W. A. Herdman, F.R.S., 329, 396, 462; Dr. Wm. J. Dakin, 396; Teeth of Very Young White Whales (*Delphinapterus leucas*), Dr. Einar Lönnberg, 270; the Origin of the Domestic "Blotched" Tabby Cat, H. M. Vickers, 298, 331; R. I. Pocock, 298; Insectivorous Mammal *Solenodon paradoxus* of San Domingo, Glover M. Allen, 315; the International Zoological Congress at Graz (August 15–20, 1910), 318; Affinities of the Mammalia as Deduced by the Study of the Skull, Prof. Gaupp, 319; Occurrence of Hermaphroditism in Lamellibranchs, Prof. Pelseneer, 319; Colour-physiology, Dr. Paul Kammerer, 319; Power of Regulation in Echinoderm Eggs, Prof. Conklin, 319; Distribution of Species of Partula, Prof. Crampton, 319; Lord Morton's Quagga Hybrid and Origin of Dun Horses, Prof. James Wilson, 328, 494; Prof. J. C. Ewart, F.R.S., 328, 494; an Interesting Donkey Hybrid, R. I. Pocock, 329; the Spotted Kudu, R. Lydekker, F.R.S., 396; Zoological Work in India, 406; Variation in Indian Rats, Dr. R. E. Lloyd, 407; Life-histories of Northern Mammals: an Account of the Mammals of Manitoba, Ernest Thompson Seton, 423; the Habits and Distribution of Scutigera in India, A. D Imms, 429; Coral and Atolls, F. Wood-Jones, 432; the Cocos-Keeling Atoll, Dr. F. Wood-Jones, 528; The Reviewer, 529; European Hedgehog, E. Hollis, 437; Science in Modern Life, Zoology, Dr. J. Ainsworth Davis, 464; List of the Zoological Gardens of the World in September, 468; Structure, Development, and Significance of the Parietal Eye of Saurians, Dr. M. Nowikoff, 469; a History of British Mammals, G. E. H. Barrett-Hamilton, 493; Death of John Willis Clark, 468; Obituary Notice of, Dr. Sidney F. Harmer, F.R.S., 501; Nomenclature in Zoology, 503; Tierbau und Tierleben in ihrem Zusammenhang betrachtet, Prof. R. Hesse and Prof. Franz Doflein, 1, Der Tierkörper als selbständiger organismus, Prof. Richard Hesse, 538; the Zoological Region of South Africa, J. Hewitt, 542

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

THURSDAY, JULY 7, 1910.

THE LAWS OF HEREDITY.

The Laws of Heredity. By G. Archdall Reid. With a diagrammatic representation by Prof. H. H. Turner. Pp. xi+548. (London: Methuen and Co., Ltd., 1910.) Price 21s. net.

DR. ARCHDALL REID confesses that he is an "extreme Darwinian." It is interesting that he has reached this position from the study of the human species. He finds that this "vast field of research has been left practically untilled by students of heredity." He is not, properly speaking, a naturalist; in fact, he has rather a poor opinion of naturalistic work, and especially, I am sorry to say, of botanical. This is the more remarkable as Darwin himself loved "to exalt plants," and largely drew upon their study for his theory. The author is, however, a physician who, unlike most of his calling, is not satisfied with being empirical. He finds himself "able to watch, under conditions ensuring great accuracy, the tremendous and crucial experiments made by nature." With many of his results we are already familiar from his previous writings. They are beginning to obtain general acceptance; in proportion as they do so, they must profoundly change our mode of dealing with social problems of the utmost importance.

The object of the present work is apparently to set out the results of his investigations in a systematic form, and to show that they can be exhibited as deductions from widely accepted principles. The method has undoubtedly the advantage that it has enabled him to look at the whole subject from a new point of view, and to bring a very acute criticism to bear upon a good many questions on which opinion at the moment is much divided.

As Mill long ago pointed out, all science tends to become deductive, and biology cannot be excluded. But the progress which any particular science can make in this direction altogether depends on the certainty which attaches to the assumptions or propositions with which we start. And where the phenomena, as in the case of biology, are complicated and obscure, the difficulty must always arise as to whether the proposition we start from is really exhaustive of the fact. The validity of the conclusion cannot exceed that of the premises. Lord Kelvin's attempt to determine the age of the earth is an example. The conditions of the problem have proved to be insufficient, and I suppose no physicist would now refuse an evolutionist a blank cheque as to time.

Darwin himself linked together a number of separate inductions into a more comprehensive one from which he then argued deductively. Dr. Archdall Reid has continued the process, and in the first ten chapters of his book has attempted a synthesis of existing evolutionary theory. It is to be noted that when this is done the order of exposition is rarely that in which discovery was made. This is well known, for example, to be the case with the text-book treatment of the Newtonian theory. The process is, however, valuable, as it not merely brings to light a clear chain of causation, but by vigorously testing the strength of each link, often reveals unsuspected weakness, and may even suggest new discovery.

The author accepts and starts from Weismann's theory of the continuity of the germ-plasm. From this he makes the fundamental deduction that "individuals, for example, men, are nothing more than dwellings which the germ-plasm builds about its germinal descendants." Thence it follows "that the child inherits nothing from his parent." What it does inherit is nothing more than what was "inborn" in the germ-plasm from which it started. The germ-plasm, under the stimulus of nutrition, reproduces itself, and also produces the enveloping soma. But the latter also requires the stimulus of use ("injury" may be regarded as use with a minus sign), as well as that of nutrition: a limb will not reach full development unless used, and mental powers will remain dormant unless exercised. But the characters so developed are "rooted, as it were, in the germ-plasm." They flow from it: the question which has long divided biologists is whether modification of those characters produced by the stimulus of use can flow back and be transmitted to a succeeding generation. Darwin latterly apparently thought they could.

Herbert Spencer built upon their doing so his ethical system. "Most biologists reject the Lamarckian doctrine," on the ground that it is against the weight of evidence. That is my own position. But the author himself admits that there is some evidence in its favour, yet unhesitatingly also rejects it on deductive grounds. The argument is rather subtle; but it amounts to this: a character which develops under the stimulus of use cannot develop under the stimulus of nutriment alone. If it did so it would be "a miracle." But I am not sure that this is not an assumption. In a unicellular organism the soma and germ-plasm are identical, and as we rise in the scale of plants the separation of the germ-plasm is far from being as complete as it is in animals. In many plants, as in the well-known case of Begonia, a somatic cell will reproduce the whole individual, germ-plasm and all. I am not prepared to assert that the new germ-plasm is free from derived somatic influence. On the other hand, I know of no reason to think that it is not.

The Lamarckian doctrine being dismissed, natural selection is examined. Like Prof. Karl Pearson, Dr. Archdall Reid infers this immediately from "selective mortality" in mankind. He points out that this cannot be proved in the case of "wild plants and animals," but "presumably" it occurs. I doubt if disease is a dominant selective factor in nature, though no doubt it has been occasionally operative, and on a large scale. He puts the theory on too narrow a basis, and ignores the struggle for existence. What plants have to fight for is room to perfect their seeds and space for them to germinate.

This is not the only short cut to the root of the matter. "The plain fact that living beings are able to exist is a proof of adaptation." It does not appear to me to be self-evident, though Paley would probably have agreed. Anyhow, it is rather like trying to enter Darwinism by the back-door instead of toiling up the steps. I collect a somewhat better argument. Man is "manifestly a bundle of adaptations." "The growth of modern physiology implies merely an increased power of interpreting human traits in terms of their utilities." "Presumably adaptation is not less perfect in plants and lower animals than in man." Yet, as Rolleston used to tell us at Oxford, that sort of statement would not convict a poacher. Fortunately, evolutionists have a better case for the court.

Next we come to variation, which affords the material for natural selection to work upon, and some important conclusions are arrived at. Excluding any possible influence of the soma, and I agree, variation must be resident in the germ-plasm. "Reasoning by analogy," it is inferred that this is itself "established and maintained by natural selection." This involves the paradox that it preceded that which produced it. "Its origins are lost in obscurity." No doubt; but if I may try my own hand at deduction, I would suggest that primitive variation was a necessary consequence of molecular instability, and as I regard natural selection as a sort of physical principle like "least action" or gravitation, it would begin to operate at once.

The most fundamental point in the whole argument is the relation of the germ-plasm to the environment. Here two classes of facts have to be faced; first, the undoubted one, on which I have often insisted, that a few years' cultivation of a wild species breaks down its stability; and, secondly, such cases as the supposed degeneration of European dogs in India. I can only accept variation at present as an unresolved phenomenon. I have never contended that the environment could act as more than a stimulus to it, and I have no doubt that it does. Someone has used a better expression in saying that it pulls the trigger. To suppose that it has any directive action lands one at once in Lamarckism. The degeneration question is much more serious. To attempt to get over it by saying that "evolution is never perfect" and that "exceptions occur" is not "facing the music." Now this story of the degeneration of domestic animals and plants is an obsession in India. I have had occasion to test it in the case of the latter, and satisfied myself that it was due to mongrelising; and, as to Clayton's beans, I completely exploded a similar case in Arabis some years ago in these pages. My own conclusion is that variation is inherent and spontaneous in the germ-plasm; and the "germinal power of resisting enforced change" is an undoubted fact which manifests itself in "specific stability."

The varying germ-plasm inherits and transmits variations. Thus we are led to the thorny question of recapitulation. Sedgwick agrees that it is "a deduction from the theory of evolution," but that it "is still without satisfactory proof." On the other hand, in the same volume, W. B. Scott finds that in brachiopods, "in the more advanced genera, the developmental stages clearly indicate the ancestral genera of the series." The botanist is constantly running up against recapitulative structures. When he finds a trace of a prothallus in a flowering plant and a spermatozoid in the pollen-tube of Salisburia, it is difficult to avoid the conclusion of Bower that land-plants had aquatic ancestors. We must, however, agree with Prof. Sollas that "nature no doubt is a strict adherent to logic, but she betrays a singular want of method in recording the steps of her argument."

Dr. Archdall Reid thinks, and no doubt rightly, that "the main reason against a full acceptance of the Darwinian doctrine" is "the retrogression of useless parts and organs." His solution of this difficult problem is one of the most novel and interesting things in his book, and will probably be subjected to most criticism. Thirty-two yearlings, costing 51,520 guineas, only produced two winners. From this and similar cases he draws the inference that retrogression preponderates over progression. He accounts for it by supposing that there has been a selection of germ-plasms which "tended on the whole to vary retrogressively." But retrogression in turn "is checked only by selection." The difficulty at once arises to reconcile this view with the biometric result which he admits, that "variation tends to occur about equally about the specific mean." Incidentally it may be noted that he identifies retrogression with reversion.

The various solutions of the problem which have been attempted are discussed. There is a risk that the terminology used may cover a *petitio principii*. Given an organism, how is it to be adapted to a different environment? The adjustment may be effected by further complication or by simplification. It may be noted that in regard to the latter there is a close parallel in the evolution of machinery. Whole trains of mechanism are continually being swept away with an increase of efficiency. Compare, for example, a turbine with a marine engine. Here structural retrogression has made for functional progression. We owe it to Lankester for pointing out that "degeneration" is really simplification leading to closer adaptation. Progress in biology is not ethical, but position in the phyletic scale. The last of the Plantagenets is said to have kept a turnpike; but he may have been not the less authentic.

The instability of prize-bred domesticated races requires careful scrutiny. The late Duke of Devonshire pointed out to Lankester that racehorses are bred for speed and not for "points." The conclusion that I draw from Sir Walter Gilbey's facts is that breeders have not yet succeeded in fixing this particular quality. But short-horns, which are bred for points, have reached a high degree of stability; if they had not no one would give a thousand guineas for a bull. The purchase of a possible racehorse is confessedly a gamble. For my own part, I am content with Lankester's view that nature "with remorseless thoroughness" can throw overboard hereditary tendencies, if it is advantageous to do so; and this is really the same thing as Dr. Archdall Reid's selection of retrogressive germ-plasms, except that he throws on natural selection the burden of defeating its own aim.

Apart from speculation, we have in Galton's law of regression to mediocrity an empirical result which is perfectly general inasmuch as it deals impartially with excess and defect. It produces "a sensible stability of type and variation from generation to generation." It has always appeared to me the most important positive addition to the Darwinian theory, and it has seemed possible that it would open the door to a mechanical explanation of retrogression, or, as I prefer to say, of simplification; and this is apparently in Archdall Reid's mind, as he remarks that "regression is but the first phase of retrogression," though he has not followed it out further. Regression is independent, apparently, of natural selection, while retrogression is not.

This leads to another point which is often overlooked. The mere "maintenance of a structure" is dependent on the continued action of natural selection. As Poulton insists, it is by its operation that "all functional parts of an organism are kept up to a high standard." It may be a private heresy of my own, but I can attach no more meaning to the "cessation" and "reversal" of selection than if those terms were applied to gravitation.

The chapter on Mendel's laws is altogether admirable. It is probably the most luminous account of them which has been published. "There can be no doubt of the actual occurrence of the Mendelian phenomena. We must, endeavour, therefore, to estimate the part played by them in nature." Now where species or stable varieties are crossed we get simple blending, as in the Mulatto. "Mendelian reproduction is one of the rarest things in nature." "Mendelian traits . . . are common only when artificial varieties . . . are crossed by man." It would be impossible with any justice to attempt to summarise the argument. The majority of Mendelian traits "are concerned with reproduction." The illuminating conclusion, in which, however, the author finds himself anticipated by T. H. Morgan, is reached that they are analogous to sexual characters which are alternative, *i.e.* are latent or patent in the opposite sex. If this explanation holds good, and it has the obvious merit of including phenomena not obviously connected at first sight, it effectually disposes of "segregation"; and "unit-characters" necessarily follow. But their existence had already become precarious, for Prof. Karl Pearson kindly informs me that he has entirely failed to discover any which, to put it briefly, can be described as having unitary properties. It is pointed out that the inheritance of mutations is alternative, and the inference is drawn that characters which blend in crossing cannot have arisen as mutations.

Lastly, we come to the "Function of Sex." This is found to be an adaptation "to blend parental characters." Further, it is concluded that "blending, with its swamping effects . . . eliminates useless characters and variations." This at once explains retrogression, and at bottom on this head there is probably not much difference between Lankester and the author. Mutations are alternative and Mendelian; fluctuations are blended; whence Galton's law of regression and stability at once follows. "The average experience of the whole race . . . becomes the determining factor in evolution."

Two incidental points deserve notice. Parthenogenesis "occurs as a rule amongst simple forms." But it is found to occur much more frequently than was supposed amongst flowering plants; the dandelion is an example. Still, it may be presumed that sexual reproduction and cross-fertilisation occasionally occur. Fertility, both on biometric and general grounds, is thought to be a transmissible adaptation. Karl Pearson has, however, arrived at the important conclusion that there is "little or no demonstrable inheritance of fertility." Further, he is "forced to the conclusion that the smallness of the hereditary factor in fertility is an essential feature of Darwinian evolution." It is interesting to note that in this case deductive reasoning has led to diametrically opposite conclusions.

This disposes of the first part of the book. I do not know that I have come across anything more suggestive on the subject since the "Origin" itself. It may be added that Prof. Turner has thrown the main argument into a quasi-mathematical shape in the appendix. The latter and larger portion of the book is difficult to review in any reasonable space. It is a striking commentary on the contention of de Vries that organic evolution has nothing to say on social problems. It ranges over a wide field, including even a short system of philosophy, and will probably be found the more interesting because the least technical, and might well have been published separately.

Disease and immunity are admirably discussed. Races become tolerant through selection working on germinal variation. Protoplasm learns to neutralise toxins. Twenty years ago I ventured with bated breath to hint the possibility of its education. The result is that the microbe and not the sword is the ultimate "empire-builder"; and subject-races will either absorb or expel their conquerers. The argument is extended to alcohol and narcotics. All races who win their freedom from vicious indulgence must first be slaves to it. Insusceptibility to its charm, though not precisely parallel to disease-immunity, is, like it, a product of germinal variation. Meanwhile, selection slowly eliminates those who do not possess it. If it is true that the English are the most drunken of existing races, and that "about one death in seven" amongst them is due to alcohol, it has its work cut out for it. Still, it is at work; and any attempt to interfere with it by the total suppression of alcohol would simply result in the production of a more susceptible race.

Fortunately, though susceptibility is germinal, indulgence is an acquired habit. It follows that the children of drunkards will not necessarily follow in their parents' steps, and Karl Pearson confirms this from biometric data. The same reasoning applies to slum-dwellers. Here also the injury is somatic and not germinal, and would disappear if the conditions were improved; it is not transmitted, but reproduced in the offspring, which the experience of Dr. Barnardo's Homes shows is still capable of healthy development. Slums are continually recruited from outside; it is probable, therefore, that little, if any, germinal mischief has been produced. But it can be shown on Dr. Archdall Reid's own principles that, given time, an adapted and degenerate race would develop, which would be parasitic on the community, and probably prolific.

The chapters on mind I must leave to the psychologist. Lankester is followed in seeing in "the relatively enormous size of the brain in man and the corresponding increase in its activity and capacity," the fundamental distinction between man and other animals. "Educability is nothing more than a power of growing mentally under the stimulus of experience." This is inherited, while the resulting mental acquirements are not. The real test of education is the *quality* of thinking produced. I cannot, however, follow the author in his condemnation of Karl Pearson's Huxley lecture, the conclusions of which I believe to be, not merely perfectly sound, but of the deepest importance. Dr. Archdall Reid tells us that "ability is inborn"; Karl Pearson says it is "bred." I fail to see the distinction. Feeble-mindedness is found to consist in "incapacity to learn" and to be a "reversion to a pre-human mental state." Being germinal, it is inherited, and the community is justified in restraining its marked fertility.

Here I must conclude my review of a very remarkable book; the more remarkable as it is the work of a man somewhat aloof from the scientific world, and written as the recreation of a strenuous professional life. The author invites criticism, and I have not stinted it. He will doubtless get plenty more.

Perhaps Dr. Archdall Reid's more vulnerable point is the superior certitude which he (and Dr. Donkin) claim for deduction over observation and experiment (which is only observation of facts not immediately patent). It is true that when we come across an apparently irreconcilable fact, its improbability depends on the certitude of the law with which it conflicts. It may be due to experimental error in its widest sense; but it may be the germ of a new discovery. Newton laid aside his theory for a time because he could not reconcile it with the moon's motion. But Greenwich did not abandon it when it was found that the path of Halley's comet was not an ellipse. Certitude is built up by accumulated verification. Even mathematics, which are purely deductive, cannot wholly dispense with it. It was long thought that the conversion of linear into circular motion was impossible until Peaucellier effected it. And even so distinguished a mathematician as Sylvester once told me that he had published a number of theorems which, when tested arithmetically, proved to be untrue. Experiment cannot always wait on deduction. Röntgen's great discovery was an accident. A discrepancy in the weight of nitrogen revealed argon. It would possibly have been a long time before physicists found out for themselves Brownian motion and osmotic pressure unless botanists had done it for them. Darwin found by experiment that cross-fertilisation was advantageous to plants, and it is difficult to see how the fact could have been arrived at in any other way.

Huxley must have projected a prophetic eye into the future when he wrote:—

"The great danger which besets all men of large speculative faculty, is the temptation to deal with the accepted facts in natural science, as if they were not only correct but exhaustive; as if they might be dealt with deductively, in the same way as propositions in Euclid may be dealt with. In reality every such statement, however true it may be, is true only relatively to the means of observation and the point of view of those who have examined it. So far it may be depended upon. But whether it will bear every speculative conclusion that may be logically deduced from it, is quite another question."

The warning is not unneeded in many directions. It is, I think, particularly needed in regard to Dr. Archdall Reid's impatience with biometry and taxonomy, or rather, I should say, imperfect acquaintance with their aim and methods. He appears to think that biometric method begins and ends with mere enumeration. But such a research as that of Karl Pearson on the distribution of stars in space would show him that it goes a good deal farther. As Karl Pearson tells us, biology "has now developed theories of such complexity, that without the aid of the highest mathematical analysis it is wholly unable to state whether its theories are accurate or not." For my part, when a distinguished mathematician is willing to devote his splendid gifts to the task, my attitude is not querulous, but one of profound gratitude.

And taxonomy is even less a ground for impatience. For, as Linnæus saw, its real aim is to embrace all organisms in a natural classification. The principle of descent is implicit in this, and it was therefore towards it that all taxonomists were unconsciously working. Far from being hostile, it was amongst the systematists—Hooker, Asa Gray, Bentham, Bates, and Wallace—that Darwin found his most ardent champions.

W. T. THISELTON-DYER.

THE METABOLISM OF MARINE ANIMALS.

Die Ernährung der Wassertiere und der Stoffhaushalt der Gewässer. By Prof. August Pütter. Pp. iv+168. (Jena: Gustav Fischer, 1909.) Price 5 marks (unbound).

TWO years ago Prof. Pütter published three papers dealing with the metabolism of marine animals. The thesis advanced as the result of these investigations may be briefly summarised as follows:—the nutrition of a very great number of marine animals belonging to all phyla is not effected in the manner characteristic of the mammal, that is, by the ingestion of solid organised food, and by the subsequent digestion and absorption of this matter by special organs, but by the direct absorption of carbon and nitrogen compounds which are contained in solution in the sea. The notion that many animals were really saprozoic in their habits was not really a new one; most internal parasites, whether provided or not with an alimentary canal, obviously exhibit such a mode of nutrition; but the hypothesis that animals living in the open feed otherwise than by the ingestion of solid organised food, or by the utilisation of photosynthetic products elaborated by the activity of commensal algæ, was a new one, and has provoked much discussion. Pütter's methods have been criticised by Henze and Lohmann, and the paper now under review amplifies the author's former work, and to some extent meets the criticisms advanced.

The proof of the thesis is developed along three main lines. The author has studied the intensity of metabolism in a number of forms, and has found that this is proportional to the unit of surface, and not to the unit of mass. Therefore the relatively minute organisms which are found among the plankton, or even those larger animals which are provided with a large absorptive surface in the shape of gills, ctenidia, respiratory plumes, &c., and internal diverticula, are able to utilise the exceedingly dilute solution of organic carbon and nitrogen compounds contained in sea water. The intensity of metabolism is measured by the oxygen consumption and the carbonic acid output, and, generally speaking, the rate of exchange is, roughly, constant in animals of the same general type of organisation, when it is regarded as a function of the unit of surface. The divergencies from this approximately constant rate are to be regarded as dependent on the deviations from the usual mode of metabolism characteristic of the animal group considered.

The second line of proof depends on the existence of compounds of carbon other than carbonates, and compounds of nitrogen other than ammonia, nitrates, and nitrites, in solution in sea water. From the author's point of view the sea is an immense storehouse of dissolved food-stuff, which is utilised by most marine animals. In his first papers, Pütter estimated that the water of Naples Bay contained some 65 milligrams of organic carbon (volatile and higher fatty acids, and carbohydrates) per litre. Shortly afterwards Henze showed that the amount was greatly over-estimated, and that the proportion of such substances present was so small that it lay within the limits of error of the experimental methods employed by Pütter. Raben, however, showed that the water from the North Sea and Baltic did actually contain measurable quantities of organic carbon varying from about 3 to 37 milligrams per litre. If these results should be confirmed, they would back up Pütter's hypothesis, since the solution would then be sufficiently concentrated to act as a food medium.

The third line of proof is much stronger, but it depends on the author's estimates of the rate of exchange of oxygen and carbonic acid in the animals studied. Taking the case of plankton-feeding creatures, he shows that it is, in most cases, impossible that a sufficient amount of food can be obtained from the plankton to account for the rate of metabolic exchange. A sponge (Suberites), for instance, of some 60 grams weight required about 0·92 mgrm. of carbon per hour. Now taking a certain density of the plankton, this postulated that the sponge would have to pass some 242 litres of water through its canal system in order to get the necessary food-stuff from the plankton. It is quite impossible, of course, that the animal can filter this volume of fluid in the time. It has been shown by Lohmann that Pütter underestimated the density of the plankton, and by Henze that he over-estimated the concentration of the sea water in carbon compounds. But when the revised values are substituted, the argument is not materially affected. A further instance of the same nature is that of the copepod Calanus. If this animal feeds exclusively on plankton diatoms it must ingest some 16,000 medium-sized Coscinodisci, or about ten millions of Thalassiosiræ, in order to account for its metabolic exchange. Such figures appear to preclude the possibility of an exclusive feeding on diatoms.

It is, of course, quite probable that marine animals may feed in the same way as internal parasites, by absorption of dissolved food-stuff, and that this mode of nutrition may proceed simultaneously with that depending on the existence of an alimentary canal. If the metabolism of the lower invertebrates had been studied as carefully as that of the warm-blooded animal, this contention might have been accepted long ago. It is mainly by analogy with the latter that we ascribe respiratory functions to the structures called gills; they might just as reasonably be regarded as organs for absorption of food-stuff. However this may be, it appears from the work now noticed that the conclusions are only very probable ones until the data representing the rate of exchange of oxygen and carbonic acid have been critically revised. The proof or disproof of the author's thesis will be effected by such revision.

J. J.

SMALLPOX AND VACCINATION IN BRITISH INDIA.

Smallpox and Vaccination in British India. By Major S. P. James. Pp. xi+106. (Calcutta: Thacker, Spink and Co., 1909.) Price 7*s.* 6*d.*

AT a time when the study of tropical diseases is setting its indelible mark on the history of the progress of medicine, it is well to be reminded that in the tropics we have diseases that can by no means be considered exclusively tropical.

Major James's work deals with smallpox in India, that is, in a country, as the author bids us bear in mind, where the people

"live amid surroundings which could not be more favourable to the spread of epidemic disease if they had been especially devised to that end."

In a country "where sanitation is still in its infancy," where a continually growing proportion of the population lives in the towns and cities, where there is an enormous and continued extension of movement among the population and of communication within the country generally, where that typical "insanitary" disease, cholera, has on the whole increased, and where, in spite of all this, smallpox has decreased. Those who have studied the decline or disappearance of smallpox in other countries know that there is one, and only one, factor which could explain such a phenomenon, viz. vaccination; and that vaccination is the cause of the decline in India the author shows in plain and easily understood language, and with the aid of simple statistics that require no alleged "jugglery" for their setting forth.

Although there is a general belief that inoculation, the precursor of vaccination, was in use in India from time immemorial, yet the author adduces evidence that in modern times, where we have trustworthy information, it was entirely unknown in certain provinces, but he does not suggest any explanation of this curious discrepancy. Where inoculation was practised it was apparently done with marked success, but the regulations attending it were strict. At a later period, when irregularities in the practice arose, it became one of considerable danger, and was gradually superseded by the introduction of vaccination.

In chapter iii. is given a short account of the origin of vaccination from the first introduction of human vaccine threads into India in 1902 down to the use of calf lymph at the present day. It is interesting to note the opposition to vaccination in Bengal, as a few years ago the writer experienced there perfectly irrational opposition to the making of finger-pricks for simple blood examinations.

The following simple tables will suffice to give an idea of how smallpox had decreased from periods in which there was "less" vaccination to those in which there was "more," but to be fully appreciated the original data in Major James's book should be consulted.

	1868–1887 Smallpox death-rate per million of population	1888–1907 Smallpox death-rate per million of population
Bombay	537·2	240·5
Central Provinces	1020·1	502·7
Punjab	1099·3	520·7
Madras	1163·9	673·0
Berar	1083·1	183·0
British India as a whole	1032·3	466·0

If these latter figures are compared with the chart of the total number of vaccinations performed in British India, it will be seen at once that the fall in smallpox mortality coincides with the rise of vaccination.

Another method which is independent of statistics of population is to consider the proportion which smallpox deaths bear to the total deaths from all causes in two periods, one with "less" and the other with "more" vaccination. If an "epidemic" is now arbitrarily defined as one in which the deaths from smallpox form 5 or more per cent. of the deaths from all causes, we get the following data here put in tabular form:—

	1868–1887 No. of epidemics	1888–1907 No. of epidemics
Central Provinces	5	0
Punjab	7	0
British India as a whole	9	0

Another interesting observation is that prior to 1886 the attack rate among natives was always greater than among the European troops, but that after this date the position was reversed. The explanation given by the author is that since 1885 vaccination and successful re-vaccination have been less carefully attended to among Europeans than among native troops, and figures are given showing that among Europeans in 1906 there were more than 20,000 individuals without any marks or record of vaccination—a sufficiently lax condition of affairs—but the proof to be complete should have given the corresponding figures for the native troops. Another very interesting table is that showing the constantly greater incidence of smallpox among the wives of European soldiers than among the men, while as regards cholera and enteric fever the reverse is the case. The difference is due, no doubt, as the author points out, to the almost total absence of successful re-vaccination among the women. To the table there should, we think, have been added the "strength" of the women.

Other equally convincing tables are given, invariably pointing to some factor (vaccination) influencing the figures in the same direction; the tables, moreover, have the merit of being simple, though, as the author points out, if subjected to analysis they would be even more convincing, if that were necessary.

The laborious task the author set himself has been well done. We are not aware what steps are taken in India to explain the merits of vaccination to the people, but nothing could do so better than this book, or a short digest of it if that be possible.

THE ALTERNATE-CURRENT THEORY.

The Foundations of Alternate Current Theory. By Dr. C. V. Drysdale. Pp. xi+300. (London: Edward Arnold, 1910.) Price 8s. 6d. net.

IN English text-books on electrical engineering one finds occasionally an attempt to elucidate some property of an electric circuit by a mechanical model. A favourite analogy is a water-tank with pipe and stop-cock. The head of water represents E.M.F., the pipe takes the place of the conductor, the stop-cock that of the switch, and the flow of water represents the current. Also, a railway waggon with buffer-springs is often used to explain inductance and capacity. These analogies are, however, only used as additional explanations of a theory built up independently of them. In the present book they are the theory itself, or rather the foundation on which the author builds up the theory of alternating-current working. Hence it becomes a matter of the greatest importance that the mechanical properties of the particular model chosen should not merely approximately, but with mathematical precision, represent the corresponding electrical properties of the circuit it is intended to represent.

It becomes thus necessary to idealise the mechanical model by attributing to it properties which differ more or less from those it actually has in its natural condition. Take as an example the conceptions of electric current and ohmic resistance. According to the author's "foundations," these are respectively represented by speed (linear or angular) and friction. But what kind of friction? The coefficient of friction as applicable to solid bodies will not do, for this implies the existence of pressure between the surfaces in contact, and there is nothing analogous to pressure in the electrical case.

Thus one is driven to assume that ohmic resistance can only be represented by liquid friction of a particular kind, namely, of a kind which will cause the frictional resisting force to increase exactly in proportion to the speed with which a body is moved through the liquid. The author takes a boat which is towed through the water, and assumes that the pull in the tow-rope is exactly proportional to the speed. As an alternative to the tow-rope he assumes that the boat is fitted with a propeller which exerts the same thrust at all speeds, and he uses this model to illustrate the case of an inductive circuit. The mass of the boat corresponds to the inductance; the frictional coefficient, that is, the resisting force per unit speed, corresponds to the ohmic resistance, and the speed to the electric current. The E.M.F. is represented by the thrust of the propeller. Under these conditions the speed of the boat will increase by a logarithmic curve, and approach asymptotically the final value where the thrust of the propeller is exactly balanced by the frictional resistance. Thus, having discarded our conception of the real nature of ships' resistance and propeller thrust and substituted an idealised model, the performance of this model is an exact representation of what goes on in an electric circuit, and the equation of the speed of the boat is identical with the equation of the current in the electric circuit.

The author has not contented himself by merely imagining mechanical models, but has actually constructed one so as to be able to demonstrate the properties of an electric circuit. The model consists of a square frame, one side being provided with rails for a car to travel along. To represent ohmic resistance, the car can be fitted with a paddle moving in a liquid. The mass of the car represents inductance, the force with which it is pulled along stands for E.M.F., the speed for current, the displacement for quantity of electricity (coulombs), and if a capacity effect is to be shown an elastic string is attached to the car. In addition to this model, the author has others to show various electrical phenomena, all of them very ingenious and instructive, especially when he shows side by side curves of harmonic motions obtained by oscillograph attached to the electric circuit, on the one hand, and, on the other, curves obtained by mechanical means from the corresponding models.

The book is divided into four parts. In the first the fundamental principles are established by mechanical analogies; then comes an exposition of harmonic motions; whilst in the third part the properties of alternating-current circuits are studied in detail, including a chapter on the symbolic method. In the fourth part we find practical applications to transformers, motors, polyphase circuits, and high-frequency oscillations. At the end we find a number of problems given as exercises for students. These are well selected.

GISBERT KAPP.

OUR BOOK SHELF.

The New School of Japan, Founded for the Purpose of Making the Use of the Newly Invented Letters. Pp. x+58. (Tokyo: Dokuritsu Bungakki.)

THIS singular production is an attempt, by means of a quaintly conceived dialogue between two Japanese script reformers, to enlist home and foreign support, especially financial support, towards the promulgation of yet another script for the purposes of the Japanese written language, by modifications of and additions to the roman alphabet of the West. But European scholars have already accomplished this, and the existing system of romanisation is sufficiently perfect for all practical purposes. That system uses the roman letters, as we use them, to transcribe the characters of the Japanese syllabary, each of which represents a vowel or an open syllable; thus *ka, ki, ku, ko, ke* represent simply and adequately corresponding simple *kana* (syllabic) characters. But the proposed system would use single alphabetic letters to represent the *kana*. Thus *ka, ki*, &c., are written *n, v, u, k*; for *ke* a sort of reversed *k* is used. The modifications of sound, voicing, doubling, and lengthening are denoted by ordinary devices and combinations of these, and a few new letters are invented. Thus *Kono hon wa, Okuma Shigeru to Yamada Eizo* . . . (this book contains a talk between Okuma Sh. and Yamada Ei.) is printed, according to the new system, *Pk cx g Ttuf-Cat m Ofr-Tict* (two or three new letters are represented here by their nearest usual ones). Eizo Yamada is the "originator" of the new system; the preface, dated November, 1909, is signed by him and Muneyasu Oki, who is "business associate," and photographs of inventor and associate follow the preface.

For our part we fail to see any advantage whatever in this proposal. Why the Japanese continue to put their thought on paper under a variety of forms that render mere decipherment an impossibility to all foreigners save a very few who have time and patience, or are under some necessity to undertake a most repulsive study of several years' duration at least, the people of Japan alone can tell. Written Japanese, mainly on this account, is more difficult to acquire, even to read merely, than Chinese, yet with a very few changes the difficulty might be very greatly lessened without change of character, and with romanisation would largely disappear. In no long course of time, probably, the unintelligent use of the Chinese ideograph would diminish, the assimilation of written to colloquial speech would develop, and Japanese would present only the ordinary difficulties incident to a strange vocabulary, a syntax based upon impersonality and lack of inflections, and a mass of idioms necessarily differing widely in allusion and reference from those of Aryan languages.

F. VICTOR DICKINS.

Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History). Vol. ii., the Cretaceous Bryozoa. By Prof. J. W. Gregory, F.R.S. Pp. xlviii+346; 9 plates. (London: Printed by order of the Trustees, 1909.)

OWING to the author's absence from England and his retirement from the staff of the Museum, a period of ten years has elapsed between the date of publication of the present volume and its predecessor. This unusual delay has, however, been by no means an unmixed disadvantage, since it has enabled Prof. Gregory to incorporate information and to take advantage of theories of classification which would not have been available had this volume appeared several years earlier. It was originally intended to complete the subject in two volumes, but the wealth of material has rendered it necessary to allot a third volume—now in preparation by Prof. Gregory's successor in the Museum, Mr. W. D. Lang—to the Chilostomata.

In concluding his share of the work, Prof. Gregory gives a valuable general account of the Cretaceous bryozoan fauna and its relationships. The Cretaceous is the era in which the modern types of Bryozoa first attained to importance and replaced the older forms. The most characteristic group of the epoch is the Cyclostomata, which is now a waning type, and dates from the Jurassic. A second ordinal group, the Trepostomata, represents a Palæozoic type, which became decadent in the Upper Cretaceous, and finally disappeared in the Cænozoic. On the other hand, the Chilostomata, of which but two Jurassic species are known, attained an enormous development in the Upper Cretaceous, and forms the dominant type in the seas of to-day.

After a long review of the classification of the Cyclostomata, Prof. Gregory points out the value of the Bryozoa for zonal classification of the Chalk, remarking that recent investigations have shown—in contradistinction to older views—many of the species to have a very restricted vertical distribution.

The work is a most valuable and trustworthy contribution to the natural history of the Cretaceous Bryozoa, which, in Great Britain, at any rate, have previously received comparatively little attention at the hands of palæontologists.

Problèmes et Exercices de Mathématiques générales. By Prof. E. Fabry. Pp. 420. (Paris: A. Hermann et Fils, 1910.) Price 10 francs.

THIS useful collection reminds us that mathematical examinations are not peculiar to Great Britain, and provides an interesting specimen of the kind of questions set in France to candidates of about the same standing as English candidates for an ordinary science degree. It contains the enunciations of 739 problems, ranging from elementary algebra and calculus to solid geometry and differential equations, and also including about a hundred questions in statics and dynamics. Pages 81–420 contain the solutions, which, as might be expected, are clear and elegant. No book of this kind can supply the place of a competent teacher, but a student who has to work by himself will find Prof. Fabry's work very helpful, and a good model in point of style. M.

LETTERS TO THE EDITOR.

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

Arthur's Round Table in Glamorgan.

THE history of the Gorsedd of the Bards is closely bound up with the history of Glamorgan. Early in the history of the winning of the district by the Anglo-Normans, one of the earls of Gloucester, as lord of Glamorgan, took the institution under his protection and patronage, and it became known as Gorsedd Tir Iarll, "Gorsedd of the Earl's Land," and the district, comprising the parishes of Llangynwyd, Bettws, and Margam, is still called after the title of the noble patron of the bards. From about the middle of the twelfth century, the history of the institution, as well as the succession of presiding bards, is as clear as one might expect to find the history of a largely secret society to be. What history is recorded in bardic writings of the institution before that date represents it as Arthur's Round Table, moved from place to place with

The Maesteg Circle-avenue and its Builders.

the seat of government, from Caerleon-upon-Usk to Loughor, back to Cardiff, its wanderings having been confined within the boundaries of the diocese of Llandaff, until finally it found a resting-place in the Earl's Land. There is little reason to doubt the substantial truth of such records, and it is something to note that Arthur's Round Table, by name, has been all along regarded as the living institution known as Gorsedd of the Bards of the Isle of Britain.

There are bards still living who were received as members of the Gorsedd by bards who represented an unbroken tradition and succession in the Earl's Land at least from the twelfth century. One of these bards, "Morien," known also as "Gwyddon Tir Iarll," was present at the "re-awakening," in bardic parlance, of Arthur's Round Table on June 22, 1910, when a temple-observatory, which I had the honour of erecting at Maesteg, in the parish of Llangynwyd, the centre of the Earl's Land, was duly opened by the Archdruid of Wales, assisted by officers and members of the National Gorsedd, and other bards and friends of the bardic cause.

In designing the work, I endeavoured to combine the essential requirements of bardic tradition with all the ascertained principles of primitive architecture as shown in monuments of which the bardic Gorsedd is a representative. Every detail was based either on tradition or actual practice as observed in monuments. As at Avebury and Stonehenge, the avenue was added to the circle. Each stone selected has a fairly straight side, which has been utilised as an independent alignment. The avenue, as well as the tallest stone, are approximately oriented to the sun's place on St. David's Day, March 1. Three divisions of the year, and alignments to sunrise or sunset for every three weeks, are provided by the stones. The use of each stone will be found by keeping its straight side to the right. The diameter of the circle is 27 feet; the length of the avenue 54 feet; the total length of the work is 81 feet. In all such measurements, the Gorsedd rule that all extensions should be in threes, or multiples of three, was observed. The width of the avenue represents the distance, as measured on the horizon and viewed from the centre stone, between Candlemas and the equinox. True to ancient practice, the westward view of the avenue is "blocked" by a stone, which otherwise represents the fashion in Aberdeenshire circles, noticed by Sir Norman Lockyer, of placing a stone at right angles to the direction required.

JOHN GRIFFITH.

Llangynwyd, Glam.

Halley's Comet.

I DO not know if the enclosed is of any general interest or not; it is an attempt to photograph Halley's comet (as seen here) without any special apparatus. The tail was about 90° long on May 17, and probably 115° on May 18,

Halley's Comet in Pisces as seen at 5.30 a.m. on May 17 with 15′ exposure.

taking the calculated position of the nucleus, which had not risen when dawn came. On May 20 (on the other side) the tail was only 15° or 20° long, but both twilight and moon interfered. It was 35° long on May 23.

JAMES MOIR.

Mines Department, Johannesburg, June 10.

Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19.

WHEN Halley's comet was passing across the sun on May 19 we took, at the central telegraph station at Stockholm, some observations of earth-currents, which were measured on two lines, Stockholm-Göteborg and Sundsvall-Stockholm. The measurements were performed from minute to minute from 0h. 40m. to 3h. 45m. a.m. (mid-European time). The geographical coordinates for the three places mentioned are the following:—

Sundsvall ...	$\phi = 62°\ 23'$ N.	...	$\lambda = 17°\ 19'$ E. from Greenwich
Stockholm ..	59 21	...	18 3
Göteborg .	57 42	...	11 58

The resistance of the line Stockholm-Göteborg was 2940 ohms, and that of the line Sundsvall-Stockholm 2336 ohms. From the current-strengths measured in milliamperes we obtain the potential differences expressed in millivolts per km. by multiplication with r/l, r indicating the ohm-resistance of the line and l the distance in km. from end to end. For calculating the components of the potential difference E.-W. (V) and N.-S. (V′) we have the formulæ

$$V = 7{\cdot}73i - 3{\cdot}32i'$$
$$V' = 0{\cdot}871i + 6{\cdot}60i',$$

i and i' indicating the observed current-strengths on the Stockholm-Göteborg and the Sundsvall-Stockholm lines. The measured current-strengths proved considerably above the normal at this time of day, though by no means reaching to that of a magnetic storm. The two components, expressed in millivolts per km. (every fifteenth minute), are as follows. The potential differences are considered positive in the directions E.-W. and N.-S.:—

h. m.	V	V′	h. m.	V	V′
0 45 ...	−55·6 ...	− 6·3 ...	2 15 ...	−16·5 ...	+24·6
1 0 ...	− 6·8 ...	+ 2·0 ...	0 30 ...	−23·5 ...	+12·7
0 15 ...	+ 3·9 ...	+ 0·4 ...	0 45 ...	−25·5 ...	+16·7
0 30 ...	− 3·4 ...	− 9·5 ...	3 0 ...	− 7·2 ..	+ 1·3
0 45 ...	− 6·2 ...	+ 4·2 ...	0 16 ...	− 0·4 ...	− 5·6
2 0 ...	− 8·0 ...	+15·8 ...	0 30 ...	− 8·8 ...	−10·2
			0 45 ..	−16·9 ...	+ 2·9

The greatest disturbances occurred shortly before and after 2h. a.m.: V max. = +68·1, V′ max. = +56·6 millivolts per km.

D. STENQUIST.
E. PETRI.

Leptocephalus hyoproroides and L. thorianus.

IN my paper "On the Occurrence of Leptocephali (Larval Muraenoids) in the Atlantic West of Europe" (*Meddelelser fra Kommissionen for Havundersøgelser*, Serie Fiskeri, Bind iii., No. 6, 1909, p. 12, Pl. i., Fig. 8, Pl. ii., Figs. 1–7), I have described and figured a hitherto unknown Leptocephalus species under the name of *Leptocephalus hyoproroides*, n.sp. It had escaped my attention, however, that this name had already been employed by P. Strömman in "Leptocephalids in the University Zoological Museum at Upsala," Upsala, 1896, p. 30, Pl. iv., Figs. 5–6, for another form similar in habit, but differing quite definitely in several characters, *e.g.* the pigmentation and position of the anus, from the form described by me. I would therefore propose that the name of the latter should be changed to *Leptocephalus thorianus*, n.sp. (after the Danish research steamer *Thor*, on the cruises of which the species in question was discovered).

JOHS. SCHMIDT.

Static Charge in Bicycle Frame

WHILE riding a bicycle recently I was overtaken by a thunderstorm, and took shelter beneath a convenient tree after propping the machine against a wall. When the rain had ceased, in the course of about fifteen minutes, I re-mounted, with my hands upon the handles in the usual manner. The handles are of composition, resembling vulcanite or a similar non-conducting material, the pedals are shod with rubber, and the leather saddle completes the insulation of the rider from the frame. Upon exchanging my grip of one of the handles for the bar, I felt the effects of a static charge which was sufficiently startling to endanger equilibrium for the moment. I do not suggest that the pneumatic tyre, which successfully insulates a vehicle from the earth, adds a new terror to locomotion, for even a timid rider in traffic would hardly be endangered, but it would be interesting to know if this phenomenon has been observed before, either on cycles or motor-cars.

ROBERT S. BALL, JUN.

189 Gleneldon Road, Streatham, London, S.W., July 2.

MARINE BIOLOGICAL PHOTOGRAPHY.

THOUGH year by year photography plays a greater part in the illustration of works on natural history, marine biology does not appear to have received its full share of attention from the scientific photographer.

It can be claimed for photography that it is an accurate and rapid method of making marine biological records. The rapidity admits of the recording of delicate structures during life, thus avoiding the opacity and distortion that so soon follow death; but the main advantage lies in the fact that by means of photography the number of workers making records can be greatly increased. Expert biologists who have the time to make drawings of minute structures are distinctly limited in number, whereas the photographer with but a general biological knowledge is able to make accurate and useful records of structures, possibly quite new to him, and many points of which he might miss were he to draw them.

FIG 1.—Young Thornback Ray.

In order to derive the full advantages offered by photography, the worker must be prepared, in addition to illustrating minute structures, to deal with the habits, movements, characteristic postures, and general external appearance of any particular marine animal. Such records should preferably be made in natural environments, but, failing this, in special tanks.

Prof. Reighard, in his contribution "Photography of Aquatic Animals in their Natural Environments," describes very fully subaquatic photography and photography with the camera above water. Subaquatic photography, however, has a very limited application, mainly in consequence of the want of light, and for obtaining details of external structure is not nearly so satisfactory as photography in special tanks.

With the camera above water the main difficulty to be overcome is due to the photograph having to be taken through two media, air and water, for the light reflected from the surface of the water, being greater than that reflected from the object to be photographed, the desired image is obscured in the general fogging of the photographic plate. When photographing a submerged object with the camera directed at an angle to the surface of the water, this reflection from the water can be avoided by holding a screen at a suitable angle immediately above the object.

When taking a photograph directly above the object, the light must be cut off above the camera. The illustration of a young thornback ray was taken in 8 inches of water, with a golf umbrella held over the head of the operator.

For tank work the most useful arrangement is a tank about 3 feet long, 2 feet high, and 6 to 8 inches from front to back, the bottom and sides being of wood, the front and back of $\frac{1}{4}$-inch plate-glass. Inlet and outlet pipes pierce the sides, and there must be arrangements for a constant supply of salt or fresh water which can be sent through the tank at will. The specimen placed in the tank usually sulks at the bottom; if, after a time, the water is suddenly turned on, the fish or other creature heads up to the stream, and a snapshot can be taken in a natural position. For the above work it is desirable to use a reflex camera with a rapid lens of not less than 8-inch focal length.

For the photography of comparatively small and microscopic marine objects a special apparatus is necessary. I use a portable apparatus with which it is possible to take a photograph of a specimen in a horizontal or vertical position, by transmitted or reflected light, and by means of a mirror to see the object up to the last moment before exposure, so as to ensure a living specimen being photographed in a suitable position. There is also a fixed stage upon which a specimen can be placed in a tank or cell, and a photograph taken of any desired magnification without moving the specimen.

When photographing from life-size up to 25 magnifications I use lenses of 6-inch, $3\frac{1}{2}$-inch, and 35-mm. focal lengths, on a camera having an extension of 36 inches without a microscope. For higher magnifications I drop a microscope into the apparatus, and get any desired magnification up to 2600 with a 1/12-inch oil immersion.

FIG. 2.—Whelk feeding on Crayfish.

The exceptional length of bellows extension is necessary in order to obtain a high degree of magnification from a lens of comparatively long focus, thus ensuring all parts of the specimen being in focus at the same time.

The advantages of such an apparatus at a biological station or on a research boat are obvious, for specimens taken from the trawl or tow-net can be placed in suitable tanks or cells by the biologist, and

FIG. 3.—Pecten turning over.

photographed, living, anæsthetised, or dead, by an assistant. Any number of useful records could thus be made from fresh specimens of any particular catch. For photographic purposes it is desirable to obtain perfect living specimens; but the photography of

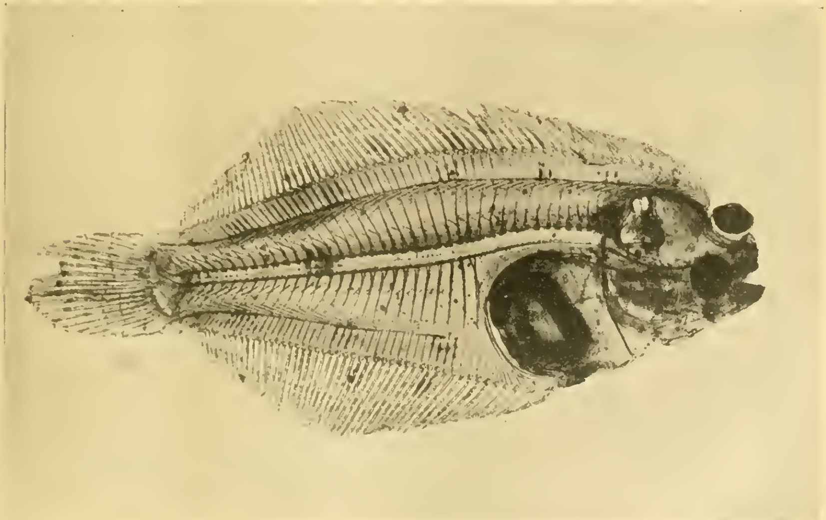


FIG. 4.—Plaice Larva.

numerous imperfect specimens is also very valuable, for at any time a perfect drawing can be made from the material so collected.

As an additional use, this apparatus can with advantage be employed when counting specimens in the analysis of a plankton catch, for the area under the field of the microscope can be thrown on to a sheet of paper and the specimens ticked off.

When working with artificial light, the illuminant should be of sufficient power to ensure against the want of light being a hindering factor. I use a very useful little arc lamp made by Messrs. Leitz, when electric power is available; failing this, an oxyhydrogen light, though good results can be obtained with an acetylene lamp. When using arc or limelight it is necessary to have a cooling tank between the light and the specimen.

With either arc or limelight, working with a Zeiss microplanar lens at F. 4·5 on a medium rapid plate, a full exposure can be obtained in one-tenth of a second up to twenty-five magnifications.

Reference has been made already to photographs taken in natural environments. As an illustration of the recording of the habits of marine animals is shown the photograph of the common dog-whelk (Buccinum) holding with its foot the abdomen of a dead crayfish. On removing the crayfish it was found that the whelk had partially sawn through the shell by means of its radula.

A characteristic movement is shown in the photograph of a pecten turning itself over.

Recently I had the opportunity of taking numerous pecten photographs under the direction of Mr. W. J. Dakin, and by his kind permission I am able to show an instantaneous photograph of this mollusc, in the act of turning itself over, after having been placed on the left valve. The other photographs taken showed the gradual opening of the pecten, until the valves were separated as much again as in the photograph shown. The present illustration shows the sudden act of closure, by which the turning movement is brought about, almost completed.

Of photographs taken with the special apparatus described, two illustrations are given; the first that of a plaice larva 13 mm. in length, and magnified five times; the second that of a crustacean, one of the Mysidacea, 2 mm. in length, magnified fifteen times. This photograph shows very distinctly the two statocysts on the uropods or appendages of the sixth abdominal segment, and gives a good general view of the animal.

FIG. 5.—A Mysidacea.

Higher magnifications of any particular part are obtained as described by slipping the microscope into the apparatus.

In addition to the above methods, the natural colours of marine animals may be recorded on the autochrome plate. The autochrome plate is particularly useful when it is desired to make a permanent record of a stained specimen where the staining is of a fugitive character.

FRANCIS WARD.

SOME EXTINCT VERTEBRATE ANIMALS FROM NORTH AMERICA.[1]

A NEW volume of collected papers, published by the American Museum of Natural History, New York, enables us to realise how important and numerous are the additions to our knowledge of extinct vertebrate animals still made by systematic explorations in North America. The contributions now received deal with the work of only four years, 1904–8, accomplished by one institution; but they make great advances in nearly all parts of the subject to which they relate, and their value is increased by the excellent text-figures and plates with which they are illustrated. The pioneer discoveries of Leidy, Marsh, and Cope furnished for many years a continual series of surprises for the student of extinct vertebrates; their successors during the past decade and a half have not only filled in many details in the preliminary view thus obtained, but have also been scarcely less successful in recovering unexpected groups and missing links. Present explorers have, indeed, the advantage of being able to pursue their work in the remote west in peaceful leisure, without any armed escort, and so have facilities for determining the relative positions of the strata from which they excavate the various fossils. In the early days, with hurried traverses, there was a tendency to decide the relative ages of the fossils solely by their own peculiar features, without any exact observations in the field. The result was sometimes an argument in a vicious circle. As shown by the volume now before us, that is all changed. We find detailed descriptions of specimens from the Permian of Texas, the Upper Cretaceous of Montana, the Eocene of Wyoming, and the Miocene of South Dakota. Accompanying them are well-illustrated exact accounts of all these formations and localities, determining the relative ages of the genera and species which were obtained from them.

The scientific work of the palæontologists in the American Museum is of two kinds. Part is devoted to the reconstruction and mounting of skeletons of general interest; part is concerned with the most detailed and special research, for which it often happens that not more than mere fragments are available. The publications record the results in both directions, and thus provide ample material, not only for the specialist, but for anyone interested in the broader features of natural history. It must also be added that the reconstructed skeletons are prepared with the greatest scientific care. The fine example of the Columbian mammoth now described, for example, was mounted after an elaborate study of the arrangement of the footprints of a living elephant and the attitude of its limbs when walking. The skeletons of Equidæ were similarly mounted after studies of the living horse—especially after a study of the Arab, to which one article in the new volume is devoted. Among startling mounts for which existing animals give little help may be specially mentioned the reconstructed skeleton of Naosaurus, which is one of the primitive reptiles from the Permian of Texas not hitherto found in a complete state. It is a long-bodied, squat reptile, with a formidable array of sabre-like teeth, and a high, thorny frill along the back, which is supported by the much-elongated neural spines of the vertebræ (Fig. 1). Prof. Osborn, who describes this specimen, is careful to explain exactly on what material the various parts of the recon-

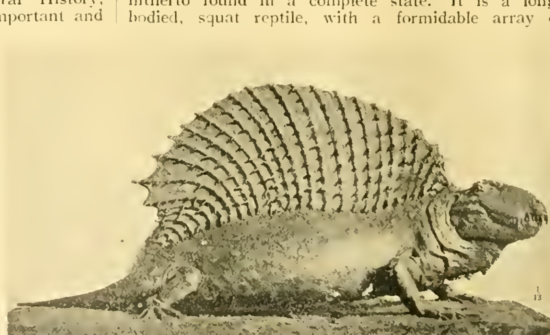


FIG. 1.—Model of *Naosaurus claviger*, by Mr. C. R. Knight.

[1] "Fossil Vertebrates in the American Museum of Natural History." Department of Vertebrate Palæontology. Vol. iii., Articles collected from the American Museum Bulletin for the years 1904–8, by H. Fairfield Osborn, &c. (New York, 1909.)

struction are based, so that each may judge of the extent to which it is trustworthy.

Perhaps the most interesting real novelty is a small skeleton from the Middle Eocene of Wyoming, determined by Prof. Osborn to belong to a primitive armadillo. Fragments of this animal were obtained some years ago by Dr. J. L. Wortman, and ascribed by him to a Lemuroid under the name of Metacheiromys. Four good specimens now seem to show that it is truly an armadillo, differing chiefly from the typical existing armadillos in "the probable presence of a leathery instead of a bony shield, of an enamel covering on the single large caniniform teeth in the upper and lower jaws and the degeneration of other teeth." This discovery confirms the suppositions of Marsh, Wortman, and Schlosser as to the existence of Edentata in North America in the Eocene period; and it adds to the difficulties of understanding the early Tertiary mammal faunas of South America.

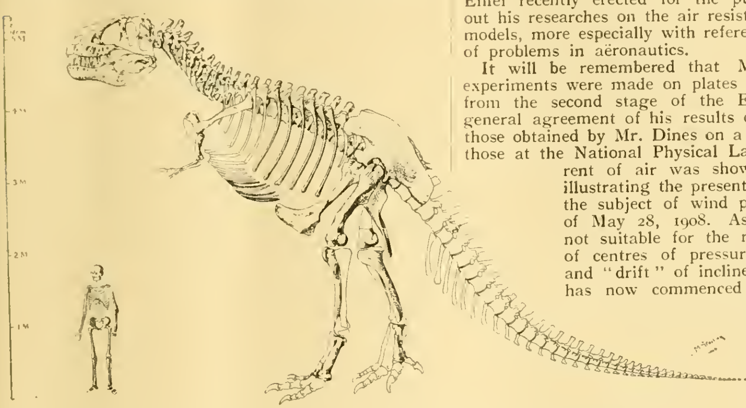


Fig. 2.—Restoration of *Tyrannosaurus rex*. From the type skeleton, American Museum of Natural History.

Another astonishing discovery is that of a colossal carnivorous Dinosaur, Tyrannosaurus (Fig. 2), from the Upper Cretaceous (Laramie formation) of Wyoming and Montana. It has hitherto been supposed that the flesh-eaters were all much smaller than the largest vegetable-feeders among Dinosaurs; but here is a reptile like Megalosaurus, with a skull from 4 to 5 feet in length, and when standing on its heavy hindquarters reaching a height of from 16 to 17 feet. Another new herbivorous Dinosaur, Ankylosaurus, from the same geological formation, measures 14 feet in length, and is armoured like the South American Glyptodons.

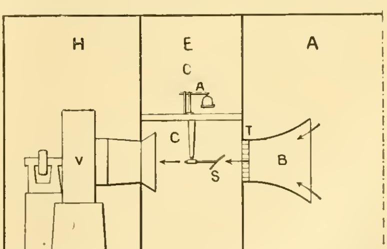
The technical papers on remains of horses and rhinoceroses, by Prof. Osborn and others, and on camels and deer, by Dr. Matthew, are of extreme scientific value. The discussion of the extinct horses is especially exhaustive, and the result is that it becomes impossible at present to recognise any exact genetic series. Mr. Gidley even remarks that "there is a considerable phyletic hiatus between the groups of the Equidæ, which are as yet not bridged over by intermediate forms"; and he adds that this hiatus is particularly marked between the Anchitherium-group and the Protohippus-group, which "greatly overlap each other in time." Dr. Matthew's explanation of most of our difficulties in understanding the evolution of the European and North American Tertiary mammalia is that northern Asia was their actual place of origin. He thinks that "in Europe, on one side of this centre, in America, on the other side, we have parallel series of approximate phylogenies; sometimes closer in the one country, sometimes in the other." Until the early Tertiary mammalia of northern Asia are discovered, we cannot advance much further towards real origins.

Prof. Osborn and his associates are indeed to be congratulated on the wide import of the work they have done, and the excellent manner in which it is published. We would commend it to the notice of all students of biology. A. S. W.

EXPERIMENTS ON AIR RESISTANCE.

In *La Nature* (February 26) there is a description by M. Fournier of the new laboratory which M. Eiffel recently erected for the purpose of carrying out his researches on the air resistance of plates and models, more especially with reference to the solution of problems in aëronautics.

It will be remembered that M. Eiffel's earlier experiments were made on plates and models let fall from the second stage of the Eiffel Tower. The general agreement of his results on flat plates with those obtained by Mr. Dines on a whirling table and those at the National Physical Laboratory in a current of air was shown in the curves illustrating the present writer's article on the subject of wind pressure in Nature of May 28, 1908. As this method was not suitable for the rapid determination of centres of pressure, and the "lift" and "drift" of inclined plates, M. Eiffel has now commenced experiments in a current of air, and the manner in which this current is maintained presents some novel and interesting features. Hitherto, experiments by this method have been carried out by suspending the models in a long channel with parallel sides through which air was drawn by means of a fan. This arrangement is open to two objections—(1) the difficulty of maintaining the velocity of the current uniform across the channel, and (2) the limited size of the models which could be used without an appreciable effect on the resistance due to the walls of the channel. The first difficulty is overcome by introducing resistances to the flow where necessary, which is a long and tedious process, and the second by limiting the size of the models to within two or three per cent. of the area of the channel. The novelty of M. Eiffel's method consists in his using a comparatively short channel, and in suspending his models in a closed



chamber which constitutes an enlargement of the channel.

The general arrangements will be clear from the diagrammatic sketch in the figure. C is the observation chamber, which is air-tight, and provided with a platform for carrying the observer and the necessary measuring appliances. B is the bell-mouthed air inlet, which is provided with a series of guide plates of honeycomb section on the delivery side to ensure that the air enters the chamber in parallel filaments. V is the outlet and suction fan. S is the model under test, connected to the weighing beam at A.

The advantages of this method as regards simplicity, comparative cheapness of construction, and convenience in making the observations are obvious, and in respect of its accuracy it is claimed that, using the results of M. Eiffel's earlier experiments on falling plates as data, a complete check has been afforded by the results obtained in the new apparatus. It may be doubted, however, if the accuracy of this method is so great as that obtained in a carefully designed parallel channel, for there can hardly fail to be a disturbance of the stream lines due to the sudden enlargement at the inlet similar to that observed in the flow of water. From a curve published in the article, it appears that plates as large as 90 cm. by 15 cm. have been used in a current drawn from an inlet 150 cm. in diameter. According to the writer's experience with this method, the apparent pressure for normal impingement of the current on a plate the area of which is the same fraction of that of the inlet as in the examples cited would be about 10 per cent. in excess of its true value, but in the case of small inclinations, which is, of course, relatively more important in aëronautical work, the error would be much smaller, and possibly of the same order of magnitude as those incurred in the estimations of the velocity of the current. In this branch of aëronautics valuable results may be expected from M. Eiffel's researches.

T. E. Stanton.

C. H. GREVILLE WILLIAMS, F.R.S.

Charles Hanson Greville Williams was born at Cheltenham, September 22, 1829, the son of S. Hanson Williams, a solicitor; his death occurred on June 15, 1910. He commenced his professional career as first assistant to Prof. Anderson, of Glasgow University; after some years spent in research work he moved to Edinburgh, where he conducted a tutorial class under Dr. Lyon Playfair. From 1857 to 1859 he was lecturer on chemistry in the Normal College, Swansea. In 1859 he returned to Glasgow as chemist to the works of Messrs. Miller, chemical manufacturers. He migrated to Greenford Green in 1863, remaining with Messrs. Perkin until 1868. About that year he entered into partnership with M. Édouard Thomas, at the Star Chemical Works, Brentford, the firm being makers of coal-tar colours, and subsisting until 1877. Mr. Greville Williams about this time gave up his connection with manufacturing chemistry and became photometric supervisor to the Gas Light and Coke Company, with whom he remained until 1901, then retiring into the country, where he seldom saw his old friends and acquaintances, but was much interested in the study of the ancient Egyptian language and the translation of inscriptions. Until rheumatism disabled him he was an expert draughtsman and calligraphist, a fair game shot, and an enthusiastic angler. Although in reality a charming companion, with unusual conversational powers, and a keen appreciation of literary and artistic culture, Greville Williams possessed a very modest and retiring disposition, and became, especially of late years, an almost complete recluse. He was more nervous about his state of health than he need have been, and, in consequence, cut himself off unnecessarily from scientific and social intercourse. This isolation was also due, no doubt, in part to his straitened circumstances, which necessitated strict economy and debarred him from the continuance of his scientific researches—hard lines for a thorough enthusiast; and such he was, possessed, moreover, with the true chemical instinct and a general scientific aptitude. It is a pity that the genius for investigation which was shown in his researches on isoprene, on beryl, and on the bases from bituminous shale, from the Boghead mineral, and from the destructive distillation of cinchonine, did not develop in accordance with more modern methods in his later years. But he made many interesting discoveries, and has left a considerable record of thoroughly sound work.

Greville Williams was elected F.R.S. in June, 1862. He outlived the rest of the distinguished "fifteen" of that year. It was in 1862 also that he joined the Chemical Society. He contributed a number of papers to the publications of these societies, as well as many notes to the *Chemical News*, and also wrote articles for Ure's Dictionary and for Watts's Dictionary, as well as for the *Journal of Gas Lighting*. His chief literary work was "A Handbook of Chemical Manipulation" (Van Voorst, 1857); a supplement appeared in 1879.

On November 25, 1852, Greville Williams married Henrietta Bosher; she died on February 16, 1904. One son and three daughters survive.

The writer of this notice has lost a friend of nearly sixty years' standing—a friend of rare quality and of high Christian character.

A. H. C.

NOTES.

We announce with deep regret the death, on Monday last at Milan, at the age of seventy-five years, of Prof. G. V. Schiaparelli, Foreign Member of the Royal Society.

The death (on June 12) is announced of Dr. W. H. Seaman, professor of chemistry in Harvard University, at the age of seventy-three years.

We regret to announce the death, on July 4, of Mr. R. Russell, I.S.O., who was for thirty-six years connected with the administration of education in Natal. In 1877 he became Superintendent of Education, and retired in 1903.

At the general monthly meeting of the members of the Royal Institution, held on Monday last, it was announced that the King has consented to become Patron of the institution.

The Janssen prize of the Paris Academy of Sciences has been awarded to Prof. W. W. Campbell, director of the Lick Observatory, University of California.

Sir J. J. Thomson, F.R.S., has been elected president of the Junior Institution of Engineers, in succession to Sir H. J. Oram, K.C.B.

Dr. F. A. Bather, F.R.S., has been appointed by the trustees to represent the British Museum (Natural History) at the forthcoming International Geological Congress in Stockholm.

The Cullen Victoria Jubilee prize has been awarded by the Royal College of Physicians of Edinburgh to Dr. R. W. Philip, for his work on tuberculosis. The prize is awarded once in every four years for the "most important contribution to practical medicine."

THE Journal of the American Medical Association states that a bronze relief portrait of Prof. W. Osler, F.R.S., has been placed in Osler Hall of the Medical and Chirurgical Faculty, Baltimore. It is an enlargement of the small one now in the Johns Hopkins Medical Library.

MR. C. O. WATERHOUSE, I.S.O., who for the period of forty-four years was in the service of the trustees of the British Museum, has just retired from the position of assistant-keeper in charge of the insect section of the Zoological Department of the Natural History Museum. To mark the occasion of his retirement, he was last week presented by many colleagues and friends with an illuminated address, a Sheraton bureau-bookcase, a gold watch, and an aneroid barometer.

PROF. ANGELO MOSSO asks us to announce that the Monte Rosa laboratories, which are equipped with all necessary scientific instruments, will re-open on July 15, and that the Royal Society has at its disposal nominations for two workers in botany, bacteriology, zoology, physiology, terrestrial physics or meteorology.

THE banquet to the five past-presidents of the Chemical Society (Prof. W. Odling, F.R.S., Sir Henry E. Roscoe, F.R.S., Sir William Crookes, F.R.S., Dr. Hugo Müller, F.R.S., and Dr. A. G. Vernon Harcourt, F.R.S.) who have attained their jubilee as fellows of the society is to take place at the Savoy Hotel on Friday, November 11 next. Applications for tickets must be made to the assistant secretary of the society by, at latest, November 4. It will be remembered that the banquet was postponed from May 26 in consequence of the death of the King.

A REUTER message from Catania states that a strong shock of earthquake was felt on Sunday morning in Sicily, at Giarre, Linguaglossa, and Zafferana. A slight shock was experienced at Mimeo.

THE twenty-first annual conference of the Museums Association was opened on Tuesday at York, when the president, Dr. Tempest Anderson, delivered an address on "Volcanoes and their Museum Treatment," and papers were read by Dr. F. A. Bather, F.R.S., Dr. Scharff, Dr. E. L. Gill, and Mr. L. E. Hope on, respectively, "Palæontology Exhibits at the Japan-British Exhibition," "Cleaning Bones by a Dry Sand Process," "A Method of Exhibiting Corals," "A Simple Way of Exhibiting the Reverse of Coins and Medals," and "The Natural History Records Bureau at the Carlisle Museum."

AN exhibition of Hygiene was opened at Buenos Aires on July 3. The British section is reported to be small. It is divided into twenty-nine sub-sections, and contains specimens of surgical instruments, orthopædic appliances, and drugs. The French section is incomplete. Italy exhibits numerous health foods. Chile furnishes exhaustive bacteriological laboratories, mainly for veterinary research. The Argentine Asistencia Publica displays first-aid and life-saving appliances, preventives, &c. The promised agricultural and railway exhibitions are expected to be opened this week.

THE fifth meeting of the International Congress of Mathematicians will take place at Cambridge in 1912. In connection with one of the sections of the congress, an International Commission on Mathematical Teaching has been constituted, which includes delegates appointed by the various Governments interested in the congress, and a series of national sub-commissions has been established to assist the International Commission. The President of the Board of Education has appointed Sir George Greenhill, F.R.S., Prof. W. W. Hobson, F.R.S., and Mr. C. Godfrey to be the British delegates, and he has further appointed an advisory committee to assist the commission in the collection of reports and papers on the teaching of mathematics, and this committee, which is to act also as the British sub-commission, has been constituted as follows:—Mr. C. E. Ashford, Sir G. H. Darwin, F.R.S., Mr. C. Godfrey, Sir George Greenhill, F.R.S., Mr. G. H. Hardy, F.R.S., Prof. W. W. Hobson, F.R.S., Mr. C. S. Jackson, Sir Joseph Larmor, F.R.S., Prof. A. E. H. Love, F.R.S., and Prof. G. A. Gibson. Mr. C. S. Jackson is honorary secretary to the sub-commission.

THE programme of the joint summer meeting of the Institution of Mechanical Engineers and the American Society of Mechanical Engineers is now available. As has already been announced, the meeting will take place in Birmingham and London on July 26 to 30. The following papers are to be read and discussed:—In Birmingham: English running-shed practice, by Mr. C. W. Paget; engine-house practice, or the handling of locomotives at terminals to secure continuous operation, by Mr. F. H. Clark; handling locomotives at terminals, by Mr. F. M. Whyte; handling locomotives, by Mr. H. H. Vaughan; American locomotive terminals, by Mr. W. Forsyth; high-speed tools, and machines to fit them, by Mr. H. I. Brackenbury; tooth-gearing, by Mr. J. D. Steven; interchangeable involute gearing, a joint paper by Members of the Committee of the A.S.M.E. on standards for involute gears. In London: electrification of suburban railways, by Mr. F. W. Carter; cost of electrically-propelled suburban trains, by Mr. H. M. Hobart; economics of railway electrification, by Mr. W. B. Potter; electrification of trunk lines, by Mr. L. R. Pomeroy; electrication of railways, by Mr. G. Westinghouse.

IN connection with the summer meeting of the Association of Technical Institutions, the Mayor and Mayoress of Salford are to give a garden-party in Peel Park, Salford, and hold a reception in the Royal Museum and Art Galleries on Thursday, July 14.

THE sixty-ninth annual meeting of the Medico-psychological Association of Great Britain and Ireland will be held at the Royal College of Physicians, Edinburgh, on July 21 and 22, under the presidency of Dr. John Macpherson. Dr. C. H. Bond, 11 Chandos Street, Cavendish Square, W., is the honorary general secretary.

AN International Congress of Forensic Medicine will be held at Brussels on August 4 to 10. The programme will include psychological medicine, bacteriology, toxicology, and legislation in relation to legal medicine. Governments, academies of medicine, universities, and associations of chemists and toxicologists have been invited to send delegates. There will be an exhibition of apparatus and medical instruments in connection with the congress. The general secretary is Dr. C. Moreau, rue de la Gendarmerie, 6, Charleroi.

ACCORDING to the Journal of the Royal Society of Arts, the second International Congress on Industrial Diseases is to be held in Brussels on September 10 to 14 next. Among the questions to be discussed are:—Can industrial diseases be distinguished from accidents? What should be their distinctive characteristics? What medical equipment is provided in mines, factories, workshops, &c.? the present state of the problem of ankylostomiasis; the eye and eyesight in connection with industrial diseases; work in compressed air.

The tenth International Geographical Congress is to be held in Rome on October 15 to 22, 1911. The congress will be divided into eight sections, and communications may be made in Italian, French, German, or English. Abstracts of papers proposed for presentation to the meeting must be sent in not later than April 30, 1911, and reports on subjects brought before previous congresses or suggested by the executive subcommittee must be received not later than August 31, 1911. The president of the congress is the Marquis Raffaele Cappelli, president of the Italian Geographical Society.

According to *Science*, plans for the extension of the American Museum of Natural History are being prepared by the trustees. The present building, erected between 1874 and 1908, includes eight units, and the plans now in preparation contemplate an additional six units, completing the central hall, the east and west transepts, the east entrance pavilion, and the south-east façade.

A society called the Christopher S. Ledentzoff Society for the Development of Experimental Sciences and their Practical Applications has been formed in connection with the Moscow Imperial Technical School, the objects of which are to assist discoveries and experiments in connection with natural science; to develop technical inventions and improvements; to investigate and apply to practical use any scientific or technical discovery or improvement. The society expresses the hope that its aims will attract the notice of all similar institutions and persons working in scientific and technical spheres, and appeals for assistance to all such institutions and persons for any support which might be given by (*a*) interchange of correspondence; (*b*) a supply of lists of privileges and patents, and reports on scientific and technical subjects. Further particulars as to the aims of the society may be obtained from the secretary, care of the Imperial Technical School, Moscow.

A geographical society, called the Servian Geographical Society, has been established at Belgrade. Its first president is Prof. J. Cvijic. The society proposes to begin the publication of a quarterly journal in January next.

The Institute of Chemistry of Great Britain and Ireland gives notice of the following examinations:—in biological chemistry, bacteriology, fermentation and enzyme action, with special reference to the chemistry and bacteriology of food-stuffs, water-supply and sewage disposal, and the application of biological chemistry to industries and manufactures, beginning on Monday, October 17 next; in chemical technology in October next, the exact date to be announced later.

Speaking in the House of Commons on Wednesday of last week on the Colonial Office Vote, Colonel Seely, the Under-Secretary for the Colonies, referred to the subject of sleeping sickness, and the work that has been done or is in progress in combating it. Coincident with the coming of the white man there had been, he said, a spread of various diseases. The spread of sleeping sickness alone had been most remarkable and disastrous. How many persons had died they did not know, but that hundreds of thousands had died they did know. Tremendous efforts had been made by many countries, and he thought we might claim especially by this country, to remove this great scourge. Sir David Bruce went, with his wife, into the heart of the plague-stricken country, and spent many months there investigating this great scourge of sleeping sickness. Almost every person in the place where he lived was suffering in some degree from this sickness, and when he told the House that, out of the hundreds of thousands of cases, they did not know of a single case of recovery, he thought they would realise to how great an extent those who tried to deal with the disease took their lives in their hands when they went out to these countries. He had mentioned Sir David Bruce, but there were many others. Some had already died in this great cause, and their names were, alas! already forgotten. But when the history of brave deeds came to be written, the deeds of those men who had gone into the heart of Africa to try to combat this insidious and most fatal of all diseases would not be forgotten, and would perhaps be considered as giving more striking proof of the ability of men to overcome natural fear than almost anything else in the annals of mankind. We now knew that these diseases were caused by flies, but the difficulty of finding a remedy was immense. It was thought that the removal of the natives from the infested areas might prove a remedy. Sleeping sickness was caused by the tsetse-fly, and it was thought that if the population could be removed from the shores of the lakes where alone that fly could live, they would be cured. Unfortunately, that had not proved to be entirely the case. But still we did know a great deal more than we did before about the origin and cause of sleeping sickness, and we had checked the mortality to a most remarkable degree.

Dr. W. L. Duckworth and Mr. W. J. Pocock contribute to vol. xiv. of the Cambridge Antiquarian Society's Proceedings for the current year a paper on a collection of human bones found in the course of excavations on the site of an Augustinian Friary near the Corn Market, Cambridge. Among these appear specimens of a tall, broad-headed race which may be assigned to the British Bronze-age type, to early Danish immigrants of the Borreby class, or to later arrivals from a southerly region, perhaps Normandy or Burgundy, these last being foreign ecclesiastics who founded the Cambridge Friary. After full discussion of the question, Dr. Duckworth favours the last explanation. An excavation at Durham supplies similar relics of foreign bishops, and the proportion of these broad-headed men is too great to be provided by the local mediæval population, which, though it doubtless contained individuals of the Bronze-age type, was yet, on the whole, characterised by a very large majority of individuals with distinctly narrow heads.

Mr. W. Morfitt has been for some time engaged in the examination of a series of pit-dwellings accidentally discovered in the district of Holderness, in the East Riding of Yorkshire. Canon Greenwell and Mr. R. A. Gatty contribute an account of these discoveries to the June issue of *Man*. The people occupying this district, much of which, since their time, has been destroyed by encroachments of the sea, were evidently a very early Neolithic race, probably an early branch of that which introduced polished stone implements. Those which they possessed are almost Palæolithic in character. The fauna, however, which consisted of *Bos longifrons*, the horse, sheep or goat, hog, and red deer, is distinctly Neolithic. The only evidence of their acquaintance with the sea is the vertebra of a whale, which, on the analogy of the Guachos of the River Plate, Prof. Boyd Dawkins supposes to have been used as a seat.

The Takelma language, one of the distinct linguistic stocks of America, is now nearly extinct, being spoken by only a few survivors of the tribe in the Siletz Reservation, western Oregon. It is therefore fortunate that Mr. E. Sapir, working under the direction of the American Bureau of Ethnology, has been able to secure the record of a considerable body of their tribal mythology and folklore. This report, issued by the University of Pennsylvania, and forming part i., vol. ii., of their Anthropological Publications, is valuable from a linguistic point of view. The beliefs and mythology of the tribe exhibit curious resemblances and variances when compared with those of the neighbouring tribes, the explanation of which awaits further investigation.

To the June number of the *American Naturalist* Dr. R. L. Moodie contributes a note on the alimentary canal of a branchiosaurian salamander from the Carboniferous shales of Mazon Creek, Illinois, for which the new generic and specific name *Eumicrerpeton parvum* is proposed. The specimens, for there are two, are preserved in nodules, and were it not that soon after death the œsophagus became loosened and displaced, the viscera would recall those of a freshly dissected modern salamander. The author has compared the viscera with those of several genera of modern salamanders, and finds that they come nearest to those of an immature example of *Diemyctylus torosus* from Orcas Island, Puget Sound, the next nearest being Desmognathus, Spelerpes, and Hemidactylus. It is suggested that the adults of the three latter retain an ancestral condition of the intestine which is transient in Diemyctylus, and the author finds in the resemblance of the viscera of the fossil to the recent forms confirmation of his theory that modern salamanders are directly descended from the Branchiosauria.

In the same (June) issue of the *American Naturalist* Dr. J. Stafford gives a further account of his investigations on the early developmental history of the Canadian oyster, of which the first part was published in the journal cited for January, 1909. The author systematically employed plankton-nets in collecting the larvæ, which he claims to have been the first to recognise definitely in Canadian waters. He has also identified stages in development hitherto unobserved, including the young stages of the spat. He has defined the spatting period and the period during which the larva is free-swimming, while the developmental history has been followed up to adult stages. His results will, it is believed, be of importance in connection with commercial oyster-culture.

In a report on the giant moth-borer (*Castnia licus*), published at Georgetown, Demerara, Mr. J. J. Quelch directs attention in the strongest manner to the damage threatened to sugar-cane plantations, which form the staple industry of the colony, by the attacks of this insect. In spite of remedial measures, Enmore Plantation, where this insect inflicted so much damage in 1904 and 1905, is still suffering great loss, while Non Pareil Plantation is equally, if not more severely, affected. Some idea of the nature of the damage may be gleaned from the fact that the adult caterpillars are 3 inches in length and nearly ½ inch in thickness, and that their growth is abnormally rapid. Concerted action on the part of plantation-owners is essential if the plague is to be stayed.

A list of the grasses of Alaska, prepared by Prof. F. Lamson-Scribner and Mr. E. D. Merrill, occupies vol. xiii., part iii., of the Contributions from the United States National Herbarium. Most of the material examined comes from the coast region, as very few botanists have ventured into the practically unknown regions of the interior, so that the present list may be regarded as a working basis for future collections. It is very remarkable that not a single species of the series Panicaceæ has been collected, while all the tribes except Bambuseæ of the other series Poaceæ are represented. Poa furnishes a number of species, while Calamagrostis, Bromus, and Agropyron are well represented. The authors have provided analytical keys to the genera and species, as well as a short description for each item.

The authentic list of new garden plants of the year 1909 has been issued as Appendix iii. to the current volume of the *Kew Bulletin*. The Orchidaceæ provides, as usual, more species and varieties than any other family, amongst them being *Cirrhopetalum longissimum*, a fine plant introduced from Siam; *Dendrobium Sanderae, D. acuminatum*, both from the Philippines; and *Megaclinium purpureorachis*, from the Congo. China supplies a fair quota of plants, notably *Primula Forrestii, P. Littoniana, P. Bulleyana*, and *Rhododendron Souliei*, besides sharing with Japan in the supply of species of Juglans. The genus Salix receives additions from Asia, while Mexico furnishes several species of Mammillaria. The Kew introductions include an Encephalartos, *Baikiaea insignis*, a leguminous evergreen tree, and *Strophanthus Preussii*, a climbing shrub, all from tropical Africa; also *Euphorbia Ledienii*, from South Africa. Six new species of the fern genus Nephrolepis and *Adiantum grossum* are noteworthy.

The International Commission on Glaciers has just issued the fourteenth report upon "Les Variations périodiques des Glaciers," by Prof. E. Brückner and M. E. Muret (*Extrait des Annales de Glaciologie*, t. iv., March, 1910, pp. 161–76. Berlin: Borntraeger, 1910). This useful report, covering the year 1908, shows that the majority of glaciers under observation still continue to shrink, though the changes, as a rule, are not important. In the Swiss Alps fifty-three glaciers are probably or certainly decreasing, while fourteen are in the opposite condition. In the eastern Alps only one glacier shows some advance; in the others the general retreat continues. This it does, so far as observed, in the Italian and French Alps, but in the Pyrenees there is generally an increase, though not large. Of Norwegian glaciers thirty-five have been observed, and the table published ranges in most cases from 1904 to 1908 inclusive. In the latter year ten glaciers were growing and twenty-two shrinking. The author, Mr. P. A. Øyen, directs attention to the fact that in the central highlands the oscillation of the glaciers nearly corresponds with that of the climate, but in the western coast range it is rather retarded. In Sweden some advance is perceptible. The North American glaciers are oscillating, more especially in Alaska, and from Asia little precise information has been received. Evidently the ground which glaciers began to lose nearly half a century ago has not yet been recovered.

The June number of the Journal of the Royal Geographical Society contains papers read before the society by Dr. T. G. Longstaff on glacier exploration in the eastern Karakorum, and by Prof. J. W. Gregory on the geographical factors that control the development of Australia. Dr. Longstaff achieved four important feats: the discovery of the Saltoro Pass; the fixing of the watershed in the eastern Karakorum; the discovery of the Siachen Glacier, the greatest glacier in Asia; the discovery of the peak "Teram Kangri," with an altitude of at least 27,500 feet, and possibly the highest mountain in the world. Prof. Gregory emphasises the isolation of Australia, the contrast between the marginal and the interior zones, and discusses the problem of the water-supply, the growth of population, and the question of the possibility of white colonisation in tropical countries such as North Australia.

In one of the useful scientific papers contained in the report of the Prussian Meteorological Institute for 1909 Prof. Hellmann compares the results of the exposure of thermometers in windows and in screens, such as are now generally used in this country, with the view of a future critical discussion of temperature conditions in Germany. The first part of the inquiry, contained in the report for 1908, showed that the introduction of the window screen about the year 1880, instead of the unprotected window exposure adopted at all stations prior to that date, did not interrupt the homogeneity of the observations. In the second part of the inquiry, experiments carried out at Potsdam as regards window exposure and exposure in "Stevenson screens," now used at about two-thirds of the German stations, show that not only the readings obtained by these two methods, but those at some of the more recent stations, are not strictly comparable. The differences are relatively small in coastal cloudy and windy weather, but considerably greater in dry and sunny inland districts. For details of this interesting discussion reference must be made to the tables and curves of the mean daily range shown for each month in the original paper.

Every month sees a fresh issue of the bulletins from the Bureau of Entomology of the United States Department of Agriculture. In Circular 119 Mr. Webster describes the clover root-borer (*Hylastinus obscurus*, Marsham), which has been introduced from Europe and become established in fields of red clover in the eastern States and elsewhere, causing considerable damage. The life-history has been investigated, but no method of extermination could be discovered. Mr. Ainslie deals with the large corn-stalk-borer (*Diatraea saccharalis*, Fab.). This insect burrows in the stalks of maize close to the ground, and so weakens them that they often break off in a strong wind. It was originally a sugar-cane pest, and came from the West Indies and from Central and South America, but for some time now has devoted its attention to maize.

The presidential address delivered by Prof. M. C. Potter before the British Mycological Society has now been issued, and deals with bacteria in their relation to plant pathology. The subject has been much neglected both by bacteriologists and mycologists, in spite of the fact that at least ten plant diseases are considered to be caused by bacteria. They are pear-blight (*Bac. amylovorus*), yellow disease of hyacinth (*Pseudomonas hyacinthi*), canker of the olive (*Bac. oleae*), corn-blight (*B. zeae*), potato wet-rot (*B. solaniperda*), soft rot of hyacinth (*B. hyacinthi-septicus*), bacteriosis of the vine (*B. uvae*), cucurbit wilt (*B. tracheiphilus*), brown rot of Cruciferæ (*Pseudomonas campestris*), and potato and tomato disease (*Bac. solanacearum*). A discussion of the problem is given and a bibliography is appended.

The Chemical Society's Journal for May contains two papers by Mr. H. E. Watson on the molecular weights of helium, neon, krypton, and xenon. The neon was prepared in a state of exceptional purity by fractionating 40 litres of a mixture of helium and neon over charcoal at the temperature of liquid air, and full details are given of the methods used both in effecting the purification and in measuring the density of the gas; repeated determinations with various highly purified fractions gave values ranging from 0·8997 to 0·9006, the mean of eleven values being 0·9002. In the case of helium only two measurements were made, giving the values 0·17830 and 0·17814, mean 0·1782; as the gas which was weighed amounted only to 0·05 gram, the experimental error is placed at 1 part in 2000. Reduction of observed densities to zero pressure gave for the molecular weights of the gases of the series the values:—helium, 3·994; neon, 20·200; argon, 39·881; krypton, 82·92; xenon, 130·22.

Although the use of oil as a means of securing more rapid dissipation of the heat generated in transformers has become almost universal in the case of large transformers, very little information has been available as to the relative merits of the various oil- and air-cooling devices. This information is now supplied in a paper by Mr. R. D. Gifford, of the University of Birmingham, which will be found in the May number of the Journal of the Institution of Electrical Engineers. His measurements show that if the cooling effect of the air in the case of a transformer be taken as unity, that of the free air would be about 1·1 and that of a strong air blast about 2. With oil cooling the effect rises to about 3, and if the oil itself is cooled by the passage of cold water through a worm immersed in the oil, the cooling effect becomes 6 or 7.

Bulletin No. 40 of the Engineering Experimental Station of the University of Illinois consists of an account of measurements made by Messrs. J. K. Clement and C. M. Garland of the heat transmitted through a steel tube of 1¼-inch external diameter, with walls ⅛-inch thick, from steam outside to water inside running through the tube. The temperature of the outside surface of the tube was measured at two points by means of thermojunctions of copper-constantan placed in small holes drilled in the tube. The temperatures of the incoming and outgoing water and of the steam were determined by mercury thermometers. Curves are given showing the variation of the heat transmitted with the velocity of the stream of water and with the temperature of the steam, and the resistance to the transmission of heat is shown to be almost entirely concentrated in the films of stagnant steam and water in contact with the surfaces of the steel tube. The authors regard the present communication, not as one devoted to new facts, but as a demonstration of the utility of their method of measurement, and propose to apply the method to the investigation of problems connected with steam boilers. We should like to point out that a good deal of work has already been done in this direction both in this country and in others, and it is to be hoped that the new experiments will be directed to the solutions of problems which have not been already dealt with by Mr. Jordan or by one or other of the experimenters mentioned in Prof. Dalby's bibliography of the subject contained in the Journal of the Institution of Mechanical Engineers for last year.

We learn from *Engineering* of June 24 that Lloyd's Register of British and Foreign Shipping is about to issue rules for internal-combustion engines for marine purposes. The rules are divided into four headings. The section concerning construction strongly enforces the importance of accessibility for examination and repair, and requires that engines of more than 60 brake-horse-power, which are not reversible, and are manœuvred by clutch, must be fitted with a governor or other arrangement to prevent the racing of the engine when declutched. The cylinders are to be tested by hydraulic pressure to twice the working pressure to which they will be subjected; the water-jackets of the cylinders to 50 lb. per square inch, and the exhaust-pipes and silencers to 100 lb. per square inch. The tables are comprehensive, embracing smooth-water and open-sea service boats, and engines of 4-stroke cycle and 2-stroke cycle. Separate fuel-tanks are to be tested, with all fittings, to a head of at least 15 feet of water. Oil-fuel pipes are to be of annealed seamless copper, with flexible bends, conical joints metal to metal, with a cock or valve at each end of the pipe conveying the fuel from the tank to the carburettor or vaporiser. The machinery is to be submitted for survey annually, and practically all parts are to be examined, the fuel-tanks and all connections being, if deemed necessary by the surveyor, tested to the same pressure as when new. The screw-shaft is to be drawn at intervals of not more than two years.

In directing attention to the diversity of published results of compressive tests on cubes of concrete, the *Builder* for June 18 suggests that the explanation is to be found in the different methods and different pressures used in ramming the concrete into the test moulds. We may add to this explanation the fact that variation in the water used in mixing the concrete under test is a most important factor, influencing both the ramming pressure required and also the strength of the resulting specimen. Our contemporary suggests that an appliance such as is used in the Charlottenburg laboratory might be adopted in this country. In this appliance a ram is lifted by gearing and released by a cam, the arrangement being such that the ram always falls from the same height. After each blow the ram is automatically moved for a short distance in a direction parallel to the axis of the actuating wheel, while the mould is moved perpendicularly to the same axis. The effect is to ensure uniform ramming of the whole. It is stated that the experience at Charlottenburg shows the resistance of test blocks so prepared to be very uniform for concrete of given composition.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY:—

July 12. 14h. 11m. Jupiter in conjunction with the Moon (Jupiter 2° 58′ S.).
15. Mercury. Illuminated portion of disc = 0·978, Venus = 0·813.
16. 10h. 39m. Minimum of Algol (β Persei).
19. Saturn. Major axis of outer ring = 39·96″, minor axis = 12·35″.
21. 9h. 6m. Uranus in conjunction with Moon (Uranus 3° 44′ N.).
27. 6h. 29m. to 9h. 9m. Transit of Jupiter's Sat. III. (Ganymede).
27–31. Meteors abundant from Perseus and Aquarius.

HALLEY'S COMET.—A number of observations, generally confirmatory of those already noted in these columns, are recorded in No. 4421 of the *Astronomische Nachrichten*. Dr. Wolf gives a sketch of the tail showing its position, with regard to the surrounding stars, and its form as shown on a photograph taken on May 12 at 14h. 15m., Königstuhl M.T. This shows that a straight, narrow tail extended from the head to just south of 70 Pegasi, and from there to the end was bounded by two faint clouds of cometary matter, too faint to be seen visually. The outline of the northern cloud was very irregular, and departed considerably from that of the visual tail, and in any discussion as to whether the earth passed through any mass of cometary material these abnormal extensions must be taken into consideration.

Prof. Seeliger reports that, at Munich, careful observations failed to reveal any trace of the comet's head or nucleus during its passage across the solar disc, nor were any magnetic or electrical phenomena recorded which could be, with certainty, attributed to the comet. So many observers report the non-detection of the nucleus that it must now be taken as fairly certain that the material of which the head and nucleus are composed is too tenuous to interfere, effectively, with the passage of light.

M. Eginitis gives further details as to observations at Athens Observatory, and directs special attention to the peculiar shape presented by the comet on the evening of May 20. The appearance was very similar to that of a crescent moon, with a very bright condensation at the centre of the convex arc, and no extended tail was seen; such a form might be explained by assuming that the axis of the tail was nearly in the line of sight. This would also explain the apparent anomaly of the slight tail being turned towards the sun if one supposes that the curvature was sufficiently great; in this case, the passage of the earth through that part of the tail extending to its orbit would have been delayed some forty to sixty hours, and it appears to be probable, if these observations of May 20 are verified, that a passage did actually take place.

M. Comas Sola gives drawings showing the definite duplication of the nucleus on June 2, and the appearance of four or five separate condensations, *globes*, on June 4.

In an interesting communication to the *Comptes rendus* (No. 26, June 27, p. 1732), M. Nordmann discusses the amount and the nature of the light emitted by the comet, as observed with his colour-screen photometer. He finds that on three dates of observation, April 25, May 15 and 23, the nucleus contributed only about one thirty-seventh of the total light emitted by the head. By comparing his values with the observed diameters of the nucleus and coma, respectively, he deduces that towards May 15 the mean intrinsic light of the nucleus was about nineteen times that of the visible part of the coma. Taking the theoretical increase of light of a comet as varying in the ratio $1/r^2\Delta^2$, and comparing his observed with the calculated values, M. Nordmann finds that between April 25 and May 23 the augmentation of the brilliancy of the nucleus was much less than provided for by the theory. Finally, by the employment of his colour-screen method, M. Nordmann found that the distribution of energy in the spectrum of the nucleus was very similar to the distribution in the solar spectrum, and hence he concludes that the light of the nucleus is almost exclusively, if not entirely, reflected sunlight.

Mr. Leach, Malta, reports that, after finding the comet so faintly distinguishable on June 14, he gave up all hope of seeing it again. On June 25, however, he saw it quite clearly at 9 p.m., and was able to follow it each evening until the day of writing, June 30; with field-glasses, a tail 2° or 3° in length was clearly visible.

EPHEMERIS FOR COMET 1910*a*.—In No. 4422 of the *Astronomische Nachrichten* Prof. Kobold gives a continuation of his ephemeris for comet 1910*a*. The position is changing very slowly, and for July 7 is 21h. 40·5m., +33° 21·4′; an observation by Prof. Barnard on June 7 gave a correction of +7s., +1·6′, and showed the magnitude to be about 16·0.

PHOTOGRAPHS OF MOREHOUSE'S COMET.—From the Tokio Observatory we have received part vi., vol. iii., of the *Annales*, in which are reproduced nearly fifty excellent photographs of Morehouse's comet, 1908*c*. Messrs. Hirayama and Toda briefly describe the separate photographs, and discuss the remarkable changes which took place in the comet's tail. By comparing their results with those obtained at the Yerkes and Heidelberg Observatories, they find that between October 1 and 2 a recognised detached mass, at a mean distance of 2·4° from the head, was receding at an hourly rate of 8·5′; other values are:—October 15, 1° from head, northern mass 3·1′, southern mass 3·4′, per hour; October 15–16, 1·4° from head, 3·1′ per hour. As is pointed out, the accumulation of such data will serve to determine the nature of the repulsive force. A discussion of the photographs also discloses that on November 13, 14, 15, and 16, the outer streamers of the tail appeared to change in phase, predominating southwards on November 13 and 15, and northwards on November 14 and 16. This might be ascribed to a rotation of the head, with a period of forty-eight hours, but further discussion is necessary to establish this; in any case, the photographs show that if such a rotation existed it was not uniform throughout the tail, for the outer and inner streamers did not rotate with the same angular velocity.

THE DETERMINATION OF POSITION NEAR THE POLES.—As an excerpt from the *Geographical Journal* for March, we have received a copy of a paper by Mr. Hinks dealing with the methods of determining an observer's position when near the poles. Mr. Hinks suggests that a theodolite, say a 3-inch, read on both faces, would prove the most suitable instrument, and then proposes a modification of Sumner's method for the reduction of the observations. Two observations of the sun at two different known G.M.T.'s give two circles of equal altitude which intersect at the observer's position; a simple graphical method may be used for the reduction. A most interesting discussion, by well-known explorers, followed the reading of the paper and dealt, with varying conclusions, with the several points raised by Mr. Hinks; the chronometer difficulty appears to be an important one, and some curious refraction anomalies have to be considered.

The same subject was discussed by Herr Charlier in a paper which appeared in No. 4393 of the *Astronomische Nachrichten*.

THE VARIATION OF LATITUDE.—The usual provisional results obtained by the International Latitude Bureau are published, for 1908·0–1910·0, by Prof. Albrecht in No. 4414 of the *Astronomische Nachrichten*. A marked increase in the amplitude of the departure of the momentary, from the mean, pole took place during 1909, the previous curve, 1907–9, having shown a regularly increasing spiral form. During the ten years that the International Service has been at work the curve has been fairly regular, with maxima in the years 1903 and 1909; the latter is clearly shown on the chart published with the results.

NEW CANALS AND LAKES ON MARS.—Seventeen "canals" and two "lakes" which were seen at the Hem Observatory, and which M. Jonckheere has been unable to identify from previous records, are enumerated in No. 4420 of the *Astronomische Nachrichten*. This brings M. Jonckheere's total of new "canals" up to forty, the previous lists having appeared in earlier numbers of the same journal. One of the "lakes," at the junction of Aethiops and Cambyse, is described as small and feeble, and the other, at the junction of Astaboras and Anubis, as large and diffuse.

THE INTERNATIONAL CONGRESS AT DÜSSELDORF.

THE fifth International Congress of Mining, Metallurgy, Mechanical Engineering, and Practical Geology met at Düsseldorf on Monday, June 20. Whilst, strictly speaking, this is the fifth congress, it is only the third that has assumed a really international character. The first congress was held in Paris in the year 1878, in connection with the Great Exhibition of that year, its initiation being due to the efforts of a number of prominent French mining and metallurgical engineers, and more especially to that well-known French association, the Société de l'Industrie minérale. The next great Paris Exhibition of 1889 again provided the occasion for a second congress, but both these first two congresses were attended mainly by French engineers, and could scarcely be called international. At the Paris Exhibition of 1900 a vigorous effort was made to interest foreign as well as French engineers, and was supported warmly by both their English and their German colleagues, our Iron and Steel Institute and Institution of Mining Engineers both taking an active part in forwarding the scheme. This congress was thoroughly international in all respects, and at its closing meeting it was decided to hold a quinquennial international congress, the next, that of 1905, to be held at Liége, in connection with the International Exhibition planned for that year. This congress, again, was completely successful, and its members gladly accepted the invitation of the Rheno-Westphalian Mining and Metallurgical Industry to hold the next meeting at Düsseldorf. This town is in many respects the centre of the above industries, and is remarkable not only for its great industrial development, but also for its highly advanced artistic culture; it is, furthermore, well situated on the main railway system of central Germany, affording ready communication with all neighbouring countries, and is thus admirably adapted for the purpose of such a congress. On the opening day the congress numbered 1762 members, of whom 1128 were Germans and 634 foreigners, the latter comprising 94 from France, 74 from Great Britain, 65 from Austro-Hungary, and 57 from Belgium. The number of entries in the different sections were:—Mining, 1141; metallurgy, 1140; engineering, 939; geology, 784. Of course, it will be understood that many members had entered their names in more than one section.

The great majority of the members of the congress had arrived in Düsseldorf on Saturday and Sunday, June 18 and 19, and on Sunday evening there was an informal open-air gathering at the Zoological Gardens, this being an excellent opportunity to make and renew many acquaintanceships. The actual work of the congress began next morning, the meeting-place being the *Tonhalle*, a concert-hall belonging to the town of Düsseldorf, the large main hall of which was admirably adapted for the general meeting of the congress. There are several smaller lecture-rooms available for the meetings of the sections, although it must be admitted that the accommodation thus provided was in some cases barely sufficient for the large audiences that assembled to hear some of the more important of the papers. The geological section met in a suitable room close to the *Tonhalle*.

The general meeting was opened on Monday morning by the president of the organising committee, Mr. Edward Kleine, who welcomed the congress in a short address, in which he referred more particularly to the increase in the production of coal and iron that had taken place since the last meeting of the congress. His speech was translated, first into French and then into English, by Mr. E. Schaltenbrand, chairman of the board of management of the Steelworks' Association. The Prussian Minister of Commerce, His Excellency Mr. Sydow, also welcomed the members of the congress in the name of the Prussian Government and of the Imperial Chancellor.

The honorary consultative committee of the congress was then formed, after which the meeting broke up into the various sections, of which there were five, namely, i., Mining; ii*a*., Practical Metallurgy; ii*b*., Theoretical Metallurgy; iii., Mechanical Engineering; iv., Applied Geology.

The official list of papers submitted to these sections is as follows:—

Section i., Mining.—W. Zäringer (Nordhausen), the freezing process and its latest developments; F. Bruchausen (Dortmund), shaft sinking by the process of petrifaction; H. Grahn (Bochum), the use of compressed-air locks in sinking; — Viebig (Kray), the use of reinforced concrete in mine workings; Prof. J. Stumpf (Berlin), the steam-engine with unidirectional flow of steam, with especial reference to its use as a winding engine; W. Schultze (Essen), recent improvements in pumping plant; O. Pütz (Tarnowitz), the present position of hydraulic stowage in Germany; Dr. W. Kohlmann (Diedenhofen), the mining development of the Minette iron-ore district; P. Nicou (Nancy), the present position of the Minette mining industry in French Lorraine; Prof. K. Haussmann (Aachen), modern improvements in mine surveying; Prof. G. Franke (Berlin), conveying of coals from the working face; J. Loiret (Clermont-Ferrand), value of a rescue-chamber in an outburst of carbonic acid gas at the Singles Colliery, July 26, 1909; sudden outbursts of carbonic acid gas in the collieries of the Central Plateau of France; S. v. Bolesta-Malewski (Nalenczow), critical observations on the existing methods of winding, and a proposal for their modification; F. Schember (Vienna), the development of machine kirving in coal mining; Dr. H. Bruns (Gelsenkirchen), to what extent does coal mining contribute to the dissemination of infectious diseases? F. Trippe (Dortmund), hydraulic impregnation of the coal-face in the solid, and hydraulic coal-getting by the Meissner method; J. Taffanel (Lens), the French experiments upon coal-dust; W. E. Garforth (Pontefract), the British coal-dust experiments.

The last two very important papers were admirably illustrated, that of Mr. Garforth by a very fine series of coloured lantern-slides, and that of Mr. Taffanel by lantern-slides and by the kinematograph.

There were further presented to this section two reports on the testing of colliery ropes, namely, Prof. H. Louis (Newcastle-on-Tyne), report on the testing of colliery ropes in England; L. Denoel (Liége), the testing of winding ropes in Belgium. These are to form part of a complete international report on the standardisation of rope-testing.

Section ii.a, Practical Metallurgy.—Dr. Blasberg (Dahlhausen), changes in the composition of fire-brick; G. Arnou (Paris), notes upon electro-steel; P. Breuil (Couillet), rail-steel; — Esser (Differdingen), the present position of the Thomas process in Germany; Prof. G. Franke (Berlin), the present position of the briquetting and nodulising of iron-ores in Germany; R. Genzmer (Julienhütte), the open-hearth ore process in Germany; J. Hofmann (Witkowitz), gas-producers; H. Terpitz (Hubertushütte), the employment of various kinds of gas in the open-hearth furnace, and their respective influence on the quality of the products; O. Friedrich (Julienhütte), recent improvements in the construction of open-hearth furnaces; C. Grosze (Metz), the present position of the methods of purifying blast-furnace gases in Germany; Prof. F. Herbst (Aachen), on the development of coking as regards the construction of coke ovens and the improvement in mechanical appliances; Prof. E. Heyn (Gross-Lichterfelde), contribution to the subject of rusting; C. Irresberger (Mülheim), present-day iron-foundry practice in Germany; O. Mauritz (Nürnberg), the economics of the various forms of working blowing-engines in steel works; Dr. B. Neumann (Darmstadt), the existing processes for the production of electro-steel in Germany; H. Ortmann (Völklingen), improvements in the construction of rolling-mills during the last decade; Dr. R. Passow (Aachen), the value of the microscope in judging blast-furnace slags; Dr. J. Puppe (Dortmund), the results of recent investigations in rolling-mill practice in Germany; Dr. O. Rau (Aachen), the advances in the recovery of by-products in coke-oven plants; Dr. B. Schück (Berlin), a new process for the generation of hydrogen, and its application in metallurgy.

Section ii.b, Theoretical Metallurgy.—Dr. C. Benedicks (Upsala), the synthesis of meteoric iron; Prof. W. Borchers (Aachen), the reactions in the melting and refining of copper, their acceleration, and their simplification by electric smelting; Dr. K. Bornemann and P. Müller (Aachen), the electrical conductivity of alloys in the liquid state; Dr. H. Braune and E. Hubendick (Stockholm), the generation of producer-gas, free from tar, from uncoked fuel, from the point of view of organic chemistry; C. Brisker (Leoben), the theoretical and practical importance of the electric blast-furnace; G. Charpy (Montluçon), the part played by carbon and carbon monoxide in metallurgical reactions; Dr. W. Conrad (Vienna), the current and the voltage in the electric furnace; Dr. G. Gillhausen (Aachen), the balance of heat and of matter in the blast-furnace; Dr. P. Goerens (Aachen), the gases contained in the various kinds of iron; Dr. H. Grossmann (Berlin), the volumetric estimation of nickel and cobalt; Prof. Guillet (Paris), the thermic treatment of special steels; certain practical and theoretical observations upon cementation; — Joisten (Aachen), the influence of heat treatment upon the dimensions of the grain of iron; Prof. J. W. Richards (South Bethlehem), Gruner's ideal working of a blast-furnace; the *rationale* of dried blast; E. Richarme (Zarizinsky Savod), the dephosphorisation of iron in the presence of carbon; Prof. R. Ruer (Aachen), the iron-nickel system; O. Thallner (Remscheid), the relations between the thermic effect, the metallurgical phenomena, and crystallisation in basic and acid processes of electric fusion; F. Weyl (Aachen), cementation *in vacuo*; Dr. H. Winter (Bochum), the influence of galvanisation on the strength of wire; Prof. F. Wüst (Aachen), the causes of the economy of fuel and the increased production in the blast-furnace by the use of heated and dried blast; Prof. F. Wüst and — Felser (Aachen), the influence of segregation on the strength of ingot-iron.

It need only be said here that the division of the metallurgical section into two portions was rendered necessary by the large number of metallurgical papers presented, and even so the sections were somewhat overweighted with work.

Section iii., Mechanical Engineering.—M. Androuin and C. Stein (Paris), the influence of the improvements in heating on the development of machine forging; T. v. Bavier (Düsseldorf), the development of ventilators and compressors in German mining; P. Bernstein (Cologne), hydraulic compressors; P. Bodenstein (Kalk), modern ore-dressing; W. Ellingen (Cologne), aërial ropeways of great capacity; — Giller (Mülheim), haulage by compressed-air locomotives in mines; G. v. Hanffstengel (Leipzig), the cheapening of the cost of transport by means of wire-rope and electrical aërial railways;— Heym (Wetter), the influence of electricity on the development and efficiency of lifting appliances in mines and works; Dr. H. Hoffmann (Bochum), the working of motor engines, especially for winding engines, rolling-mill engines, and dynamos; Prof. P. Langer (Aachen), recent experience in large gas-engine plants; K. Maleyka (Berlin), electricity in metallurgy; W. Philippi (Berlin), electricity in mining; C. Matschoss (Berlin), the position of mining and metallurgy in the history of machine construction; Dr. Rateau (Paris), turbo-compressors; — Stach (Bochum), the development of independent and of central condensation; heat accumulators for the utilisation of waste steam; F. Tillmann (Saarbrücken), underground haulage.

It will be noticed that very few of these papers deal with purely engineering subjects; some of them are in the main metallurgical, and most of them are upon mining subjects. The only reason for their inclusion in this section lies in the fact that the other sections were overcrowded.

Section iv., Applied Geology.—Dr. C. Barrois (Lille), the origin of the clastic coal deposits and of the erratic pebbles found in the north of France; Dr. Beyschlag (Berlin), communication on the iron-ore supplies of the world; C. Capacci (Florence), the gold deposits of Abyssinia and Erythrea; Dr. G. Fliegel (Berlin), the tectonics of the Lower Rhine basin, and their importance in the development of the lignite formation; — Holz (Aachen), the utilisation of water-power, with special reference to Germany and Scandinavia; M. Krahmann (Berlin), the modern policy respecting mineral deposits, and its problems; P. Kukuk (Bochum), the tectonic conditions of the coal deposits of the Lower Rhine and Westphalia in the light of the most recent investigations; E. Link (Essen), the dams of the Ruhr district, and particularly the dam of the Möhne valley; A. Macco (Brühl), the science of mining economics, its objects and its limits; L. Mintrop (Bochum), on artificial earthquakes; H. Mortimer-Lamb (Montreal), the unique mineral resources of Canada; Dr. M. Mourlon (Brussels), a synthesis of Belgian geology as obtained from documents; Dr. H. Potonié (Berlin), the origin of coal; Prof. A. Renier (Liége), the state of our knowledge of the general stratigraphy of the Belgian coal-formation; B. Schulz-Briesen (Düsseldorf), the scientific and economic importance of practical geology; Dr. G. Steinmann (Bonn), the composite mineral veins in the South American Cordilleras; Dr. O. Stutzer (Freiberg), recent springs; H. Werner (St. Andreasberg), the silver-bearing veins of St. Andreasberg in the Harz; Dr. W. Wunstorf (Berlin), the coal-bearing formation in the region of the Rhine and the Maas; Dr. S. Papavasiliou (Naxos), on Grecian emery.

All this formidable list of papers was disposed of by the various sections in three sessions, on Monday morning and afternoon and on Tuesday morning. Whilst the standard of the various papers was, on the whole, a high one, some being, indeed, of especial interest, the discussions were disappointing, being, in general, brief, and of no great importance; the great majority of the papers were not discussed at all. This was probably due to the large number of papers set down for reading. It would have been far better to have limited their number, or to have read them only in the briefest abstract, so as to have left time for adequate discussion, this being usually the most interesting feature of such gatherings.

Tuesday afternoon, June 21, Wednesday, and Thursday were devoted to excursions, of which there was a list of more than forty, which gave an opportunity to see all the more important collieries and iron works of this flourishing industrial region. A special set of geological excursions was arranged for the members of section iv. An interesting series of trips had also been arranged for the ladies accompanying the members to a number of points of interest in and near Düsseldorf. The social functions included a reception on Monday evening, given by the town of Düsseldorf, a leading feature of which was an admirable speech by Mr. Marx, the Mayor of Düsseldorf. On Tuesday evening an official dinner was given in the large hall of the *Tonhalle*, after which a little allegorical play was performed. The conception of this was due to Dr. Schrödter, one of the general secretaries of the congress, and both the idea and its execution were in every respect beyond praise. On Wednesday evening a trip on the Rhine was made in one of the large steamers that ply on this river. This was rendered especially interesting by the presence of Count Zeppelin, who had come over in the forenoon from Friedrichshafen in his latest airship, the *Deutschland*.

The closing meeting of the congress took place at Essen under the presidency of Mr. Kleine. The secretaries of the various sections presented short reports on the work of each section. The only resolution submitted to the General

Meeting was one from the Mining Section, declaring that it was urgent that some international system for the unification of mining statistics should be adopted. This resolution was unanimously agreed to, and it was decided that steps should be taken to bring it to the notice of the various Powers that had sent representatives to the congress. An invitation to hold the next quinquennial congress, namely, that of 1915, in London was then submitted to the meeting by Prof. H. Louis (Newcastle-on-Tyne), and supported by Mr. G. C. Lloyd, secretary of the Iron and Steel Institute, and Dr. J. B. Simpson, president of the Institution of Mining Engineers. The invitation was tendered on behalf of the University of London, the Imperial College of Science and Technology, the Geological Society of London, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Society of Chemical Industry, the Institution of Mining Engineers, the Institution of Mining and Metallurgy, and the Institute of Metals, and it was unanimously and enthusiastically accepted.

This ended the business of the congress proper, but a reception was given in the evening by the town of Essen, and on the following day a numerous contingent of members left in two special trains for Brussels, where arrangements had been made to receive them at the exhibition now in progress there.

From every point of view the Düsseldorf Congress may be pronounced a brilliant success. The local members exerted themselves to the utmost to entertain their visitors, and, thanks in no small degree to the excellent system of organisation that pervaded the whole affair, everything went without a hitch. It is a matter of sincere satisfaction that English technologists will now have an opportunity afforded them of returning the splendid hospitality of their foreign colleagues, but they will have to exert their utmost endeavours if they propose to maintain the high standard of excellence that has been set by the congress of 1910.

THE TUBERCULOSIS CONFERENCE AND EXHIBITION.

THE annual meeting of the National Association for the Prevention of Tuberculosis and the conference is still in full swing, though by the time that this goes to press most of the work, except the exhibition and the public lectures, will have been completed. A local committee, consisting of the Right Hon. Lord Balfour of Burleigh, K.T., Sir Alexander Christison, Bart., as chairman, Dr. R. W. Philip, treasurer, and Drs. W. Leslie Lyall, Geo. A. Mackey, and James Miller, secretaries, and a number of public and medical men, prepared an admirable programme for the large number of members, old and new, which has been carried out both fully and successfully.

The exhibition, which is probably the best of the kind that has yet been seen in this country, containing not only the ordinary travelling specimens, but a number of very fine preparations from Edinburgh and Cambridge illustrating the various phases of the tuberculous process in man and in animals, was opened on Friday, July 1, by the Countess of Aberdeen, whose interest in this work induced her to send over the Irish exhibit that has done such excellent service in Ireland. On the evening of the same day Prof. McWeeney, of Dublin, gave an interesting lecture on "Consumption: what it is and how it can be prevented."

On Saturday morning the teachers and scholars in the various school centres were addressed by the Countess of Aberdeen at one, by Dr. Jane Walther at another, and by Drs. Gray, McWeeney, Squire, and Woodhead at others. These addresses, according to the newspaper reports, appear to have been followed with keen interest by both teachers and scholars.

In the afternoon, the Royal Victoria Hospital Farm Colony at Springfield, Lasswade, a beautiful and healthful spot, was opened by Lady Dunedin. This farm is for convalescents from phthisis, and is to be a kind of training ground for those who have to earn their living after their recovery. As it is only at the stage of opening, little of the plan of operations could be seen, but it appears that Frimley is the model on which it is to be carried out.

On Sunday there was a special service for university students in the McEwan Hall (the "Aula" of the University). Dr. Norman McLeod presided, and Dr. Kelman and Dean Wilson both took part in the service. Prof. Osler, of Oxford, spoke of man's redemption of man, referring to the great work done during the last fifty years by those who had set themselves to the amelioration of the sufferings and disease of their fellows. Then followed a short service in memoriam of Robert Koch, in which Dr. Hermann Biggs, of New York, and Drs. Woodhead and Philip took part. The whole service was most impressive, and was attended by a very large congregation.

On Monday evening the annual meeting of the National Association for the Prevention of Consumption, presided over by Lord Balfour of Burleigh, was a most successful gathering, and, like all the other meetings, was very largely attended.

This was followed by a reception given by the Right Hon. the Lord Provost, Magistrates, and Council of the City of Edinburgh, in the splendid Museum of Science and Art, at which the members of the association and their friends were most hospitably entertained.

The four conference meetings, at which such subjects as "The Avenues of Infection in Tuberculosis," "The Prevention and the Administrative Control of Tuberculosis," "The Incidence of Tuberculosis in Childhood," and "The Working Man in Relation to Tuberculosis," were well attended, and the subjects were well discussed. These discussions should be productive of much good in the way of disseminating information on the various points raised. Popular lectures were given on Friday, Saturday, and Tuesday, and others will be given up to the end of the week, each lecture being in charge of an authority on his subject.

This conference and exhibition is an advance on anything of the kind that has yet been attempted, and its usefulness and popularity should encourage the executive of the association to repeat the experiment of a provincial meeting.

INTERNATIONAL UNION FOR COOPERATION IN SOLAR RESEARCH.

THE fourth conference of the International Union for Cooperation in Solar Research will take place on Mount Wilson, California, between August 29 and September 6. The meeting promises to be a very successful one, about forty astronomers and physicists from Europe having signified their intention of being present, as well as a large number of Americans.

The members of the union and others who have accepted Prof. Hale's invitation are invited by the Astronomical and Astrophysical Society of America to attend a meeting of that society which will be held at Harvard College Observatory on August 17. At the end of this meeting the astronomers will be taken from Boston to California by the train leaving Boston on August 20. One day will be spent at Niagara Falls, and another at Chicago, where, however, the time will not be sufficient to visit the Yerkes Observatory. The journey from Chicago to Pasadena will be made by the southern route, and a visit will be paid on the way to the Lowell Observatory at Flagstaff, while two days will be spent at the Grand Canyon. The party will reach Pasadena on August 27.

After the meeting, it has been arranged that visitors who may wish to join shall travel by way of Santa Barbara and Monterey to San José, from whence the Lick Observatory may be visited.

Those intending to travel with the party from Boston to Pasadena, or join the party at any point on the way, are requested to send in their names to Prof. S. I. Bailey, Harvard College Observatory, Cambridge, Mass., at as early a date as possible, in order that the necessary railway arrangements may be made.

As regards the meeting itself, it is proposed that the visitors should stay in Pasadena until Tuesday, September 13, on which day they will leave for Mount Wilson, the journey occupying about seven hours. The meeting will be held during the four remaining days of the week, and the return journey will take place on Sunday, September 4.

On September 6 it is intended to make an excursion to Los Angeles, and the meeting will conclude with a banquet after returning to Pasadena.

MODERN SUBMARINE TELEGRAPHY.[1]

THIS lecture relates to modern submarine telegraphy, and, therefore, I shall omit the historical part of the subject and start with the cable itself, as we deal with it now. The signals to form the messages are sent over the submarine cable as electric currents. The cable consists of a central copper wire; this is the conductor for the current, and to prevent the electricity escaping from the wire it is insulated along its entire length by gutta-percha.

Gutta-percha is chosen for submarine work because of its very high insulating properties and its not being acted on, or suffering chemical change, under water. The gutta-percha-covered wire is called the core; this core, before it can be laid at the bottom of the sea, must be surrounded by jute serving and steel wires for protection when being laid and during its existence after.

When dealing with the electrical properties of a cable, the core only is considered, and for all practical purposes it may be taken that the return conductor to the current is the water immediately outside the gutta-percha. A core of any given length has a certain time rate of signalling;

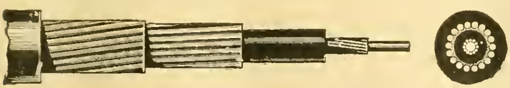


FIG. 1.—Atlantic 1894 Cable.

that is to say, when a voltage is applied at one end, the effective current, that as a consequence flows in the wire, does not arrive at the distant end instantaneously, but takes time to grow.

The time rate of signalling is inversely proportional to the product of the resistance of the wire and the electrostatic capacity of the core. This is termed the "K.R." or capacity resistance law, a law first pointed out by Lord Kelvin. It follows from this law that if you double the length of any given kind of cable you reduce its speed for signalling to one-quarter.

The time rate is inversely proportional to the resistance multiplied by the capacity. If you make a certain sized core (size of gutta-percha) with a large copper, up to a certain point you decrease the resistance and increase the capacity; but there is a critical value giving the minimum K.R. This critical limit, or the point when the size of the copper is reached to give the lowest K.R., is when the diameter of the copper is to the diameter of the core as 1 : 1·65.

There is another advantage in keeping the resistance low for any K.R.; the time constant only determines the time when the current at the far end reaches a certain percentage of the possible maximum after the application of the voltage at the sending end. Of course, the quantity of current after any given time is determined again by the voltage of the sending battery, and is inversely as the resistance of the cable.

For instance, if two cables were constructed of equal K.R., but one had a larger copper of half the resistance of the other, with equal sending batteries, the one with the lower resistance would deliver twice the current at the receiving end, at the ends of equal times, and could therefore be made to work at a faster rate. It should also be a cheaper cable, because copper is less expensive than gutta-percha.

Against these electrical advantages should be placed several mechanical disadvantages; the reduction of the thickness of the insulation might result in a greater liability to faults developing after the cable was laid. With such a heavy wire, which would naturally have to be well stranded, to reduce the stiffness, the liability of the decentralisation during manufacture would be greater than with existing cores.

These mechanical difficulties could, I feel sure, be overcome, say, by greater care being taken in the manufacture or by substitution for the present yielding gutta-percha of dry cotton or similar material well impregnated with gutta-percha compound.

[1] Discourse delivered at the Royal Institution by Mr. Sidney G. Brown.

I take an Atlantic cable laid in 1894 (Fig. 1) as having the greatest size of copper for size of core; I take this core to illustrate the improvement that might result by increasing the copper up to the largest size electrically permissible:—

1894 *Cable.*

Diameter of core	0·466 inch
Diameter of copper	0·202 inch
Resistance per nautical mile... ...	1·684 ohms
Capacity per nautical mile	0·420 microfarad

The cable is 1852 nautical miles long and its K.R. is 2·41, and its speed of working under the capacity block system of duplex, about 205 letters per minute.

The Ideal Core. (FIG. 2.)

Diameter of core	0·466 inch
Diameter of copper	0·282 inch
Resistance per nautical mile	0·864 ohm
Capacity	0·700 microfarad
K.R. for 1852 nautical miles ...	2·06

The speed of working with the same duplex system is about 240 letters per minute, and the current received with this speed would be twice as strong as in the actual cable, so that a still greater speed than that given would result, perhaps a speed of 260 letters per minute, a sending battery of 40 volts to be used on both cables.

The copper conductor offers resistance to the electric currents that flow along it; this resistance by itself would, with sufficiently sensitive receiving instruments, not affect the speed of signalling; it produces what is termed "attenuation," or a weakening of the signalling current.

There is also a lateral storage of electricity along the outside of the copper due to the capacity of the insulating material to absorb a charge of electricity; this property is termed the electrostatic capacity of the core.

To allow this to be more fully understood, I shall take mechanical analogies. *Resistance* in electricity is equivalent to *friction* in mechanics, *capacity* to *elasticity* of a spring, and *self-induction* to *inertia*. If I force water through an iron pipe, the friction in the pipe offers resistance to the flow of water; the same quantity that is forced in flows out at the receiving end, but the energy accompanying the flow of water suffers attenuation, as part is wasted in overcoming the frictional resistance.

Suppose that, instead of taking an iron pipe, I take a soft india-rubber pipe, a new kind of phenomenon will be noticed. As I force the water in, the resistance that the

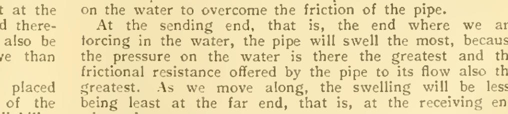


FIG. 2.—Ideal Cable.

water encounters in flowing along the pipe causes the rubber to swell, and the rubber will continue to swell until it has acquired sufficient strain to press with sufficient force on the water to overcome the friction of the pipe.

At the sending end, that is, the end where we are forcing in the water, the pipe will swell the most, because the pressure on the water is there the greatest and the frictional resistance offered by the pipe to its flow also the greatest. As we move along, the swelling will be less, being least at the far end, that is, at the receiving end where the water escapes.

At the instant that we start forcing the water in, practically none escapes at the receiving end, the pipe commences to stretch and the water begins to flow out, continuously increasing in quantity, until it obtains a steady value; this steady value is reached when the pipe has ceased to expand.

The time taken for the pipe to expand and for the water to reach a steady value is termed the variable period. The less the elasticity of the pipe and the less the resistance to water flowing through it, the less the time taken to reach the steady value. This is equivalent to our submarine cable, where the less the capacity and the less the resistance, the less the time constant, or the quicker the rate of signalling.

Now the swelling of the pipe or the capacity effect of the cable does not destroy the energy in the water or of the electricity respectively; this is very different from the waste of energy through resistance, and if by some method we could compensate for the capacity we could signal

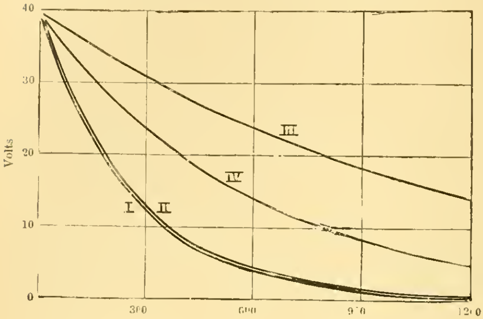


FIG. 3.

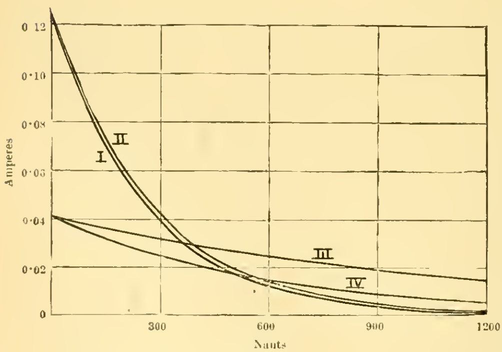


FIG. 4.

The above curves are plotted from the results given in Table I.

through the conductor at any rate we liked, being limited only by the strength of our battery and the sensitiveness of our receiver. I may say that the current usually received would be 1000 times greater if we had no capacity but only the resistance to deal with.[1]

As before stated, the cable has resistance; the current therefore suffers attenuation. It also possesses capacity; the signalling currents through it therefore suffer distortion. Before dealing with this distortion, I must refer you to the diagram of the signals as they are sent into the cable (Fig. 5) and received from it on the siphon recorder. You will notice that the signals, arranged to form the alphabet in the cable code, are of varying lengths, being 1, 2, 3, 4, and 5 times the length of the individual or shortest signal. Sending and receiving on this principle is electrically equivalent to working the cable with varying electrical frequencies of 6, 3, 2, &c., complete periods per second.

[1] I must here refer to the fact that Mr. Heaviside twenty years ago showed that by giving series inductance to a cable we could greatly increase our rapidity of signalling.

This will be understood from Table I. and Figs. 3 and 4 showing curves.

Unfortunately, we see no practical method of carrying out Mr. Heaviside's suggestion, so that I must go on considering the submarine cable as it really is.

TABLE I.

Nauts (x)	I.		II.		III.		IV.	
	Volts.	Amps.	Volts.	Amps.	Volts.	Amps.	Volts.	Amps.
0	40 0	0·1264	40·0	0·1264	40·0	0·0408	40·0	0·041
300	12·25	0·039	12·7	0·042	31·0	0·0316	23·7	0·0244
600	3·8	0·0125	4·4	0·0137	23·9	0·0244	14·2	0·0147
900	1·1	0·005	1·5	0·0055	18·5	0·0189	8 3	0·0088
1200	0·35	0·0012	0·48	0·00155	14·2	0·0146	5·1	0·0051
1500	0·15	0·00065	0·2	0·00083	11·0	0·0112	3·04	0·0031
1825	0·0453	0·000143	0·0418	0·000132	8·32	0·0085	1·71	0·00175
Total lag behind V_0	371°	371°	392°	347°	1717°	1714	1714°	1714°

Except in Case I. (near its end), the lag in every case is proportional to x.

Frequency, 6·36 per second

Submarine telegraph cable $-r=1·684$ ohms per naut, k 0·42 mfd. per naut. The current received by recorder would be 82 times this if we had no capacity

At x nauts from sending end these are the volts and amperes:—

I. There is a recorder with 317 ohms resistance at the end of 1825 naut cable.

II. Infinite cable.

III. Infinite cable, 0·4 henrys per naut; no leakance. Not much distortion.

IV. Infinite cable, 0·4 henrys per naut; leakance, $1·768\times10^{6}$ ohms per naut to give *no* distortion.

(See Figs. 3 and 4.)

The lower the frequency the less the capacity affects the current, so that the higher frequencies of 6 and 3 a second are more attenuated than those of 2 and less. The signals that form the letters in the alphabet are differentially attenuated; the quicker signals, such as those forming a C, are much weaker when they arrive to operate the receiving instrument than the slower signals that form the letters M, O, and so on for the other and longer signals.

Submarine cable signalling of the present day affords us an electrical illustration of the fable of "the tortoise and the hare" or the principle of "more haste, less speed."

As the slower signals get through the cable with more vigour than is necessary, the ingenuity of experimenters is to retard them and to assist as much as possible the quicker ones so that all the signals, whatever their period, shall arrive with exactly the same strength.

Cromwell Varley in 1862 patented a system for the reduction of distortion on cables by inserting condensers of suitable capacity in series with the conductor at each end of the cable.

The reason for the abolition of distortion is obvious; the condenser absorbs the signals of slow frequency, while the cable transmits them. The condenser allows the signals of high frequency to pass through it, although the cable has attenuated them. It is therefore possible so to arrange the condensers at each end of the line that the condensers and the cable together will more or less correct one another and the distortion be reduced.

Unfortunately, the absorption of a series condenser is relative, and is inversely proportional to the frequency; it absorbs more of the slow than the quick signals; at the same time it does absorb some of the quick, and so far as that is concerned it is harmful; it diminishes distortion, but at the same time it adds to the attenuation.

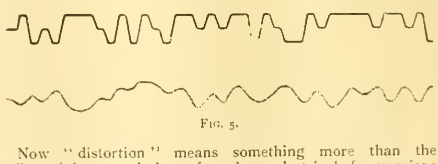


FIG. 5.

Now "distortion" means something more than the differential transmission of various electrical frequencies; it also means the "phase relation" of the current to the voltage, and this "phase relation" varies with the various frequencies, so you see that "distortion," looked at from all sides, is rather a complicated phenomenon. By "phase relation" we mean the position of the current with regard to the voltage producing it. To understand what "phase relation" means, let us take the analogy of a pendulum in motion.

The force keeping the pendulum swinging is a maximum at the end of each swing, while the greatest velocity resulting from this force is at the middle of the swing; obviously the times of greatest speed and greatest force are not coincident; the one is out of phase with the other by what mathematicians would determine, in the case of the pendulum, as 90°, or a quarter period.

Now the current leads the voltage at the sending end of the cable by 45°. If a series condenser is introduced to diminish distortion, it still further increases the lead, and reduces the effective power into the cable. The effective power can only be a maximum when the current and voltage are exactly in step, or in other words, when there is no "phase relation."

A receiving condenser is also harmful for the same reason as a sending condenser. By abolishing the sending condenser and replacing the receiving one by a magnetic shunt placed across the suspended coil of the siphon recorder or relay in 1898, the speed and accuracy of signalling were materially increased.

A magnetic shunt, as employed on the cables, consists of an insulated copper wire wound round a closed circuited iron core. The resistance of the shunt is about 30 ohms; its inductance varies up to a maximum of from 20 to 40 henrys, and its weight from 1 to 3 cwt. In the case of a siphon recorder used as the receiver, the shunt short-circuits the suspended coil and the series condenser is abolished. In the case of a cable relay, the series condenser is usually retained, to ensure that earth currents are effectually stopped, but the condenser is made large.

A shunt inductance has a similar time action on the incoming current to that of a series condenser, but with this improvement—that it helps to reduce the phase distortion of current with voltage rather than accentuate it, as is the case with the condenser.

Having obtained the best value of the shunt alone, the following curious effect was discovered: that adding a condenser as an additional shunt, the size of the signals on the recorder got larger and more distinct. The mathematical reason for this is as follows: that for any particular frequency, say the highest frequency of the cable signalling, the shunts of inductance and capacity when properly proportioned act as a shunt of infinite resistance. For frequencies much below this it is as if we had no condenser at all. For frequencies much above this, it is as if we had no inductance, but only a condenser.

To reduce still further the harmful effect of phase displacement, series inductances have lately been introduced at the ends of cables, particularly at the sending end. By placing an inductive coil of low resistance in series with the battery at the apex of the duplex bridge, not only has the speed of signalling been increased, but the effect of what is known as "jar" on the duplex balance has also been greatly reduced.

Before proceeding to describe the instruments that work the cables, I will say a few words about "duplexing." All cables are now duplexed, that is to say, are arranged so that messages can be sent and received, at the same time, at each end simultaneously. The first cables were duplexed by Stearns, and later ones by Muirhead and Taylor. Duplex reduces the speed of simplex, or of working one way only, by 20 per cent., but the total carrying power of the cable, irrespective of direction, is raised by some 70 per cent., and is for this reason valuable, and repays the trouble in maintaining the balance.

Cables are duplexed by arranging an artificial or imitation cable, which is an exact electrical copy of the real, in parallel with the real cable. The current from the sending battery flows through two equal arms of capacity or inductance of a Wheatstone bridge arrangement and into the real and artificial cables.

The inductive or magnetic bridge which I have applied lately is, I think, the best to employ, because it gives in practice higher speeds than any other form of bridge. The receiving instrument is joined to the commencement of the cables, and is thus not interfered with by the sending currents, because there is no tendency for the current to flow one way or the other, the real and artificial cables having exactly the same electrical properties and acting on the sending current in the same way; but the current that is received flows only from the real cable, and is not balanced by any from the artificial, so that the receiving instrument is worked by it.

When duplex is properly adjusted it is said to be in balance, from its similarity to the adjustment of an ordinary balance used for weighing goods. Take the ordinary balance as an illustration of the electrical one. Let one scale-pan represent the cable, the other the artificial; if equal weights are placed in each pan the beam will not turn, but the beam will turn if, while equal weights are or are not in the pan, a small weight is added or placed on one pan.

In the cable "duplex," the receiving instrument will not be affected by the sending current, because the voltage is always the same on each side of the instrument, but will turn to indicate a signal when a voltage is received or is added to or subtracted from the voltage already on the cable side, due to a voltage being applied to the cable at the far end.

In Fig. 6 is shown the simplest diagram of a cable "duplex," and Fig. 7 illustrates its mechanical equivalent; the lettering is similarly related.

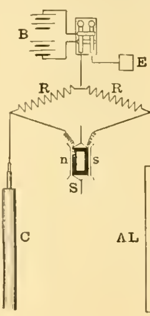


FIG. 6.

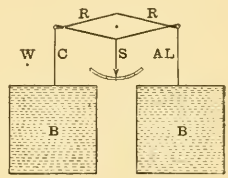


FIG. 7.

RR are the two resistances or the arms of the balance; S is the receiver or indicator, which shows a difference of voltage or weight; B is the battery voltage or weights in the pan; C and AL are cable and artificial line respectively, or the two pans of the balance.

If the battery B sends equal currents into cable and artificial line, as it should do if there is a perfect balance, no current will flow through S, and thus the receiver S is unaffected by the sending voltage; or, if the pans of the balance have equal weights B placed on them, the indicator S will not move. On the contrary, if a voltage is received from the cable C, this voltage is added to or subtracted from whatever voltage may be in C at the time, due to the sending battery, and thus there will be a difference of potential across S, and the receiving instrument will be worked from currents sent from the far end of the cable, and from these currents only.

In the mechanical analogy a small weight W is added to or taken from one of two equal weights in the pans C and AL, and the beam will be tilted and will be moved by this weight only however the weights B B are varied.

The voltage of the battery as applied to the sending end of a cable is very much greater than that received from the cable to work the instrument, say in the relation of 40 volts to 1/20 volt in the case of a moderately long cable, or as 800 is to 1, and the sending and received currents resulting from the same follow a similar proportion.

In the mechanical illustration I have therefore indicated the weights B and W as squares having this proportion to give a visual indication of what this means in the balance. The proportion I have given is only the relation of the sending voltage to that received. If the balance were out to this proportion, the sending voltage would affect the receiver with disturbances equal in size to those due to the receiving voltage; the duplex would then be very badly indeed out of balance.

To receive properly, the sending voltage must produce no movement of the receiver whatever; that is to say, any disturbance due to this cause must certainly be less than one-tenth of that due to the arrival current.

Taking the figures I have given, we see that the balance must be obtained and maintained so that, applying 40 volts to the cable and artificial line, the two currents dividing must not vary more than what will produce 1/200 volt; that is, must be balanced to an accuracy of 8000 to 1.

If, after the duplex has been established, the artificial line varies in its electrical properties as much as 1/8000 of its value, the balance would require adjustment so as to keep it useful for receiving. The sensitiveness under these conditions may be considered as equivalent to the sensitiveness of an ordinary metal balance that with 8 grams in each pan must turn accurately with 1 milligram.

It is now found necessary to maintain still more perfect balances for my new method of "high-speed working of cables"; in fact, a balance that must be maintained to within the proportion of 72,000 to 1. To do this, the very greatest care has to be directed to questions of insulation and temperature correction, and special appliances are supplied to obtain this high degree of accuracy. In fact, the future of "high-speed working of cables" is locked up very much with this question of more delicate and accurate balances; and if still more perfect balances could be obtained, still higher working speeds of cables would immediately be possible.

I now come to the instruments employed to work the cables, starting with the sending end. As before pointed out, the various letters of the cable alphabet are composed of combinations of + and − electrical impulses, or of the records that these impulses produce. The letter *e* is a + impulse, *t* a − one; *a* is composed of two impulses, a + and −, and so on for all the other letters. The operator has, therefore, first to translate the message to be sent into the cable code, and then to tap on the sending-key the order of the impulses that make up the code message. A sending-key consists of two levers; the depression by the finger of either one or the other determines which end of the battery, the + or − end, is joined to the cable.

Sending messages by hand is open to two objections: one the want of speed, the other the want of accurate spacing of the letters. A good trained clerk can send at the rate of about 140 letters per minute; but as most cables are capable of being worked at greater speeds, automatic or machine transmission has now become universal.

An automatic transmitter is an instrument that does the work of the clerk in sending; the two levers of the hand key are now operated upon by mechanism driven by a motor, through the agency of a perforated ribbon. Everyone who is acquainted with the pianola or automatic piano-player knows that the music to be played is punched as holes in a broad paper strip; this strip is run through the machine, and determines which levers are to press upon the keys of the piano.

The operation of the automatic transmitter is precisely like this, only instead of the extended keyboard there are two keys, a + and −, and the paper strip is a narrow ribbon with only two rows of holes to work the levers.

To send a message, the clerk first of all, by means of a hand perforator, punches the message as combinations of holes in the paper ribbon; this ribbon, after being perforated, is fed through the automatic transmitter.

The automatic transmitter is a motor-driven instrument, adapted to feed the perforated ribbon over the ends of a pair of blunt needles. These needles are kept perpetually moving up against and away from the moving ribbon, but if there is a hole in the paper, that particular needle over which it is fed will find it, and the needle will move a little way through the hole. Attached to the two needles are contact levers which connect the cable with one or the other pole of the sending battery.

When there are no holes in the paper ribbon, the needles move up against the paper, the further movement is arrested, and the contact with the battery is not closed, but the battery circuit is closed when there is a hole in the paper, because there is nothing now to block the needle, and the further movement through the hole enables the contact lever to close the battery circuit and thus send the signal.

The sending levers do one or other of two things: they join the cable to earth (in other words, they short-circuit the cable end) or they disconnect the cable from earth and connect it to the battery, so that the battery may send a signal. At the end of each signal the cable is automatically put to "earth."

Every signalling impulse due to each hole in the paper is, therefore, divided into two parts, the battery or signalling and the earthing portion. These two portions are adjustable relatively to one another; when the best relationship has been found, it is maintained at that adjustment. The object of earthing the cable after the battery contact is to allow the cable to discharge itself, and thus clear itself for the next signal. Automatic transmitters constructed on this principle are called "plain" automatics, and are in universal use.

The "curb" was a device applied to an automatic transmitter to sharpen the signalling impulse, and thus gain greater definition and increased speed by reversing the battery at the termination of every battery period. The reverse battery voltage helped to neutralise the charge already in the cable, and thus discharge the cable in quicker time than by simply earthing the cable, as in the "plain" automatic.

Unfortunately, the use of the "curb" results in a greater voltage stress on the sending end of the cable, for the reason that the reverse voltage of the "curb" is added to the voltage already in the cable ready to discharge, and the rapid reversal of current resulting upon the application of the "curb" is liable to cause "jar" disturbances on the duplex balance. For these reasons "curb" automatics are not now employed.

Instruments adapted to receive messages at the end of long submarine cables must of necessity work at the highest possible speed that the cable will allow, and are of extreme sensitiveness, and as a consequence are of great delicacy.

There are two kinds of receivers now commonly employed, viz. the siphon recorder and the "drum" cable relay. The siphon recorder, invented by Lord Kelvin in 1867, is an instrument that inks the message as received on a moving band of paper. The "drum" cable relay, by means of an electric contact-making device, brings in a fresh source of energy from a local battery, so that the electric signalling impulses are multiplied many times over in power, and are thus enabled to do many useful things besides inking the message, such as working signalling keys to re-transmit the message on to another line, or to guide the levers of an automatic punching machine to perforate the message. The siphon recorder requires the constant attention of a clerk, the "drum" cable relay does not.

The siphon recorder consists of a bent glass siphon tube nearly as fine as a human hair. The siphon is suspended by a fine bronze wire; one end of the tube dips in a reservoir of blue aniline ink, the other end can move across the surface of a travelling band of paper, upon which it inks its movement. If the end of the siphon touched the paper, the friction thus introduced would be fatal to the proper working of the instrument, because of the loss of sensitiveness; it is therefore kept in a state of constant vibration by attaching the tube near its end by means of a silk fibre to an electromagnetic vibrator. The message is thus recorded as a close row of ink dots on the moving paper, and the glass tube is quite free to swing sideways under the action of the received signals.

The siphon tube is joined by two silk fibres to a rectangular suspended coil of fine insulated copper wire, which coil hangs in a strong magnetic field. The currents from the cable flow through the wire of the suspended coil, and the reaction of these currents with the magnetic field causes the coil to oscillate to one side or the other, depending upon the direction of the current. The motion of the coil is transmitted by means of the two fibres to the siphon, and thus the signals are recorded as received.

Ever since the invention of the siphon recorder, efforts have been made to turn it into a relay, but two difficulties had to be faced. The extreme feebleness of the received signalling currents was such that they were incapable of opening and closing a battery circuit so as to do useful work in that circuit.

The reason for this is that a certain force is required to press the relay contacts together to complete the circuit and a certain force to break the circuit when formed; these forces of "make" and "break" are too great for the cable relay to supply under normal working conditions.

The second difficulty was the want of definition in the signals received to operate a relay; they were too ill-defined, and the zero line wandered too greatly to ensure that a relay with a fixed mechanical zero would work satisfactorily.

These two difficulties were overcome by the invention of my "drum" cable relay and my magnetic shunt. The drum cable relay (Fig. 8) is very similar to the siphon recorder. It is the same, so far as the suspended coil and connecting fibres are concerned, but in place of the siphon tube a relay contact arm is provided.

The end of this arm is arranged to press upon the surface of a revolving drum. The outer drum surface of gold or silver is divided into three parts: a central insulated portion, upon which the end of the contact arm normally rests when no signals are received, and portions one on each side of the central one. These outer divisions are included in the circuit of a local battery and two post-office pattern relays.

When the relay arm is deflected to one side or the other, upon the receipt of the signal, it slides or skates into contact with one or other of the outer portions of the drum, and thus closes circuit of the battery through one or other of the post-office relays; this second relay is thus operated, and in turn works a "sounder" key to re-transmit the signal into a second cable.

To reduce the electrical resistance that is found to exist in the contact between the relay pointer and the revolving drum, and to allow a large current to pass, condensers are placed across to short-circuit the contact.

These short-circuiting condensers are very important to the proper working of the relay, as without their aid very little current indeed could be obtained in the local circuit to do useful work. The cable relay is a delicate instrument, and mechanical effects had to be produced by means of energy four-millionths of that required to produce one candle-power of an ordinary carbon lamp. The operation of the relay throughout is quite automatic and trustworthy, and no clerk is required to supervise.

The drum relay has two properties that peculiarly fit it for cable work:—(1) the relay contact is always made, because the contact arm never leaves the surface of the drum; (2) by the rotation of the drum, the friction between the arm, to side motion, and the surface of the drum is reduced in a most wonderful way, so that the arm may be moved by the extremely feeble forces received at the end of the cables.

The relay has a fixed mechanical zero, the centre of the insulated portion, to which the end of the arm must return after every signal or group of signals, and the zero of the electrical signals has been made by electrical adjustment to coincide with the mechanical zero. If there were not this coincidence there would be mutilation of the re-transmitted signals.

The working of the relay is complicated by the requirements of the service, which demand that a condenser should be included in the suspended coil circuit. The object of this condenser is to exclude the possibility of interference from "earth" currents, which sometimes flow along the cable.

The presence of the "earth" current is due to outside electrical influences, atmospheric or celestial.

Now these "earth" currents, if allowed to flow through the suspended coil, would produce deflections that would interfere with the proper working of the relay.

The magnetic shunt which is always placed across the coil does shunt the "earth" current to a very great extent, but does not always get rid of it, and so to make matters sure the "unshunted" series or Varley condenser is included in the system.

The condenser, unfortunately, polarises or charges up under a series of signalling impulses of the same polarity or sign, and for this reason itself causes a wandering of the electrical zero of the signals. We are therefore trying to stop one kind of variable zero effect by a device that produces another one of its own.

The effect of the wandering zero due to the series condenser can be cured, because the wandering, unlike that of the "earth" currents, follows a regular law, viz. the law of the signals themselves. The relay produces the signals and combination of signals in its local circuit, precisely the same as the signals or combination sent through the cable that work it, and are at the same time causing the variable zero. Current is therefore taken from the local circuit and passed through an electrical retarding device, which is called the "local correction circuit," consisting of a series of inductances and shunting resistances. The local circuit is so adjusted in its value that the current at the far end rises exactly as there is a drop in the received signalling current through the series condenser.

The correction current is passed through a separate winding on the suspended coil of the relay, and produces an effect on the coil exactly opposite to that produced on the main winding by the variable zero itself, that is to say, two variable zeros of equal strength but of opposite directions are superimposed on the suspended coil, and thus neutralise one another. The variable zero of the signals themselves is thus eliminated.

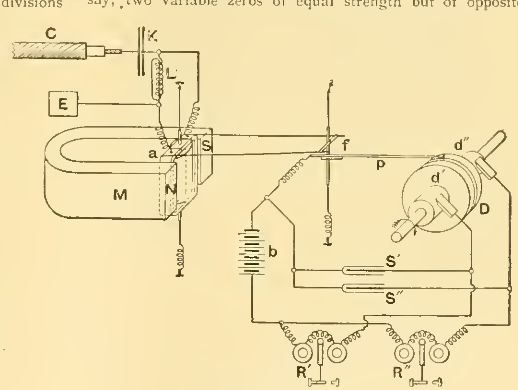


FIG. 8.—Drum Cable Relay.

Local correction is a very important part of the relay adjustment, and cannot very well be dispensed with.

The Eastern Telegraph Company generously lent me their lines for a trial of my "high-speed" system of working. The cable over which the tests have taken place stretches from Porthcurnow in Cornwall to Gibraltar, and is normally worked at 170 letters per minute, each way, with the siphon recorder as receiver. With the new method, using a special relay (Fig. 9), traffic has been carried continuously, duplex, at 230 letters per minute. On special trial runs, not carrying traffic, and not sending into the cable at the receiving station, although on duplex conditions, a speed of 280 letters per minute has been obtained.

The principle of operation is as follows. When a submarine cable is forced much beyond its normal speed of working, the quick-changing signals, such as make up the letter *c*, are the first to fail, or in other words, do not arrive with sufficient strength to work the receiver.

It was found on trial that allowing more of the current from the cable to flow through the receiver, say by increasing the size of the receiving condenser, the first and last signal of a series of reversals could be obtained with sufficient strength efficiently to work the relay.

The relay, once started, is arranged to bring in fresh energy from its local battery, through a special retarding circuit, to add to the strength of the quick-changing currents on its own coil, and thus the reversals are made strong enough to give a record, which without this aid they would have been unable to do.

By these means weak signals are built up at the receiving end of the cable, and the speed of working can thus be materially increased.

It is fortunate that the class of signal that has the greatest difficulty in getting through the cable is the

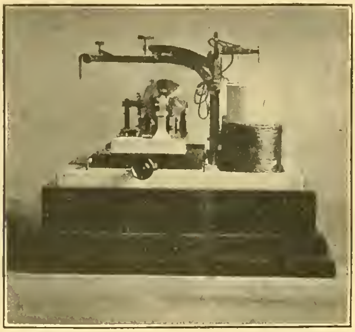


FIG 9.—High-speed Relay (side view). The pointer is constructed of quartz fibres kept in tension by a thin copper wire, the whole weight of the pointer being not more than one or two grains.

easiest to be added to when received. The "high-speed" relay works, therefore, not from the signals received from the cable only, but also from those that it transmits through its own local circuit, the record that it makes being the combined action of the two.[1]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DUBLIN.—Mr. M. W. J. Fry has been appointed professor of natural philosophy at Trinity College.

LIVERPOOL.—Mr. E. C. C. Baly, F.R.S., assistant professor of chemistry and lecturer on spectroscopy at University College, London, has been appointed Grant professor of chemistry at the University of Liverpool in succession to the late Prof. Campbell Brown.

LONDON.—Miss H. L. M. Pixell, demonstrator in zoology at the Bedford College for Women, has been elected by the Reid trustees to a Reid fellowship, tenable for two years. Miss Pixell proposes to spend some months next year in Vancouver, investigating the marine fauna of the Georgian Straits.

OXFORD.—Mr. R. R. Marett, secretary to the committee for anthropology, has been appointed reader in social anthropology.

Mr. C. H. Manley has been elected to a Bracegirdle exhibition, following on an examination in chemistry. The exhibition is tenable for three years.

THE honorary degree of Doctor of Science has been conferred upon Sir John Murray, K.C.B., F.R.S., by Harvard University.

A PROFESSORSHIP of commercial geography has recently been established at the Export-Akademie of the Imperial Austrian Handelsmuseum at Vienna, and Dr. F. Hiederich has been appointed the first holder of the chair.

[1] A man of science of my acquaintance tells me that I ought to put things in this way. A fluttering current arrives too weak to make a signal, but all it can do is *just to hint* that it wishes to make a signal, the hint is recognised, and the local battery makes the signal required.

DR. A. C. CRAWFORD has been appointed professor of pharmacology at Stanford University, and Prof. G. H. Cox has been placed in charge of the department of geology and mineralogy at the Missouri School of Mines, Prof. L. S. Griswold having vacated the chair of geology at that institution.

THE United Services' College at Windsor possesses an aviation workshop, built and furnished by Mr. P. Alexander, in which instruction is given in the making of model aëroplanes. Hitherto the use of the workshop made by the students has been voluntary, but in the next term aviation is to be made a special subject of instruction.

AN annual prize (to be known as the "Howard T. Ricketts prize") has been established at Rush Medical College, of the University of Chicago, in memory of Dr. H. T. Ricketts, who recently died in Mexico of typhus fever while investigating that disease. The prize will be awarded to the student presenting the best thesis embodying the results of original investigation on some topic relating to dermatology.

IN continuation of the successful evening courses in aëronautics at the Northampton Polytechnic Institute, Clerkenwell, during the session 1909–10, extended courses of a more complete and practical nature are being arranged for next session, and Mr. F. Handley Page has been appointed to take charge of them. The institute has under consideration the establishment of full-time day courses in aëronautical engineering extending over four years, further particulars of which will be published later.

THE model for the memorial in the Medical School of Trinity College, Dublin, to the late Prof. D. J. Cunningham, F.R.S., is now completed, and the bronze portrait panel will, it is hoped, be placed in position by the time of the opening of the school for the coming winter session. As it is proposed shortly to close the subscription list, it is hoped that friends and pupils of Prof. Cunningham who desire to contribute will communicate with the honorary treasurer or honorary secretaries of the Cunningham Memorial Fund, Trinity College, at an early date.

THE Essex Education Committee has arranged for a twelve days' visit (ranging from July 14 to 26) of agriculturists and horticulturists to Ireland. The programme is a comprehensive one, and will afford the party opportunities of seeing the organisation and practice of agriculture and horticulture on farms and holdings varying in size from four or five up to three hundred and fifty acres; also of studying the schemes of instruction and agricultural institutions of the Department of Agriculture, the work of the Congested Districts Board, and the Irish Agricultural Organisation Society. This is the first time the Essex Education Committee has organised a visit to Ireland, but successful tours in Denmark, Holland, Hungary, and Scotland have been undertaken under its auspices in recent years.

THE Secretary of State for the Colonies has selected Dr. Joseph Pearson as director of the museum at Colombo, Ceylon, in succession to Dr. Arthur Willey, now appointed professor of zoology at McGill University, Montreal. Dr. Pearson has for some years held the post of chief demonstrator and assistant lecturer in the zoological department of the University of Liverpool, and previous to that he had held appointments on the zoological staffs at Cardiff and at Belfast. His original work has been chiefly in marine biology, including several reports upon Holothuroidea of tropical seas, and an exhaustive memoir upon Cancer, the edible crab. Dr. Pearson's removal has created a vacancy in the zoological staff at the University of Liverpool which will be filled by the appointment of Mr. R. Douglas Laurie as senior demonstrator and assistant lecturer, while Dr. W. J. Dakin will join the staff as second demonstrator.

EARLY in the present year University College, Reading, appointed a deputation to visit certain universities of Canada and of the United States with the object of investigating methods of agricultural education and research, and also other aspects of university development. The deputation left England on May 6, and was absent six weeks. The tour included the McGill University at Montreal, the Macdonald College, St. Anne de Belle Vue, the State Experimental Farm at Ottawa, the University of Toronto, the Ontario College of Agriculture at Guelph, Cornell University, Wisconsin University, and Harvard University. In each case the members of the deputation made it their principal object to acquaint themselves with the agricultural activities of the institution visited, and their work was greatly facilitated by the cordial assistance of the Government and other authorities both in Canada and in the United States. It is hoped to publish a report during the course of the ensuing autumn containing the substance of the information gained and emphasising certain conclusions.

The 1910 report of the council of the City and Guilds of London Institute to the members of the institute is now available. As usual, full particulars are provided of the work done during the previous year at the Central Technical College, the Finsbury Technical College, the other schools and colleges in connection with the institute, and the department of technology. In the section of the report dealing with the department of technology, it is pointed out that the preliminary education of candidates who enter technical classes is evidently very often the reverse of satisfactory. It was noted in the last report that the institute, in conjunction with the Board of Education, was taking active steps to encourage the attendance of young persons engaged in different trades at evening continuation classes, with the view of their acquiring a competent knowledge of English, arithmetic, drawing, and elementary science before entering upon their first year's course of training in technology. The committee regrets, however, to state that it has been found very difficult to enforce the regulations introduced in 1908, by which, in certain textile subjects, students of registered classes in technology were only to be admitted to the first year's examination on satisfying the institute that they possessed the necessary preliminary knowledge. Notwithstanding the growth of group courses and the increased facilities for the attendance of students at evening continuation classes, it has not been found possible to insist on evidence of attendance at continuation classes prior to the admission of students to a technical school. It has proved necessary to decide that the full enforcement of the regulations in question should be postponed until 1912. Commenting on the results of the examinations conducted throughout the country by the institute, the report says the independent criticisms from examiners in wholly distinct subjects show that many teachers, while undoubtedly using their best efforts to acquaint the students with the technical details of their trade, fail to obtain good results owing to their giving instruction on wrong lines, paying too much attention to description and too little to the theory of the subject and to the principles underlying the work in which they are engaged. This may be partially due to lack of experience in teaching and failure to realise the difficulties of their students. The institute concurs in a suggestion made by its inspectors that if the education authority could send a comparatively inexperienced teacher to visit some of the schools at which successful classes are conducted and see their methods of work, such a visit would amply repay its cost.

SOCIETIES AND ACADEMIES.

London.

Geological Society, June 15.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. W. **Cross**: The natural classification of igneous rocks. The author reviewed the various systems of classification which have been proposed. He discussed the origin of the difference of composition of igneous rocks due to:—(1) primæval difference, (2) magmatic differentiation, (3) assimilation, and pointed out that differentiation and assimilation are in a measure antithetical processes. The following general conclusions were formulated:—The scientific logical classification of igneous rocks must apparently be based on the quantitative development of fundamental characters, and the divisions of the scheme must have sharp artificial boundaries, since none exist in nature. Chemical composition is the fundamental character of igneous rocks, but it may be advantageously expressed for classificatory purposes in terms of simple compounds, which represent either rock-making minerals or molecules entering into isomorphous mixtures in known minerals. It is probable that the magmatic solution consists of such molecules, and that the norm of the "quantitative system" is a fairly representative set of these compounds. The actual mineral and textural characters of igneous rocks are variable qualifiers of each chemical unit, and should be applied as such to terms indicating magmatic character.—H. **Bury**: The denudation of the western end of the Weald. There are two main theories of Wealden denudation:—(1) attributing the removal of most of the Chalk to marine planation; and (2) denying planation, and relying solely on subaërial denudation. Prof. W. M. Davis's suggestion of a subaërial peneplain forms a sort of connecting link between the two. The evidence in favour of planation which Ramsay and Topley brought forward is inconclusive, and might plausibly, if it stood alone, be attributed to pre-Eocene causes. On the other hand, Prestwich's arguments against planation are equally weak, while the Chalk plateau to which he directs attention strongly supports Ramsay's views. The distribution of chert is fatal to Prof. Davis's hypothesis, and very difficult to account for, except on the marine theory. In the case of the river Blackwater it can be proved that, long after the Hythe beds of Hindhead were uncovered, the river-system remained extremely immature, and this affords very strong grounds for the acceptance of the marine hypothesis. The evidence of the other western rivers is less conclusive, though the Wey and the Mole both provide minor arguments pointing in the same direction. The anomalous position of the Arun, at the foot of the northern escarpment of the Lower Greensand on either side of the Wey, is almost certainly due to comparatively recent captures from the latter river, and affords no ground for assuming a river-system of great age matured on a Miocene peninsula. There is no proof that any of the existing connections between rivers and longitudinal folds are of a primitive character, and, on the other hand, there are many alleged examples of transverse disturbances having served as guides to consequent rivers. This again, on the whole, supports the marine hypothesis, especially if, as there are reasons for believing, the longitudinal folds are older than the transverse.—Dr. J. W. **Evans**: An earthquake model. This model is designed to show the successive conditions that result in an earthquake shock:—(1) slow relative movement between two extensive portions of the earth's crust lasting over a long period, and causing (2) a state of strain in the intervening tract, leading to (3) fracture which relieves the strain and allows (4) the adjoining portions of the rock on either side to fly back by virtue of their elasticity, so as to resume, so far as possible, their original relation to the rock-masses with which they are still connected. This movement of release may give rise to two kinds of periodic disturbance: (5) short-period vibrations, due to a sudden arrest by an obstacle and constituting the earthquake properly so called, and (6) a slower backward and forward swing of the rock about the position of equilibrium.

Royal Microscopical Society, June 15.—Prof. J. Arthur Thomson, president, in the chair.—Prof. J. Arthur **Thomson**: Some alcyonarians collected by Mr. J. Murray, of Sir E. Shackleton's Antarctic Expedition. The species, of which there were four, were *Clavularia rosea*, Studer, *C. chuni*, Kükenthal, *Alcyonium paessleri*, May, and *Ceratoises delicatula*, Hickson.—E. M. **Nelson**: Apparatus for increasing the power of an achromatic condenser.—E. B. **Stringer**: The use of the mercury vapour lamp in observing the rings and brushes in crystals.

Linnean Society, June 16.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. R. N. **Salaman**: Male sterility in potatoes, a dominant Mendelian character, with remarks on the shape of the pollen in wild and domestic varieties. The paper was based upon experiments made by the author in his own garden at Barley, near Royston, Herts, during the past four years; but on this occasion the author confined his remarks to the pollen, leaving other points for some future occasion. He pointed out that "dead" pollen-grains, or none, were usually associated with flowers of heliotrope colour.

Royal Anthropological Institute, June 28.—Sir H. Risley, president, in the chair.—W. J. Lewis **Abbott**: The classification of the British Stone age, and some new and little known horizons and cultures. After pointing out that the implementiferous deposits have not always been laid down in an unbroken chronological sequence, so that the number of feet at which an implement is found above Ordnance Datum is not always enough in itself to determine its age, the author urged that none of the systems of classification which have been formulated upon the conditions which obtain on the Continent are applicable in this country, where the conditions do not necessarily obtain. He suggested that nature in the first instance furnished man with the prototypes of his tools, and that subsequently he discovered new methods of working flint, and these gave rise to new sets of shapes. In the author's opinion, therefore, these groups of implements, representing various cultures or industries, must enter as basal units in the classification. The author then went into details of two such industries, which he has named the Prestwichian and Ebbsfleetian respectively. Each of these is characterised by a set of special implements worked in a special manner. Although the author had been working at this industry for many years, it was only recently that a large deposit of them was found; this was at Northfleet, where the deposit fills a hollow some six acres in extent. The principal implement of this industry is a large weapon, weighing sometimes as much as 7 lb., and resembling a gigantic spear-head. For this implement the author proposed the name Prestwich. The great peculiarity of this implement was that, when finished, another implement was struck off it without impairing its efficacy. This latter the author has named after Sir John Evans. The author suggested that these may have been used as tallies in a bargain, as it seems clear that they were religiously kept. The implements occur in enormous numbers, and include large axes, with a rounded edge and triangular, heavy side choppers, spear-heads of peculiar type and of large size, and knives, many of which are more than a foot long.

Edinburgh.

Royal Society, June 6.—Prof. Hudson Beare, vice-president, in the chair.—Dr. R. A. **Houston**: Two relations in magnetism. By a simple application of the two laws of thermodynamics, relations were established between each pair of the quantities, magnetic force, stress, and temperature. The chief novelty lay in the manner in which the relations were deduced.—A. D. **Ross**: A new method of differentiating between overlapping orders in mapping grating spectra. The method consisted in photographing the Zeeman effect in the spectrum, a thin plate or lens of optically active quartz or other allogyric substance being introduced between the source of light and the slit. The plane of polarisation of the components was thus rotated by amounts depending on the wave-length. Owing to the selective or polarising action of the grating itself, the intensity ratios between the components in triplets, quartets, &c., gave an indication of the approximate wave-length. The method had been successfully applied to the mapping of spectra of certain rare elements. It greatly reduced the cost of the work, and might be expected to reveal, incidentally, series among the spectrum lines.—Dr. H. **Walker**: The variation of Young's modulus under an electric current, part iii. In this continuation of previous papers a number of new results were given. In particular, the effect of increasing tension on the phenomenon was investigated. The peculiar law of variation of Young's modulus under increasing currents, as shown in the cases of the four metals iron, nickel, copper, and platinum, gradually changed as the tension was increased, until, finally, all peculiarity vanished.—Prof. W. **Peddie**: Continuous and stable isothermal change of state. James Thomson's form of continuous isothermals was discussed, and was shown to be inapplicable below the triple point. For example, water free from ice-nuclei and vapour-nuclei must pass either to the solid or to the vapour state. If it follows the paths of Thomson's curves, two such paths must exist; but no physical distinction remains to determine which shall be selected. A modification of Thomson's form of isothermal was suggested, in which no unstable part occurred. In the liquid state, under decreasing pressure, the volume would increase until, without change of density, a molecular re-arrangement would take place and the substance become solid. Under increasing pressure the volume of the solid would decrease until, by molecular re-arrangement, the vapour state would be reached. The applicability of this representation above the triple point, when solid does not exist, was shown to be complete.

Calcutta.

Asiatic Society of Bengal, June 1.—Dr. L. L. **Fermor**: A Palæolithic implement of manganese ore. The paper gives a description of a Palæolithic implement which is unique in that it is made of manganese ore.—F. D. **Ascoli**: Rivers of Dacca district. The paper deals with the changes that have taken place in the courses of the rivers of the Dacca and Faridpur districts since the desertion by the Brahmaputra of its old channel north of Dacca. The author attributes the origin of these changes to the incursion of the Teesta into the Brahmaputra in 1787, and shows that the principal changes now going on are not, as Fergusson anticipated, in the Ganges at and above the confluence at Goalundo, but further to the south in the Rajnagur area.—D. **Hooper**: Medicinal lizards. The dried lizard sold in the bazaars of northern India is *Scincus mitranus*, Anderson, and not, as quoted by writers on Indian materia medica, *Lacerta scincus*, Linn. References are given to the uses of this lizard in medicine, and to the use of other saurians in Europe and China.

DIARY OF SOCIETIES.

FRIDAY, July 8.

Physical Society, at 5.—A Thermo-electric Balance for the Absolute Measurement of Radiation: Prof. H. L. Callendar, F.R.S.—The Convection of Heat from a Body cooled by a Stream of Fluid: Dr. Alexander Russell.—On Hysteresis Loops and Lissajous' Figures, and on the Energy wasted in a Hysteresis Loop: Prof. S. P. Thompson, F.R.S.—The Energy Relations of certain Detectors used in Wireless Telegraphy: Dr. W. H. Eccles.

CONTENTS.

	PAGE
The Laws of Heredity. By Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S.	1
The Metabolism of Marine Animals. By J. J.	5
Smallpox and Vaccination in British India	5
The Alternate-current Theory. By Prof. Gisbert Kapp	6
Our Book Shelf	7
Letters to the Editor:—	
Arthur's Round Table in Glamorgan. (*Illustrated.*)—Rev. John Griffith	8
Halley's Comet. (*Illustrated.*)—Dr. James Moir	9
Earth-current Observations in Stockholm during the Transit of Halley's Comet on May 19.—D. Stenquist and E. Petri	9
Leptocephalus hyoproroides and *L. thorianus*.—Johs. Schmidt	9
Static Charge in Bicycle Frame.—Robert S. Ball, jun.	9
Marine Biological Photography. (*Illustrated.*) By Francis Ward	10
Some Extinct Vertebrate Animals from North America. (*Illustrated.*) By A. S. W.	12
Experiments on Air Resistance. (*With Diagram.*) By Dr. T. E. Stanton	13
C. H. Greville Williams, F.R.S. By A. H. C.	14
Notes	14
Our Astronomical Column:—	
Astronomical Occurrences in July	19
Halley's Comet	19
Ephemeris for Comet 1910*a*	19
Photographs of Morehouse's Comet	19
The Determination of Position near the Poles	19
The Variation of Latitude	20
New Canals and Lakes on Mars	20
The International Congress at Düsseldorf	20
The Tuberculosis Conference and Exhibition	22
International Union for Cooperation in Solar Research	22
Modern Submarine Telegraphy. (*Illustrated.*) By Sidney G. Brown	23
University and Educational Intelligence	28
Societies and Academies	29
Diary of Societies	30

THURSDAY, JULY 14, 1910.

TOTEMISM UNVEILED.

Totemism and Exogamy: a Treatise on Certain Early Forms of Superstition and Society. By Prof. J. G. Frazer. In four vols. Vol. i., xix+579; vol. ii., ix+640; vol. ii., ix+583; vol. iv., v+379; eight maps. (London: Macmillan and Co., Ltd., 1910.) Price 2*l.* 10*s.* net the four vols.

PROF. FRAZER is a great artist as well as a great anthropologist. He works on a big scale; no one in any department of research, not even Darwin, has employed a wider induction of facts. No one, again, has dealt more conscientiously with each fact; however seemingly trivial, it is prepared with minute pains and cautious tests for its destiny as a slip to be placed under the anthropological microscope. He combines, so to speak, the merits of Tintoretto and Meissonier. What, then, we may ask, of the philosophical result, of the theory which should emerge from all this acreage of minute workmanship?

In "Totemism and Exogamy" (so far the most voluminous of his anthropological treatises) he admits—the passage is an interesting one—that he has

"never hesitated either to frame theories which seemed to fit the facts, or to throw them away when they ceased to do so; my aim in this and my other writings has not been to blow bubble hypotheses which glitter for a moment and are gone; it has been by a wide collection and an exact classification of facts to lay a broad and solid foundation for the inductive study of primitive man."

To the mind of the truly scientific inquirer, the theory of a subject is a continuously modified machine, the object of which is at once to sort the elements of a combination and to re-combine them, so that by a turn of the handle the observer can reproduce the original process in all or any of its parts. Such a machine only arrives at perfection after a long evolution guided by the "method of trial." Prof. Frazer in anthropology, as Darwin in biology, is content to try new models, and to fit new parts, not with the meticulousness of static curatorship, but with the abandon of experimental genius.

This method and its result are illustrated in a very perfect way by that portion of the book which is concerned with totemism. This portion (if we may express our own belief at the risk of offending Prof. Frazer's characteristic modesty), is actually "The Complete History of Totemism, its Practice and its Theory, its Origin and its End." Commencing with a reprint of the first (1887) edition of "Totemism," a model of its kind, a brief and digested survey of the then known facts (and in its working hypotheses innocuous enough to serve as an introduction for the complete treatise), he next reproduces his first tentative theory in "The Origin of Totemism" (*Fortnightly Review*, 1899), namely, that the essence of it is the "external soul," as suggested in "The Golden Bough" of 1890, only to discard it, in the light of the remarkable discoveries made by Messrs. Spencer and Gillen in Central Australia, for another form, a system of magic, "designed to supply a community with all the necessaries of life, and especially with the chief necessary of all, with food," a notable picture of cooperation tinged with superstition. Next, in the reprint, "The Beginnings of Religion and Totemism Among the Australian Aborigines" (*Fortnightly Review*, 1905; articles expanded from "Observations on Central Australian Totemism," in the Journal of the Anthropological Institute, vol. xxviii., 1899), he reproduces his third hypothesis.

As this, in the present writer's opinion, when completed by the discoveries of Dr. W. H. R. Rivers, and fully expounded in vol. iv., is the final explanation of the mystery of totemism, and as even its author admits that "here at last we seem to find a complete and adequate explanation of the origin of totemism," it calls for detailed attention. In 1899, Messrs. Spencer and Gillen described the Arunta and Kaitish method of determining the totem.

"A person derives his totem neither from his father nor from his mother, but from the place where his mother first became aware that she was with child. Scattered all over the country are what Messrs. Spencer and Gillen call local totem centres, that is, spots where the souls of the dead are supposed to live awaiting reincarnation, each of these spots being haunted by the spirits of people of one totem only; and wherever a pregnant woman first feels the child in her womb, she thinks that a spirit of the nearest totem centre has entered into her, and accordingly the child will be of that local centre, whatever it may be, without any regard to the totem either of the father or of the mother."

This Prof. Frazer terms conceptional totemism.

"The theory on which it is based denies implicitly, and the natives themselves deny explicitly, that children are the fruit of the commerce of the sexes."

He gives probable reasons for this apparently strange ignorance.

Turning now to the summary and conclusion in vol. iv. of the present work, we read:—

"Obviously, however, this theory of conception does not by itself explain totemism. . . . It stops short of doing so, by a single step. What a woman imagines to enter her body at conception is not an animal, a plant, a stone, or what not; it is only the spirit of a human child which has an animal, a plant, a stone, or what not for its totem. . . . For the essence of totemism . . . consists in the identification of a man with a thing, whether an animal, a plant, or what not. . . . Absolutely primitive totemism . . . ought to consist in nothing more or less than in a belief that women are impregnated without the help of men by something which enters their womb at the moment when they first feel it quickened."

The "missing link" was found in the Banks' Islands by Dr. W. H. R. Rivers. Here the natives

"identify themselves with certain animals or fruits and believe that they themselves partake of the qualities and character of these animals and fruits. . . . The reason they give for holding this belief and observing this conduct is that their mothers were impregnated by the entrance into their wombs of spirit animals or spirit fruits, and that they themselves are nothing but the particular animal or plant. . . ."

The theory, as thus completed, "accounts for all the facts (of totemism) in a simple and natural manner."

Hence, as secondary results, the practice of abstaining from killing and eating the totem, and conversely of occasionally eating a little; the belief that men have a magical power over their totems, particularly that of multiplying them; the belief that people are descended from their totems, and that women sometimes give birth to these animals or plants; the fact that people often confuse their ancestors with their totems; and, lastly, the fact that totems comprise an immense range of organic, physical, and artificial objects, the reason being

"that there is nothing from the light of the sun or the moon or the stars down to the humblest implement of domestic utility which may not have impressed a woman's fancy at the critical season and have been by her identified with the child in her womb."

One great merit of the theory, it will be seen, lies in this—that it rests upon a psychical phenomenon of universal occurrence. In a very interesting section, the author connects the facts of totemism with the "longings," the *envie,* of pregnant women. The persistence of the belief and the difficulty of explaining away the physical results of "maternal impressions" on the offspring are most significant. As the author observes, if totemism existed to-day in England, the child of the lady who had a "longing" for raspberries, would, being marked with a raspberry, clearly outlined on the back of the neck, have had a raspberry for its totem. The possibilities latent in such world-wide ideas may explain, suggests the author, the remarkable preservation of clan type in clan exogamy.

"The children of each clan take after their mothers or their fathers, as the case (that is, of residence) may be, according as the mental impressions made on pregnant women are derived mainly from their own clan or from the clan of their husband."

We are glad to see that the author recognises, and continually emphasises, the primary independence of totemism and exogamy; they "are fundamentally distinct in origin and nature, though they have accidentally crossed and blended in many tribes." Throughout the book exogamy is treated as an accidental adjunct of totemism. Yet a complete explanation of its origin and evolution is attempted. In our opinion, this explanation is unconvincing. By a curious irony, J. F. Mclennan, the discoverer of both institutions, never essayed an explanation of totemism, but concentrated his mind on an explanation of exogamy, now shown conclusively to be erroneous. Prof. Frazer, on the other hand, found in totemism his first interest, and his explanation of it constitutes his greatest triumph, while in dealing with exogamy he seems to be engaged on a secondary problem. An excellent discussion of theories is followed by a comparison of the action of exogamy to that of scientific breeding. His account of the development of exogamy from an original prohibition of the "marriage" of brothers and sisters is masterly enough, and we are grateful for it. That the later prohibitions were deliberate we cannot doubt; it is when he follows Messrs. Howitt, Spencer, and Gillen in asserting that the first dichotomy of the primitive group, for the prevention of brother-sister unions, into two halves was also deliberate, that we feel unsatisfied. He rests on an assumed and unexplained superstition (as to the evil effects of incest) in the primitive mind. Nor does he explain how a group, however small, could be divided into two. On what *principle* could it be done? Here he ignores Mr. J. J. Atkinson's theory of primal law.

Nearly two thousand pages are occupied with an ethnographical survey of totemism, an invaluable compilation. The maps, including that of the distribution of totemic peoples, are a new and useful feature. The notes and corrections bring the reprints up to date. A. E. CRAWLEY.

A THEORY OF PREHISTORIC RHODESIA.

Prehistoric Rhodesia. By Richard N. Hall. Pp. xxviii+88. (London: T. Fisher Unwin, 1909.) Price 12*s.* 6*d.* net.

MR. R. N. Hall, the South African excavator, is not very tolerant of criticism. He is up again, and running full tilt against Dr. Randall Maciver, who, in "Mediæval Rhodesia," dared to try to demolish his prehistoric Semitic Zimbabwe theory. Whether Dr. Maciver was right in all his contentions as to the stratification of Zimbabwe, the Nankin china found in it, and so forth, cannot be decided until after he has replied to Mr. Hall's objections as stated in this book. We have little doubt that his reply will finally dispose of these objections, which, of course, Mr. Hall was perfectly justified in advancing if he felt that Dr. Maciver had not handled the evidence rightly. It is, however, a pity that in doing this Mr. Hall allows a certain tone of bitterness to appear in his references to his antagonist.

Mr. Hall is still dominated by the idea that he can find Semitic traces in South Africa. But, again, he brings forward no satisfying proofs of any tangible Semitic influence there. Round towers with conical tops are no proof of Semitic connection. It is not only the Semites who have built such. "Cones" are no speciality of the Semites. In support of the idea that Cones mean Semites, Mr. R. N. Hall brings forward references to Messrs. L. W. King and H. R. Hall's book, "Egypt and Western Asia." Mr. R. N. Hall's note referring to this supposed support for his theory reads as follows:—

"In King and Hall's 'Egypt and Western Asia' reference is made to 'the great cone' at Sinai in the Elamite kingdom (p. 159); to the remains of a 'temple-tower' at Ninib at Babylon (p. 166); to the 'temple-towers' erected by Gudea at Shirpurla in southern Babylonia (p. 217); to 'massive temple-towers' at Samarra on the Tigris (p. 284); to 'cones' in Assyria (p. 392); and to the 'temple-tower' of Ashur (p. 410)."

Now, apart from the extraordinary solecisms "at Sinai in the Elamite kingdom," and "at Ninib at Babylon" (does Mr. R. N. Hall not know where Elam was, where or what Sinai is, or that Ninib was a god?), on referring, incredulous, to the work of Mr. L. W. King and his coadjutor, Mr. R. N. Hall's namesake, we find that this note of the South African Mr. Hall's is one of the oddest farragos of misquotations and miscomprehensions that we have ever seen. The "'great cone' at Sinai in the Elamite kingdom" (which is as if one were to say "at Mont Blanc in Russia") is the representation of a mountain-peak on the well-known stela of the Babylonian king Naram-Sin, which represents that monarch conquering his enemies in a mountainous country, presumably Elam. How Mr. Hall has got Sinai in appears from a neighbouring sentence, in which Messrs. King and H. R. Hall say that Naram-Sin "made an expedition to Sinai." But that does not matter; what does matter is that Mr. Hall quotes Messrs. King and Hall as speaking of this "great cone" as if it bore out his theory, as if it were a building, whereas what they actually say is "the great cone in front of Narâm-Sin, which is probably intended to represent the peak of the mountain." What right has Mr. Hall, then, to refer to the authors of "Egypt and Western Asia" at all? If he disagrees with them as to the interpretation of the cone on the monument, let him say so. But the relief showing the king before the "cone" in question is dead against him in that case.

The "'temple-tower' at Ninib at Babylon" is the "ziggurat" or "temple-tower" of the temple *of Nabû at Birs Nimrûd,* which is the site of the ancient Borsippa, not Babylon; and these ziggurats were not conical at all, nor do King and Hall, either in connection with that at Borsippa or that at Shirpurla, mention anything like a cone in connection with them!

The "'massive temple-towers' of Samarra on the Tigris" are a gem. Samarra is a comparatively modern city, with mediæval walls, over which one sees the gilt domes of two mosques, and a peculiar minaret rather like that of Ibn Tulún, at Cairo. Messrs. King and Hall, writing picturesquely, say:—

"Such a picture as that of the approach to the city of Samarra, with its mediæval walls, may be taken as having its counterpart in many a city of the early Babylonians. The caravan-route leads through the desert, and if we substitute two massive temple-towers for the domes of the mosques that rise above the wall, little else in the picture need be changed."

Mr. Hall has too hastily assumed that these massive temple-towers were conical, or even domed, like the modern mosques. The analogy need not be taken so literally as all that!

Finally, the "'cones' in Assyria" which Mr. R. N. Hall says are mentioned on p. 392 of Messrs. King and Hall's book are the objects thus referred to on that page:—

"Last year a small cone" [*sic:* Messrs. King and Hall do not speak of "cones" in the plural, as Mr. Hall misquotes them] "or cylinder was found, which, though it bears only a few lines of inscription, restores the names of no less than seven early Assyrian viceroys whose existence was not previously known."

These small objects, measuring about nine inches or a foot long, are usually called cones, but they are more properly nail-shaped. What they have to do with Mr. R. N. Hall's theory of conical buildings being Semitic it is hard to see.

The examination of this footnote was interesting, but is not calculated to strengthen one's faith in Mr. Hall's theory, and his authorities do not seem to bear him out so much as he thinks. A more careful study of Semitic lore will probably lead him later to see, himself, the weak points of his dogma. As for the supposed Semitic traits of the Makaranga, on which he lays such stress (p. 400), we fail to see in the long list given by Mr. Hall any peculiarity which is common to Semites and Makaranga only; most of these characteristics are shared by every negro tribe in Africa, and the fact that some of them were also shared by the Semites proves no more than that primitive people all the world over have similar customs, especially with regard to marriage, ritual cleanliness, and the like matters. In this list, also, Mr. Hall shows an inability to distinguish between strong and weak evidence. What is the use to his thesis of such an absurdity as his thirty-eighth resemblance between the Makaranga and Semites,

"Iron rods were the insignia of old Ma-Karanga chiefs, and it was illegal for any ordinary member of the tribe to own such an article. These iron sceptres have their parallel in Semitic countries, where gold was of more value than iron, and are mentioned in the Scriptures"?

What is the point of the solemn information "where gold was of more value than iron" in this particular connection?

We really believe that Mr. Hall does himself and his theory an injustice in his unskilled manner of presenting his ideas and his inability to distinguish between good and bad evidence. Thus the rather "muzzy" photograph facing p. 398 which purports to show the "Semitic Appearance of a Karanga, Zimbabwe," is absolutely bad evidence. Where is this supposed Semitic appearance? In this negro's rather large nose? Does not Mr. Hall know that the purest Semites of Arabia have straight noses, not at all like the "Jewish" type?

Were it pruned of these and other absurdities, Mr. Hall's theory would command serious attention, for it is by no means impossible that Arab traders may have penetrated as far south as Sofala, even so early as the time of the Himyar kingdom, and have exercised a civilising influence on the negro tribes, as the Portuguese did on the tribes of Benin. But granted what one knows now of the capability of certain negro tribes to evolve cultures of their own, Mr. Hall is a bold man to deny the possibility of the truth of Dr. Maciver's theory, that the buildings of Zimbabwe are the work of a native race of comparatively modern times, independent of foreign influence. In any case, until the question of the "Nankin china" is finally settled, it is of little use for Mr. Hall to go on drawing "evidence" of supposed Semitic connections in South Africa, which are presumably no older than the early Middle Ages, from "cones" in Mesopotamia of any date between 3000 and 1500 B.C., especially since these "cones," when examined, turn out to be either mountains, or square, flat-topped towers, or votive offerings, a few inches high, which are shaped like nails!

THE MARINE FAUNA OF JAPAN.

Beiträge zur Naturgeschichte Ostasiens. Edited by Dr. F. Doflein. Japanische Alcyonaceen. By Prof. W. Kükenthal. Pp. 86+Tafel v. Price 4 marks. Japanische Gorgoniden. Teil i. Die Familien der Primnoiden, Muriceiden, und Acanthogorgiiden. By Prof. W. Kükenthal and H. Gorzawsky. Pp. 71+Tafel iv. Price 3.60 marks. Japanische gorgoniden. Teil ii. Die Familien der Plexauriden Chrysogorgiiden und Melitodiden. By Prof. W. Kükenthal. Pp. 78+Tafel vii. Price 6 marks. Hydroidpolypen der japanische Ostküste. Teil i. Athecata und Plumularidæ. By E. Stechow. Pp. 109+Tafel vii. Price 5 marks. Japanische Antipatharien. By E. Silberfeld. Pp. 30+Tafel ii. Price 2.50 marks. Japanische Medusen. By O. Maas. Pp. 52+Tafel iii. Price 4 marks. Japanische Actinien. By Dr. A. Wassilieff. Pp. 52+Tafel ix. Price 2.70 marks. Japanische Ctenophoren. By Dr. Fanny Moser. Pp. 77+Tafel ii. Price 5 marks. Über japanische Seewalzen. By E. Augustin. Pp. 44+Tafel ii. Price 3 marks. (München: K. B. Akademie der Wissenschaften, G. Franz'schen Verlags, J. Roth, 1906–9.)

IT has been known for some time to zoologists that the southern coasts of Japan possess a very rich and varied marine fauna. The *Challenger* expedition gave us some indication of it, and various special memoirs by Japanese writers that have appeared in recent years have served to maintain and stimulate our interest in it. But the nine memoirs dealing with the collections made by Dr. F. Doflein in the Sagami and Sendai bays during the years 1904–5 bring home to us with great effect the amazing wealth with which our Japanese friends are favoured in respect of their submarine zoological treasures.

Dr. Doflein is a fortunate, and also undoubtedly a skilful, collector, for he has not only obtained a very large quantity of material, and succeeded in bringing it home in an excellent state of preservation, but he has been able to enlist the services of a number of eminent zoologists with special knowledge of the various groups, and to publish these memoirs in sumptuous style. Judging from the series already published, there can be little doubt that the results of Dr. Doflein's expedition will form a very important contribution to our knowledge of the systematic zoology of the Japanese waters.

For the three memoirs on Alcyonaria, Prof. Kükenthal, of Breslau, is very largely responsible, and those who are interested in this group of Cœlenterata will find in them descriptions of a large number of new species, profusely illustrated by coloured plates and photographs. Prof. Kükenthal is so well known as a leading authority on the Alcyonaria that it is hardly necessary to remark that his elaborate descriptions of the new species and his profound knowledge of the history and literature of the group give his contributions to the series a very high position. But although there is a great deal that is new in these three memoirs, there is no new genus that strikes us as being particularly interesting or important. Among the Alcyonacea, the genus Spongodes (which has been re-named Dendronephthya by the author) is represented by fifteen species, of which six are new to science, and Nidalia by seven species, of which five are new. The genus Alcyonium, on the other hand, is represented by only one species, which is described under the new specific name of *Alcyonium gracillimum*. A new species of Siphonogorgia having been found in Sagami bay, the author takes the opportunity of giving us a very valuable summary of the characters of all the known species of the genus, including in the list the species formerly separated under this generic name Chironephthya.

The title "Japanische Gorgoniden" given to the other two memoirs on Alcyonaria is rather misleading, as the family Gorgonidæ has not yet been dealt with; but it is nevertheless in the suborder Gorgonacea rather than in the Alcyonacea that the richness of the Japanese fauna is so pronounced. The genera Chrysogorgia, Melitodes, and Plumarella appear to be particularly well represented, and in the family Plexauridæ two new genera, Anthoplexaura and Paraplexaura, are described, as well as several new species of the older genus Euplexaura.

The memoir on the hydroid polyps by Stechow is in some respects the most remarkable and valuable of the series, and special attention may be directed to the interesting introductory statement, and particularly to his valuable tabular scheme of the classification of the hydrozoa. Many previous attempts have been made to bring into one system the hydroid and medusoid forms belonging to this class. On careful analysis and consideration, this system will probably be found by systematists to be the best that has yet been suggested. Of the many interesting hydroids that are described in this memoir, the most remarkable is the one to which the new generic name Hydrichthella is given. It was found epizoic on the new alcyonarian Anthoplexaura described by Kükenthal. It is a curious coincidence in zoology that the only other example of a hydroid epizoic upon an alcyonarian was also described last year. On January 30, 1909, a paper by Miss W. Coward was read before the Koninklijke Akad. van Wetenschappen of Amsterdam on a new hydroid (Ptilocodium) epizoic on specimens of the genus Ptilosarcus collected by the *Siboga* expedition. In the same year Stechow described the genus Hydrichthella on Anthoplexaura. There can be little doubt that the two genera are very closely related, but it is more than probable that it will be found advisable to join them in one generic group. If this be done the question of priority will arise, and the name will be Ptilocodium or Hydrichthella according to the publication of Stechow's memoir before or after January 30.

The genus Dendrocoryne of Inaba found in Japanese waters has created some special interest of recent years owing to its relationship to the genus Ceratella, that occurs in Australian waters, on the east coast of Africa, off Hawaii, and elsewhere. The points of difference between Dendrocoryne and Ceratella do not appear to some authors sufficiently important or constant to justify their separation into two genera, but a very strong protest must be made against this author's practice of reviving the obsolete generic name Solanderia for Ceratella and throwing the literature into confusion thereby. M. Haime, who examined the type-specimen of Solanderia (Duch. and Michel.), declared that it was undoubtedly a Gorgonid. The genus was therefore rightly ignored by Gray, and the magnificent memoir by Baldwin Spencer on *Ceratella fusca* has firmly established the proper generic name once and for all time.

Of the other memoirs in this series, the space at our disposal does not allow us to make more than passing notice. We observe some excellent coloured plates in the account by Maas of the Japanese medusæ, and we are glad to observe that the wandering genera Gonionemus and Olindioides are becoming more definitely settled in the order Trachomedusæ. The Ctenophora do not seem to be very well represented in the Japanese fauna, but Dr. Fanny Moser's memoir on this group is a very important contribution to our knowledge of several of the important genera, as the author takes the opportunity to give a critical summary of all the known species of the Lobatæ, Beroidæ, and Cestidæ.

Silberfeld adds to his account of the few new Japanese Antipatharia a useful list of all the species of the order that have been described since the publication of Brook's *Challenger* monograph.

The memoirs by Augustin on the Holothuria, and by Wassilieff on the sea anemones, fully maintain the high standard of excellence that marks the earlier numbers.

S. J. H.

THE CAMBRIDGE PUBLIC ORATOR.

Orationes et Epistolae Cantabrigienses (1876–1909). By Dr. John Edwin Sandys. Pp. xiv+290. (London: Macmillan and Co., Ltd., 1910.) Price 10s. net.

THIS very attractive volume, bound in the light blue which stands for the colour of Cambridge, contains the Latin speeches and letters which for thirty-three years Dr. Sandys has delivered as public orator for the University of Cambridge. In 1909 Dr. Merry, the public orator of Oxford, published his admirable orations, delivered in the Sheldonian Theatre during thirty years, and in the same year, by a curious chance, appeared a volume containing 141 brief speeches delivered by three successive public orators of Trinity College, Dublin—Drs. Palmer, Tyrrell, and Purser.

It was a strange coincidence that in the course of a year the two great universities of England and the most ancient university of Ireland should have given to the world these characteristic effusions of university sentiment. This form of literary composition will appeal in a different way to different minds. But none will fail to see in it a somewhat interesting specimen of an art now obsolescent and destined, perhaps, soon to pass away, which recalls the time when Latin was the *lingua franca* of the learned world, and when the universities affected to convey their sentiments only in the learned tongue.

So long as this time-honoured custom is observed, it will recommend itself by the happy classical turn of phrase and the ingenious adaptation of Latin idiom to very post-classical themes, to which the public orator must often have recourse; and of these arts Dr. Sandys is a past-master. His career in Cambridge was most brilliant, and among other distinctions he won the coveted Porson prize. He was at once designated successor as public orator to that great composer in Greek and Latin, the late Sir Richard Jebb. His orations are characterised by an elegance of Latinity and a felicity of allusion quite worthy of his distinguished predecessor. The public orations not only excite the interest of scholars, but sometimes evoke humorous comment from the undergraduates, as when Dr. Travers-Twiss at Oxford found a flight of superlatives (in which such speeches naturally abound) capped from the gallery by a new adjective. "Illustrissimus, præclarissimus," said the orator; "et Travers-Twissimus" was the contribution of an inglorious undergraduate rival.

The *éloges* in the volume before us are not only charming examples of polished Latinity, but they are admirable specimens of brief and pointed criticism. A man's work is often summed up in a few words which could not be bettered in as many pages. One specimen of this delicate art will serve *instar omnium*. The great poet and critic, Matthew Arnold, writes thus to Dr. Sandys:—

"A thousand thanks for the printed copies of your speeches which you have so kindly sent to me. I am glad the speeches are in this permanent form. For myself I can only say that I could wish the next age (if the next age inquires at all about me) to read no other and no longer character of me than yours."

The reader should turn to the *éloge* (No. 71, p. 39) to see that the words of Matthew Arnold are justified. For those who have not the book we will make an extract, which shrewdly characterises Arnold's dealings with the Philistines, his εὐτραπελία, "cultured insolence," as Aristotle calls it, and another which compares his style to the Thames by which he was born, "Though deep yet clear, though gentle yet not dull":—

"Quam suaviter subamarus est quotiens Attico quodam lepore et salibus quicquid insulsum est irridet, Graeca quadam elegantia quicquid barbarum est contemnit. De gravioribus vero argumentis, quanto animi candore, quanta subtilitate, disputat. Idem poëta quam venustus, quam varius."

"Equidem crediderim Thamesin ipsum inter rura illa fluentem, ubi poëta ipse natus erat, alumno suo exemplar suum praetulisse, suum ingenium inspirasse; qui amnis, poëtarum laudibus celebratus, tranquillus at non tardus it, profundus at pellucidus idem est."

How happily he alludes to the work of Huxley:—

"Olim in oceano Australi, ubi rectis 'oculis monstra natantia' vidit, victoriam prope primam, velut alter Perseus, a Medusa reportavit; varias deinceps animantium formas, quasi ab ipsa Gorgone in saxum versas, sagacitate singulari explicavit; vitae denique universae explorandae vitam suam totam dedicavit."

And we must quote his reference to Joseph Chamberlain's "grand refusal" of the Home Rule Bill, and his allusion to the great statesman's love for orchids.

"tdem cum nova quaedam de Hibernia consilia sibi periculosa esse viderentur, maluit a duce suo, maluit etiam ab amico suo, discedere quam insulas nostras in uno coniunctas, quod ad sese attineret, sinere divelli. Ipse inter senatores suffragiis electos partium suarum ductor constitutus, socios suos quam fortiter ducit, adversarios quam acriter oppugnat! Etenim, quamquam in rerum natura eos potissimum flores diligere dicitur, qui solis a radiis remoti in horto secluso ab aperto caelo delicate defenduntur, ipse vitae publicae solem atque pulverem numquam reformidat, quolibet sub caelo ad dimicationem semper promptus, semper paratus."

But we cannot indulge in quotations which would reach to infinity. In nearly six hundred specimens of the art of Dr. Sandys there is hardly one from which could not be quoted some felicitous phrase or allusion. The letters written in the name of Cambridge are as happy. Among these, specially interesting are the letter to the American Cambridge and that to Lord Morley. The volume is one to which the scholarly reader will recur again and again with interest and admiration. R. Y. Tyrrell.

PSYCHICAL RESEARCH.

Spirit and Matter before the Bar of Modern Science. By Dr. Isaac W. Heysinger. Pp. xxviii+433. (London: T. Werner Laurie, 1910.) Price 15s. net.

The venue of Dr. Heysinger's elaborate though very readable work is the debatable land where three rival powers meet—religion, philosophy, and science. He shows very clearly that these three explainers are to some extent merging; the sharp distinctions are vanishing. Religion is freeing itself from rigid metaphysical dogmas, philosophy is becoming more concrete, and science is becoming more philosophical—is recognising that it cannot provide ultimate explanations of anything. The hope of the future is in a spiritual interpretation of the universe. This interpretation is being forced upon us as the only possible one by the recent advances in psychology and psychical research.

In dealing with spiritualism and occult phenomena generally, Dr. Heysinger takes up a sane and scientific position. He demolishes Hume's argument of "impossibility," quoting Huxley in support of the view that nothing can safely be called impossible outside mathematics and formal logic. As to miracles, either ancient or modern, the really scientific man will say:—"It is a question of evidence; I will make no *a priori* decision, either for or against." The evidence brought forward during the last twenty-five years, by such men as Sir Oliver Lodge, Sir William Crookes, Prof. James, Dr. A. R. Wallace, F. W. H. Myers, and other careful investigators, seems sufficient to establish at least a *prima facie* case. Nevertheless, as the author is careful to point out, it must not be rashly conceded that all psychic phenomena are due to the agency of disembodied spirits; many of these phenomena are probably the work of the subliminal consciousness of some living person, or even of some impersonal world-soul, as many philosophers have thought; but, in many cases, the evidence seems to be sufficient to justify at least a provisional hypothesis that the minds of discarnate people are somehow still producing effects in our material world, by some such process, perhaps, as telepathy. The phenomena are various in kind, from planchette-writing to "apparitions"; but they point in the same direction—to survival of human personality past the wrench of bodily death, and consequently to a spiritual interpretation of experience.

The present reviewer is a member of the Society for Psychical Research (though belonging to its "sceptical wing"), and has devoted much time and thought to the subject for many years. He is dubious about "materialisations," and has lurid opinions about "slate writing by spirits" (or, rather, about the mediums who produce it), but personal experience has convinced him that things do happen, sometimes, which seem inexplicable by orthodox hypotheses. The thing to do is to maintain a rigorously scientific attitude, to observe the phenomena with all possible keenness and precaution against fraud or illusion, and to beware of drawing hasty inferences. Darwin collected facts for many years before he "permitted himself to speculate" concerning explanations. It is perhaps too much to expect that such caution should be shown by psychical researchers, for the subject is more intimately connected with our deepest interests; but it is nevertheless desirable. On the other hand, it can truthfully be said that there is more foolishness shown by the ignorant disbeliever who has never investigated than by the man who has learnt a little and is apt to believe too much.

Dr. Heysinger's book may be warmly recommended. Not the least of its good features is its tremendous armoury of quotations—showing very wide reading—from all the leading investigators. J. A. H.

PSEUDOCYTOLOGY.

The Plant Cell, its Modifications and Vital Processes. A Manual for Students. By H. A. Haig. Pp. xxx+799. (London: C. Griffin and Co., Ltd., 1910.) Price 6s. net.

Writers of elementary text-books might be expected to take some trouble to ensure that their statements are, at any rate as far as possible, accurate and clear. It is a matter of common experience that failures in both respects are not uncommon, and the author of the book before us has compiled a volume which may have some merits, but they are hardly those which the ordinary student will appreciate.

To start with, we may remark that some of the illustrations and photographs are decidedly good, but that the text strikes us as useful chiefly as an exercise in criticism for more advanced students. What are we to make, for instance, of such statements as the following:—"The various forms of 'pits' occurring in the walls (of tracheids) may possibly be of use in sap conduction, but, as a matter of fact, these pits function more as a means of exit for the protoplasm after it has finished its work in the Xylem elements." The confusion (on p. 115) between normal and homotypic nuclear division is absurd. *Germination* of pollen, &c., is wrongly and very misleadingly described as *maturation*.

The development of the angiospermic embryo seems to be confused with that of the fern, and the development of the archegonium (called by the author the oogonium), so far as it is intelligible, is quite incorrect. By the way, the chemiotactic substance emitted from the archegonium is said to be "malic acid or an enzyme."

Few botanists will agree with the view that the homosporous fern-prothallium can be properly, or otherwise than misleadingly, regarded in the light of a "fusion of two prothallia produced by the germination of a potentially double (male and female) spore."

Turning to the part of the book dealing with physiological topics, we find the statement that "Much of the reserve starch in the tuber is formed at first in plastids, and by the time the tuber is full grown, all the plastids have been converted into starch," and, *in a footnote,* we are further gravely informed that "some of the starch is, however, formed in the tuber by the translocation of carbohydrate from the cells of remote parts." It would have been of interest to know what proportions of the starch do and do not respectively owe their origin to this process.

The above citations, which could easily have been added to, may suffice to exhibit the side of the book which a teacher would find defective or effective according to the use he made of it with his students.

But it may be said that it is not fair to judge a book on the "plant cell" by the same canons that would apply to a work more ostensibly on botany, structural, morphological, and physiological. But, as a matter of fact, the volume is really compiled on these lines, and if it were to be criticised from a cytological standpoint the verdict would be far more disadvantageous. It is a pity that the author has not more fully and carefully surveyed his proposed field of work before writing a book. He has evidently aimed at clearness, and, with more knowledge and care, may still produce a useful contribution.

BIOLOGY AND HUMAN LIFE.

Science from an Easy Chair. By Sir Ray Lankester, K.C.B., F.R.S. Pp. xiii+423. (London: Methuen and Co., Ltd., 1910.) Price 6*s.*

IN this volume of forty-three collected papers, the popularisation of science surely reaches high-water mark. To be vividly interesting without offending against accuracy, to season an abundance of solid fact with ideas so that the result is an intellectual feast, to illustrate scientific method by stratagem so subtle that the reader does not know he is being educated—that is what Sir Ray Lankester has achieved. He calls it "Science from an Easy Chair," and so be it; but we hope the delighted reader will realise that it is science from a rich experience of lifelong observation and research. Since Huxley, no one has had a deeper influence on British zoology than the author, and even these parerga show the hand of a master.

Some of the papers are good tracts for the times. The first one, entitled "Science and Practice," with the hygienic triumphs at Panama for its text, illustrates what science can do, if it be allowed, for "the establishing of the kingdom of man." The pages headed "Darwin's Theory Unshaken" should be of use to those who mislead the public by declaring that Darwinism is dead. Other papers show, very briefly, of course, what a living Darwinism has to say about the re-stocking of our villages, the feeble-minded, and various disquieting features of our British birth-rate and death-rate. Apart from such serious questions, it is interesting to notice how many of the papers have a practical point—the poison-vine in England; oysters; the heart's beat; sleep; cholera; sea breezes, mountain air and ozone; oxygen gas for athletes and others; hop blight; phylloxera; clothes moths; and more besides. This is symptomatic of our times, but it is also what we expect from the author of "The Kingdom of Man," that masterly exposition of the sound doctrine that science is for life—*savoir, prévoir, pourvoir!*

Another set of papers deals with subjects in regard to which much progress has been recently made. Among these we find the extraordinary story of the common eel, illustrated by a beautiful coloured drawing which shows the contrast between the mature "silver" eel and the immature "yellow" eel. Another of this type is the account of the human skull from the Chapelle-aux-Saints, in the Corrèze, of the Heidelberg lower jaw, and other recent additions to the data from which the pedigree of man is being patiently worked out. We may also notice the interesting account of the new fresh-water medusoids. A third set—not that we are attempting to classify the forty-three—includes a number of delightful natural-history sketches, such as one on gossamer (where, by the way, it seems to be suggested that the somewhat mysterious parachute-making habit is confined to autumn), or another on honey-dew, or another on the jumping-bean. It seems to be a rotatory easy-chair from which this pleasant science comes, for the author takes the whole world for his province, from microbes to comets, from the land of azure blue to "the starres that wonne on highe," not forgetting either to write of dragons. Quite by itself, with a delightful *note personnel,* is the account of Metchnikoff's day with Tolstoi last year. We hope for many more volumes of the "Easy Chair Series." J. A. T.

ALPINE FLOWERS.

(1) *Alpine Flowers and Gardens, Painted and Described.* By G. Flemwell. Pp. xiv+167. (London: A. and C. Black, 1910.) Price 7*s.* 6*d.* net.

(2) *Summer Flowers of the High Alps.* By Somerville Hastings. Pp. xxvi+85. With an index and 39 colour plates from direct colour photographs by the author. (London: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net.

(1) A SERIES of twenty well-executed colour prints appears to be the *raison d'être* of this volume on alpine flowers and gardens. The author, who is also the artist, knows his Alps and alpine flowers well, and has contrived to write an interesting and instructive account of the alpine flora in its various aspects. He

is without doubt an enthusiast on the subject, and something of a poet as well, but it is unfortunate that poetical descriptions and Latin names of plants are but ill-assorted companions, and the frequency of the necessary names detracts considerably from the purely æsthetic pleasure of perusing the volume.

The Alps, with their flora, are described at the different seasons of the year, and the beauties of each are duly eulogised; to our thinking, however, the concluding chapters on the abuse and protection of alpines, and on some gardens in the Alps, are the most worthy portions of the volume. In the former chapter the good work done by the "Swiss League for the Protection of the Natural Beauties of the Alps" receives well-deserved commendation, for it is largely owing to its efforts that much wanton destruction of alpine plants by the thoughtless tourist and so-called lover of plants is gradually being stopped. In the final chapter the Thomasia gardens, near Bex, Rambertia, at the summit of the Rochers de Naye, and Linnæa, at Bourg St. Pierre, are described.

The author wonders why we in England have not attempted to create alpine pastures; he seems to forget the peculiar beauty of English pasture as it is with its buttercups, cowslips, and orchis, daisies and red sorrel. Very possibly he might find that English grasses ere long would hold the field where once his less resisting alpines were planted. On laying down this book we cannot but feel that Mr. Flemwell is more at home with the brush than with the pen, and that in writing a book on alpine flowers and gardens he would have produced a more useful volume had his fancies been more restrained.

(2) This work is an interesting contrast to the preceding, and affords an example of the present limitations of the art of colour photography. In a few cases, as, for instance, the plates of *Trifolium alpinum* (plate xi.) and *Saxifraga aizoides* (plate xx.), the results are good, but in many of the others the green of the leaves or of the background has come out badly. Blue and violet flowers are perhaps the least successful; it may be that the original photographs have suffered considerably in reproduction, but from the examples before us we cannot entirely agree with the author that "the pictures are true portraits of the flowers 'at home.'" A page or so of descriptive text accompanies each illustration, and there is a general introduction to the volume occupying sixteen pages which in some places needs textual revision; for instance, we do not imagine that the author means to suggest that Baedeker or Bradshaw is either an efficient or an inefficient plant press.

OUR BOOK SHELF.

A Manual of Practical Farming. By John McLennan. Pp. xi+298. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* 0*d.* net.

THE number of books dealing with special branches of science applied to agriculture is great and is steadily increasing; we have books on agricultural chemistry, botany and entomology, on the soil, on fertilisers and feeding-stuffs; there are also a number of large treatises and encyclopædias on agriculture. But only few writers have attempted to produce a small, handy book on practical agriculture dealing with the subject as a whole; the majority have been deterred by the difficulty of reducing so wide and complex a subject to the necessary small dimensions.

Mr. McLennan has essayed the task that many have avoided. His aim has been to give the farmer useful practical instruction, and also to set forth "the results of scientific research as far as known and as far as they square with practical experience." In the first object he will probably be found to have succeeded; he clearly knows the men for whom he is writing, and furnishes facts and illustrations that will be useful and will also show what has been accomplished by competent workers. The average American farmer does not yet get all he might out of his land. To some extent the untrained amateur is a factor in the case, as he is beginning to be in England, and our author has something to say about the would-be poultry farmer who came out from the city without any knowledge, but "full of literature on the subject, built elaborate houses, runs, brooders, and incubators, purchased high-priced eggs and costly fowls. He could figure out a comfortable living for himself and family, with freedom from city cares. He usually remained two years; the feed bills exceeded the receipts for eggs; the roup got his hens, and lice got his chickens; his enthusiasm waned, and he went back to his counter."

In his second object—the presentation of the scientific aspects of agriculture—our author is less successful. He shocks us on the very first page by saying that "the soil and the subsoil are primarily composed of molecules; that is, minute grains of rock of varying size and forms. These are simply a result of the action of the elements, such as frost, rain, wind, and heat, in breaking down and disintegrating the surface rock." This is a typical example of the "science" set out for the reader. If the author could persuade some scientific friend to read through the book and make the necessary alterations for the second edition its value would be much enhanced.

Leitfaden der Mineralogie. By Prof. Julius Ruska. Pp. viii+144. (Leipzig: Quelle und Meyer, 1910.) Price 2 marks.

THIS "Guide to Mineralogy" is intended for the use of younger boys in German schools who have not yet received instruction in mathematics, physics, and chemistry. Although it is customary to defer the study of mineralogy until after the latter subjects have been started, it is the author's belief that it is a subject that of itself can be made intelligible and interesting to younger boys. After a brief introduction of four pages, in which hardness and specific gravity are dealt with, he plunges into the subject, explaining such terms and principles as are necessary when occasion arises. The order in which the more common minerals are described follows the usual classification into elements, sulphides, oxides, carbonates, &c. Commencing with sulphur, an opportunity is given to explain some of the principles of crystallography in connection with the rhombic system of crystals; and under the sulphides, galena, zincblende, and iron-pyrites, the three important classes of the cubic system are described. A large amount of information is given in a very concentrated form, and possibly such an essence of mineralogy might not agree with quite young boys.

A striking feature of the book is its wealth of illustrations. Besides the sixty-nine figures on the coloured plates, there are 215 figures in the text, all of which appear to have been specially drawn for the book, and many are quite original. The coloured figures are reproduced by the three-colour process, and are on the whole satisfactory, though one or two are scarcely recognisable. The text-figures include line-drawings of the forms of crystals, and excellent half-tones representing actual crystals and mineral specimens.

To the English student of mineralogy such a book might be used with advantage as a German reading book. The sentences are short and not involved.

A Synopsis of the Orthoptera of Western Europe. By Dr. Malcolm Burr. Pp. 160. (London: Oliver Janson, 1910.) Price 3*s*.

The present work appeared in instalments from 1903 to 1909 in the *Entomologist's Record*, and in its present form will be extremely useful as an introduction to the subject, and as a tourist's guide, especially as its small size renders it more convenient than Brunner von Wattenwyl's work on European Orthoptera, or that of Tümpel's on those of Central Europe. Dr. Burr's work includes all the countries west of (and including) the neighbourhood of Vienna. For eastern Europe we have (for those who can use it) the great Russian expansion of Tümpel's book by Jacobsen and Bianchi, which includes all the Orthoptera of central and eastern Europe, and Palæarctic Asia.

Dr. Burr has given short but careful descriptions of genera and species, and also tables of species under the genera, and he has very properly included the more important naturalised species, such as *Periplaneta australasiae*. Orthoptera are, however, very liable to be carried about from one place to another, and mere casual visitors are very properly only mentioned by name, as on pp. 17, 18, &c. A long-legged Japanese grasshopper, *Diestrammena marmorata*, not mentioned by Dr. Burr, has several times been captured recently in London.

Prehistoric Man. By Joseph McCabe. Pp. viii+128. (London: Milner and Co., Ltd., n.d.) Price 1*s*. net.

This book gives an excellent popular exposition of the present state of our knowledge of prehistoric anthropology. The chapters on Palæolithic man and his implements are full of interest. Within the last few years a considerable number of more or less complete Palæolithic skeletons have been discovered in France and elsewhere, and great additions have been made to our knowledge of man in this distant epoch. In this little volume will be found a lucid description of the latest discoveries. The author is not content to give a mere list of more or less disconnected data, but always endeavours to weave his material into a continuous evolutionary story. This tendency, though admirable in a popular writer, appears in some cases to lead to a slight distortion of the facts in order to make them fit into the theory. For example, the Palæolithic race represented by the Grimaldi, Galleyhill, and other remains is assigned to the later Palæolithic, though the geological evidence appears to be pretty clear that these remains belong at least to the middle Palæolithic. The Gibraltar skull has recently been shown by Dr. Keith to have been the first Palæolithic skull found (1843) in Europe, and to represent one of the most primitive races. This discovery does not appear to have been known to the author.

The chapters on the Neolithic and Bronze ages show that our knowledge of these periods is still in a very unsatisfactory condition, but that is not, of course, the fault of the author of this work.

(1) *Metallografia applicata ai Prodotti Siderurgici.* By Umberto Savoia. Pp. xvi+205. (Milan: U. Hoepli, 1909.) Price 3.50 lire.

(2) *Lo Zinco.* By Prof. R. Musu-Boy. Pp. xiv+219. (Milan: U. Hoepli, 1909.) Price 3.50 lire.

Both these little treatises belong to the excellent series of "Manuali Hoepli," and, like other members of the series, are written by specialists in their respective subjects. They possess the merit, common to practically all other works of this series, of imparting in the fewest possible words the most essential facts and principles. The treatise on the metallography of iron is essentially a practical guide for the laboratory worker. Its author was sent from Italy to study the methods adopted in the laboratories of Le Chatelier, Fremont, and Guillet, and on returning home established the metallographical laboratory of the Milan steel works. The author has selected for description the methods he has found best suited in practice, and has illustrated the work by nearly 100 of his own microphotographs of steel in its different states.

The treatise on zinc is of a more general character, and calls for little comment. It deals with the ores, methods of extraction, history, statistics, and uses of the metal.

LETTERS TO THE EDITOR.

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

Ooze and Irrigation.

May I be allowed to reply to some inquiries?

(1) It is thought by some that my remarks applied especially to foreign lands. Let me point out that the ooze of our English rivers is often just as fertile as that of the Nile, and that the number ot annelids found in the ooze is enormous. This may be illustrated by reference to the Thames. The late Frank Buckland tells us that when he kept fish he "fed them with red worms collected from the Thames mud. These worms cost 4*s*. 6*d*. a quart; the price of Thames worms, like everything else, has increased considerably." Now whether these worms were true annelids, or merely the larvæ of insects, the point is the same. In the case of Tubifex and its allies, a quart would mean many hundreds of thousands. Mr. Shrubsole, myself, and others, have frequently examined the ooze from various parts of the Thames, and the number of different species of mud-frequenting worms is very great, while it is utterly impossible to estimate the total of individuals.

(2) Another interesting point is continually coming under my observation. When a number of annelids taken from the ooze is examined, it is found that the tail, which is in constant rhythmical motion in the water, is festooned with numbers of symbiotic vorticels. These move to and fro in the water, and are constantly capturing the bacteria and other lowly forms of life with which the putrid water is laden. So far as I am aware, no biologist has ever given this fact, or the action of the vorticels, any detailed study with a view to ascertaining their action, and their relation to their host on the one hand, and the water and soil on the other.

(3) It would be of great value to science if someone would carefully examine the ooze before and after passing through the bodies of annelids, and ascertain what is the nature of the change that has taken place. Is there any difference between the quantity of nitrogen in pure mud and that which has been digested?

These and many other problems having a vital bearing on agriculture need attention, and it is to be hoped that at least a small portion of the time of the new commission will be devoted to a subject of such importance.

Malvern. HILDERIC FRIEND.

IN some interesting remarks upon this subject (NATURE, pp. 427, 489), the Rev. Hilderic Friend suggests—and I believe he is correct in assuming for the first time—that the alluvial mud of such a river as the Nile derives its fertility, not from the nature of the sediment itself, as usually supposed, nor entirely from bacteria, but from the multitudinous remains of annelids that live in the mud.

That there is "need for careful study of the alluvium of rivers from this point of view," and any other, is to be freely admitted. If we except the study of pre- and post-Pleistocene deposits carried out by Mr. Clement Reid, and summarised in his "Origin of the British Flora," there is scarcely another work that can be mentioned dealing with the subject. It is true that lately the Geological Survey have become alive to the necessity of introducing details as to the fertility or otherwise of the soils derived from the geological formations surveyed. But these are isolated, and are but the necessary outcome of previous activities of agricultural experimental stations. But neither have these latter undertaken any systematic study of the character and constituents of river alluvium. The nearest approach to a treatise on the subject is Darwin's "Earthworms," and his work, whilst dealing with terrestrial forms and their influence in fertilising, renewing, and enriching the soil, strangely enough bears out Mr. Hilderic Friend's suggestion as to the cause of alluvial fertility.

For without earthworms, what would the soil be? *Ergo*, without fluviatile annelids, what would the alluvium be—but a sterile accumulation of sand? Here we may add that where worms are too plentiful on land bad results follow, so too we may assume, accepting the worm-fertilising theory as correct, that an excess of annelids tends to cause, as on land, putrefaction, as may be illustrated by the case of ponds overstocked with blood-worms, causing the appearance of blood, which was a fruitful source of superstition in former days, notably at Garendon in this district.

But apart from theoretical considerations, based on the hypothesis that Tubifex and other annelids do tend to increase fertility, we may attempt to draw an analogy with former conditions, and so to some extent corroborate Mr. Friend's very probable theory.

All who have made any study of the palæontology of the Trias (referring here specially to Britain) are familiar with the extreme barrenness of great thicknesses of both Lower and Upper Keuper relieved alone by certain limited horizons at which a definite flora and fauna is to be met with.

It has been assumed, and there is *apparently* no great reason against this on a purely faunistic basis, that the Trias is a desert formation; but on other grounds, and also from a study of the flora and fauna, I have come to the conclusion (during a study of the Midland Trias, in which I am aided by a Government grant from the Royal Society) that the whole of the Triassic formation is a *delta* formation, in other words, that from the Bunter (first suggested to be a delta deposit by Prof. Bonney) upwards conditions similar to those in the Nile area prevailed during Triassic times, and were responsible for its *formation.* Locally, wind acted on rocks, but formed no deposit.

Now it is a remarkable fact that in the deposits in the British Keuper, in which alone plant-remains have so far been discovered, or where carbonaceous deposits occur, that a common associate of the plant-remains is a form of track or casting which has usually been ascribed to annelids or crustacea; and we must not overlook the fact that annelids alone are not the predominating component of the fauna of alluvial tracts, but Protozoa in their myriads, occasionally sponges, Crustacea (minute and large), insects, scorpions, and molluscs form a large proportion of the bulk of alluvial deposits. Of these, annelids and Crustacea are most likely to be preserved, and are most often discovered in the rocks. So that it seems that only where annelid life in Triassic times was abundant was plant-life in evidence, just as now only where the Nile is alluvial does it yield productive results, due, apparently, to the same cause. The analogy I have drawn strengthens Mr. Friend's theory, and, moreover, if the worms be found to be actually conducive to fertility (by experiment or otherwise), my case for the delta-origin of the Trias will receive additional confirmation.

It would seem to us that no more fitting study could be made by the lake surveys that are now going on in different parts of the kingdom than the very probable connection between worms and alluvium, for it seems that Mr. Friend has more or less proved his case without much need for argument. This affords another instance of the utility of beings hitherto supposed to have no useful part to play in the history of time or things.

July 2. A. R. HORWOOD.

A Singular Mammal called "Orocoma."

IN a letter of the Jesuit Father Cat at Buenos Aires, dated May 18, 1729 ("Lettres édifiantes," éd. Lyon, 1819, tom. v., p. 406), the following passage occurs:—

"Outre ces animaux, il en est un qui m'a paru fort singulier: c'est celui que les Moxes appellent *orocoma* [or *ocorome*, according to the "Abrégé d'une Relation espagnole," in the same tome, p. 66]. Il a le poil roux, le museau pointu, et les dents larges et tranchantes. Lorsque cet animal, qui est de la grandeur d'un gros chien, aperçoit un Indien armé, il prend aussitôt la fuite; mais s'il le voit sans armes, il l'attaque, le renverse par terre, le foule à plusieurs reprises, et quand il le croit mort, il le couvre de feuilles et de branches d'arbres, et se retire. L'Indien, qui connoit l'instinct de cette bête, se lève dès qu'elle a disparu, et cherche son salut dans la fuite, ou monte sur un arbre, d'où il considère à loisir tout ce qui se passe. L'orocomo ne tarde pas à revenir accompagné d'un tigre qu'il semble avoir invité à venir partager sa proie; mais ne la trouvant plus, il pousse des hurlemens épouvantables, regarde son compagnon d'un air triste et désolé, et semble lui témoigner le regret qu'il a de lui avoir fait faire un voyage inutile."

In asking what mammalian species this "orocoma" is, and whether there is the slightest foundation for this story, I fully know I am showing my great ignorance. I hope the Editor and his readers will forgive me, taking into account the entire absence of a scientific reference library in this part. KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, June 15.

Pwdre Ser.

WHEN a boy, at the latter end of the 'thirties of last century, I was told by a well-known man of the name of West—lock-keeper on the river Witham at Lincoln—that he had seen a star fall on the south common there, where he had a cow grazing, and that, on going up to it, he found nothing but a lump of jelly. At this distance of time I cannot recall all he said, but I remember he described the object as shining and as about the size of a plate. I have no recollection of his calling it luminous.

Up to this time I have always thought my informant was under an illusion, but, after Mr. McKenny Hughes's article, there seems to be something more than I was aware of in the account he gave me.

F. M. BURTON.

Highfield, Gainsborough, July 2.

Curve Tracing and Curve Analysis.

I HAVE unwittingly done an injustice to Mr. R. H. Duncan's book on "Practical Curve Tracing" (vol. lxxxiii., p. 461). I judged by the review of it in NATURE of June 9 that it deals only with the subject indicated by its title. After writing to you regretting that no author deals with practical curve analysis, I bought Mr. Duncan's book, and find that, after describing each class of curve and how to trace it, he gives clear directions for reversing the process and deducing a formula from a given curve. So far as it goes, the book excellently meets the want which I expressed, and my only regret is that the author has not developed the subject a little further.

A. P. TROTTER.

London, July 5.

THE AKIKUYU OF EAST AFRICA.[1]

IT may be said at once that this is a very valuable contribution to the ethnology of Africa. In its thoroughness it recalls work characteristic of the latest German school. A trifling defect is the trick which both authors have of separating their African words into syllables, no doubt to facilitate immediate pronunciation by the unlearned; but, although this plan might be recommended in certain important words at their first appearance, it becomes irritating to the eye when perpetuated throughout the book, and sometimes the separation of syllables cuts athwart the etymology of root-words. The same remarks apply to the introduction of the apostrophe after the initial "m" or "n." To anyone really versed in Bantu studies this apostrophe is anathema, as it is quite unnecessary. A writer fastidious about Bantu prefixes supplies a *hyphen* between the prefix and the root, and not an *apostrophe*.

Perhaps, without ungraciousness, another criticism might be added—that the book would have been even more valuable than it is if the authors had either been more widely read in regard to other African studies or had submitted their MS. to a specialist in comparative African ethnology in England or Germany, who could have explained many points which are acknowledged as obscure by the authors, and enabled them to have instituted the most interesting comparisons. The book is such a good one, so likely to take a permanent place as a standard work, that it is to be hoped in a further edition these suggestions may be taken note of.

The Akikuyu (*A-* is a corruption of the plural prefix, *Ba-*, *ki-* is probably the eighth prefix often applied to "languages," "sorts," or "kinds," and the root of the name is really *kuyu*) are a collection of clans of Bantu-speaking negroes which inhabit the elevated plateaus of equatorial East Africa on the eastern side of the great Rift Valley. In language, and perhaps partly in racial origin, they are akin to the Bantu tribes round the slopes of Mount Kenia and the riverside people of the Tana River; also, less markedly, to the A-kamba of the East African plains between these highlands and the sea coast. The Akikuyu specially are greatly interfused with Masai blood, so that many of them have a strong facial resemblance to the Masai, though not so tall in stature. It is very seldom that one meets amongst them the rather prognathous Pigmy type observable here and there amongst the nomad Ndorobo, who dwell on the fringe of their territory to the north. Obviously, they are a remnant of the Bantu invasion of East Africa, of a generalised negro type which at one time or another has intermixed very freely with the Masai, retaining, however, their own Bantu dialect. This, by some centuries of comparative isolation, has become distinctly peculiar in the form of its prefixes and some elements of its grammar. The dense forests of their plateau country have enabled them to resist complete extermination and absorption at the hands of the Masai, when some century ago that bold offshoot of the Nilotic peoples overran the countries between the Victoria Nyanza and the Indian Ocean.

According to the traditions collected by Mr. and Mrs. Routledge, the Akikuyu were preceded in their occupation of these forests by a diminutive race known as the Agumba, and also by the Ndorobo. The last-named is a nomadic people of very mixed elements—composed partly of Bushmanlike Pigmies and degraded Hamites—which ranges in scattered hunting colonies all over equatorial East Africa. The Agumba may have been the Bushmanlike Pigmy race which seems to have inhabited East Africa in ancient times, and to have left many traces of its presence in existing tribes between Abyssinia on the north and Nyasa on the south. Or, again, the Agumba may have been a branch of the Congo Pigmies, the physical type of which can apparently be traced as far east at the present day as the western slopes of Mount Elgon. According to the traditions collected by the authors, these Agumba finally went westwards to "a big forest."

FIG. 1.—Costume of a Neophyte as he dances prior to Initiation to Manhood. From "With a Prehistoric People."

Mr. and Mrs. Routledge think that the root-word *kuyu* refers to the great fig-trees which are abundant in the forests of the Akikuyu country, fig-trees, probably, that produce bark cloth. But it may also be a word meaning "up above," the lofty region, from the Bantu root kulu, gulu, or zulu, the letter *l* being

[1] "With a Prehistoric People. The Akikūyu of British East Africa." Being some Account of the Method of Life and Mode of Thought found existent amongst a Nation on its First Contact with European Civilisation. By W. Scoresby Routledge and Katherine Routledge (born Pease). Pp. xxxii+392. (London: Edward Arnold, 1910.) Price 21s. net.

much disliked in many of these East African Bantu dialects, and either dropped or changed into a y sound. Certainly, according to the traditions of the Akikuyu, their upland country was until a hundred years ago (more or less) a region of unbroken forest (we may add, West African in its flora and fauna) which was nourished by an exceedingly heavy rainfall. This great equatorial forest of Africa obviously extended at one period right across the continent to the shores of the Indian Ocean. It has left traces of its peculiar flora and even fauna in the islands of Zanzibar and Pemba, and on the north coast of Lake Nyasa. This must have been a forest which contained not only the West African antelopes and pigs, birds, spiders, and butterflies, still found in Kikuyuland, but the gorilla and chimpanzee, and other types which once ranged uninterruptedly between West Africa and Further India. Consequently, Kikuyuland, from the point of view of palæontology, would, if there were any Tertiary or alluvial deposits (dried-up lakes, &c.), probably yield as interesting results in its exploration from that point of view as in ethnology and botany.

FIG. 2.—A Medicine Man. From "With a Prehistoric People."

The book under review, besides giving these interesting details as to the traditions and chronology of the Akikuyu, describes the people and their pursuits, their food and cookery, agriculture, domestic animals, arts and crafts, warfare and weapons, blood-drinking, betrothal and marriage, and general position of women, dances, initiation ceremonies, religion, conceptions of God, notions as to life after death, medicine, folk-lore; and also the position of this interesting people under the new British Administration. The authors have received much assistance from Mr. C. W. Hobley, one of the principal officials of East Africa, who is so very well known for his own ethnographical and linguistic studies of East African peoples.

Specially noteworthy are the illustrations and description of the Kikuyu "bull-roarer" used in various ceremonies, the modelling of fetishes (human figures), blacksmith's work, and initiation ceremonies, with their appropriate dances and costumes. In the interesting article on the medicine-man, the etymology of his name—Mundu Mugū—is not quite rightly hit off (in the quotation from Mr. McGregor). Mugū is really a contraction of the prefix and root of the widespread Bantu word Mu-logu, or Mu-logo, meaning magician, either good or bad. This root *-logo* ranges mainly over western Bantu Africa, and assumes sometimes very altered forms, such as -doki, -lozi, -roho. It is a parallel to the equally widespread root *nganga;* but *-logo* has to do rather with the evil side of magic or of spiritual influence, while *nganga* may well have been in its origin applied to some new wisdom from the north, something to do with iron-working or superior knowledge of a practical, material kind. (For instance, *Bu-nganga* in some Bantu languages means "gunpowder.")

There is an appendix to the book which gives an interesting note by the late Colonel J. A. Grant on iron-smelting in East Africa.

In their bibliography dealing with the Kikuyu and their language, the authors omit any reference to the present writer's vocabulary of Kikuyu in his work on the Uganda Protectorate. For various reasons, this vocabulary, though short, is of interest, as it represents the dialect of the westernmost part of the Kikuyu range, and is therefore interesting for comparison with the nearest (but very dissimilar) Bantu dialects of the regions immediately to the east of the Victoria Nyanza.

H. H. JOHNSTON.

TEMPERATURES IN THE FREE ATMOSPHERE.[1]

DR. WAGNER has given us a comprehensive discussion of the temperature results obtained with registering balloons in Europe during the period July, 1902–June, 1907, and has incidentally furnished an excellent practical tribute to the collective publication

[1] "Die Temperatur Verhältnisse in der freien Atmosphäre [Ergebnisse der internationalen unbemannter Ballonaufstiege]." By Dr. Arthur Wagner. Beiträge zur Physik der freien Atmosphäre. Bd. iii. Heft 2–3. (Leipzig: Verlag von Otto Nemnich.)

of the international observations under the direction of Prof. Hergesell. The author's primary object was to deal with the annual variation of temperature, but he has found room also for the consideration of many associated questions. Altogether 380 ascents were considered, all of which reached 8 km. and twenty-nine of which reached 16 km. Doubtful observations were rejected.

The principal features in the annual variation of temperature are as follows. From the surface up to 3 km. the date of minimum temperature gets later and the annual range decreases by about 4° C. From 3 to 10 km. the minimum temperature occurs at the beginning of March, but at still greater heights there is a comparatively sudden jump back to the beginning of January. The annual range increases from 3 to 7–8 km. by about 4° C., then decreases up to 10 km. by about 6° C., and finally remains nearly constant from 11 to 16 km. The results agree, on the whole, with those obtained by the present writer and Harwood from a slightly different period of observation. Dr. Wagner deduces, from a consideration of the first two terms of the Fourier series expressing the variation, that the difference between the maximum and the mean temperature exceeds that between the mean and the minimum, and that this asymmetry increases with height; it appears doubtful if it is justifiable to neglect the third term, which increases with height and tends to diminish the asymmetry mentioned.

The effect of water vapour on the gradient of temperature is shown in the differences between winter and summer. The following table gives the gradients for summer (June, July, August) and winter (December, January, February), (1) from the present paper; (2) from the report of the present writer and Harwood; (3) for ascending saturated air:—

Height km.	(1) Winter	(1) Summer	(2) Winter	(2) Summer	(3) Winter	(3) Summer
1–2	3·3	5·3	2·2	5·6	5·6	5·1
2–3	4·5	5·0	4·3	5·6	6·5	5·4
3–4	5·7	5·6	5·6	5·4	6·8	5·5
4–5	6·2	6·1	6·5	6·0	7·3	6·0
5–6	7·0	6·6	7·0	6·3	7·9	6·5
6–7	6·9	6·9	7·3	7·1	8·6	7·1
7–8	7·0	7·4	7·6	7·3	9·0	8·0
8–9	5·9	7·2	6·6	7·3	9·3	8·5
9–10	5·0	6·1	5·1	7·1	9·6	9·0
10–11	3·5	3·9	3·6	4·3	—	—

From 3 to 8 km. the gradient is less in summer than in winter, while the difference between the "saturated" adiabatic gradients is greatest from 2 to 8 km. The approximation to the adiabatic state is closer in summer than in winter.

Dr. Wagner attributes the annual variation to convection and conduction from the earth's surface, to condensation of water vapour, and to radiation, solar and terrestrial. A further cause ought to be included, viz. the transference of energy in a horizontal direction. The effect of conduction might fairly be neglected, since even at 100 m., if conduction alone were active, the amplitude of the yearly variation would be less than 1/1000th of the amplitude at the surface. The decrease of the amplitude up to 3 km. appears to be a result of the action typified by v. Bezold's law. The increase above 3 km. is probably rightly attributed to the effect of the increased water vapour on the average gradient in the summer months. Condensation of water vapour is, moreover, held responsible for the relatively slow cooling of the middle layers from summer to autumn, but it is probable that the above-mentioned horizontal transference of energy and the radiation also contribute to this effect. The radiation tends to increase the temperature of the earth and lower atmosphere when the amount of water vapour is increased, if the effect is not counterbalanced by increased reflection of solar radiation from clouds. In this connection it may be pointed out that there is no experimental evidence to justify the assumption repeatedly made that the air between 3–4 and 8 km. may be regarded as diathermanous. At 5 km. the average vapour pressure is not much below 1 mm., and the experiments of Paschen and Rubens and Aschkinass show that for a vapour pressure of 1 mm. half the radiation of a full radiator between 12 and 20μ would be absorbed by a path of about 400 m., and half that between 5 and 8μ by a path of 50 m., while the CO_2 absorption would add slightly to the absorption in the former region; and these results are affected but little by the later experiments of Scheiner and von Bahr.

Dr. Wagner finds that the departures of the temperature in different localities from the general mean values are small except for south Europe, where the temperature is considerably above the mean in the convective region, and for east Europe, where the converse is the case. The peculiarity in the latter region is largely due to the influence of Pavlovsk, lat. 60°, which is the only station in the region besides Koutchino, lat. 56°.

The mean value of H_c, the height at which the advective region is reached, for different regions is as follows:—

Central	North	South	East	West Europe
10·54	10·18	11·07	10·22	10·62 km.

Dr. Wagner deduces from these results that the value of H_c decreases from ocean to continent, as well as from equator to pole. It is true that radiation effects alone would tend to make H_c less over a dry continental area than over the ocean at the same or a higher temperature, but it is doubtful if such an effect can be traced in these figures, according to which north Europe (Berlin and Hamburg) has a lower value than east Europe (Pavlovsk and Koutchino).

In considering the variation of temperature with the pressure distribution, Dr. Wagner wisely adopts the plan of eliminating the annual variation, and as he uses no ascents from east or south Europe, the correction for the local variation of temperature is inconsiderable. It ought, however, to be remembered that, although the mean temperatures of the year are not far different, say, for Paris and Vienna, the corrections to be applied to ascents made in the same month at those two places are not necessarily the same. Dr. Wagner's results corroborate those previously found in proving that cyclones are in general colder than anticyclones, but a consideration of special cases led to the important conclusion that for rapidly moving systems these conditions were reversed, a result foreshadowed by the work of Hanzlik.

The mean temperature in October at 2 km. over Berlin on p. 95 is wrongly given as 0·6° C., and this error is mainly responsible for the peculiar change in the half-yearly variation at that height. In differentiating Δb on p. 99 the variation of T is not negligible. It is simpler to proceed from the fundamental equations, which lead to the result that the height at which Δb is a maximum is given by

$$h = RT_M^2/T_h = RT_0 \text{ nearly,}$$

where

$$\frac{h}{T_M^2} = \int_0^h \frac{dh}{T^2}$$

and T_h is the temperature at the height h and T_0 that at the surface.

The paper includes useful tables giving the pressure and the density at different heights, the variation of temperature on surfaces of equal pressure, and the temperatures in different quadrants of cyclones and anticyclones.

It is full of interest, and stands as an example of the "thorough" policy of Prof. Hann, to whom, indeed, it would not do discredit. E. GOLD.

THE GULF STREAM DRIFT AND THE WEATHER OF THE BRITISH ISLES.

ALTHOUGH it has been known for very many years that the climate of these islands and of northern Europe generally is far milder than it would otherwise have been owing to a large body of warm water flowing past its shores from the south-west, it is only within recent years that attempts have been made to trace any detailed connection between the state of the Gulf Stream Drift [1] and the weather.

Now that systematic hydrographic observations have been accumulating for a number of years it is becoming possible to attack seriously this interesting problem, and the results so far obtained certainly look promising.

The immediate causes of the weather in the British Isles are undoubtedly to be sought in the various atmospheric disturbances which arrive from the Atlantic, but there can be no doubt that another very important factor to be considered is the temperature of the adjacent seas. This is influenced by the Gulf Stream Drift.

The problem is, however, complicated by the fact that there is some doubt as to whether the Gulf Stream Drift may not be a direct result of the atmospheric circulation in the huge cyclonic system which rests over the North Atlantic, with its centre at Iceland.

Be that as it may, there is undoubtedly a very intimate connection between the oceanic and atmospheric circulations in the North Atlantic region, so that if the atmospheric circulation becomes more vigorous, the Gulf Stream Drift moves faster, and *vice versâ*. This is well shown in a paper by Meinardus in the *Meteorologische Zeitschrift*, xxii., 398, 1905. Such a connection was, however, to be expected, not only if the Gulf Stream Drift were directly due to the atmospheric circulation, but also if, as seems more probable, both were due to the same cause, namely, the excessive cooling at the poles of the earth, coupled with the rotation of the earth about its axis. On this view both the oceanic and atmospheric circulations are of the nature of convection currents, and primarily due to the same cause, but in the course of ages these two distinct circulations have so adjusted themselves that any change in the one rapidly causes a corresponding change in the other.

It seems probable, therefore, that the Gulf Stream Drift, owing to its inertia and its great heat capacity, should have a similar effect to that of the flywheel of an engine, and tend to obliterate the disturbances due to the more unstable and variable atmospheric circulation. In this case the Gulf Stream Drift should have a very considerable regulating influence on the *general* type of weather prevailing in the British Isles.

Let us consider the probable influence on the temperature and on the rainfall. In the winter the temperature of the Gulf Stream Drift is higher than that of the land, while in the summer it is lower. Consequently during the winter time the winds blowing from the Atlantic tend to raise the temperature of the land, while in the summer they tend to lower it, and it is clear that variations in the temperature of the Drift must be expected to affect the temperature of the winds blowing over it, and consequently the temperature on land as well. Such effects on the land temperature will probably be far more important in the winter than in the summer, owing to the relatively greater power of the solar radiation during the summer.

The effect on the rainfall will be equally marked, for the amount of moisture carried by the winds and available for precipitation as rain depends largely upon the temperature of the sea over which they have blown. The warmer the sea the more moisture is taken up and the more precipitation may be expected on the neighbouring land.

In this way, for instance, it is possible to account for the low rainfall last year in the western parts of Great Britain and Ireland—parts which are usually very wet—for during 1909 the temperature of the Gulf Stream Drift was below the normal, and hence the winds blowing from it were not so heavily charged with moisture as usual.

The somewhat lower land temperature seems to have just about compensated for this by the time the winds reached the east of Great Britain, so that the rain fell there instead of in the west. The result of this was an abnormally high rainfall in the east, and with the low one in the west the rainfall over the British Isles as a whole was exactly equal to the average.

It will be very interesting to see if this is what may be generally expected in years when the Gulf Stream Drift is weaker than usual.

There is clearly a possibility of being able to predict the *general* character of the weather in these islands several months in advance from the results of hydrographic observations. It is, of course, a very complex question, and at present one cannot be too confident, but I am certainly of the opinion that such predictions will be possible.

In another place I have thrown out the suggestion that, as the February hydrographic observations made in the Irish Sea this year were almost identical with those of last year, there was some probability that the weather during 1910 would be somewhat similar to that of last year. It was never expected that the suggestion would attract the attention it has done, but it is interesting to note that the May hydrographic observations are also very similar to those of last year—if anything, even less favourable.

H. BASSETT.

[1] The warm water flowing round the British Isles to Scandinavia used to be called the Gulf Stream. The Gulf Stream proper is now considered not to extend further east than Newfoundland, while its fan-like extension which crosses over to Europe is known as the Gulf Stream Drift.

PROF. G. V. SCHIAPARELLI.

PROF. SCHIAPARELLI, whose death we briefly announced last week, for many years occupied a prominent position in the world of science. Half a century has passed since he began his career as second assistant in the Brera Observatory of Milan, and nearly as many since he was elected to fill the position of director. In that position he exhibited much energy, and increased the reputation of the observatory. But his greatest success came to him early, and though he worked long and diligently, giving evidence of patient industry and practical skill as an observer, he will be remembered mainly for having satisfactorily established the connection between meteors and comets. It was a brilliant discovery founded on acute penetration and sound reasoning. It was, moreover, a discovery that the public were able to appreciate, and by popular applause he was lifted at once into the front rank of astronomers. He was entitled to all the renown which he acquired. For though others may have entertained similar views and expressed them more or less distinctly, they fell short of demonstration. Prof. Kirkwood, for example, had put the pertinent question, "May not our periodic meteors be the débris of ancient but now disintegrated comets, whose matter has become distributed around their orbits?" At a moment when we are remembering with gratitude the eminent services of the distinguished Italian astronomer, there is no necessity to stir old controversies; but when so many, from the time of Halley, have been so near a solution of the puzzle, it may quicken our appreciation of his genius to remember that he carried the question one step beyond his predecessors, removing it from the grounds of conjecture to the certainty of conviction. In this connection it is not out of place to recall the remarkable series of letters that Schiaparelli addressed to Father Secchi in 1860, models of close reasoning leading to a successful result. But as is frequently the case when a brilliant discovery is made, it is possible to detect a certain amount of luck contributing to the final outcome.

Schiaparelli's crowning success was the recognition of the similarity of the orbit of the August meteors with that of the comet of 1862. That this particular comet of long period should have returned to the sun only a few years previously to the discovery, and that its path had been well determined, was a most fortunate circumstance, and one that not only strengthened the evidence of identification, but affected the popular estimate of the certainty of the result. Similarly, with the near coincidence of the return of the comet of 1866 with the great November shower, and less conspicuously that of the 1861 comet with the April Lyrids, astronomers had the advantage of dealing with trustworthy elements. If these comets had passed through perihelion without being observed an important link would have been wanting in the chain of evidence. As it is, these earliest cases of identification are the most conspicuous and the surest examples of a relation, as significant as it was unexpected. For his part in the happy result Schiaparelli was deservedly awarded the gold medal of the Royal Astronomical Society in 1872.

In some other directions the work of Schiaparelli has not received the same complete recognition. In 1877, when Mars was in a favourable position for observation, he announced the detection of the famous canals which have since been the subject of fierce dispute and controversy. Whether these "canals," interrupting the continental areas, are existent and permanent phenomena has been much questioned; though the doubts expressed do not relate so much to the existence as to the interpretation that has been placed upon them. Schiaparelli regarded the "gemination" of the canals as a periodical phenomenon depending on the seasons, and was firmly convinced of their alternate obliteration and reappearance. The only point on which we need insist here is the effect that his industry and acuteness of vision have had on the development of astronomical observation. It has been the means of attracting a vast amount of attention to the planet, has enormously increased the activity of observation, and led to the training of a class of observers, who have taken up the subject of planetary markings with avidity. Schiaparelli has written much on the appearance of Mars, and a very large literature has collected round this subject, due largely to his initiative.

Another subject with which his name will be connected is the attempt to derive the times of rotation of Mercury and Venus. Our information on this topic is vague, and the data uncertain. Notwithstanding the care bestowed on the observations, and the plausible nature of his deductions, his results have been accepted with some hesitation. From his patient watching, and from the length of time devoted to the study, his conclusion that Mercury turns on its axis in the same time that it revolves round the sun is entitled to very great consideration. This result was published in 1882, and it was not until some years later, 1890, that he declared that Venus behaved in a similar manner to Mercury. The long interval showed that Schiaparelli did not jump to conclusions, and the limits he assigned to the rotation, between six and nine months, prove that he was not inclined to accept a hypothesis, however specious, in favour of the results of observation.

These three conclusions, having reference to the connection of meteors with comets, to the surface markings of Mars, and to the velocity of rotation of the interior planets, are no small achievement in the life of one astronomer. It need not be said that they do not exhaust his scientific activity. A vast amount of routine work, of double-star measurement, and of the position of planets, stands to his credit. He was the author of some 250 papers in various journals, and his memory is as much entitled to our respectful homage for his industry as for his originality.

W. E. P.

PROF. J. G. GALLE.

WITH deep regret we have to announce the death, on July 10, at ninety-eight years of age, of the veteran astronomer Prof. J. G. Galle, the doyen of the Associates of the Royal Astronomical Society, into which body he was elected in 1848. For many years he had been connected with the Berlin Observatory, and will be remembered as the last of the little band of astronomers who were associated in the discovery of Neptune. Galle it was who had the good fortune to carry to complete fruition the successful analyses of Adams and of Le Verrier. It was his lucky chance to compare Bremiker's map with the sky, to detect the planet, and establish its identity by determining the motion. He long outlived all his companions and associates in that historic scene enacted in the Berlin Observatory on September 23, 1846, the antecedents of which have been told so many times that it is unnecessary to refer to them here more particularly. It is more pertinent to recall, as more likely to have been forgotten, that he was one of the first to have seen the "crape" ring of Saturn. When this discovery was announced in 1850, simultaneously by Bond and Dawes, Galle directed attention to some observations he had made twelve years earlier, in 1838–9, in which he had actually measured the diameter of this interior dusky ring. The observations were communicated at the time to the Berlin Academy, but Galle did not insist on their importance, as he could not persuade himself that the phenomenon was permanent and not due to the effect of contrast.

From Berlin, Galle went to Breslau, and there he proposed that method of determining the solar parallax, by observations of small planets, which has since proved so successful. His earliest attempts in this direction were applied to measures of Phocaea, and later, from observations of Flora, he deduced the value of 8·87″. This was at a time when astronomers were beginning to discard Encke's value of 8·58″ in favour of Le Verrier's 8·95″. In another direction it is not possible to overlook a very distinct service which Galle rendered to astronomy. His catalogue of cometary orbits has long been a standard work of which many astronomers have proved the usefulness. But comets and meteors long had great attractions for the aged astronomer. It will be remembered that he was among the first to point out a connection between the April meteors and Comet I, 1861, and to direct attention to the fact that Biela's comet would explain the appearance of the Andromeda shower.

Galle remained at Breslau in full scientific activity until 1897, when he retired to Potsdam after a long life earnestly devoted to astronomy, the interests of which he did much to forward by his zeal and energy.

THE HON. CHARLES STEWART ROLLS.

It is with deep sorrow that we have to record the death of the Hon. C. S. Rolls by an accident on Tuesday last, during the aviation meeting at Bournemouth. It seems that Mr. Rolls went up in his biplane for the alighting competition, and during the descent the newly fitted tail-piece of his aëroplane suddenly broke, and the whole machine collapsed and fell to the earth from a height of forty or fifty feet. Mr. Rolls was picked up unconscious and died almost immediately from concussion and laceration of the brain.

Charles Stewart Rolls was the third son of Lord and Lady Llangattock, and was born in 1877 and educated at Eton and Trinity College, Cambridge. From his early youth he was deeply interested in things mechanical, and his brief career, so sadly brought to an end, shows how successfully he utilised his mechanical capacity.

Different from many men, Charlie Rolls, as his friends called him, when he set about doing anything, always entered deeply into the subject in a thoroughly scientific manner. Whether the object on hand was connected with cycling, ballooning, motoring, or aeroplaning, in the last two of which he was a pioneer, it was always the same, and his mind was continually bent on finding out the "whys" and the "wherefores," and improving the existing state of things. The thoroughness with which he was always associated was strongly brought to my notice in the many balloon trips that I made with him, and his inquiring turn of mind was often displayed when perched up aloft in the clouds. Perhaps the best example is instanced in the quiet manner in which he spent weeks in practising gliding before finally mounting the full-sized aëroplane.

It has been said of Rolls that he was born restless, and those who knew him know how true this description was. Yet he was never flurried, but always calm and collected. It was this trait in his character that probably made him so successful in his manifold ventures.

In the death of Rolls, Britain has lost her most daring and brilliant aviator, and his friends mourn the loss of a dear comrade. William J. S. Lockyer.

NOTES.

We congratulate Sir William Crookes, F.R.S., on the new honour conferred upon him, namely, that of appointment to the Order of Merit, announced in the *London Gazette* of Friday last.

The death is announced, at the age of forty-eight years, of Prof. Hugo Erdman, professor of inorganic chemistry in the Berlin Technical High School.

The annual meeting of the Imperial Cancer Research Fund will be held at the Royal College of Surgeons on Wednesday, July 20, Mr. A. J. Balfour presiding.

The *Globe* states that Herr Frick, who for many years has been engaged in exploration and scientific research, particularly in South America, where he studied the habits and customs of the Indian tribes, has been murdered by Indians in southern Bolivia.

The death is announced in the *Athenaeum* of Prof. T. Zona, of the University of, and observatory at, Palermo; also of Prof. A. P. Sokoloff, formerly the holder of the chair of geodesy at St. Petersburg, and more recently the vice-director of the Pulkowa Observatory. Prof. Sokoloff retired from the latter position in 1905 in consequence of ill-health.

The following officers of the Royal Society of Medicine were elected last week for the year beginning on October 1 next:—*president*, Sir Henry Morris, Bart.; *honorary treasurers*, Sir W. S. Church, Bart., and Sir F. H. Champneys, Bart.; *honorary librarians*, Mr. R. J. Godlee and Dr. Norman Moore; *honorary secretaries*, Dr. A. Latham and Mr. H. S. Pendlebury.

At the annual business meeting of the Museums Association, held last week in York, Mr. H. M. Platnauer was elected president, and Messrs. C. H. Hunt and Deas vice-presidents. A resolution was adopted by the meeting expressing the desire that, in any revision of the grants-in-aid to provincial museums, the Board of Education would consider the advisability of continuing assistance towards the purchase of science objects.

Among the communications to be brought before the eighth International Physiological Congress at Vienna in September next are the following:—demonstration of method of testing colour perception spectrometer and demonstration of lantern test for colour-blindness, by Dr. Edridge-Green; the changes produced by radium in normal cells, by Dr. A. S. Grünbaum; and the summation of stimuli, by Drs. F. S. Lee and M. Morse.

The thirty-ninth meeting of the French Association for the Advancement of Science will be held at Toulouse on August 1 to 7. The president for the year is Prof. C. M. Gariel. Among the names of the presidents of the numerous sections, we notice the following professors of the University of Toulouse:—Prof. Emile Mathias, physics; Prof. Victor Paquier, geology; Prof. M. Leclerc du Sablon, botany; and Prof. Ch. Fabre, agronomy. M. Émile Marchand, the director of the Observatory of Pic du Midi, is the president of the section of meteorology.

The annual meeting of the British Pharmaceutical Conference will be held at Cambridge on July 26 and 27. In his presidential address, Mr. F. Ransome will deal mainly with the cultivation of medicinal plants and with medicinal plant investigation. Among the subjects of papers promised for the meeting are:—the bacteriological testing of disinfectants; an insect pest in belladonna; the proposed essential oil monographs; phosphoric acid and ammonium phosphate; the limitations of water analyses reports, both bacterial and chemical; and note on the periodicity of the properties of the elements: new arrangement.

We have been favoured with a copy of the preliminary programme of the fifth International Congress of Photography, which is to be held in Brussels on August 1 to 6 next, from which we learn that section i. (organised by the Société française de Photographie) will deal with photo-chemistry and the scientific applications of photography; section ii. (organised by the Association belge de Photographie), the technique of photography and the industrial applications of photography; and section iii.

(organised by the Institut international de Bibliographie), photographic documents and legislation relating to documentary photography. As has already been stated in these columns, the correspondent for the United Kingdom is Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

The death occurred at Washington, on June 26, of Prof. Cyrus Thomas, a veteran authority on the diverse subjects of ethnology and entomology. He was born in Tennessee in 1825, and from 1850 until 1865 he practised law. For the next four years he was pastor of a Lutheran Church. He was then successively an assistant on the U.S. geological surveys of the territories, professor of natural sciences at the Southern Illinois Normal University, State entomologist of Illinois, a member of the U.S. Entomological Commission, and (since 1882) a member of the staff of the U.S. Bureau of Ethnology. His earlier writings were on entomological topics, but his most numerous and best known works were concerned with the North American Indians of prehistoric times.

A list of the Civil List Pensions granted during the year ended March 31, 1910, has just been published as a Parliamentary Paper. Among the pensions granted in recognition of scientific work we notice the following:—Mr. Thomas Bryant, in recognition of his services towards the advancement of surgery, 100*l.*; Mrs. M. L. Gamgee, in consideration of the valuable contributions to physiological science of her husband, the late Prof. Arthur Gamgee, 70*l.*; Mrs. E. J. Seeley, in consideration of the valuable writings on geology and palæontology of her husband, the late Prof. H. G. Seeley, 70*l.*; Miss H. S. Murphy, in consideration of the services rendered by her father, the late Prof. E. W. Murphy, in furthering the use of chloroform, 50*l.*; Mr. J. Sully, in recognition of his services to psychology, in addition to his existing pension, 95*l.*; Mrs. Joanna Calder Fraser, in consideration of the value of the investigations in anatomy and embryology of her husband, the late Prof. A. Fraser, 70*l.*; Miss Julia Dobson, in recognition of the important services rendered by her brother, the late Surgeon-Major G. E. Dobson, F.R.S., to zoological science, in addition to her existing pensions, 15*l.*

Prof. T. H. Core, formerly professor of physics in the Owens College, Manchester, died on July 9 at Withington, near Manchester, in his seventy-fourth year. When the late Balfour Stewart was appointed professor of natural philosophy in the Owens College in 1870, Mr. Core came from Edinburgh to take up the post of professor of physics, a post which he held until his retirement in 1905. Up to the appointment of a professor of applied mathematics in 1881, he took charge of the more mathematical parts of the physics teaching, but as time went on he withdrew from the more advanced work, and for several years before his retirement only lectured on experimental mechanics. He was an extremely clear lecturer, and many Owens' men who have distinguished themselves in science owe their first love of their subject to Prof. Core. He was in great demand as a popular lecturer on scientific subjects throughout the cotton towns around Manchester, and acted as examiner to many of the better schools of the district. He was of a retiring disposition, and never took a prominent part in university politics. Outside his teaching work, his principal interest lay in astronomy, and he was one of the founders, and the first president, of the Northern Astronomical Association.

It is with regret that we learn of the death of Dr. Wilhelm Winkler, who since 1887 made valuable observations of sun-spots, double stars, comets, &c., at his private observatory at Jena. Born at Eisenberg in 1842, Dr. Winkler studied at Leipzig, and developed a practical, as well as mathematical, ability, which displayed itself in the making of watches and clocks. Then in 1875 he set up a 4½-inch Steinheil refractor at Gohlis, and made position-measures of comets, observations of occultations, &c. Later, in 1878, he commenced daily observations of the solar surface, communicating his results to Prof. R. Wolf and then to Prof. Wolfer. As ill-health prevented him from observing regularly, he directed observations made by his wife, and so kept up the continuity of the records. Removing to Jena in 1887, he employed a 6-inch refractor, fitted with clock, circles, and micrometers, for the observation of double stars. Unhappily, about two and a half years ago, a sarcoma necessitated the removal of his left eye, and this, with other serious complaints, considerably curtailed his astronomical work and caused him much suffering, which lasted until his death on June 17. Dr. Winkler's genial presence and devoted labours will, however, be sorely missed by his numerous friends and fellow workers.

We notice with regret the announcement of the death, on July 9, of Mr. Harry W. Cox, at the age of forty-six. Mr. Cox was one of the first in this country to realise the importance to the medical profession of Röntgen's discovery, and to take up the design and manufacture of X-ray apparatus. He commenced at once to manufacture coils, interrupters, and accessory apparatus for the application of the X-rays in medical diagnosis, and to import X-ray tubes and other adjuncts to enable medical men in this country to apply the new discovery. He was always ready to work out new ideas and designs, and probably his most noteworthy achievement was to place on a practical basis the stereoscopic method of localising foreign bodies, with its corollary, the cross-thread method of localisation. The stereoscopic method also enables a picture to be obtained of the position of parts in cases of fracture and dislocation. In his investigations he exposed himself freely to the action of the X-rays, and, like so many of the pioneers in this work, he contracted X-ray dermatitis in a severe form. The disease progressed slowly but relentlessly, and he died after several years of suffering. Now that the danger of undue exposure to X-rays is understood, and efficient protective apparatus has been constructed, there is no need for an operator to take any risks, while patients run no risk whatever; for the exposures necessary for purposes of diagnosis are short, while for purposes of treatment the dose can now be accurately measured and regulated. There is thus great cause for gratitude and honour to those who, at the expense of permanent injury to themselves, have enabled their successors to work in this field in safety.

A tablet in memory of Richard Hakluyt was unveiled in Bristol Cathedral on Thursday last. Among those present were Sir Clements Markham, K.C.B., F.R.S. (representing the Royal Geographical Society), Sir W. Lee Warner (representing the India Office), Admiral Sir Lewis Beaumont (of the Navy Records Society), Mr. W. Phillips (of the American Embassy), and Mr. A. Gray (of the Hakluyt Society). Sir Clements Markham said that Westminster Abbey, where Hakluyt was buried, or Christ Church, Oxford, where he was a student, would have formed a fitting place for that memorial, but, on the whole, Bristol had the better right. It was from that ancient port that there were sent the first voyages of discovery which occupied Hakluyt's thoughts and researches. At Bristol he was canon for more than thirty years, and there he must have conducted his researches and collected information. The most important feature in Hakluyt's character was his strenuous continuity of aim through life. He set himself to remedy two great evils of his time—the ignorance of English seamen in matters relating to the scientific branches of their profession, and the loss of records and stories of ancient voyages and travels. Besides writing and lecturing, he travelled a great deal, collecting stories and information, and set on foot work such as was now carried on by the Royal Geographical Society and other organisations. He was one of the founders of our Colonial Empire.

In distributing the prizes last week to the students of Guy's Hospital Medical School, Prof. Howard Marsh said that medicine had now become a department of biology, and it had given a powerful impetus to the study of biological science. The result had been the discovery of a new world of micro-organisms, of the existence of which nothing was known before the days of Pasteur and Lister. By far the greater number of diseases were due to the presence of micro-organisms. Who could doubt that in the next thirty years tuberculosis, which in England caused the death of 70,000 persons every year and the spoiling of the lives of probably twice that number, would be entirely swept away? Science was the acquisition of facts, and the results of research had been one of the marvels of our time. How should research be carried out? Could the man in the street tell them that? Was any man who knew nothing of biology in a position to save life? How was such a man justified in bringing charges of inhumanity and cruelty against men of science, and saying that what was being done ought to be put down by the strong hand of the law? When the public knew what advances had been made, and were told by such men as Lister and Paget that they had been gained by the only method by which they could have been achieved, who was competent to contradict them? And when it was understood that what was being done was done under Government supervision, and that no man could perform an experiment without a special licence, would not the public be satisfied that the matter was in safe hands? Would they not go further, and be grateful to those who, with unending labour, rendered such great services, and would they not extend to them their full confidence and support?

The Milan correspondent of the *Daily Chronicle* states that an Italian Royal Commission, appointed to inquire into the condition of the Leaning Tower of Pisa, has reported that the structure is in danger of collapse. The tower was begun in 1170, and took nearly a couple of centuries to complete. "Our explorations," say the members of the commission, "led to the wholly unforeseen and distressing discovery that, instead of being founded upon a massive, spacious base, as was generally believed since Grassi, in 1831, and Rohault de Fleury, in 1859, published their collections of plans, the actual foundation simply consists of ring-shaped masonry exactly corresponding in girth to the huge cylindrical mass superimposed thereon. In fact, the diameter of the inner ring foundations is 7 metres 40 centimetres, which is precisely that of the space inside the tower. This discovery, taken together with the further astonishing fact that the foundations are merely 3 metres (9 feet 9 inches) beneath the surface, constitutes henceforth incontrovertible proof that the campanile was originally built perpendicularly, and that its leaning propensities, which are becoming more and more accentuated, are due to other causes than the intention of its constructors." It is stated that the tower is farther from the vertical than it was eighty years ago. The reasons given for this difference are principally that the base of the tower has always been immersed in water, and that a deep cistern dug quite near seventy years ago with the unsuccessful object of draining a basin around the foot of the tower made matters worse. The tower was also considerably weakened by earlier excavation for a basin for mensuration purposes.

In a letter to the current issue of the *Lancet*, Dr. H. W. Thomas, of the Liverpool School of Tropical Medicine, gives an interesting account of the special screening against mosquitoes which has been effected on a freight boat of the Booth Line sailing from Liverpool to Porto Velho, a small place up the Rio Madeiro, a tributary of the Amazon. The screening of the ship is so arranged that the living quarters of the crew and officers are protected from mosquitoes. Each port-hole is provided with a movable screened frame, which is so adapted that the port-hole can be closed and screwed down without withdrawing the screen. The entrances to the main deck are protected by wire gauze spring doors, and at each side of the ash-shoot, which is of necessity open to the ingress of mosquitoes, extra sets of screened doors are placed. The doors and port-holes of the outside bridge deck cabins are also screened; the doctor's quarters and the hospital are situated further aft, and are thoroughly screened. The interior arrangements permit of no old-fashioned water reservoir over the wash-basin in the cabins, and running water is supplied everywhere. The slops from the basins run into pipes emptying directly over the side. This arrangement very satisfactorily deprives the Stegomyia larvæ of breeding places in the cabins. The ventilator pipes in the cabins and along the alleyways are each protected by a wire gauze screened frame, which slips into a grooved moulding fixed round the shaft, and is kept in place by three small buttons. The screening is composed of 18-mesh phosphor-bronze wire, a material which is more suitable for a moist, humid climate than brass or copper.

The *Journal of Hygiene* for April (vol. x., No. 1) contains a report on an investigation of "grouse disease" by Drs. Cobbett and Graham-Smith. It was found that the diseased birds generally harbour large numbers of intestinal worms, in particular a "strongylus" (*Trichostrongylus pergracilis*), which may occur in hundreds or even thousands. The conclusion is that the disease does not appear to be a specific bacterial infection, but that those birds which are more or less severely affected by strongyli suffer injury, partly by interference with nutrition, partly by the absorption of irritating or poisonous substances, which weakens them, and in bad weather may prevent them from gaining a living, and also renders them susceptible to various bacterial infections. Messrs. Hewlett, Villar and Revis also contribute a second part of their investigations on the nature of the cellular elements present in milk. Further evidence is presented showing that the cells are not leucocytes, that they may be present in enormous numbers in perfectly healthy cows, and that they are not necessarily indicative of any inflammatory condition.

In the first part of *Folk-lore* for the current year Dr. W. H. R. Rivers publishes a paper on the position of the father's sister in Oceania, particularly with reference to Banks' Island. The problem to be explained is the close connection between an individual and his father's sister in the case of people among whom the rule of matrilinear descent prevails. This relation closely resembles that of a man with his maternal uncle in patrilinear races, and it has therefore been suggested that the relation in Banks'

Island may be a survival in mother-right of a preceding condition of patrilinear descent. This theory Dr. Rivers dismisses as quite opposed to all known facts. The theory which he finally adopts is that when, for instance, a fragment of a man's umbilical cord and parings of his nails are given to the sister of his father, the intention is to entrust them to her as the representative of a group which, according to rules of descent, is necessarily foreign, and therefore hostile, in the hope that she may be able to prevent any member of that group from working black magic against her nephew. It is also possible that this strange relation indicates an increasing recognition of the kinship of the father, who deputes his sister to perform certain acts as an assertion of his paternity, thus bringing her functions into line with those which, according to one view, belong to the Couvade.

The remains of the gigantic extinct Australian marsupial, Diprotodon, have just been re-arranged in a newly constructed wall-case in the Geological Department of the British Museum (Natural History). The restored skeleton of the animal, for which bones and plaster casts were given by the South Australian Museum, through Dr. E. C. Stirling, F.R.S., occupies the greater part of the case. It displays especially well the massive carpal and tarsal bones and the diminutive toes, which are so characteristic a feature. The limb-bones from Queensland, described by Owen, are arranged on a shelf above the skeleton, and include the first discovered femur, which was originally mistaken for that of an elephant. The skull, as described by Owen, was purchased in a restored state in a saleroom, and has now been carefully divested of all superfluous plaster, proving that the restoration erroneously increased its length by 4 inches. With the skull are several well-preserved jaws showing all the teeth. Palæontologists are still awaiting with interest the promised complete description of Diprotodon by Drs. Stirling and Zietz, of the South Australian Museum.

Among other additions to the exhibited collection in the Geological Department of the British Museum (Natural History) may be mentioned a new model of the skull and mandible of the gigantic extinct lemur, *Megaladapis insignis*, from Madagascar. Thanks to the explorations of Dr. H. F. Standing in the swamps, the model is no longer in any respect hypothetical. It clearly suggests an animal adapted for an aquatic life, and the characters of the known limb-bones confirm this suggestion. To the table-case near the fossil lemurs has just been added a plaster cast of the much-discussed Palæolithic human skull from Galley Hill, in Kent. The original specimen still remains in a private collection.

In the *Entomologists' Monthly Magazine* for the current month, the Rev. F. D. Morice records a male saw-fly from Brockenhurst new to the British fauna. Provisionally the specimen is referred to *Neurotoma mandibularis*, a Continental species hitherto known only by the female. A detailed description, in Latin and English, is appended.

British Birds for July opens with an obituary notice, accompanied by an excellent portrait, of the late Mr. Boyd Alexander, who, it will be remembered, was murdered on April 2 by hostile natives in the heart of Africa to the north-west of Abeshr, in the Wadai. In another article Mr. W. Farren records, with illustrations, the nesting of the marsh-warbler in Cambridgeshire in June, 1909; only one previous instance, and that many years ago, is known of the species breeding in that county.

It has been pointed out by a correspondent that in a note upon a paper by Prof. Steinmann on ammonite phylogeny (Nature, vol. lxxxii., p. 289, January 6) the author was somewhat misrepresented. It was stated "that, in place of being a member of the 'Circumnodosi' group, Heterotissotia is really related to the Triassic Ceratites, of which it is to be regarded as the Cretaceous descendant." It should have read "that Heterotissotia is nearly related to the Triassic Ceratites, and especially the 'Circumnodosi' group, of which it is to be regarded as the Cretaceous descendant."

In the May number of *Spolia Zeylanica* Mr. T. Southwell records the capture of a large female saw-fish (*Pristis cuspidata*) on the Ceylon pearl-banks in December last. The specimen, which measured 15 feet in length, and weighed about 17 lb., was of special interest on account of containing twenty-three intra-uterine embryos. All these embryos were in a horizontal position; but while some had their beaks close to the aperture of the cloaca, others were exactly opposite. They measured 14 inches in length, and in each the yolk-sac was united to the abdomen by a placental stalk 5 inches long. The teeth, from twenty-three to twenty-eight in number on both sides, were arranged irregularly, varying between alternation and a distribution in pairs.

In the same issue (*Spolia Zeylanica*, vol. vi., p. 174) Mr. H. O. Barnard states, as the result of personal observation, that the alleged partiality of cobras for music is a myth. "The sole effect, so far as I could see, was to arouse their curiosity, as they would project their heads out of their holes equally well for any kind of noise, from the shrill piping affected by snake-charmers down to the tinkling noise made by dragging a chain past their dwelling, or even that made by light and repeated tappings with a switch close to their holes. It would appear, however, that the tone must be high, as grave sounds, such as tom-tom beating or deep notes from a flute, had no effect upon them." Mr. Barnard likewise confirms the observations, made in the London Zoological Gardens, as to the absence of a "fascinating" influence of serpents on birds.

In No. 1745 of the Proceedings of the U.S. National Museum Prof. T. D. A. Cockerell discusses the bees of the genus Nomia, with the description of several new species. All the American members of the group are referred to the typical genus, although an alternative classification is mentioned, in which Nomia would be excluded from the American fauna. If this scheme were adopted, there would, however, be difficulties with regard to the non-American forms, which are not easy to classify. "The group," it is added, "is a peculiar one, and apparently its little morphological jokes must not be taken too seriously."

The gipsy moth is so important a pest that a laboratory has been established at Melrose Highlands, Massachusetts, known as the Gipsy Moth Parasite Laboratory, where a complete study may be made of the parasites. Mr. J. C. Crawford has issued a description of several members of the families Chalcididæ, Perilampidæ, Pteromalidæ, and Eulophidæ occurring in the United States or introduced from Europe or Japan and known to be parasitic on the moth. The paper is published by the United States Department of Agriculture, Bureau of Entomology.

The *Agricultural Journal of British East Africa* does not confine itself entirely to agriculture, but includes papers on other subjects connected with the Protectorate. Part iv. of vol. ii. contains, as special agricultural papers, accounts of the Guayule rubber industry and of Ceara rubber in German East Africa, in addition to papers on tea cultivation at Limoru. Among the more general papers is an interesting diary of a journey made by Mr. E. Battiscombe down the Tana River; photographs are reproduced showing typical views and native huts.

THE current issue of the West Indian Bulletin (No. 4, vol. x.) contains a description by Mr. Joseph Jones of some cacaos grown at the Dominica Botanic Station. The root disease of sugar-cane (*Marasmius sacchari*) is also discussed, and found to be prevalent in all districts of Antigua, although planters do not readily recognise it, and therefore cannot apply remedial treatment as early as is desirable. There is an interesting paper by Mr. G. Moody Stuart on implemental cultivation, in which attention is directed to the necessity for using the best and most efficient tillage implements, some suitable types of which are described.

THE theoretically ideal method of dealing with insect pests is to encourage their natural enemies, but it is of limited application, because complications invariably set in sooner or later. The natural enemies of the sugar-cane pests were recently described in the *Agricultural News* (No. 209). Several parasites are known of the sugar-cane borer (*Sphenophorus obscurus*), one being a Tachinid fly, one a Histerid beetle, and one a beetle of the family Elateridæ. Attempts are being made in Hawaii to introduce the natural enemies of the pests occurring there.

WE have received a little booklet, "How to Use Nitrate of Soda," with a preface by Dr. Bernard Dyer, in which summaries are given of various field trials with this fertiliser. Several old misconceptions are dealt with; it is shown that nitrate of soda is not a mere stimulant, but a true plant food, and that it does not exhaust the soil. The necessity for potassic and phosphatic manuring and for periodical liming is also emphasised. Whilst primarily intended for practical men, the pamphlet is also of interest as showing what has been done with artificial manures.

A REPORT describing the experiments made during 1909 at the Harper Adams Agricultural College, and in the counties of Staffordshire and Shropshire, has lately been issued. One of the most notable features is the cropping power of a wheat, Browick grey chaff, recently introduced to the district by the college authorities; other wheats selected from Fife are also under investigation. We have also received the report on experiments with potatoes made in 1909 by Mr. Stewart, of the Edinburgh and East of Scotland Agricultural College. The effect of a change of locality on the vigour of the plant was well marked; apparently the best change is from a later or colder district to one earlier or warmer. Thus in the south-east of Scotland it was found advantageous to procure seed from the north, just as in England it is found profitable to procure seed from Scotland or Ireland.

REFERENCE is made in the *Kew Bulletin* (No. 5) to the flowering of the Burmese rose, *Rosa gigantea*, in the Himalayan section of the temperate house, this being the first record for the gardens. Another interesting item is the production of carpophylls on a plant of *Cycas Micholitzii*, which is being cultivated in the water-lily house.

THE current number of the *Kew Bulletin* (No. 5) opens with a report, by Dr. J. M. Dalziel, on the botanical resources of Yola province, northern Nigeria. Shea kernels (*Butyrospermum Parkii*) and gum are the chief commercial vegetable products. The author was not able to trace the sources of the gum beyond recognising that it is obtained from species of Acacia and Combretum, notably *Acacia senegal* and *Combretum verticillatum*, with admixtures of inferior gum from such sources as *Anogeissus leiocarpa* and species of Albizzia. Odorous resin is obtained from two species of Boswellia—new to science—and *Daniella thurifera*. Diagnoses of new Lauraceæ from the Malayan region, by Dr. J. S. Gamble, include a dozen species of Cryptocarya and ten of the genus Beilschmiedia.

IN the first issue of the meteorological chart of the North Atlantic for July, published by the Meteorological Committee, the synchronous weather charts show that from June 9–12 inclusive an area of high barometric pressure remained nearly stationary in the neighbourhood of the Azores, and afterwards travelled slowly eastward and north-eastward, causing a gradual improvement in the weather over the British Isles. Icebergs have been sighted with increasing frequency on the Banks of Newfoundland, drifting south, but the total number is below the normal. It is stated that navigation opened earlier this year than for some years past, owing to the exceptionally favourable conditions of the ice, not only in the St. Lawrence, but also in the White Sea and the Baltic. The first steamer reached St. Petersburg on April 18, only a week later than the earliest date of arrival there on record.

THE Bulletin of the Manila Weather Bureau for November, 1909 (recently received), contains particulars of two notable typhoons which crossed the Philippine Archipelago during that month. The first, on November 6–7, was remarkable for the unusual violence which it displayed in the Visayas and the China Sea, and for the changes in direction of the track while traversing the China Sea. Attention is directed to the occurrence at two stations of ball-lightning, which is said to be extremely rare in the neighbourhood of a cyclonic vortex. The second storm, November 12–23, was distinguished by the extraordinary development which it acquired in the China Sea, and especially by the fact that for several days it remained practically stationary to the east of the Paracel Islands; from November 18 to 21 the mean velocity of translation was only about 1·5 miles per hour. The tracks of the typhoons are laid down, and isobaric charts drawn from all available observations and reports; much credit is due to the Weather Bureau for its persistent efforts to throw light on the behaviour of these destructive storms.

THE present summer has so far proved cool and unsettled, and to the present it has given cause for suspicion that the season may prove as unfavourable as that of last year. The summary just issued by the Meteorological Office for the five weeks ended July 9 shows the mean temperature for the period to be in fair agreement with the average, but there has so far been a marked absence of high day temperatures. The rainfall has been in excess of the average over the whole of England and Ireland, but there has been a slight deficiency of rain in Scotland. The greatest excess for the five weeks is 1·69 inches in the south-east of England and 1·54 inches in the Midland counties, whilst in nearly all districts the excess is more than an inch. The duration of bright sunshine is deficient in England and Ireland, but there was a slight excess in Scotland. At Greenwich, the mean conditions for June were for the most part in fair agreement with the normal, but the weather was by no means agreeable. The rain fell at the commencement and end of the month, the aggregate measurement being 2·11 inches, which is only 0·07 inch more than the average, but rain fell on sixteen days. The mean temperature was about 1° above the normal, and the duration of bright sunshine was twelve hours less than usual.

Messrs. R. W. Paul have issued a pamphlet entitled "The Equipment of a Modern Elementary Electrical Laboratory," in which a standardisation of instruments is advocated with the view of attaining an interchangeability of instruments, shunts, and multipliers so that any one instrument may be easily adapted for measuring a wide range of currents and voltages. The instrument recommended for the use of elementary students is the unipivot galvanometer, which has a range of 240 microamperes unshunted, and may therefore be used instead of a mirror galvanometer for many experiments. An appendix gives a list of experiments suggested for an elementary course in electrical engineering and the apparatus required for carrying them out. We think that Messrs. Paul advocate too strongly the advisability of making the carrying out of experiments easy to the student. A great part of the benefit to be derived from an experimental course lies in learning to overcome practical difficulties, and students brought up on experiments that are so carefully prepared as to eliminate such difficulties do not, as a rule, become skilful experimenters in the more advanced stages.

Vol. vii. of Contributions from the Jefferson Physical Laboratory of Harvard University contains 463 pages of reprints of fifteen papers which have appeared in the American scientific periodicals during the past year. Of these papers, we have already noticed one in these columns, that on certain thermal properties of steam, by Mr. H. N. Davis. Another of exceptional interest, by Mr. H. W. Morse, deals with the evaporation from a solid sphere. The spheres experimented on were of iodine, and had radii between 0·2 and 1 millimetre. They were supported on a thin lamina of glass attached to the end of a thin fibre of glass, the other end of which was clamped firmly in a horizontal position, *i.e.* the micro-balance of Salvioni. The evaporation took place in a large box with glass sides, through which the deflection of the micro-balance was measured by means of a microscope. The rate of evaporation proved to be proportional to the radius of the drop, and not to its surface.

An advance copy has reached us of the catalogue of mathematical and scientific instruments to be on view at the International Exhibition at Brussels this year. This catalogue has been prepared under the auspices of the Board of Trade by the National Physical Laboratory; it refers only to the exhibits of British manufacturers. It includes detailed descriptions and illustrations of many of the instruments. A glance through this catalogue gives a very good idea of the rapid advances that are being made in the design of physical apparatus. It is invidious to select any names of exhibitors; it is enough to say that most of the leading makers of electrical, optical, surveying, navigational, and meteorological instruments are amongst them, and that the addition of historical references and lists of original publications makes the book a valuable one for reference. The price is only sixpence post free on application to the director, Exhibitions Branch, Board of Trade, Broadway, Westminster. We may add that the catalogue has been compiled free of cost to the exhibitors, and it is hoped that the prospect of the publication of a similar catalogue for the International Exhibition at Turin next year will induce other firms to avail themselves of the many facilities which the new Board of Trade department now affords to exhibitors.

We have received from Messrs. Baird and Tatlock (London), Ltd., a copy of the gas-calculator designed by Dr. R. C. Farmer. The diagram consists of four vertical lines; the two on the left are graduated in temperatures for wet and dry gas respectively; the line on the right is graduated in pressures (mm.). A celluloid strip bearing a black ruled line is laid across the observed pressure and temperature of the gas, and the corrected volume of 1 c.c. of gas is read off directly on the middle line. The latter is also graduated to read the logarithm of the weight of 1 c.c. of nitrogen. It is claimed to give the volume with an accuracy of 1 part in 5000, and this we have found to be the case if 0·00367 be taken as the coefficient of expansion of the gas in question. The diagram is extremely rapid and convenient in use, but it should not be lost sight of that an accuracy of 1 in 5000 is not possible with the more expansible gases.

The synthesis of camphoric acid, as announced by Komppa in 1903, is adversely criticised by M. Blanc (of the Sorbonne, Paris) and Dr. J. F. Thorpe in a recent communication to the Journal of the Chemical Society. One of the critical stages in the synthesis consists in the methylation of a diketoapocamphoric acid with the view of completing the total of ten carbon atoms present in the molecules of camphor and of camphoric acid. Using the ester of the acid, the methylation-product is a crystalline substance melting at 85° to 88°, and was supposed by Komppa to have the new methyl-group attached to carbon; it is now shown that the methyl-group is easily removed by cold caustic potash, and is undoubtedly attached to oxygen and not to carbon; the reduction of the compound to camphoric acid would therefore involve an important molecular re-arrangement, and even if it were effected could scarcely be regarded as a direct building up of the camphor molecule.

We have received from the Thermal Syndicate, Ltd. (Wallsend-on-Tyne), its list of pure fused silica ware. The manufacture of articles from fused silica has engaged the attention of experimenters for a long time; but, owing to the high fusing point of quartz, the difficulties met with in manufacturing articles were very considerable. The Thermal Syndicate has developed a most successful process for fusing and working silica in an electric furnace. Only in 1904, a basin of 25 cubic centimetres capacity was considered an achievement; but at the present time, pipes 12 inches in diameter and 30 inches long, and vessels of 50 litres capacity, are being manufactured. The articles manufactured by the Thermal Syndicate which are placed on the market under the trade name "Vitreosil" are of very varied character. The ware is used in the manufacture of sulphuric acid, for nitre pot pipes, and for the basins for cascade concentrators, of which there are more than 600 in use in the British Isles, representing an output of about 22,000 tons of acid. It is also used to a smaller extent in the manufacture of nitric acid, and for making the pipes which carry the gases from the roasters in the manufacture of hydrochloric acid. It can be used for making condenser worms, small electrolytic tanks where the process requires the maintenance of a high temperature, and so on. The great advantage of "Vitreosil" is that it is practically unaffected by temperature changes, the coefficient of expansion being about one-seventeenth that of glass. Owing to this property, its high fusibility and its resistance to acids, quartz is now being very largely used for the manufacture of laboratory apparatus.

The issue of the "Statesman's Year-book" for 1910 has been published by Messrs. Macmillan and Co., Ltd. This is the forty-seventh annual publication of an invaluable work of reference. The information throughout the 1500 pages has been corrected to the latest available date, and the changes made necessary by the death of King Edward VII. and the accession of King George V., as well as those arising out of the Union of South Africa, have been recorded. The proposed changes in the administration of the Belgian Congo are indicated; the sections on China and on the Anglo-Egyptian Sudan have been improved. Among matters of current interest, reference may be made to the articles on "Second Chambers" and the results of the census of production. As usual, the annual provides a number of new maps, and among them may be mentioned those showing the development of the Congo, the proposed Central Scotland and Georgian Bay Ship Canals, the United South Africa and South African railways, and South America, showing the railways. Altogether, this edition of the "Year-book" is well up to the high standard one associates with Dr. Scott Keltie's editorship. The price of the book is 10s. 6d. net.

Messrs. Rebman, Ltd., hope to publish during the present month a new book by Dr. Bernard Hollander entitled "The Mental Symptoms of Brain Disease," with a preface by Dr. J. Morel, Belgian State Commissioner in Lunacy.

A second edition of Dr. Washington's "Manual of the Chemical Analysis of Rocks" has been published by Messrs. John Wiley and Sons in New York and Messrs. Chapman and Hall, Ltd., in this country. The first edition appeared in 1904, and was reviewed in these columns on January 5, 1905 (vol. lxxi., p. 219). The present issue has been revised and somewhat enlarged.

OUR ASTRONOMICAL COLUMN.

Halley's Comet.—Dr. Ebell's ephemeris for Halley's comet is continued in No. 4423 of the *Astronomische Nachrichten*, and gives the positions, &c., up to September 18. On July 16 the comet will be in R.A. 10h. 59·4m., dec. $-4°$ 2·7′, and its estimated magnitude will be 6·3, so that further observations in these latitudes are impossible. The distances from the earth and sun, on that date, will be 197 and 162 million miles respectively.

Owing to its apparent proximity to the sun, the comet could not be extensively photographed at any one observatory, but it is hoped that when the results from various observatories come to be compared, there will be a fairly continuous record which will enable the changes in the tail to be closely followed. An example of such change is afforded by the negatives secured at Johannesburg on April 21 and Kodaikanal on April 22, the latter showing, among other changes, a large contorted streamer on one side; the similarity to the tail of Morehouse's comet is thus emphasised.

A spectrum of the comet, taken at Mount Wilson, was described by Prof. Fowler, at the last meeting of the Royal Astronomical Society, as being of the usual type. Dark Fraunhoferic lines, due to reflected sunlight, are shown in the narrow strip of the spectrum due to the nucleus, and in that of the coma the bands at λλ 473, 421, and 388 are seen. Prof. Fowler suggested that the unequal intensities of the five heads in the cyanogen, 388, band were, possibly, indications of a rather low pressure condition. A comparison of this spectrum with that of Daniel's comet (1907), taken by Prof. Campbell, shows that they are practically identical.

In the *Comptes rendus* (No. 1) for July 4 Prof. Eginitis describes the appearance of the comet at Athens since its inferior conjunction. An increased activity of the nucleus ejected large masses of matter to great distances, and on May 31 an aigrette was seen, which was brighter than the nucleus itself and turned away from the sun; this was made up of straight streamers 50″ long diverging to form an angle of 60°. It was also noticed that, after the passage, the tail became much more brilliant than before, an effect which the author ascribes, in great part, to the change in the relative positions of the comet, the sun, and the observer. From this he deduces that the brilliancy of the tail is largely due to reflected sunlight, and suggests that it affords further evidence that the tail is, to an appreciable extent, made up of fine, solid particles.

Photographic and visual observations of the spectrum, made at the Madrid Observatory since the conjunction, are described by Father Iniguez. Photographs taken on June 1, 3, and 6 show the continuous spectrum and seven superposed monochromatic images of the coma. The three least refrangible of these were observed in May, and of the four new ones the two brightest are in the extreme ultra-violet, beyond the continuous spectrum. The plate taken on June 1 shows each of the three less refrangible bands doubled. Three of the four more refrangible bands are well defined, and their wave-lengths are given as 437, 425, and 391; the other is broad, extending from λ 399 to λ 407. The visual observations indicate an intrinsic change in the band recorded as λ 567 on May 27 and as λ 559 on May 30; on the former date the red edge was sharp, whereas on the latter it was diffuse, and was not the most intense part of the band. The green band at λ 512 on May 27 and λ 516 on May 30 was sharp and apparently composite, and the difference of wave-length is attributed to a relative change in the intensities of the components *inter se*. Apparently the band at λ 472 did not change. The visual and photographic observations of the tail showed various, although not pronounced, changes, which are discussed in the note; until May 6 the tail was of the first type, but from then until the passage of the comet it was of the second, reverting to type i. after the passage.

Prevention of Dew Deposit upon Lens Surfaces.—In a paper published in No. 7, vol. lxx., of the Monthly Notices, Mr. Franklin Adams states that the Mervel Hill photography of the northern hemisphere stars could have been completed in two years instead of nearly six if some means had been devised for preventing the deposition of dew on the lens surfaces.

He then describes a method by which the difficulty has now been overcome. An air-pump, driven by a motor, delivers a current of dried air on the lens surfaces, inside the camera, and on the film of the plate, thus preventing the dew deposits. The air is dried by forcing it over pumice stone soaked in sulphuric acid and then over glass wool.

A Variable Star as a Time Constant.—Having regularly observed a variable star, No. 33 in the Harvard list, in the cluster M. 5 (Libra), Prof. Barnard discusses its light-changes in No. 4409 of the *Astronomische Nachrichten*. This star was compared with a neighbouring star, which is designated k, and for ten years its period has apparently remained unchanged. Therefore Prof. Barnard suggests that it, and other similar variables, might prove useful for providing a check on the constancy of the earth's rotation, or any other possibly variable elements of the solar system. It rises sharply to a maximum, at which it seems to remain for only a few minutes, and then declines quickly until it is as bright as k; after that the decline is more leisurely. At minimum the magnitude is 14·6, and the increase is rather more than 1·2 magnitudes, the period being 0·50147+d. To facilitate observations of this interesting time-standard, Prof. Barnard gives an ephemeris which is useful up to the year 1918.

Radiation and Absorption.—In discussing various astronomical phenomena, the observer often has to study numerous laws concerning radiation and absorption, and this frequently necessitates looking them up especially. To obviate waste of time in this direction, Prof. Humphreys brings together, in No. 4, vol. xxxi., of the *Astrophysical Journal*, the chief laws, and discusses the general formulæ by which they are expressed. Thus the equations for the Doppler, Maxwell-Bartoli, Zeeman, and other effects are explained, and the most convenient formulæ for general use are collected in an invaluable summary which should prove of great convenience.

THE FIFTH INTERNATIONAL CONGRESS OF ORNITHOLOGISTS.

THE fifth International Congress of Ornithologists took place in Berlin from May 30 to June 4. Like all the former congresses of its kind, it was well attended, although only a single American and comparatively few English ornithologists were present.

The opening address of the president, Prof. Anton Reichenow, of Berlin, was a lucid, though necessarily short, review of the progress of ornithology within the last 150 years and its present status.

The Hon. Walter Rothschild delivered a lecture on the former and present distribution of the so-called Ratitæ, embracing also some very interesting recent investigations by Mr. C. W. Andrews on the egg-shells of certain ostriches, especially some pieces of the egg of a fossil ostrich, found last year by Messrs. Rothschild and Hartert in the Algerian Sahara. Baron Loudon gave descriptions of the bird-life in Talysch and Transcaspia; Prof. Koenig narrated his journey up the Nile to Lado and Gondokoro; Dr. Otto Hermann explained the activity of the Royal Hungarian Central Bureau of Ornithology; Dr. Thienemann that of the "Vogelwarte Rossitten," especially the method and results of his experiments with "ringed birds"; while the other lectures held in the general meetings were about bird-protection and the preservation of "nature's monuments" as connected with bird-life. Numerous communications were made and lectures delivered in the various sections, their number being so great that in some of the sections the time available was hardly sufficient, and discussions had sometimes to be cut short. Of the lectures in the sections, mention can only be made of a few, as most of them were only of interest to specialists.

The proceedings of section i. (systematic, palæontology, anatomy, and geographical distribution) were opened with a lecture by Dr. Hartert, on "what we ought to do and what we ought not to do." The speaker pointed out many evils and shortcomings in the technical treatment of modern bird-study; he specially urged greater care to avoid new synonyms, demanded better descriptions, more cooperation, &c. He pointed out the necessity of liberality in lending specimens to competent persons and institutions, and regarded museums which did not lend material to others as behind the times. He also made clear the necessity of greater care in preparing and preserving the material for study, especially bird-skins, held that they should be more exactly and more securely labelled, and discussed various other technical details.

Mr. Friedrich Rosenberg spoke about the development of the Colymbidæ, Prof. Jacobi discussed the development and systematic position of the "Impennes," and Geheimrat Prof. Virchow gave the results of his study on the mobility of the nuchal vertebræ in the Spheniscidæ.

Prof. Neumann discussed zoogeographical problems, specially referring to the necessity of careful geographical study in connection with the description of subspecies of birds, and their distribution.

In section ii. (migration) a number of lectures were given, of which that of Rittmeister von Lucanus, about the height at which birds migrate, appeared to be of special interest.

In section iii. (biology, oology, acclimatisation), Mr. Lucanus also made very important statements regarding the psychology of birds. Dr. and Mrs. Heinroth lectured on the biology of certain Anatidæ, and on the breeding in captivity of Caprimulgus and Locustella.

Graf Zedlitz dealt with the breeding-seasons of African birds.

Dr. Weigold gave interesting details about the former and present status of bird-life on Heligoland, and recommended the continuation of regular observations on that island "before it would be too late."

In section iv. (bird-protection) the necessity for the prohibition of the introduction of feathers and bird-skins for millinery purposes was urged, and the question of international bird laws discussed.

Section v. was devoted to poultry and other domesticated birds, and appeared to be well attended.

At the meeting of the International Ornithological Committee it was decided that the *Ornis* should not be continued in the form of a regular periodical, but of irregular volumes containing the proceedings of the various ornithological congresses, and special scientific treatises, in the event of material and means being available for the purpose.

In every town a congress has its peculiar features. While some of the characteristics of the fourth Congress of Ornithologists in London were the excursions to Tring and Woburn Abbey, and the visit to the Bempton Cliffs, with their breeding-colonies of sea-fowl, the congress at Berlin was remarkable for the various liberal entertainments in the town. The city gave a dinner in the famous Town Hall, the Zoological Garden Society a luncheon, the Ornithological Society a supper, and one evening was pleasantly spent in the natural history theatre, called "Urania."

An illustrated guide and excellent map of Berlin were presented to every member, also a reprint of Lichtenstein's very rare "Verzeichniss einer Sammlung von Säugethieren und Vögeln aus dem Kaffernlande," of 1842, a description of the "Vogelwarte Rossitten," and various other pamphlets and booklets. E. H.

THE DANGERS OF FERRO-SILICON.[1]

FERRO-SILICON, averaging about 13 per cent. silicon and made in the blast-furnace, has been used in steel works, and to a certain extent in iron foundries, for many years. Steel castings were made with about 0·3 per cent. silicon to help in the prevention of blow-holes, and at the same time to aid in giving the properties required by engineers; and in foundries the ferro-silicon is used to add to mixtures of iron, such as those containing large percentages of scrap, that would otherwise yield a hard casting, as the added silicon has the effect of changing the combined to free or graphitic carbon on cooling. Within the last few years much richer ferro-silicons have been made in electric furnaces, and have found a ready sale. They are useful for special crucible steels and for certain steels for electrical work, and also for adding silicon in the ladle in the case of basic open-hearth practice, as there it is impossible to do this efficiently on the hearth, though it is easily done in the acid process.

With the electrically produced high-grade ferro-silicon came trouble. The present writer remembers the great interest taken in the earliest recorded case of this trouble as given by Dr. Dupré and Captain Lloyd at the Iron and Steel Institute in May, 1904. Owing to a fire having occurred on a vessel, the cargo, including 50 per cent. grade ferro-silicon brought from Trieste, was discharged on December 17, 1903. On January 12, 1904, the forty-eight drums containing the ferro-silicon were removed to a warehouse in Bootle, and whilst being rolled from the truck on to the concrete floor one drum exploded. Dr. Dupré and Captain Lloyd, after careful investigation, pronounced the explosion to be due to PH_3 evolved owing to the action of damp air, and gave a weighty and serious warning with regard to the handling and storing of this comparatively new product.

So explosions and spontaneous ignition came in the train of the new material; but it was to make its powers felt in another way. On the S.S. *Vaderland*, Antwerp to New York, over a hold in which ferro-silicon was stored, fifty steerage passengers were made ill and eleven died, of whom nine were buried at sea, and two corpses landed at New York, as plague was feared. In March, 1906, two children died on a Rhine boat. On October 21, 1905, two children died on board a "keel" on the Keadby Canal; the father and mother were taken seriously ill, but recovered *on deck*. In February, 1907, on the *Olaf Wyjk*, Gothenburg to Antwerp, four passengers died. In May, 1908, on the S.S. *Uleaborg*, Stockholm to St. Petersburg, the crew and second-class passengers were taken ill, and two died. On October 29, 1908, on the keel *Harry*, Captain Bamfield and the mate, his grandson, started from Goole with ferro-silicon on board, apparently consigned as "scrap iron." On the night of Friday, October 30, the mate was

[1] "On the Nature, Uses, and Manufacture of Ferro-silicon, with Special Reference to possible danger arising from its Transport and Storage." Local Government Board Report, 1909. By Dr. S. M. Copeman, F.R.S., S. R. Bennett, and Dr. H. Wilson Hake. Pp. viii+115. (Cd. 4958.) Price 1s. 11d.

taken seriously ill and removed. The captain took his wife and grandson on board and proceeded, but all three were taken ill. Bamfield died on November 6 and his grandson on the previous day. The cause of death was certified under that convenient term "ptomaine poisoning," but was afterwards proved to be due to fumes from the ferro-silicon of 50 per cent. grade (actual analysis, 53·9 per cent. silicon).

It required, however, yet another tragedy, with the added scare of cholera, to compel investigation, and this was provided by the case of the S.S. *Ashton* in December, 1908, on which, after a voyage of twenty-four hours only, from Antwerp to Grimsby, all the occupants of the emigrant quarters, fortunately only five in number, died between 6 p.m. on December 12 and 12.30 p.m. on the following day. This time cholera was feared, but examination by the Government bacteriologist at once negatived this view. Mrs. Bamfield wrote on December 17, 1908:—"It has occurred to me since reading the account of this poisoning that there may be some of this (scrap) in the S.S. *Ashton*." Immediately these deaths were reported in the newspapers, Mr. Hodgson, Mrs. Bamfield's son-in-law, wrote to Dr. Simpson, medical officer of health for Grimsby, making a similar suggestion, and that this was the cause of the deaths (p. 20):—"It was apparently in consequence of this letter that attention came to be directed to the possibility of the deaths on the S.S. *Ashton* having been due to the presence of the ferro-silicon on board, suspicion having arisen, in the first instance, that the fatal illness of the passengers was due to cholera." This was abundantly proved, and resulted in the elaborate investigations of which this report is the record.

The report is a valuable one, showing that the authors have recognised the difficulties and grappled with them. The original should be in the hands of all interested in ferro-silicon from a medical, a shipping, or a metallurgical aspect. As the authors themselves state, further investigation is yet required, although rules that will almost ensure safety have been found.

Ferro-silicons of low grade, containing not more than 15 per cent. silicon and made in the blast-furnace, are beyond suspicion, and as safe to handle and to store as ordinary pig iron. The high-grades, 25 to 95 per cent. silicon, made in the electric furnace, and imported to the extent of about 4000 tons per annum, mostly from France, but to a less extent from Austria, Scandinavia, &c., include the dangerous varieties. The bulk has been made to 50 per cent. grade for little apparent reason other than ease in calculation of mixtures, a matter that may excite surprise until it is remembered that a manager, with his hundred worries per day, tries to avoid the hundred-and-first, in case it might prove "the last straw." The gases given off may at first have included acetylene, owing to the ferro-silicon being made in calcium carbide furnaces, but as that is never done now the poisonous gases given off are phosphoretted hydrogen and arseniuretted hydrogen, roughly 90 to 95 per cent. of the former to 10 to 5 per cent. of the latter. All are agreed that until more is known of the fundamental causes, those varieties around 50 per cent. silicon are most dangerous, and should neither be made nor bought. La Chambre Syndicate des Forces hydrauliques states that 30 to 40 per cent. and 47 to 65 per cent. grades should be avoided, but the remarkable omission of 40 to 47 per cent. grades is not supported by any experimental proof. The authors recommend the manufacture or use of only those varieties below 30 per cent. or above 70 per cent. silicon content for the present.

The section on the functions of ferro-silicon in steel manufacture hardly gets to the root of the real idea sometimes, but is near enough for general readers; and technical men are not likely to refer to this section of the report. It will be read for the results of the experiments and general investigations carried out and the opinions formed on the results, and these can be recommended. The report contains, besides matter already indicated, reports of conferences with Sheffield firms using ferro-silicon, investigations at places of manufacture, a description of the manufacture of ferro-silicon, conclusions and recommendations, Dr. W. Hake's chemical investigations, and Mr. Bennett's report on the composition and structure of ferro-silicon.

As the PH_3 is only formed in contact with moisture, the material used to be packed in sealed drums, and sometimes was coated with paraffin wax; but this does not deal with the gas present in the cavities, and only transfers the danger, for drums exploded on opening and men removing the paraffin were made ill, so that these methods should be abandoned.

The report recognises an important point that is still obscure (p. 109):—"Dr. Heroult expressed himself as decidedly of opinion that the specially undesirable qualities exhibited by this particular grade (50 per cent.)—tendency to spontaneous disintegration and evolution of poisonous gases—were related to the amount of *aluminium* present in the alloy. He was unable . . . to advance any definite reasons for the opinion he had formed." Mr. Bennett later expressed the same opinion, and suggested that, as the heat of formation of Al_2O_3 is very great, the presence of a large percentage of aluminium is indicative of very high temperature reactions in the furnace, and that these reactions are favourable to the formation of compounds which readily break up into poisonous and explosive gases."

This can hardly be so, for Prof. Arnold, who, it is understood, will present a report later, has had one lot of ferro-silicon divided into two portions and melted in two crucibles. When molten, to one only was added 3 per cent. aluminium, and the two portions were cast into separate ingots. The present writer, being interested in the experiment, broke a piece off each ingot, and, dipping them in water, noticed that one had no particular odour, but the other smelt very strongly, the latter proving to be that to which aluminium had been added. A too enthusiastic repetition of the experiment as a test produced just a feeling of discomfort which the fresh air soon dispelled, this last being a point of much importance, as where lives were saved it was practically the governing remedy. "Two of the passengers also left their cabins and, although very weak, succeeded in getting on deck. These two survived" (p. 15). No. 5 of suggested regulations may be quoted:—"Storage places at docks or at works where ferro-silicon is used should have provision for free access of air, and should be situated at a distance from work-rooms, messrooms, offices, &c." (p. 115).

The main conclusions of the report have been mentioned, but all interested in the subject should obtain a copy, as the details of the investigations are well worthy of study.

A. McWILLIAM.

THE POSITION OF THE NEGRO AND PYGMY AMONGST HUMAN RACES.[1]

A FULL analysis of the structural features of the negro shows that in many points he is more highly specialised than the less pigmented races of mankind, while in other characters he has remained more primitive. Although on the Continent there is a decided tendency amongst anthropologists to trace the descent of the human race through a non-anthropoid stock, yet those most familiar with the anatomy of the Primates still agree with Huxley's doctrine that the community of structure shared by man and anthropoids pointed to a direct community of origin. The deeply pigmented skin was a primitive feature; the gorilla was the negro amongst anthropoids; the three species of chimpanzee varied as the period of life at which pigmentation appeared. All available evidence points to a pigmentation of the early human stock, but speculations are handicapped by an ignorance of the functional value of pigment. It appears to protect the deeper tissues from certain injurious rays which are intermediate to heat and light. The skulls of Palæolithic Europeans show so many resemblances to those of Australian aborigines that a legitimate suspicion may be raised as to whether or not they did not also share some degree of the aboriginal pigmentation. The Palæolithic Gibraltar woman, whose skull is preserved in the Museum of the College of Surgeons, shows no community with the negro in the characters of her nose. The nose of that skull is altogether unlike that of any human race now known; it shares some features with the gorilla, while

[1] Abstracts of four Hunterian Lectures on "The Anatomy and Relationships of the Negro and Negroid Races," given at the Royal College of Surgeons, England, by Prof. Arthur Keith.

in others it appears to foreshadow the prominent nose of the modern European.

The evidence of the nose of Palæolithic man leaves the question of pigmentation of the early European open. The distribution of pigmentation among modern races could be explained best by supposing that the appearance of the fairer races—the Caucasian and Mongolian—was one of the more recent events of human evolution, and that the site of their evolution was in the central populations of the more northern parts of the Old World. The frizzled hair of the negro was a highly specialised feature. Their thick everted lips, unlike the thin anthropoid lips, at first sight seem also to be so, but when the arrangement of the labial musculature is examined, it is seen that the negro's lips are more anthropoid than the European's; but the European form, notwithstanding their apparent thinness, appears to be a modification of the negro form. The high and prominent cheek-bones of the negro are due, not to an absolute greater breadth of the face, but to the fact that the muscles of mastication have become specialised in different directions in the negro and European; in the negro the masseter muscle, which arises from the cheek-bone, is particularly large, whereas in the European it is the temporal muscle, which has its fixed basis on the side of the skull, that retains the greatest relative development.

The apparent breadth of the negro's face is largely owing to the fact that the basal part of the skull, to which the neck muscles are attached, is small. The small attachment of neck is a feature of the young of all Primates, and also one in which the negro has assumed a less anthropoid form than the European. The prognathism of the negro is due to several factors; it is chiefly due, not so much to a larger, but to a healthier dental development, which ensures a due forward revolution of the jaws during the eruption of the permanent teeth, thus providing an ample air-way in the pharynx. In Europeans the revolution forwards of the jaws showed a distinct tendency to become arrested prematurely, thus contracting the pharynx. The negro condition was the more Simian, but it is also one which modern Europeans would willingly share with him, because of its functional merits. Sir William Flower's method of estimating prognathism gave misleading results. The most accurate method of stating the development of the jaws was to give the area of the palate and the total size of the teeth.

Some of the most characteristic features of the negro race were to be seen in their foreheads. While Palæolithic Europeans showed the Simian beetling brows and receding forehead, features still shown in some degree by modern white races, the great majority of African negroes were characterised by prominent foreheads and a complete absence of that condition which might be described as supra-orbitalism. It is true that some tribes on the west coast, the oceanic negroes, and the Tasmanians still retain this primitive character. Indeed, the outstanding feature of the negro's skull is a tendency to retain characters of the immature skull of other races. Those who know the psychology of the negro best ascribe to his brain the boyish nature here ascribed to his skull.

The pygmies, usually described as Negritos, are true negroes in which the tendency to assume immature characters has become hereditary to an extreme degree. They are widely distributed. Sir Harry H. Johnston has shown how they are scattered amongst the forest tribes from the west coast almost to the east coast of Equatorial Africa; they stretch southwards almost to the Cape, and isolated communities are found as far eastwards as the Philippines and New Guinea. Two explanations may be offered for their distribution:—(1) they are remnants of a race that was spread formerly throughout the southern half of the Old World; (2) they are modifications produced locally from the larger negro. The second explanation is apparently the correct one, for the Congo pygmies share all the physical features of the Bantu except size; the Bushman has the characters of the Hottentot, while the pygmies of the far east find their nearest representatives in the negroes of the Oceania. Recent advances in our knowledge of human pathology make this supposition of the origin of pygmies more probable. Disturbances in the secretion of certain glands, such as the pituitary and thyroid, lead to the production of the characters of Palæolithic features in some individuals and true dwarfism in others. In the Miocene period the large-bodied Primates had already appeared; primitive men were certainly not pygmies in size.

An analysis of the cranial features of the aborigines of Tasmania and of Australia shows that we have in these two races an early stage in the differentiation of the negro and negroid races of mankind. The Tasmanian is the most primitive type of *negro* yet discovered; the Australian, on the other hand, although deeply pigmented and less Simian in some features than the Palæolithic European, is the most primitive representative of the *negroid* race. Negroid as he is, the native Australian represents a stage in the evolution of the dominant non-negroids of the northern hemisphere. It is a remarkable fact that the negro and negroid races occur side by side, not only in Austral-Asia, but in Asia proper and in Africa. The negro Semangs of the Malay Peninsula live with the negroid Sakai as neighbours; the Veddahs of Ceylon are not far from the negro of the Andamans; even in Quaternary Europe the negro race discovered by Dr. Verneau in the caves of Grimaldi were early successors, if not contemporaries, of Palæolithic man. The Grimaldi negroes find their nearest modern representatives in the Oceanic, not the African, negro; equatorial Africa and northern Europe were the probable centre in which the black and white races had reached their present degree of structural evolution. The two centres were linked together, and always had been linked, by racial zones which showed intermediate characters. Modern anthropologists are inclined to ascribe the characters of intermediate races to intermarriage. Interbreeding had certainly played a part, but probably a small one. The truer explanation seems rather to lie in regarding intermediate races as representing intermediate stages of physical and mental evolution.

TREES AND FORESTS.

THE botanical gardens at Peradeniya, Ceylon, are celebrated for their vegetation splendour, so that a list of beautiful flowering trees recommended by the curator, Mr. H. F. Macmillan, will appeal to many outside the range of those for whom the Circular (vol. iv., No. 20) of the gardens is immediately intended. In the author's opinion, the leguminous tree *Amherstia nobilis* is not to be excelled, although *Lagerstroemia flos-reginae* passes under the name of "pride of India," and *Poinciana regia* is the famous "flame-tree." The Amherstia was introduced to Ceylon from Burma, and it is remarkable how many of the plants mentioned have been imported from the tropics of the New and Old World. *Gliricidia maculata* is a recent introduction from the West Indies; *Solanum macranthum*, the "potato-tree" from Brazil, is noteworthy as the only species of the order that grows to the size of a tree.

A description of the indigenous trees of southern Rhodesia, together with their vernacular names and products, is provided by Mr. C. F. H. Monro in the Proceedings of the Rhodesia Scientific Association (vol. viii., part ii.). An important matter is the production of timber suitable for mining, construction, and agricultural purposes. The most useful timbers are yielded by *Copaifera mopani*, *Pterocarpus angolensis*, *Photinia mahobohobo*, and *Parinarium mobola*. *Baikiaea plurijuga* is known as Rhodesian teak; *Afzelia cuanensis* supplies the local mahogany, while a somewhat similar, handsome wood is furnished by *Faurea saligna*, a species of Proteaceæ. The woods of some of these, as also of *Callitris Whytei* and *Terminalia sericea*, are said to be ant- and borer-proof.

Two forest pamphlets (Nos. 12 and 14) recently issued by the Government of India relate to *Berrya Ammonilla*, a tree, belonging to the family Tiliaceæ, that is found principally in Burma, and *Pterocarpus macrocarpus*, a leguminous tree yielding Burma padauk timber. Regarding the former, logs up to 20 feet in length, and measuring $4\frac{1}{2}$ feet in girth, can ordinarily be obtained. The timber is tough, elastic, and straight-grained; it works and finishes well, so that it would appear to be suitable for export; but the annual outturn is only computed at 1500 tons, and there is a good local demand for construction work, for carriage shafts, draught poles and various agricultural implements. Burma padauk must be distinguished from Andaman padauk, obtained from *Pterocarpus dalbergioides*, which is noted for the brilliant red colour of select logs. Although inferior in colour, Burma padauk is much superior in strength and durability, and is regularly supplied to the Ordnance Department for spokes and felloes of wheels, poles, yokes, and other purposes. Timber which does not comply with the stringent requirements of the Ordnance Department is quite suitable for wheel work, furniture, and interior decorations. Both kinds of padauk have been imported to England and America, but various causes have militated against their successful exploitation in this country.

A forest pamphlet (No. 16) issued by the Government of India is devoted to an account of experiments conducted by Mr. R. S. Hole with the view of determining the best season for coppice fellings of teak. The rainy season—mid-August to October—is frequently selected for felling, although it might be expected that, vegetative activity being then at its height, the development of coppice shoots would be poor. However, the trials carried out, with many precautions, indicate that the worst period for the fellings is from the time, April to August, when vegetative activity commences, up to and for a short time after the full development of the foliage, and that reproduction is most vigorous in the months of March and September. Incidentally, the author notes that good fertile seed has been obtained from nine-year-old coppice shoots of teak.

It is a coincidence that information regarding the importance of trees belonging to the Dipterocarpaceæ should be forthcoming simultaneously from Burma and the Philippines. In the *Philippine Journal of Science* (Botany, vol. iv., part vi.) Mr. H. N. Whitford presents some striking estimates regarding the preponderance of the family in the Philippine forests, according to which Dipterocarp trees may be expected to yield three-quarters of the total volume of merchantable timber growing in a virgin forest area computed at 30,000 square miles. He directs special attention to the value of the woods known locally as "lauan," yielded by species of Pentacme, Shorea, and Parashorea, and "apitong," yielded by species of Dipterocarpus; the former are slightly harder but similar to white pine, while the latter compare with the hard pines.

A paper on Indian State forestry, by Mr. S. Eardley-Wilmot, late Inspector-General of Forests, is published in the Journal of the Society of Arts (April 1). He mentions that the forest department has control over an area of 240,000 square miles—about one-fifth part of British India—from which 4½ million tons of timber and 180 million tons of bamboos are extracted annually. A rough demarcation of the forests is indicated as follows. They range from a height of 14,000 feet, where birch and firs supply the chief constituents, to the mangrove belts situated at sea-level. At an altitude of 8000 feet rhododendrons, oaks, cedars, and pines flourish in different regions. *Dalbergia Sissoo* and *Acacia Catechu* grow in the submontane forests. The deciduous forests at a lower elevation supply teak, sál, ebony, and ironwood, while important evergreen forests are found near the coast or further inland.

A number of interesting problems receiving attention at the Swedish Royal Forestry Institute are detailed in the Proceedings (*Meddelanden från Statens Skogsförsöksanstalt*, part vi., 1909), such as the examination of the native forests from an ecological standpoint, the best trees to plant on heath or swamp land, and the improvement of regeneration by the selection of seed. In connection with the last problem, Dr. N. Sylven communicates the results of his attempt to identify different races or types of the spruce; he distinguishes five types, according to their mode of branching, of which the so-called "kamm" type is recommended as the best seed-bearer. An extensive paper by Mr. E. Wibeck deals with the extent of the beech forests in Sweden, showing that the area has decreased greatly in a period of 200 years, having been reduced partly by human agency, by fires, for the manufacture of potash, and by excessive cutting, and partly by natural causes, such as the intrusion of the spruce.

Two articles by Mr. R. Thomson on the Jequié Manicoba rubber tree, *Manihot dichotoma*, published in the *Indian Forester* (vol. xxxvi., Nos. 1–3), contain suggestions which appear to be worthy of careful consideration. This species, indigenous to the State of Bahia, in Brazil, forms a tree about 20 feet in height, and develops a stem 20 inches in circumference. The author contends that, being much smaller than the Para rubber tree, there is less production of useless material, and that it could be planted more closely, so that by planting 1200 specimens to the acre he estimates a production of 600 lb. of rubber per acre in the fifth year. It is further suggested that climatic difficulties might be overcome by a system of cultivation in rough sheds, such as is adopted in California for growing pineapples.

TINCTORIAL CHEMISTRY, ANCIENT AND MODERN.

IN his recent presidential address to the Society of Dyers and Colourists Prof. Meldola touched upon several matters of general interest and importance. Referring to the substitution of synthetical for natural dyes, which has entailed great changes in the dyer's methods, he said:—"Such a revolution in an industry of venerable antiquity as has been effected in about half a century has, perhaps, never before been witnessed in the history of applied science. Scientific discovery has, it is true, called new branches of industry into existence, and has thus opened up new fields of human enterprise and outlets for capital and labour. But in this case there has been no new creation; an ancient industry at the touch of science has become transformed.

"If it be asked to what cause or causes this rapid development is due, there can be only one answer—the development of the science of organic chemistry. From the time of Perkin's discovery of mauve in 1856, down to the very latest patents for new dyestuffs, it has been science, and nothing but science, all along the line."

It is, of course, equally true, as Prof. Meldola has himself pointed out elsewhere, that the development of the science of organic chemistry has been greatly accelerated by the large amount of research work carried out in the laboratories of the large German colour manufactories. In regard to the general question of the interdependence of science and industry, he has been one of the chief propagandists for the last twenty-five years, on the platform and in the Press; and on this matter he said:—"It has long been familiar to students of economics—whether we in this country recognise the doctrine or not—that industrial development is ultimately dependent upon scientific development. Fiscal considerations may have some influence in promoting or retarding an industry, but primarily the financial economist, as well as the political economist, is dependent upon the materials supplied by productive industry, and the production of these materials in the most advantageous way and the addition of new materials to the resources of civilisation is the business of scientific research, and it is, therefore, scientific activity which is the real and solid basis of national prosperity. The nation which fails to realise this principle is bound to go under in the long run in that industrial struggle which is certain to become keener with the progress of science and the severity of competition arising therefrom."

This primarily important matter cannot be too often brought forward, but, at the same time, although we have much leeway to make up before we come abreast with our chief industrial competitors, there are signs that at last the nation *is* "waking up" to realise the position. The daily Press, as reflecting the average interests of the public, is now paying an increasing amount of attention to scientific matters. It is no doubt an easy matter to be adversely critical in regard to the quality of the science which is served up in our morning paper, but that is easily remedied, and the all-important matter is that science is fast achieving a prominent place as a current newspaper topic.

An adequate historical survey of the modern science of tinctorial chemistry has yet to be written. In his address Prof. Meldola supplied one chapter of such history by relating his personal experiences during the fifteen years (1870–85) he was directly connected with the manufacture of synthetical dyestuffs. It is not possible to summarise this historical survey in the space now at disposal, but the hope may be expressed that Prof. Meldola will find opportunity to write the complete story of the art of dyeing. It would be equally as fascinating as his well-known contributions to Darwinism.

Having given his personal reminiscences of the most prolific period during the rapid modern development of the industry, Prof. Meldola reverted to remote antiquity, and summarised the ancient industrial history of dyeing as described by the elder Pliny in his "History of Nature," written about the beginning of the Christian era. Indigo has probably been used by the natives of India for at least 3000 years, and by processes essentially the same as those used to-day; in fact, until Perkin's discovery of the first coal-tar dye in 1856, the art of dyeing has made comparatively little progress since the ancient Briton stained his body with woad.

The most important dye in ancient times was the Tyrian purple, the use of which was at first confined by law to the Imperial House—hence the expression "born in the purple."

"The modern sequel to this ancient chapter of tinctorial art," said Prof. Meldola, "has been supplied by P. Friedländer, who has extracted the colouring matter from the Mediterranean *Murex brandaris*, and has proved it to be dibromindigo.[1] And thus ancient observation, which found practical application in the utilisation of a certain mollusc as a source of colour, has led to a remarkable biochemical discovery; but we have had to wait some 2000 years for the answer to the question, What was the purple dye of the ancients? Shall we have to wait another 2000 years for the answer to the question, How does the living shell-fish synthesise the generator of dibromindigo?"

Much has been written, and many diverse opinions have been expressed, as to the cause or causes of the loss of the coal-tar colour industry to England. This has been variously attributed to defects in our Patent Laws, to our heavy excise duty on alcohol, and to our unsuitable industrial conditions. In this matter Prof. Meldola sounded no uncertain note. "The answer to this last question has been staring us broadly in the face for over thirty years. It is amazing that there should have ever been any doubt about, or any other cause suggested than the true cause, which is *research*—writ large! The foreign manufacturers knew what it meant and realised its importance, and they tapped the universities and technical high schools, and they added research departments and research chemists to their factories, while our manufacturers were taking no steps at all, or were calmly hugging themselves into a state of false security, based on the belief that the old order under which they had been prosperous was imperishable. It is true that when the effects of the new discoveries began to make themselves felt, one or two factories did add a research chemist to the staff, but the number and the means of work were totally inadequate. I happened to be one of them, and so I speak with some practical knowledge of the conditions. We were but as a handful of light skirmishers against an army of trained legionaries. What could three or four—say half a dozen at a liberal estimate—research chemists, working under every disadvantage, do against scores, increasing to hundreds, of highly trained university chemists, equipped with all the facilities for research, encouraged and paid to devote their whole time to research, and backed up by technological skill of the highest order? The cause of the decline of our supremacy in this colour industry is no mystery—it is transparently and painfully obvious. In the early stages of its decadence it had little or nothing to do with faulty patent legislation or excise restrictions with respect to alcohol. The decay of the British industry set in from the time when the Continental factories allied themselves with pure science and the British manufacturers neglected such aid, or secured it to an absurdly inadequate extent in view of the strength of the competing forces."

It still remains to inquire the reason for this different attitude towards chemical research which was, and is still, though in lesser degree, adopted by our manufacturers. At the time we lost the industry the skill of the British workman and the enterprise of the British manufacturer were the admiration of the world, but the colour industry did not develop here because our industrial leaders did not lay the foundation of success by subsidising and cultivating chemical research. Why? The answer to this question is to be ultimately found in the utter lack of appreciation of the value and importance of scientific method which existed at that time amongst the public in this country. It would then have been impossible to convince any body of shareholders that it was a sound business proposition to expend yearly many thousands of pounds in research work the outcome of which was problematical. It would, indeed, not be an easy task even in these more enlightened days.

WALTER M. GARDNER.

[1] *Berl. Ber.*, 1909, vol. xlii., p. 765. For this research 12,000 molluscs were extracted, the total yield of pure colour being 0·4 grms. The dibromindigo is formed from its colourless generator, which is a vital product of the organism, by the action of light. The actual compound is shown to be the 6:6ʹ-dibromindigo, but the nature of the intermediate generator has not yet been determined.

THE MEDICAL INSPECTION OF SCHOOL CHILDREN.[1]

LESS than three years ago there did not exist a medical department of the Board of Education. To-day there lies before us a Blue-book, of 170 pages, detailing, with much substance, the work undertaken or done to establish and regulate the vast system of medical inspection of schools and school children now operative over the length and breadth of England. In modern social history no movement has come so rapidly to maturity as the system of inspection here, for the first time, placed in a connected way before the general and official public. In a lucid preliminary section Dr. Newman briefly sketches the relation of our present developments to the efforts, both here and on the Continent, towards a systematic medical supervision of school children. "In the latter year (1865), the report of the School Commission in Norway did something to bring the importance of school hygiene once more before the general public, and in 1866 Hermann Cohn undertook his classic researches into the eyesight of over 10,000 children at Breslau" (p. 2). Cohn, now dead, was one of the venerable figures at the first International Congress of School Hygiene at Nuremberg. He was still full of energy and enthusiasm. Much occasional and disconnected local work followed, but "the Wiesbaden system marks the introduction of a new conception and understanding of the problem. This system, which has been widely adopted in Germany, treats the child as the centre of interest and his well-being as the end of reform, to which even the most satisfactory school environment is only a means. . . . Throughout the German Empire a large number of school doctors have been appointed, and so some 350 towns and communities have undertaken in a greater or less degree the work of medical supervision of school life" (p. 4)—a good result since the first appointments in Wiesbaden in 1896.

The English movement, though prepared for by many workers in personal and public hygiene, dates from the report of the Royal Commission on Physical Training (Scotland) in 1903. Dr. Newman does not make it perfectly clear why, at this particular juncture in British history, such a report should have been called for; but there is no doubt that the Commission arose out of the revelations of physical inefficiency made during the great South African war, particularly at the recruiting stations. There was then a rising wave of opinion on the need for better physical training in the early stages of life. Incidentally, and, as it were, casually, the supreme need for medical inspection was revealed, and, up to date, this

[1] Board of Education. Annual Report for 1908 of the Chief Medical Officer of the Board of Education. Pp. 170. Cd. 4986. (London: Eyre and Spottiswoode, 1910.) Price 8½d.

is the chief result of the Scotch Commission and the many further inquiries set going by it. Physical training has shared in the benefits of more scientific direction. The rest of the history is written in the statutes and administrative orders and circulars now current in Great Britain. A movement so wide and so costly could have emerged only from a great national awakening, and this report, the first of the new medical department, shows how far advanced the organisation already is. The report contains all the administrative detail necessary to enable the interested sociologist to grasp the significance of the movement.

Naturally, in a first report, questions of organisation and administration bulk relatively large. Dr. Newman makes very clear the relation of the new school medical officers to the public health service. This was a matter of great concern at the outset, but the solution of difficulties seems to have gone forward smoothly, and to-day any dissociation of services is the exception, not the rule. Subordination of the school medical officer to the medical officer of health, or some definite form of cooperation, seems to have been established practically in every educational area. "There is an interdependence and solidarity in these matters which can only be ignored or neglected at the price of inefficiency and failure" (p. 17).

Whole-time medical assistants are the rule, part-time assistants the exception. "There have been no cases of Authorities commencing with a few whole-time assistants and changing to many part-time assistants" (p. 19). This is a very significant fact. Of the 307 educational areas, 160 have been provided with one school medical officer each—the minimum necessary under the Code. In the other 147 areas, "there are in all 616 assistant medical officers"—122 whole-time, 494 part-time. The arrangements for twenty-one other areas have not yet been finally approved, but, approximately, 1084 medical officers are at work "in the school medical service in England and Wales" (p. 18). This is certainly a splendid record. The qualifications of officers, the part played by the teacher, the school nurse, the general scope of the work, all are discussed with quantitative references. It is estimated that, for England and Wales, not fewer than 1,328,000 children were medically inspected during 1907–8, and when to these are added 250,000 "specials," that is, children specially brought under the medical inspector's notice as needing attention, the total amounts to not less than 1½ million children. The general experience with parents is that they have appreciated the work warmly, and sometimes enthusiastically, there being a few, but only a few, complainers.

As to treatment, the facts are, of course, very meagre as yet, but not discouraging. So far as facts are available, the number medically attended to through the parents themselves runs from 20 to 60 per cent. of those brought to their notice by the education authorities. There is here abundant room for organisation and propaganda. The cost of medical inspection, so far as salaries go, runs from 4·79*d*. per child in average attendance in the counties to 7·64*d*. in the municipal boroughs and 7·56*d*. in the urban districts, or, in the same order, from 0·15*d*. of rate to 0·23*d*. and 0·28*d*.—no great outlay for so great a service.

The rest of the volume is taken up with details of the results of medical inspection in the discovery of defects or diseases. The results are necessarily "tentative and fragmentary" (p. 39), but more than enough to justify the institution of the system and to indicate the immense amount of administrative energy now directed to the amelioration of evil conditions, both environmental and personal. Cleanliness is steadily improving under the pressure of definite administrative direction. For instance, in 124 London schools Dr. Kerr found, of 92,185 children examined, 16,060 verminous, and 2228 were excluded for prosecution—the parents of 255 children being prosecuted, and fined in sums varying from 1*s*. 6*d*. to 20*s*. As a rule, the first "notice" is enough to secure cleansing. Ringworm is diminishing. Teeth are beginning to be treated, as, for instance, in Cambridge. Many other diseases now familiar to the general public are here recorded—adenoidal growths, ear discharges, short sight, &c. There is a good series of paragraphs dealing with tuberculosis, in particular with phthisis. The results in percentages for phthisis vary widely—from well below 1 to well above 4. Obviously there are differences both in the localities and in the methods of diagnosis. This is a disease that has not yet found its "level" in the professional mind. There are sections dealing with the new syllabus of hygiene, with schools for defective children, open-air schools, and many other matters of current importance.

The report, as a whole, reflects every credit on the system of medical inspection and on the Board of Education itself. Only the experienced administrator can read from these records the enormous difficulties to be overcome and the skill shown in overcoming them.

NOTES ON THE ORIGIN OF THE HAUSAS.[1]

NEXT to the Filani, the most important race in northern Nigeria is the Hausa, whose origin is undetermined. These people occupy at present most of the land between the ninth and fourteenth parallels north latitude, and the fourteenth and eleventh meridians east longitude. Their number is variously estimated; perhaps 4,000,000 is fairly accurate. They are the traders and soldiers of West Africa, and are very good agriculturists, and workers in brass and leather, but seem to have been unable to conquer under their own leaders.

The Hausas have not the fine features of the Filani, nor yet the very thick lips and flat noses of the coast negro; they are rather short and stumpy, with woolly hair. Their original country in northern Nigeria consisted of seven States, the "Hausa Bokkoi," to which an equal number, "Banza Bokkoi," were afterwards added. These States were independent of—though dependent on—one another. There are two principal theories as to their origin, viz. (1) that they were indigenous, and (2) that they came from Egypt or Ethiopia. I cannot see why these two apparently opposite ideas cannot be modified and reconciled.

It would seem that the following statements are permissible:—

(1) The religion is in too many points similar to that of the ancient Egyptians to imagine that it was formed quite independently.

(2) The Hausas have the trading and wandering instincts of the Semites, and have travelled voluntarily and without external pressure, whereas the people of most West African negro tribes have kept together, unless conquered and driven out of their country.

(3) The cephalic index is one which we would naturally expect in the descendants of a mixture of races, some having a greater, some a less, index. Because the Arabic element was in the minority, and because of the influence of environment, the Hausa cephalic index is nearer to that of the Egyptian Copts and mixed races than to that of the Arabs. The present Hausa race is a further mixture of the people who came, in A.D. 1000, with the aborigines.

(4) Arabic has had some influence in the formation of the Hausa grammar, as well as supplying about one-third of the words, and so some of the people who formed the Hausa vocabulary must have known Arabic. Again, since two-thirds of the words present no similarity to any Semitic language, it is evident that other elements are present, and some of these are related to Coptic. The word Habeshi was a term of contempt applied by Arabs to mixed races, and Hausa (Ba-haushe) is a modification.

(5) The people came from the East (ancient Ethiopia) and brought the horse. Arabs had horses at this time (1000 A.D.), and the mixture which arrived no doubt spoke a certain amount of Arabic. They may have been Hamites, but it is much more likely that they were a mixture of Hamites and Semites, together with elements of local populations encountered *en route*, and the original inhabitants of the country now forming the Hausa States. There is probably a little Berber blood also, and even a further addition of Arabic. Being ashamed of their humble origin, they invented one for themselves, and called their mythical ancestor Babushe, which is really Ba-(ha)beshi and Ba-hab(e)shi or Ba-haushe.

[1] From a paper by Capt. A. J. N. Tremearne in the Journal of the Royal Society of Arts, July 8

MODELS OF METEOROLOGICAL CONDITIONS IN THE FREE AIR.

THE photographs of which Figs. 1 and 2 are reproductions are views of two glass models constructed at the Meteorological Office to represent the temperatures and pressures in a block of atmosphere fifteen miles thick over a triangular portion of the British Isles on July 27 and 29, 1908.

Records of pressure and temperature were obtained by means of balloons carrying small meteorographs, designed by Mr. W. H. Dines, F.R.S. Corresponding values of pressure, temperature, and height were computed from the records.

Balloons were liberated at Ditcham Park, Petersfield; Pyrton Hill, Oxfordshire; Glossop, Derbyshire; Crinan, Argyllshire; and Birdhill, Co. Limerick. The courses of the balloons were in some cases traced for part of the way by means of theodolite observations.

The purpose of the models is to give a representation of the information thus obtained, and to exhibit the meteorological variations in three dimensions. Each model consists of a rectangular base, upon which is drawn an outline map of a portion of the British Isles on the scale of 25 miles to an inch, together with isobars and winds for 6 p.m. on one or other of the two days. Upon the base are erected vertical glass plates, secured at the top by a horizontal plate. In Fig. 1 (July 27) the vertical edges of the prismatic shell thus formed, from left to right, stand over the above-named stations in order, Birdhill being the corner shown at the back. In Fig. 2 (July 29) Ditcham is represented only by a standard bearing arrows to show wind direction. The recording instrument sent up from that station on that day has not been found.

Distances measured vertically along the glass sides of the models represent heights above sea-level on the scale of 5 miles to 4 inches. The vertical scale of the model is therefore twenty times the horizontal scale of the map. The total height represented is 24 kilometres (15 miles).

The observations from each station are plotted on the edges of the models. Isotherms (full lines) are drawn on the glass sides for every 5° C., the temperature being expressed in absolute measure. The space between the isotherms of 270° and 275° is filled in to indicate the position of the freezing point.

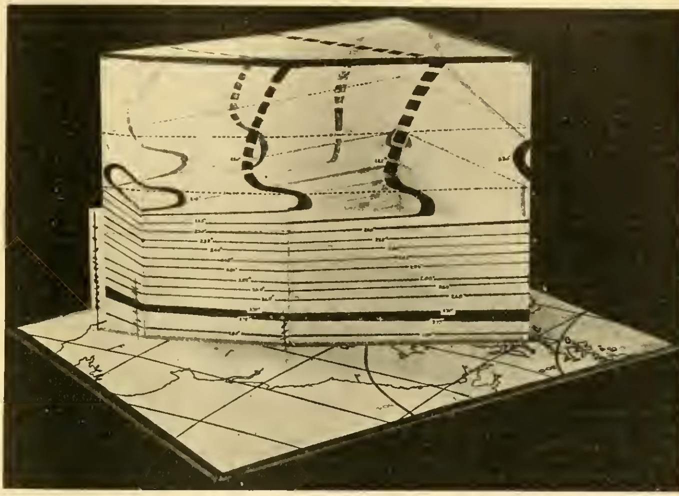


FIG. 1.—From observations taken on July 27, 1908. Block seen from the north-east. Isotherms are shown for each 5 Absolute from 280 A. to 215° A. The space between the isotherms of 270° and 275° is filled in; for other isotherms a thickness corresponding with ½° C. is covered. The beaded lines in the stratosphere are isobars for 0·2 megabar and 0·1 megabar respectively. The arrows on the standards face the wind as determined by observations with theodolites.

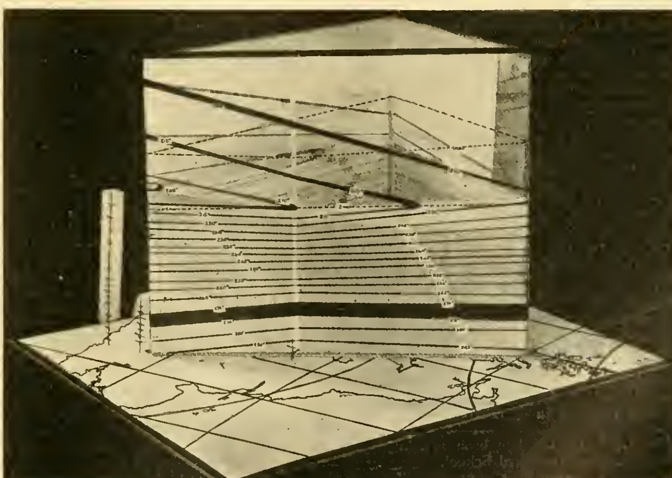


FIG. 2.—From observations taken on July 20, 1908. Block seen from the north-east. Isotherms are shown for each 5 Absolute from 285° A. to 205° A. The space between the isotherms of 270° and 273° is filled in; for other isotherms a thickness corresponding with ½° C. is covered. The beaded lines in the stratosphere are isobars for 0·2 megabar and 0·1 megabar respectively. The arrows on the standards face the wind as determined by observations with theodolites.

Both models show clearly the two main divisions of the atmosphere, viz.:—(1) "troposphere," or lower portion, in which temperature diminishes with height at a nearly uniform rate and the isothermal surfaces are approximately horizontal, and (2) "isothermal region," or "stratosphere," above the troposphere, in which temperature is nearly constant or increases slowly with height, and the isothermal planes tend to become vertical.

Isobars for one-tenth and one-fifth of an atmosphere (0·1 megabar and 0·2 megabar according to the nomenclature of the Paris Conference of Physicists, 1900) are shown by beaded lines in the upper parts of the figures.

Wind-direction observations are indicated by arrows facing the wind, carried on standards.

The chief points of difference between the two models are the following:—

	FIG. 1.	FIG. 2.
(1) Surface temperature ..	From 280° to 285°	From 285° to 290°
(2) Sea-level pressure... ...	From 1·016 to 1·023 megabar (30·0 to 30·2 in.)	From 1·026 to 1·033 megabar (30·3 to 30·5 in.)
(3) Height of lower surface of stratosphere	9 km.	10 km.
(4) Lowest temperature in stratosphere	About 215°	About 205°
(5) Wind direction at south-east angle	Nearly S. throughout	Nearly N. throughout

Both figures show that the position of the coldest air was at a height of 10–11 kilometres over the most southern portion represented.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The chair of accounting vacated by Prof. Sidney Dawson has been filled by the election of Mr. Charles E. Martineau.

Mr. W. B. Grove has been appointed honorary curator of the fungus herbarium in the Botanical Department.

Prof. R. Saundby has been appointed to represent the University on the General Medical Council for a further period of five years.

Prof. Bostock Hill is to represent the University at the Conference on School Hygiene to be held in Paris in August.

The Pro-Vice-Chancellor (Alderman F. C. Clayton) is presenting to the University a statue of His Majesty King Edward VII., in commemoration of the opening of the new buildings by the late Sovereign. It is understood that the statue is to stand in the entrance hall of the main building.

LEEDS.—Arrangements have now been completed for the establishment of a professorship of coal gas and fuel industries at the University as a memorial to the late Sir George Livesey, upwards of 10,500*l.* having been subscribed to the fund initiated for the purpose by the Institution of Gas Engineers, and an advisory committee has been formed in connection with the work to be carried out by the holder of the chair.

Dr. J. K. Jamieson, hitherto chief demonstrator of anatomy, has been appointed professor of anatomy in the University.

LONDON.—Sir Henry Roscoe has resigned his membership as a Crown nominee, and Mr. F. D. Acland has been appointed in his place.

Mr. F. L. Golla has been appointed honorary demonstrator of chemical pathology and pharmacology in the physiological laboratory of the University, and Mr. A. D. Mitchell, of Sheffield University, has been appointed scientific assistant in chemistry in the University.

DR. J. D. COALES has been appointed principal of the Wolverhampton Technical School.

MR. J. A. JENKINS, for fifteen years registrar of the University College of South Wales, Cardiff, has resigned that position.

ON July 8, the honorary degree of Doctor of Laws of the University of Edinburgh was conferred upon Prof. John Chiene, emeritus professor of surgery in the University; Prof. Matthew Hay, professor of forensic medicine, University of Aberdeen; and Prof. W. H. Perkin, F.R.S., professor of organic chemistry, University of Manchester.

THE increasing popularity of holiday courses for teachers is an excellent indication of the growing desire of schoolmasters and schoolmistresses to acquaint themselves with improved methods of instruction, and to bring their knowledge up to date by attending during their holidays lectures by experts. The County Council of the West Riding of Yorkshire has arranged a series of vacation courses for teachers, to be held at the Municipal Secondary School, Scarborough, during August next. Among the items in a very attractive programme, we notice a course of ten lectures by Prof. A. Smithells, F.R.S., on solution, and the physics and chemistry of cleansing processes; twelve lectures on the teaching of general elementary science, by Mr. W. Mayhowe Heller; and eight lectures on nature-study, by Mr. O. H. Latter. Laboratory work and excursions have been arranged in connection with these courses. There will also be a course in educational handwork, organised by the Educational Handwork Association, during July and August at the same place, and it is possible for students to take a joint West Riding and handwork course.

ON December 21, 1909, the London County Council decided to make a maintenance grant of 8000*l.* to the Imperial College of Science and Technology, South Kensington. In return for this grant it secures the privilege of nominating twenty-five students for one year's free instruction at the Imperial College. These are now to be nominated for the first time. The instruction will be of an advanced nature, and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident in the Administrative County of London, and must be students at an institution aided, maintained, or approved by the council. The free studentships do not entitle the holders to any maintenance grants, but cover all ordinary tuition fees. No examination will be adopted for the final selection of the students from the applications received. The free studentships will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. It is quite possible that, in special cases, the free places may be extended to two or more years. Application should be made without delay, as entries will not be considered after July 23. Application forms (T. 2/268) can be obtained from the Education Officer, London County Council, Victoria Embankment, London, W.C.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 30.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. A. D. **Waller**: A new method for the quantitative estimation of hydrocyanic acid in vegetable and animal tissues. The method is colorimetric, and depends on the reaction between potassium cyanide and picric acid, first studied by Hlasiwetz (*Liebig's Annalen*, cx., p. 289 [1859]), and recently applied by Guignard to the detection of minute quantities of hydrocyanic acid (*Annales Sci. Pharmacol.*, 1906, p. 415) and by H. E. Armstrong to the rapid detection of emulsin (Proceedings, March 10). The colour-scale is prepared by mixing equal volumes of a recently titrated solution of 1/10000 hydrocyanic acid and of picrate mixture (equal volumes of 0·5/100 picric acid and 5/100 sodium carbonate). From this stock solution (T 50), after twenty-four hours in an incubator at 40°, a colour-scale is prepared by further dilution with picrate mixture, to contain, e.g., 1, 2, 3, &c., parts of HCN per million, of tints T 1, T 2, T 3, &c. The estimation is made by matching the colour of the given fluid or of its distillate into picrate mixture (after suitable dilution if required), with that of the colour-scale. Thus, *e.g.*, if the tint of a distillate from 10 c.c. of blood (dil. $\times 5$) into 25 c.c. of picrate is found $=$ T 5, and the volume of picrate+distillate is 40 c.c., the amount of HCN in the distillate $= 5 \times 40$ millionths gram, *i.e.* 0·000200. A second distillation shows whether or no the whole of the HCN present has been taken over in the first distillate. Results of the application of the method to (1) a leaf of *Prunus Laurocerasus*; (2) the blood and tissues of a cat after death by a known amount of HCN; (3) the blood and tissues of a person "found dead."—Prof. A. **Dendy**: The structure, development, and morphological interpretation of the pineal organs and adjacent parts of the brain in the tuatara (*Sphenodon punctatus*). The "pineal complex" consists of the dorsal sac, the paraphysis, the pineal sac ("epiphysis"), the pineal eye, the pineal nerves and their central connections. There is a well-developed choroid plexus, with special blood-supply, on the roof of the dorsal sac, possessing histological features of considerable interest. The paraphysis is a compound tubular gland, with special blood-supply, differing markedly in histological character from the choroid plexuses. Its lining epithelium forms a syncytium, and its opening, which, in the embryo, lies just in front of the commissura aberrans, becomes shifted upwards in the adult on to the anterior wall of the dorsal sac, by the formation of a "supra-commissural canal," the original opening being blocked up by the anterior choroidal blood-vessels. The histological structure of the pineal sac points to a sensory rather than a glandular function. Its wall is essentially similar in structure to the retina of the pineal eye, consisting of radial supporting fibres, sense-cells, and ganglion-cells and nerve-fibres, and pigment may occasionally be deposited in it. The retina of the pineal eye consists of the same histological elements arranged in essentially the same way, with the sense-cells on the inside and the nervous elements in the middle. The pigment is not lodged either in the sense-cells or in the supporting fibres, but is brought into the retina by wandering pigment-cells. The pigment granules escape from these wandering cells on entering the retina, and stream inwards between the radially arranged elements. The inner ends of the sense-cells project into the cavity of the eye, and are covered each by a little cap, formed apparently by the internal limiting membrane of the retina. The developing lens of the pineal eye increases in size partly as a result of mitotic divisions in a marginal zone of undifferentiated cells. As they approach the centre the cells elongate, and some of them degenerate into a kind of mucus, which is secreted from the inner surface of the lens into the cavity of the eye, where it takes part in the formation of the vitreous body. This process of secretion continues in the adult. The nerve of the pineal sac is from its first appearance median. It joins the roof of the brain between the posterior and superior commissures. The nerve of the pineal eye is shown, especially by its development, to be primarily connected with the left habenular ganglion, which even in the adult has a different shape from that of its fellow of the opposite side. Both nerves persist in a well-developed condition throughout life. The view that the pineal sac and pineal eye are respectively the right and left members of a primitive pair of sense-organs, serially homologous with the lateral eyes, is strongly supported. Altogether six pairs of diverticula are given off from the fore- and mid-brain, viz. the cerebral hemispheres, the optic vesicles of the lateral eyes, the recessus thalami prenucleares, the pineal sense-organs, the recessus geniculi, and the optic lobes. These may all be serially homologous with one another, and each may possibly indicate a separate neuromere. There is no commissura mollis and no unpaired plexus medianus in the third ventricle. Reissner's fibre and the sub-commissural organ are very well developed.—J. A. **Crowther**: The scattering of homogeneous β rays, and the number of electrons in the atom. (1) The scattering of a homogeneous pencil of β rays has been measured for various substances and for rays of different velocity. It has been shown to obey the following statistical laws:—(i) for rays of given velocity the intensity I of the radiation contained within a given cone may be expressed by the equation $I/I_0 = 1 - e^{-k/t}$, where t is the thickness of material passed through, and k a constant depending upon the angle of the cone; (ii) for rays of given velocity the most probable angle of emergence is proportional to the square root of the thickness of material traversed by the rays; (iii) for rays of different velocities, the probable angle of emergence divided by the square root of the thickness traversed is inversely proportional to the product of the mass of the incident β particle into the square of its velocity. (2) From equations given by Sir J. J. Thomson, the number of electrons contained in atoms of different elements is deduced. It is thus found:—(i) that the ratio of the number of electrons per atom to the atomic weight is constant, the ratio being very nearly 3·0 for all the elements examined; (ii) that the positive electricity within the atom is not in an electronic condition, but is distributed fairly uniformly over the space occupied by the atom. (3) Experiments are described on the absorption of homogeneous β rays. It is shown that the first stage in the absorption of a pencil of homogeneous β rays consists in the scattering of the rays according to the laws already considered. The absorption of the completely scattered radiation is then shown to take place according to an exponential law.—F. **Isaac**: The spontaneous crystallisation and the melting- and freezing-point curves of mixtures of two substances which form mixed crystals and possess a minimum or eutectic freezing point.—Mixtures of azobenzene and benzylaniline. The results obtained in this research may be thus summarised:—(1) The freezing- and melting-point curves for mixtures of azobenzene and benzylaniline have been determined, and it has been shown that these substances possess a minimum or eutectic point at 26° for the mixture containing 19 per cent. azobenzene and 81 per cent. benzylaniline, and form a series of mixed crystals on one side only of the eutectic, viz. that with excess of azobenzene. This is, therefore, a limiting case of Roozeboom's Type 5, in which two substances, A and B, possess freezing- and melting-point curves which exhibit a minimum eutectic point, and form two series of mixed crystals, *i.e.* mixed crystals containing excess of A, and mixed crystals containing excess of B. (2) The melting-point curve has been confirmed by actual analysis of the mixed crystals. (3) The supersolubility curve, or curve of spontaneous crystallisation, has been determined for these mixtures by two methods:—(i) by noting the temperature at which a liquid mixture of known composition crystallises spontaneously in a sealed tube; (ii) by noting the temperature at which a known liquid mixture attains its highest refractive index and gives a dense labile shower when placed in the trough of the inverted goniometer. It has been shown that each mixture possesses a definite temperature of spontaneous crystallisation. The supersolubility curve shows a minimum for liquids having approximately the eutectic composition, and runs approximately parallel to the freezing-point curve. It crosses the melting-point curve three times. The nature of the mixed crystals which first separate spontaneously from any liquid mixture on the supersolubility curve has been investigated. The composition of such crystals has been determined by separating them from their mother liquor and finding their melting points. (5) A few thin sections have been ground from the solid mixtures in the neighbourhood of the eutectic, and their structures examined. These structures do not appear to be permanent. After the lapse of some months they completely changed, new crystal needles appearing all over the sections. These changes, however, appear to be very gradual, and to take place with change of temperature.—E. C. **Snow**: The determination of the chief correlations between collaterals in the case of a simple Mendelian population mating at random. This paper investigates the values which should hold for the correlations between (*a*) siblings, (*b*) uncle and nephew, and (*c*) first cousins, on the Mendelian hypothesis of "unit-characters." The correlations both for gametic and somatic characters are found. For the former, values independent of the distribution of the dominant and recedant characters among the population are obtained. These are (*a*) 0·500, (*b*) 0·250, and (*c*) 0·250. In the case of the somatic correlations, however, the results depend upon the relative numbers of the population possessing the dominant and recedant attributes before crossing. By varying this proportion, different values of the correlations can be obtained, but these are always less than the corresponding gametic ones stated above. The investigation brings out the important point that, on the Mendelian theory of heredity, the similarity between first cousins is quite as close as, or closer than, those between uncle and nephew. Biometric results previously reached have pointed to the same conclusions. This is of great interest from the medical point of view. In medical diagnosis, a man's uncles and aunts, but not his cousins, are generally considered; but the results of the present paper show that his cousins, usually more numerous, give just as good a knowledge of his constitutional tendencies as do his uncles and aunts.—C. J. T. **Sewell**: The propagation of sound in a fog. This paper is intended as a sequel to the author's previous paper on "The Extinction of Sound in a Viscous Atmosphere by Small Obstacles of Cylindrical and Spherical Form," in which the loss of energy from the primary waves owing to viscosity was investigated. In the present paper the author has included the additional loss of energy due to heat conduction. The work proceeds on much the same lines as before, and the results obtained are of the same order of magnitude. The chief interest consists in the application of the results to the effect of atmospheric fog upon the propagation and audibility of sound. Waves of high frequency suffer most. If the diameter of the drops of water in a dense fog is assumed to be 0·02 mm., and the density of the fog amounts to $4\frac{1}{2}$ grams per cubic metre, the intensity of sound of wave-length 100 cm. is reduced in the ratio of 1 to e before the sound has travelled a distance of 100 metres. If the wave-length is 1000 cm., this distance is increased to about 350 metres. In any case, the results seem to show that the presence of fog at sea must diminish quite appreciably the audibility of sound.—L. **Southerns**: A determination of the ratio of mass to weight for a radio-active substance. A determination has been made of the ratio of mass to weight for uranium oxide by comparison with the known value for a normal substance (lead oxide). It had been supposed by Sir J. J. Thomson that a radio-active substance might possess greater mass than the same weight of a non-radio-active substance, on account of the greater store of potential energy which is associated with the former. In the case of uranium oxide, the increase in the ratio of mass to weight would be about 1 in 16,000. The investigation has been made by means of a rigid pendulum fitted with two knife-edges and a hollow bob, into which could be packed either of the substances used. Special means have been employed in order to eliminate errors due to slight variations in the position of the centre of gravity of the pendulum, and to other causes. The results show that the ratio for the uranium oxide does not differ from the normal value by more than 1 in 200,000, and thus that the contemplated effect is absent.—F. P. **Burt** and F. L. **Usher**: The relative atomic weights of nitrogen and sulphur. The object of the research was to determine the combining weights of nitrogen and sulphur by the analysis of nitrogen sulphide. The method adopted was briefly as follows:—A weighed quantity of nitrogen sulphide, purified by sublimation *in vacuo* over silver at 100° C., was decomposed by subliming over red-hot quartz wool contained in a quartz tube. The sulphur was deposited a few inches beyond the wool, and the nitrogen was pumped off and estimated in a constant-volume gas burette. Assuming the density of nitrogen, the relative weights of nitrogen and sulphur could be calculated, the sulphur being obtained by difference. The problem was complicated by the impossibility of starting an experiment with the quartz wool in the reaction tube in a gas-free condition. The difficulty was overcome by measuring in blank experiments the quantity of air removable from the hot wool *in vacuo*, and by estimating traces of more condensable gas present by exposing the nitrogen to potash and re-measuring it. The final corrected N/S ratios are as follows, the weight of a "normal litre" of nitrogen in London being taken as 1·25144 grm.:—0·436847, 0·436875, 0·436839, 0·436857, 0·436897, 0·436878, 0·436898. The mean is 0·436870, and the greatest deviation from the mean is 1 in 14,000. From this ratio the atomic weight of sulphur becomes 2·067, if nitrogen be given the very probable value 14·009.—Dr. F. W. **Edridge-Green**: The relation of light perception to colour perception. It may be easily shown that light perception and colour perception are quite distinct. In fact, we can divide cases of colour-blindness into two classes, according as the defect is (*a*) one of light perception, or (*b*) one of colour perception or differentiation without any defect in light perception. Of course, both defects may be present in the same individual. The investigation of these two classes of defective vision is much facilitated by the use of a spectrometer which the author has devised for the purpose. This instrument is a spectrometer so arranged as to make it possible to expose to view in the eye-piece the portion of a spectrum between any two desired wave-lengths. Tested with this instrument, a normal individual will, as a rule, name six distinct colours, namely, red, orange, yellow, green, blue, and violet, and will mark out by means of the shutters about eighteen monochromatic patches. Occasionally we come across individuals with a greater power of differentiating hues, to whom, as to Newton, there is a distinct colour between the blue and violet, which Newton called indigo. Such individuals will mark out a greater number of monochromatic patches, from twenty-two up to twenty-nine. Those who have defective light perception for certain rays, with normal hue perception, behave exactly in the same way as a normal-sighted person with those rays removed or reduced to the same intensity, and not as if a light-perceiving substance which was sensitive to rays from a considerable range of the spectrum had been removed. Those with defective hue perception mark out with the spectrometer a smaller number of monochromatic patches than the normal, and say that there are five, four, three, two, or one colour instead of the normal six. They behave in every way as if their colour sensations were correspondingly limited. Therefore, if the normal be designated hexachromic, then pentachromic, tetrachromic, trichromic, dichromic, or monochromic correctly describes their colour-vision.—M. G. **Sykes**: The anatomy and morphology of the leaves and inflorescences of *Welwitschia mirabilis*. An account is given of the anatomy of the leaves, and of the inflorescence axes, cones, bracts, and flowers of both sexes. It is shown that the male and female inflorescences are essentially similar in their method of vascular supply and in their detailed anatomy, and it is concluded that they are homologous. Various characters suggest comparison with the Cycads and the Medulloseæ. From the position of the embryo-sac relatively to the two coverings of the ovule at various stages of development, they are regarded as two integuments. The seed can be closely compared with that of Lagenostoma; its differences from this primitive type are referable to changes dependent on the evolution of siphonogamy and possibly insect fertilisation. In both these seeds the free outer integument is regarded as a primitive character, in contrast with the fused integuments of Cycas and Cardiocarpus. In all these cases the entire vascular system appears to be integumental. The connection between Welwitschia and the Cycads, the Bennettitales and the Angiosperms, is discussed.—Colonel Sir David **Bruce**, C.B., Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie**: (1) The natural food of *Glossina palpalis*; (2) mechanical transmission of sleeping sickness by the tsetse-fly.—V. H. **Veley** and Prof. A. D. **Waller**: The comparative toxicity of theobromine and caffeine as measured by their direct effects upon the contractility of isolated muscle. It is shown by measurements of the contractility of isolated muscle that the toxicity of theobromine, the base of cocoa, is greater than that of caffeine, the base of coffee and tea, in the proportion of 3 : 2. The introduction of a second methyl group into the oxy-purine residue, namely, the formation of caffeine from theobromine, thus diminishes the toxic value, a result which is the converse of that observed in the case of the paraffinoid alcohols. The toxic effects of coffee and tea extracts are also studied, and it is shown that the effect of the former is mainly due to the caffeine contents, and not to the tannic acid.—Prof. W. B. **Bottomley**: The assimilation of nitrogen by certain nitrogen-fixing bacteria in the soil. —Prof. A. B. **Macallum**: The inorganic composition of the blood in vertebrates and invertebrates and its origin. —Mary T. **Fraser** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organism. Part vii.— The quantity of cholesterol and cholesterol esters in the blood of rabbits fed on diets containing varying amounts of cholesterol.

CAMBRIDGE.

Philosophical Society, June 6.—Mr. W. Bateson, president, in the chair.—H. H. **Brindley**: Further notes on the procession of *Cnethocampa pinivora*. Lantern-slides were shown illustrating observations on the procession of the caterpillar of this Eupterotid moth, which infests the pines of the Landes. The caterpillars march in single file from the nest tree over the sand on fine days in late March and early April, ending the last day's procession by burrowing for pupation. The general impression left by observation of processions is that the larvæ in head-to-tail contact act as one individual, and as such their course of action is very difficult to disturb by artificial interference in respect both of direction of march and general behaviour. Though removal of the leader hardly, if at all, checks the progress of a procession (in a procession of six, for instance, the leaders were removed successively and placed at the rear of the procession six times in fourteen minutes without the procession stopping), the "circulating mass" seems invariably formed on the initiative of the leader. The reason for this frequently occurring event, as, indeed, also the stimuli which determine the behaviour of a procession, remains obscure, while no explanation is forthcoming of the remarkable temporary independence of some larvæ. As in the observations by T. G. Edwards, no irritation of the skin by the poison hairs of the larvæ, in spite of frequent handling, was experienced (Fabre lays much stress on the inconvenience he suffered from this source, so the liability to irritation probably varies in different individuals).—Dr. **Graham-Smith**: The habits of *Musca domestica*.—Dr. N. H. **Swellengrebel** and C. **Strickland**: The development of *Trypanosoma lewisi* in the rat flea (*Ceratophyllus fasciatus*). A development of *T. lewisi* was found to take place first in the mid-gut, later in the hind-gut and rectum of the flea. The forms observed resembled very much the forms of *T. lewisi* in an artificial culture, except that the later stages in the flea, a return to a trypanosome form ("small trypanosomes"), are never found in culture. No such developmental forms were found in a large number of control fleas.—Dr. F. **Ransom**: The absorption of tetanus toxin.—H. **Ackroyd**: The fate of uric acid in the dog.—Dr. **Cobbett**: The absence of living tubercle bacilli from old tuberculous lesions. The author has on several occasions, while working for the Tuberculosis Commission at Stansted, as well as in Sheffield and Cambridge, found that old caseous and calcareous deposits, which were undoubtedly of a tuberculous nature, might contain no tubercle bacilli capable of infecting the guinea-pig.—W. E. **Dixon**: The action of potash salts taken by the mouth. The non-toxicity of potash salts taken by the mouth was shown to be due to the very easy excretion of these salts by the kidneys, so that their concentration in the blood was but slightly increased.—Prof. Sims **Woodhead**: The results of sterilisation experiments on the Cambridge water. Sterilisation by chlorine and chlorine compounds had given most startling results. In a series of preliminary experiments, carried out in the laboratory, it had been found that one part of available chlorine to two million parts of water was sufficient to kill all non-spore-bearing bacteria of the *Bacillus coli* type, and therefore of the typhoid bacillus type, and probably also of the cholera bacillus type, within half an hour even in the presence of the appreciable amount of organic matter that was necessarily added along with the cultures of *Bacillus coli*. Water to which had been added some hundreds of the *Bacillus coli* per c.c. was found after treatment to contain not a single living colon bacillus in 50, 60, and 100 c.c. (The unimportant spore-bearing organisms were not killed.) Having obtained these results in the laboratory, a large experimental plant capable of sterilising more than 80,000 gallons of water per twelve hours, erected at Fulbourn, was used, and three sets of experiments were carried out, one a preliminary series in which the apparatus was run at intervals as required, and then two series of experiments in which the apparatus was run for twelve hours daily for more than a fortnight in each series. The standard of the London Water Board, that there shall be no *Bacillus coli* in quantities of water less than 200 c.c., was taken as the one to be aimed at. In every case, however, quantities of 500 c.c. were examined, and after certain preliminary difficulties had been surmounted, water was obtained in which none of the observers could find the *Bacillus coli* in 500 c.c. The amount of chlorine used in these experiments varied from one part in a million to one in six million parts of water. In the earlier experiments, where up to one part of chlorine in four million parts of water was used, it was thought necessary to neutralise any remaining chlorine by the addition of sodium bisulphite. After further experiments, where smaller quantities of chlorine were used, this addition was dispensed with, as the water treated, though sterile, did not retain the slightest taste of chlorine. It was suggested, of course, that water so treated might have some effect upon the human organism. All those who were working at Fulbourn drank considerable quantities of this water, and everyone who tried it accepted it as a first-class drinking water.—F. J. M. **Stratton** and R. H. **Compton**: Accident in heredity, with special reference to right- and left-handedness. An examination of the manner in which the inheritance of Mendelian characters would be affected by the action of a constant environmental factor. The assumption is made that a certain proportion of individuals have their characters inverted in appearance by accidental causes, and an application is made to the statistics dealing with the inheritance of the mode of clasping the hands. —R. H. **Compton**: Right- and left-handedness in barley. A study of the two kinds of seedlings of barley, the folded first leaves of which are related to one another as an object to its mirror image. A considerable numerical excess of one kind is found in all the varieties studied. The dimorphism in question is not found to be hereditary, and it appears to be governed neither by the direction of twist of the last foliage leaf below the spike nor by the position of the seed on the spike.—F. T. **Brooks**: The development of *Gnomonia erythrostoma*, the cause of the cherry-leaf scorch disease. The present investigation concerns an examination of the life-history of this fungus from the cytological standpoint, very little work on the Pyrenomycetes having hitherto been done from this point of view.—Dr. A. C. **Dixon**: Jacobi's double-residue theorem in relation to the theory of point-groups.—N. R. **Campbell**: Discontinuities in light emission, ii. The paper is a continuation of one recently presented to the society under the same title. The main object of the research has remained impossible to attain. The subsidiary results do not lend themselves to summary.

Paris.

Academy of Sciences, June 27.—M. Émile Picard in the chair.—Ph. **van Tieghem**: A new classification of the Inovuleæ group.—J. **Boussinesq**: The conservation of true masses in different phenomena, principally luminous, where there appear fictitious variable masses.—Armand **Gautier**: The action of a red heat on formaldehyde. Experiments show products of decomposition to be carbon monoxide, and hydrogen, with a trace of methane.—B. **Galitzine**: A new type of seismograph for the vertical component.—Charles **Nordmann**: The brightness of Halley's comet, and the composition of its light.—Jules **Baillaud**: Photographic observations of a small planet. —L. **Letombe**: A geometrical study of distribution in machines with separate distributors.—H. **Larose**: The propagation of a discontinuity on a telegraphic line furnished with a transmitter.—A. **Debierne**: The atomic weight of the radium emanation. The author shows that by the loss of an α particle, and consequent departure of an atom of helium of atomic weight 4, the radium of atomic weight 226·5 becomes the emanation of atomic weight 222·5.—G. A. **Hemsalech**: The duration of the emission of spectral rays by luminous vapours in the electric spark.—Gabriel **Sizes** and G. **Massol**: A photographic record of the vibrations of a diapason.—Edmond **Bauer**: The emission of gases.—E. **Henriot**: The rays of potassium.—A. **Besson** and L. **Fournier**: The action of hydrogen on sulphur chloride and thionyl chloride under the influence of an electric discharge.—Witold **Broniewski**: The electrical properties of aluminium-silver alloys.—M. **Kohn-Abrest**: The nitrides and oxides obtained from aluminium heated in air.—G. **Urbain**, M. **Blondel**, and M. **Obiedoff**: The extraction of germanium from blende.—L. J. **Simon**: The acid character of oxalacetic ether.—M. **Lespieau**: The hydrogenation of acetylene compounds.—A. **Béhal**: A new tertiary menthol, and the passage of pinene into menthene. —André **Meyer**: The condensation of phenyl-isoxazolone with mesoxalic ester.—René **Maire** and Adrien **Tison**: Some Plasmodiophoraceæ.—C. **Gessard**: Blood fibrin.—

Maurice **Nicloux**: The products of decomposition of chloroform in the organism.—M. **Caullery** and A. **Lavallée**: Experimental investigation on the initial phases of infection of *Amphiura squamata* by *Rhopalura ophiocomae*.—Alfred **Angot**: The earth tremor of June 24, 1910.—P. **Vialla** and P. **Pacottet**: The culture of the Rœsleria of the vine.—A. **Marie**: The neutralising properties of a substance isolated from a normal brain.

July 4.—M. Emile Picard in the chair.—J. **Boussinesq**: The probable applicability, to rays or kathode currents, of the principle of mass constancy.—Ch. **Lallemand**: The probable exactness of different evaluations of the altitude of Lake Chad. Taking all accounts into consideration, a shore of 240 metres, in round numbers, seems nearest the truth.—D. **Gernez**: The nature of the product called by the name of black phosphorus.—Armand **Gautier** and P. **Clausmann**: The action of iron and its oxides, at a red heat, on carbonic oxide. Application to some geological data. The resulting products are carbides of iron, free carbon, and carbon dioxide, together with certain iron oxides.—Th. **Schlœsing**, fils: The production of nicotine by the cultivation of tobacco.—E. L. **Bouvier**: The pycnogonids with five pairs of paws collected by the Jean Charcot expedition on board the *Pourquoi-Pas?*—A. **Calmette** and C. **Guérin**: The re-absorption of tuberculous bacilli by cattle following on the injection of mixtures of serum of animals rendered hyper-immune, and bacilli cultivated in series on beef bile.—A. **Perot**: A study of the variation of the wave-length of solar light at the sun's circumference.—D. **Eginitis**: Some phenomena shown by Halley's comet after its passage across the sun. It seems evident that much of the shortening of the tail was due to the angle under which the comet was seen, besides it being not unlikely that some disintegration was brought about by the earth itself.—Fr. **Iniguez**: Physical observations on Halley's comet.—Serge **Bernstein**: Mechanical equations and the calculus of variations.—F. **Ducretet** and E. **Roger**: An apparatus for receiving time on land and on board ship by wireless telegraphy.—P. **Beaulard**: The electric absorption exercised by some alcohols.—Mdlle. L. **Blanquies**: The constituents of radio-activity induced from actinium.—A. **Dufour**: The rotation of a mercuric arc in a magnetic field. Observations on Döppler's phenomenon.—Louis **Malclès**: The appearance of certain dielectric anomalies by changing the state of the insulating medium. Pure vaseline, an insulator at ordinary temperatures, but a conductor in the liquid state, acts as a medium charged with free ions of both signs, the mobility of which, while non-existent when the substance is semi-fluid, only shows itself on the attainment of a clearly liquid state.—Jean **Villey**: An electrometric micromanometer.—Maurice **de Broglie**: The exclusive presence in the gases evolved from some hydrogenated flames of ions altogether analogous to those produced by Röntgen rays. It was observed, notably in the case of hydrogen, ether, aldehyde, acetone, &c., that the flames of combustion gave ions closely agreeing with Röntgen radiation in velocity.—V. **Auger**: Manganate of sodium and its hydrates. It is possible to obtain manganate of sodium by the decomposition of the corresponding permanganate by means of excess of soda.—M. **Barre**: The decomposition of thorium sulphate by water.—Léo **Vignon**: The adsorption of certain colouring matters.—E. **André**: Acetylenic ketones. The author gives the various physical constants for acetyl, propionyl, butyryl, isovaleryl, and caproyl-phenyl-acetylene. —A. **Backe**: Researches on *iso*-maltol. The author considers the probable formula of this substance to be

$$\begin{array}{l} \quad\;\; CH\text{—}O\text{—}CH \\ \quad\;\; \| \qquad\qquad \| \\ CH_3\text{—}C\text{—}CO\text{—}C\text{—}OH. \end{array}$$

—Em. **Bourquelot** and Mdlle. A. **Fichtenholz**: The presence of a glucoside in the leaves of a pear tree, and its extraction.—Paul **Becquerel**: The abiotic action of ultra-violet rays, and the hypothesis of the cosmic origin of life. Although the effect of dryness, low temperature, and cold may serve to retain the vitality of living spores in inter-stellar space, yet the fact that this space is full of ultra-violet radiation, which is shown to have a most destructive effect on spore life, goes far to discredit any theory of the cosmic origin of life.—Maurice **Arthus**: Cobra poison and curare.—M. **Szreter**: The oxidation of pure oxyhæmoglobin by pure oxygenated water.—Pierre **Girard**: The electrostatic mechanism of osmosis.—C. **Viguier**: The very rapid maturity of a Spionid larva.—Edmond **Hitzel**: A double bend in the south wall at the base of the peak of Platé, near Chedde (Haute-Savoie).—L. **Cayeux**: The existence of calcareous phosphates in diatoms from Senegal.—L. **De Launay** and G. **Urbain**: The formation of blende, and minerals derived from it.—M. **Ferret**: Some oscillations of the sea observed at Bonifacio.

NEW SOUTH WALES.

Linnean Society. May 25.—Mr. C. Hedley, president, in the chair.—E. C. **Grey**: The fatty acids of brain lipoids, part i.—E. **Meyrick**, F.R.S.: Revision of Australian Tortricina. The author dealt with the Tortricina of Australia (and New Zealand) in two papers contributed to the society's Proceedings for 1881 (vol. vi., pp. 410 and 629), the number of Australian species therein recorded being 132. The revision increases the number to 434 species, of which about 232 are described as new; the present paper, the first instalment of the revision, is concerned with 290 species, comprised in the Carposinidæ, Phaloniadæ, and Tortricidæ. For this result the author is greatly indebted to the aid of a number of Australian correspondents who forwarded collections; these, together with the material which he had himself accumulated, were taken to the British Museum, and a close comparison instituted with Walker's types, with the result, it is believed, that every one of these was identified satisfactorily. The Tortricina are considered to have originated from the Hilarographa group of the Plutellidæ.

CONTENTS.

	PAGE
Totemism Unveiled. By A. E. Crawley	31
A Theory of Prehistoric Rhodesia	32
The Marine Fauna of Japan. By S. J. H.	34
The Cambridge Public Orator. By Dr. R. Y. Tyrrell	35
Psychical Research. By J. A. H.	36
Pseudocytology	36
Biology and Human Life. By J. A. T.	37
Alpine Flowers	37
Our Book Shelf	38
Letters to the Editor:—	
Ooze and Irrigation.—Rev. Hilderic Friend; A. R. Horwood	39
A Singular Mammal called "Orocoma."—Kumagusu Minakata	40
Pwdre Ser.—F. M. Burton	40
Curve Tracing and Curve Analysis.—A. P. Trotter	40
The Akikuyu of East Africa. (*Illustrated.*) Sir H. H. Johnston, G.C.M.G., K.C.B.	41
Temperatures in the Free Atmosphere. By E. Gold	42
The Gulf Stream Drift and the Weather of the British Isles. By Dr. H. Bassett	44
Prof. G. V. Schiaparelli. By W. E. P.	44
Prof. J. G. Galle	45
The Hon. Charles Stewart Rolls. By Dr. William J. S. Lockyer	46
Notes	46
Our Astronomical Column:—	
Halley's Comet	52
Prevention of Dew Deposit upon Lens Surfaces	52
A Variable Star as a Time Constant	52
Radiation and Absorption	52
The Fifth International Congress of Ornithologists. By E. H.	53
The Dangers of Ferro-silicon. By Prof. A. McWilliam	53
The Position of the Negro and Pygmy amongst Human Races. By Prof. Arthur Keith	54
Trees and Forests	55
Tinctorial Chemistry, Ancient and Modern. By Prof. Walter M. Gardner	56
The Medical Inspection of School Children	57
Notes on the Origin of the Hausas. By Capt. A. J. N. Tremearne	58
Models of Meteorological Conditions in the Free Air. (*Illustrated.*)	59
University and Educational Intelligence	60
Societies and Academies	60

THURSDAY, JULY 21, 1910.

A STANDARD TREATISE ON PHYSICS.

Traité de Physique. By O. D. Chwolson. Translated from the Russian and German editions by E. Davaux. Second volume, fourth fascicule. Pp. 641–1188. Third volume, first fascicule. Pp. vii + 408. Fourth volume, first fascicule. Pp. vii + 430. Figures in text. (Paris: Hermann et Fils, 1909.) Price 17, 13 and 12 francs respectively.

SINCE this is a French translation of a work which has already been reviewed in part as a German translation (from the Russian), we will not do more than examine those parts in which it differs from its previous forms or which have not previously been reviewed here. It is by no means a mere translation. Extensive additions have been made under Prof. Chwolson's supervision with the object of maintaining the book level with the rapid advances in physics that have taken place. These have been made with the author's usual discriminative ability. If there is one quality more than another which strikes us about this text-book it is the rare combination of knowledge and good judgment which everywhere characterises it. Other volumes which we know may be more encyclopædic. If our object is to find out *all* that has been done on any special subject we may be disappointed if we turn up the subject here. But if our object is to find a judicious selection of the best that has been thought and written on physical questions, then we know of no better source from which our object can be attained. In other words, this is a text-book of a preeminent order, written by one who has a unique command over all branches of physical science, and who is as alive to the most recent developments as to those portions which have now become classical.

Of the additions to the fourth fascicule, which deals with diffraction, double refraction, and polarisation of light, we may point out the account of recent work by Dufet on the remarkable anomalous dispersion of the optic axes in the case of the sulphates of neodymium and praseodymium which is exhibited in the region of optical absorption. Several additional pages are devoted to an account of the optical properties of liquid crystals as studied by Lehmann and others. Two lengthy paragraphs are added by the translator dealing with the reflection and refraction of polarised light according to Green, and with the gyrostatic theory of light. These paragraphs certainly supplement the rest of the chapter into which they are inserted, and, as many readers will be glad to have them, no exception can be taken in regard to their insertion. But it may be intimated that they are considerably more mathematical than the greater part of the book, and they therefore do not harmonise very well with the rest.

We are certainly surprised to find that what is essentially a distinct treatise is bound up with this fascicule, and constitutes the end of the second volume. This consists of a note on the theory of deformable bodies, by MM. E. and F. Cosserat. This note is 220 pages long, and it does not in any sense harmonise with the work with which it is incorporated. Prof. Chwolson's work is emphatically experimental in character; the note is as strikingly mathematical. We do not wish in the slightest degree to discredit either the matter or the manner of the note taken by itself. But there does not seem to be any justification for loading a text-book which is necessarily very bulky by matter which will probably never be consulted at the same time as the body of the book itself. The MM. Cosserat's note is a distinct and useful treatise, and should be quite able to stand on its own feet.

The changes in the first fascicule of the third volume are not so considerable. This part deals with thermometry, specific heats, thermochemistry, and thermal conductivity. So far as we can find, there is only one additional section, which treats in a general way of the problem of Fourier, and gives a short account of the allied researches of M. Poincaré. This is a very useful addition.

The first part of the fourth volume has not yet been reviewed in these columns, and it deserves a more extended notice. Its subject-matter is the stationary electric field. The introduction to this part is specially noteworthy. It has seemed to Prof. Chwolson necessary to commence by giving a summary of the singular and exceptional situation in which the science of electrical and magnetic phenomena now is. At the present time one may distinguish no fewer than three various points of view from which these subjects are regarded. We have, in the first place, to deal with the *external structure* of a very great number of different phenomena which, perceived by our senses, awaken in us a representation more or less definite of what is proceeding, or, more exactly, of what seems to us to proceed in a given direction and under given conditions. Thence arises a description of phenomena and of the laws and rules by which those phenomena are regulated. Secondly, we may place ourselves at another point of view, and consider the practical applications; or, thirdly, we may endeavour to *explain* these phenomena by showing that they are the necessary consequence of the existence of a certain substratum to which the laws of mechanics and thermodynamics are applicable. In regard to this third point of view, Prof. Chwolson declares that—

> "Without wishing to exaggerate, we may say, after having glanced rapidly over the facts, that there does not exist at this moment in the part of this science which has for its object the *explanation* of phenomena, any theory which is firmly established upon which we may rely in a manner free from all possible doubt to give an account of *all* phenomena."

He recognises, however, three fundamental conceptions which excite three distinct images or pictures which give a more or less exact representation of the intimate cause of phenomena. These he designates by the letters A, B, and C. The image A, adopted in a general manner up to the year 1870, was constructed on the notion of two electricities, enjoying the property of acting instantaneously at a distance.

D

Though retained in elementary expositions, serious science has abandoned it for ever.

The image B (1870 to 1890) left entirely on one side the conception of a special electrical substance, and sought to explain electrical phenomena by the properties of the æther alone. But although this picture enabled one to form a representation of radiant electrical energy, it, too, has been found insufficient to explain a great number of phenomena.

The image C is based on the notion of *electrons*, and forms, to some extent, a combination of A and B. It supposes the existence of a special substratum, and preserves the idea of modifications produced in the body of the æther; but the electrical substance is now considered as the origin of these modifications in the æther.

We have summarised these distinctions because they characterise the entire fascicule. Prof. Chwolson adheres to these distinctions throughout, and the result is that he is able to produce a final picture which is more free from confusion than if he had attempted to remove the dividing lines between them. Again, the student will leave his perusal of these pages with a far wider conception of the general lie of the land than if one or other of these points of view had been purposely blocked out. We do not wish to disparage any recent books which emphasise one of these pictures to the practical exclusion of others. They serve their purpose. The pioneer is necessarily preoccupied with his own line of march. But there is a danger that, in the enthusiasm created by recent discoveries and the success attending the contemplation of picture C, the rest of the landscape will be forgotten. We can wish for no better training for a student than a perusal of Prof. Chwolson's treatise.

Of the general character of the book in its French form we may say that we do not like it quite so well as the German. The illustrations, which are taken from the German translation, do not show up as satisfactorily on the paper selected. But the production of a French translation will be welcomed by many to whom German is not intelligible; and it may be said without any hesitation that, in the form in which it now appears, we have a text-book of physics which is second to none in the French language. It should be in the library of every physical laboratory, and students who are taking up the subject of physics seriously will find it one of the best text-books of which to obtain private possession.

FLOWER POLLINATION.

Handbook of Flower Pollination. By Dr. P. Knuth. Based upon Hermann Müller's work, "The Fertilisation of Flowers by Insects." Translated by Prof. J. R. Ainsworth Davis. Vol. iii. (Band ii., Teil ii., of the German edition), Observations on Flower Pollination made in Europe and the Arctic Regions on Species belonging to the Natural Orders. Goodenovieæ to Cycadeæ. Pp. iv+644. (Oxford: Clarendon Press, 1909.) Price 28s. net.

VOL. III. of the English translation, which has now appeared, concludes that portion of Knuth's handbook for which that author was himself responsible. The later volumes, issued after Knuth's death by Dr. E. Loew, deal with observations on flower pollination made beyond the confines of Europe, while the earlier volumes contain the observations made in Europe and the Arctic regions, vol. iii. dealing with species belonging to the orders Goodenovieæ to Cycadaceæ.

The English translation, appearing, as it does, ten years after the publication of the original German edition, has been brought up to date in many respects. The arrangement of the Natural Orders has been altered in consonance with more recent classification, and some Orders have been merged as Sub-orders in the larger Families. In many instances new observations have been added, and additional literature is referred to, as, for instance, in the case of the primrose, the pollination of which has been much disputed, and also in the case of Pentstemon, of which genus Loew has latterly made a very considerable study.

This volume, like its predecessor, must be regarded as a most valuable book of reference, yet here and there are points of more general interest to which, perhaps, reference should be made. On p. 434, when dealing with the flower of the snowflake (Leucojum), Knuth gives an interesting summary of the method he has adopted to detect the presence of a nectary, when the position of that organ is not obvious at first sight. By suitable treatment of flowers with Fehling's solution or Hoppe-Seyler's sugar reagent he was able to detect the nectar-secreting part of most flowers. Sometimes even fairly conspicuous flowers, as, for instance, those of *Pyrola uniflora,* were found to be nectarless, and in this case, though the flower is otherwise obviously adapted to insect pollination, no insect visitors are recorded in the handbook. Indeed, this volume, like the preceding one, would yield much valuable information to anyone in search of opportunities of enriching botanical science by accurate observations in the field, for a number of plants, some of them quite common, still require their insect visitors to be recorded.

Some of the orders, like the Ericaceæ, are of interest, because in some genera, *e.g.* Calluna, Erica, and Cyclamen, the flowers, though adapted to insect pollination, and very eagerly visited by insects, are during their later stages anemophilous, the pollen becoming dry and powdery, and being readily carried by wind. On the other hand, some flowers normally adapted to wind pollination, like the sweet chestnut (Castanea), also attract insects, and are no doubt pollinated by them.

The translator has omitted to note the observations made recently on the dog's mercury (Mercurialis), which indicate that this plant is provided both with nectaries and sticky pollen, so that though apparently anemophilous, and probably at times wind pollinated, it is adapted to the visits of insects, and, as Knuth records, is often visited by them.

The anemophilous Gramineæ, too, offer many points of interest in connection with the frequent occurrence of cleistogamy and self-pollination of their flowers. Insect visits are occasionally observed in this group. Ludwig considered that the succulent shining lodicules of many grasses sometimes attract flies, which are often imprisoned by the rapid closing of the glumes. These flies seem often affected by the entomophthora disease, and it is suggested that when so suffering they are often compelled by thirst to seek the juice of the lodicules. In other cases, no doubt, they visit the flowers for the purpose of collecting pollen.

A very valuable appendix, occupying about 100 pages, is added to the volume, and gives a systematic list of the various insects which have been observed visiting flowers and the flowers which they usually frequent. This carefully compiled list will be as informing to the entomologist as to the botanist. The index of plants described in the volume which figures in the German edition has not been added in the translation, but is probably held over for the final volume.

The style of the English rendering is fluent, and generally free from the flaws that mark some translations, though the volume opens with a serious blunder in describing the flowers of Lobelia as actinomorphous. Hälftig-symmetrisch is, of course, bilaterally symmetrical or zygomorphic, as is, indeed, indicated by the concluding portion of the sentence which describes the bifid upper and the trifid lower lip. It is unfortunate that the translator has retained the use of the word œcology as a synonym for biology, in dealing with observations on flower pollination. Though formerly used in that sense, œcology has of late years been so definitely and much more correctly applied to the study of plant-life in relation to environment that it seems out of place when used for floral biology.

Apart from such minor defects, the translation will be welcomed as rendering Knuth's monumental work accessible to a wider circle of readers and students of plant biology.

PRACTICAL WORK FOR ELECTRICAL LABORATORIES.

Leitfaden zum elektrotechnischen Praktikum. By Dr. G. Brion. Pp. xiv+404. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 11 marks.

THE laboratory has always been regarded as a necessary complement to the class-room so far as physics and chemistry are concerned, but for engineering subjects it is a comparatively modern institution. There are still engineers amongst us who have had to go through their university training without enjoying the use of a laboratory, but within the last generation all technical universities and colleges have recognised the immense importance of laboratory work, and have fitted up hydraulic, heat, mechanical, and electrical laboratories on a more or less extensive scale. Teachers, as well as engineers in practice, are agreed on the necessity of supplementing the theoretical work of the class-room by experiment, and there is keen competition between the different institutions as regards the best equipment, each trying to profit by the experience of the others, and to adapt the plant to the special industrial requirements of its district.

The best equipped laboratory would, however, be of little value without good organisation in its use and scientific instruction in the way of carrying out experiments. The book under review is an attempt, and, let us hasten to say, a very successful attempt, to supply such instruction. Of all Continental technical high schools, Dresden has at the present moment the best equipped electrical engineering laboratory, and since its head, Prof. Goerges, is not only an accomplished teacher, but also an engineer of high reputation, we may expect that a book, treating of laboratory work as carried on under him, will prove a most useful publication. The author is lecturer at Dresden, and in the preface says that the methods described have been worked out from time to time by various members of the staff. This does not mean that the methods described, or even a majority of them, are new, but simply that all the methods described have actually been used in that laboratory, and that in this way the educational value of each has been put to the test.

If an author describes the equipment of and work done in the laboratory in which he works himself, there is danger that he will produce a somewhat one-sided account, but from such a reproach Mr. Brion is entirely free. All the author has to say on testing applies to any well-equipped laboratory, and there is a remarkable absence of references to special apparatus. He evidently does not hold with the custom of giving the student cut-and-dried instructions, such as "take Messrs. So and So's testing set, connect in such a manner, then turn the handle and read off the result." Wherever possible he not only lets the student build up his apparatus, but he gives him also a short theory of the test. The object of the student's work in the laboratory is primarily to verify by experiment certain physical relations of which he has heard the theory in the class-room. Since, however, the simple and fundamental physical relations are in practical machinery often overshadowed by secondary disturbing causes, it is important that these should be pointed out to the student, and that he should thus be trained to scrutinise his results so as to separate that which is important from that which is merely accidental or disturbing. In this direction, Mr. Brion has given us good advice in sufficient detail. To give such advice it is, however, necessary to introduce a certain amount of theoretical matter on a mathematical basis.

A casual glance through the pages of this book gives one more the impression of a text-book than of a laboratory manual, but on closer inspection one finds that only as much theory is introduced as is necessary for intelligent working. Among the good features of the book are the diagrammatic representations of circuits, machines, and apparatus. With a correct appreciation of the probability that the students who work now in the laboratory will in a year or two be working in practice, Mr. Brion has adopted in his diagrams the symbolic representation recommended by the Verband Deutscher Elektrotechniker. He also uses thick lines to represent wires which carry main currents and thin lines for wires carrying shunt currents or for voltmeter wires. This is apparently a small matter, but anyone who has to trace out the circuits in some complicated electrical connection will appreciate the advantage of making the distinction. It is, however, to be regretted that in the matter of notation the author is too intensely German. He puts P for force, A for energy, L for power, D for torque, and so on, all letters which have internationally already a significance. The reader is thus put unnecessarily to the trouble and mental strain to substitute for symbols he is accustomed to use (and which, to a certain degree, have already received the sanction of the International Electrotechnical Commission) others which are unfamiliar to him.

It is not necessary to enumerate the contents of this book in detail; suffice it to say that it broadly covers the subject of laboratory tests such as are necessary for students. As to the question of which tests are necessary and which may be omitted, opinions will always differ. It would be easy to give a list of tests which, in the reviewer's opinion, ought to have been included, but such criticism would hardly be fair, for a book on testing cannot contain every possible test, but only a selection of those which the author himself has found suitable. On the whole, the author has given us a very representative and useful selection, covering a wide field. His book will be found to be a most helpful guide to electrical laboratory work generally.

Gisbert Kapp.

ANCIENT HINDU CHEMISTRY.

A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D., with Sanskrit Texts, &c. By Prof. Praphulla Chandra Ray. Vol. ii. Pp. xcvi+293+152+xxi. (Calcutta: The Bengal Chemical and Pharmaceutical Works, Ltd.; London: Williams and Norgate, 1909.) Price 10*s.* 6*d.* net.

In the first volume of this book, which was published in 1902, and reviewed in these columns on May 21, 1903, Prof. Ray dealt with all the oldest (pre-Buddha) Hindu MSS., and many of the later ones. A number of MSS. remained untouched, and now that these have been examined, the concluding volume has been issued. It has been a labour of love which has occupied all Prof. Ray's spare time for the last fifteen years, and the great value of the results of his patient and laborious researches will be fully appreciated by all students of the history of chemistry.

The difficulties of determining the extent of Indian chemical lore in ancient times are profound. There is no doubt that at a very early period the Arians attained great proficiency in the manufacturing industries, which must have rested on a good practical knowledge of chemical reactions. The famous sword-blades, called by the Greeks "marvellous swords," and by the Western world "Damascened blades," were brought to Europe by way of Damascus, but were made in India. The making and polishing of glass in India, including lenses and mirrors of various kinds, spherical, oval, &c., was a well-known industry. Pliny mentions that the best glass ever made was Indian glass. In pharmacy, in dyeing, in the manufacture of perfumery and cosmetics, complicated chemical operations must have been carried out even before the time of Buddha, which is placed about B.C. 500.

There is, however, little or no trace of these things in the literature of the period. The caste system was radically opposed to the formation of a science in which practice is based on theory. The chemical industries were exercised by a despised caste, that of the *çudras*, and their labours were no doubt deemed unworthy of being described by the caste of the *Brahmins*, or priests, who alone understood the art of writing. Thus Hoefer, for example, remarks that amongst the Sanskrit manuscripts in the Bibliothèque Imperiale, of Paris, no document occurs which can be of interest to the historian of chemistry, and Berthelot in his "Origines de l'Alchemie" practically ignores India.

The MSS. patiently examined by Prof. Ray appear to consist largely of religious or philosophical reflections, with occasional somewhat obscure references to chemical subjects made for the purpose of illustration. Thus in a document called "Rasaratnakara," written by Nagarjuna, who was the High Priest of Buddha about A.D. 150, such texts as the following occur:—

"What wonder is it that cinnabar digested several times with the milk of the ewe and the [vegetable] acids imparts to silver the lustre of gold glowing as saffron?"

And a little further on:—

"Silver alloyed with lead and fused with ashes becomes purified,"

which is a clear allusion to cupellation.

It is probable that the pundits, when referring to metal-working, often knew very little of the subjects they mentioned, but Nagarjuna was celebrated as an alchemist. Prof. Ray argues at some length in favour of the indigenous origin of Indian alchemy, and, however degrading it may have been to work, it does not appear to have been derogatory to the dignity of the sages to discuss the manufacture of gold or silver. Thus—

"Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth."

The last 150 pages of the book consist of a reproduction of original Sanskrit texts, taken from many different MSS.

T. K. R.

AN ENCYCLOPÆDIA OF THE SCIENCES.

Instruments optiques d'Observation et de Mesure. By Jules Raibaud. Pp. 380. (Paris: O. Doin et Fils, 1909.) Price 5 francs.

This volume is a unit in a somewhat extensive undertaking, no less than an encyclopædia of all the sciences, pure and applied, physical and biological, material, mental, and moral. The scheme is of a somewhat novel character; its magnitude may be judged from the fact that it involves a total of some thousand volumes, arranged in forty sections or "bibliothèques," the whole to rival, we are told, the largest encyclopædias of this or any other country—and not only in size. The novelty lies mainly in the fact that each volume is to be independent, and have its own individuality; each will be a monograph dealing with a special branch of the particular section to which it belongs. The size and price will be uniform, the number of pages approximately so. One among the advantages of the scheme will be that each volume can be brought up to date independently of the rest.

The forty sections are classified in the two main divisions of "pure sciences" and "applied sciences." Each of these is again subdivided into mathematical, inorganic, and biological sciences. Each subdivision comprises a certain number of sections, and each section has its own editor. The general editor is Dr. Toulouse, of the École des Hautes Études, and among the editors of sections are included such names as Painlevé, Mascart, Leduc, Lacroix, Bertrand.

The volume under review belongs to the section of "Industries physiques" in the division of applied sciences—subdivision, inorganic. The section is to include volumes on such subjects as "Industrial Electricity" (two vols.), "Electric Motors," "Electric Traction," "Electric Lighting," "Rheostats," "Wireless Telegraphy," "The Liquefaction of Gases," "The Industrial Production of High Temperatures," &c. This volume on "Optical Instruments for Observation and for Measurement" would seem to be the first volume of the section to be issued.

Judged from its position in this hierarchy of scientific knowledge, Captain Raibaud's volume is perhaps a little disappointing. One might expect to find details of the most recent technical advances, of such a character that the skilled optician might there find help, whether as regards difficulties of design, or of construction, or methods of ensuring accuracy. In the present instance, however, questions not only as to calculation of the optical system, but as to construction and methods of test, are definitely excluded; the aim is thus only to give a general account of the optical properties of various types of instrument, with brief particulars of individual instruments and designs. Expressed shortly, the work is rather an educational text-book than a technical handbook.

From this point of view, however, and for the general reader who wishes to obtain an intelligent knowledge of the more essential optical properties and possible defects of an instrument which he may be in the habit of using, the book can be cordially recommended. More especially, the general conditions governing the formation of satisfactory images by an optical instrument are carefully and clearly discussed. Thus the first part of the work, more than one-third of the whole, deals with the general properties of instruments, definition and resolving power, brightness of the image, extent of field of view in breadth and depth, distortion, magnification—subordinate, as is rightly emphasised, to resolving power and definition—and the functions and limitations of the eye in conjunction with an optical instrument. The characteristics of binocular vision and of vision through a binocular instrument are also examined, and, in regard to measuring instruments, the general conditions affecting accuracy.

In the second part of the book the instruments considered are those of the telescope class, the microscope, the photographic objective, instruments for measuring angles, surveying instruments and telemeters, and, finally, instruments based on the principle of auto-collimation. The list, of course, is by no means exhaustive; laboratory instruments, the spectroscope, interferometer, &c., and photometric apparatus generally are not included, nor does space admit of detailed consideration of any one type. The book is, however, written by one who has had experience in handling the instruments he describes, and thoroughly familiar, not only with the optical theory, but also with the practical points affecting their performance.

OUR BOOK SHELF.

Methods used in the Examination of Milk and Dairy Products. By Dr. Chr. Barthel. Translation by W. Goodwin. Pp. xii+260. (London: Macmillan and Co., Ltd., 1910.) Price 7s. 6d. net.

THIS edition contains several additions to the original work of Dr. Barthel, and it will be found very useful to those engaged in examining milk and dairy products on a large scale. The general remarks in it apply more exactly to milk of German or Swedish origin than to milk from some British breeds of cows.

In the notes on the physical examination of milk are useful hints as to the estimation of dirt. For the determination of fat Soxhlet's aræometer method is still given a prominent place, though in most places it is superseded by less complicated and more certain methods. Wollny's refractometer method for the fat estimation, if carried out under exact conditions, seems to give very accurate results, but it is so sensitive that the least departure from the necessary conditions influences the results seriously; one advantage it possesses is that as many as 150 determinations may be made in an hour with the proper appliances and accommodation. The Rose-Gottlieb method, and various modifications of centrifuge methods, including some not requiring the use of strong sulphuric acid, are described. Tests for adulterations, artificial colouring matters, and preservatives are given. Saccharate of lime is said to be one of the latest adulterations of milk and cream; it increases their viscosity and gives them the appearance of being richer in fat; a method for its detection is given.

Methods for the analysis of butter, cheese, preserved milk—including Buddised milk, that is, milk treated with a small quantity of hydrogen peroxide—condensed milk, and desiccated milk are given. We find also some account of the decomposition products of milk, butter, and cheese; and, in an appendix, several tables of figures useful in calculating the results of analyses.

Norwegian and Other Fish Tales. By Bradnock Hall. Pp. x+243. (London: Smith, Elder and Co., 1910.) Price 5s. net.

THIS is a frankly trivial book with a quite unintelligible dedication in place of a preface. The illustrations are excellent, and the text makes good holiday reading, notwithstanding its somewhat strained humour. As the author says, "the diaries of anglers are not as a rule interesting, even to sympathetic brethren of the craft," but we think that many of the author's own experiences at least come near to proving exceptions to his own generalisation. Incidentally, we are told of certain Norwegian fish:—"Everyone thought they were salmon, but both turned out to be sea-trout when the shape of the gill covers and the tail bones were examined." It seems a pity that the precise differences between salmon and sea-trout in the shape of the gill covers and tail bones are not divulged for the benefit of fishermen and naturalists; the counting of scales in a transverse series is none too easy, and an alternative method of diagnosis (if such really exists) would be welcome.

LETTERS TO THE EDITOR.

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

Experimental Study of Fulgurites.

FULGURITES, or the tubes of fused sand which are sometimes formed when heavy discharges of lightning strike on sandy soil, are not common enough to make their study very easy. It has been frequently remarked that they usually have a spiral or cork-screw form, but, so far as I know, it has not been decided whether or not this is accidental, and whether the direction of rotation of the spiral remains constant in the same fulgurite, or whether it is always the same in the case of various discharges. Through a fortunate accident I recently hit upon a way of extending our knowledge of these curious autographs of thunderbolts. The accident referred to was the circumstance that I was standing within about 50 feet of the spot on our lawn where a rather heavy discharge struck a day or two ago. I was about to walk across the lawn at the time, but was delayed a moment to reply to a question, when the bolt fell. The report was not deafening, resembling the explosion of one of the modern dynamite cannon crackers with which we have become familiar. There was a distinct flash of fire at the surface of the ground, and a column of steam or smoke 6 or 8 feet high. On examining the spot I found three patches of withered clover in a line about 18 inches apart. At the centre of one was a hole about an inch in diameter, and in the neighbouring one a smaller hole of perhaps a quarter the size. It had been raining hard for a hour or more, and we had had much rain for the past week, which made the ground an excellent conductor, and I was surprised to find that I could pass a straw down the larger hole a considerable distance.

I melted about 15 lb. of solder in an iron pot and poured it into the hole until it was full, and then carefully excavated the cast. In digging it out, I found a lateral tube several inches below the surface joining the two holes, and one or two lateral branches to the large tube, into which the solder had not penetrated. The cast obtained was nearly 4 feet in length, and the ground was soaking wet, which surprised me a good deal, for I imagined that the discharge would spread out and become dissipated long before reaching a depth of 4 feet in wet soil. The edges of the tubes were lined with small patches of white grains of sand fused together. The metal cast had an unmistakable spiral form, which could be followed for its entire length, and was especially conspicuous at the lower or smaller end. The diameter of the artificial fulgurite increased to a depth of about 2 feet, after which it diminished gradually. The spiral form can be seen in the accompanying photograph of the cast. It was clock-wise in the downward direction, that is, it was similar to that of a cork-screw. The surface was covered with small buds, which were arranged in straight lines along its length, some of the lines 7 or 8 inches long. One of these lines can be seen in the photograph immediately to the right of the label. These lines may be due to cracks in the tube, resulting from the explosive action of the steam. The localisation of a bright light at the surface of the ground is extremely interesting. Several members of my family, who were not looking at the spot at the moment the flash struck, turned round at the report, and said that they saw a bright light and a cloud of smoke. It will be interesting to hear if others have noticed this phenomenon. It may possibly be due to the combustion of a blast of gas generated by the passage of the discharge through the soil.

On the day after the storm I found another and much larger hole on the golf links, where a very heavy discharge had struck and demolished a wooden box of sand on the top of a banked-up tee, leaving no mark, however, on an iron cylindrical can of water standing beside and in contact with the sand box. Lateral branches had spread out in all directions over the top of the tee, making furrows similar to mole tunnels. I have not yet made a cast of this hole, which is probably 6 or 8 feet deep, pending the decision of the golf committee. Similar holes must be of very frequent occurrence, and their study by this method should prove interesting.

East Hampton, Long Island. R. W. WOOD.

Photograph of the cast of a hole formed in ground by a lightning discharge.

Ooze and Irrigation.

THE valuable contribution to this subject contained in the letter of Mr. Horwood (July 14, p. 40) shows the importance of communicating the results of research. I am, in consequence, submitting a few further facts which have not heretofore been made public. Up till the present time it has been assumed that our British Annelids were limited to a few species of earthworms, and a few aquatic forms usually lumped together as Tubifex. So far is this from being the case that we have at least four distinct groups of indigenous worms, to say nothing of the many foreign species found at Kew, Chelsea, Oxford, and elsewhere. These are, first, the true earthworms, of which we have nearly forty species, now ranged under upwards of half a dozen genera. Secondly, certain species of semiaquatic worms, including not only the well-known Allurus (Eiseniella), but two species of Helodrilus. Of these, *H. oculatus*, Hoffmeister, is now known to be British, while a second species, *H. elongatus*, Friend, new to science, is at present known to occur in Cornwall in streams and lily ponds. These are of peculiar interest, both because they necessitate a revision of nomenclature and because they link on the earthworms with the aquatic forms.

Next come the ooze formers, which are exceedingly numerous, and occur in almost all our lakes and ponds, our rivers, streams, ditches, and pools, doing an immense work as scavengers and mould-makers. Lastly, we have to notice another series, which may be conveniently spoken of as white worms (Enchytræids). It is in relation to these that I wish especially to make one or two observations. Some years ago I carefully examined the banks of the Eden near Carlisle. I then found, not only a large series of water worms engaged in making ooze, but, at particular seasons of the year, an equally varied assortment of Enchytræids (Fridericia, Heulea, Enchytræus, and others) at the roots of grasses. By careful observation I found that these were most abundant at the time when decaying vegetable matter was in a state of fermentation, and that they were apparently engaged in clearing off this fermenting matter.

I have recently further observed on the Malvern Hills that, if the stones are lifted which have for a time been covering the grass and causing it to decay, one finds that, when a given stage of decay is reached, certain white worms always make their appearance; and that these Enchytræids are, curiously enough, almost invariably associated with a species of earthworm (*Lumbricus rubellus*, Hoffm.). Other observations, such as that relating to the amphibious nature of the tiny aster-worm (*Enchytraeus parvulus*, Friend), and the action of other forms on decaying seaweed and the like, will call for fuller treatment elsewhere. Enough has been said to show that a very wide field of observation is opened up, and that, while it has its interests for the geologist, it is of supreme importance for the biologist and the student of agriculture. I am at present engaged in a series of observations which are bringing many new facts to light.

HILDERIC FRIEND.

Malvern, July 18.

The Sterilisation of Liquids by Light of very short Wave-length.

DURING the past year several articles have appeared in the *Comptes rendus des Séances de l'Académie des Sciences*, Paris, on the sterilisation of liquids by ultra-violet light. The notes of M. Billon-Daguerre have particularly attracted my attention, since he has endeavoured to utilise the region of the spectrum discovered by Schumann for the sterilisation of water. It is obvious that the question of the transparency of water for light of very short wave-length is important in this connection, and, as there seems to be no data which bears on the matter, I have recently made some experiments.

I used a vacuum grating spectroscope arranged in the same way as when I investigated the transparency of some solid substances. The water was distilled, but without any special precautions, and was enclosed in a cell with fluorite windows. Two of these cells were employed, one giving a water column of half a millimetre, the other giving a millimetre column. With the half-millimetre cell in the light path the spectrum was cut off at λ 1792 (Angström units), even after a prolonged exposure. It appeared that this limit of the spectrum receded rather slowly toward the red with increase in the thickness of the water column.

As M. Billon-Daguerre wished to use light of very short wave-length, he employed a vacuum tube filled with hydrogen. This substance is known to give a strong spectrum in the region between λ 1650 and λ 1030; it must not be forgotten, however, that no lines can be ascribed to it in the region between λ 2000 and λ 1650. Thus any action due to the radiation from the vacuum tube filled with hydrogen must be confined to a layer of water so thin that light of wave-lengths shorter than λ 1650 can penetrate it. Judging from my experiments, such a layer must be very thin indeed.

Several investigators have used the mercury arc in quartz as a source of light in sterilisation experiments. There are two facts which it may be interesting to mention in this connection. In the first place, fused quartz two millimetres thick is somewhat transparent so far as λ 1500; the transparency falls off rapidly with increasing thickness. In the second place, no lines more refrangible than the strong line at λ 1850 are known in the spectrum of mercury. In this second statement my own observations are confirmed by a recent investigation of Dr. Handke.

THEODORE LYMAN.

Jefferson Laboratory, Harvard University, July 8.

Elemental Weight Accurately a Function of the Volution of Best Space-symmetry Ratios.

IT is a fact little known, but of the first magnitude, that equal spheres or corpuscles cannot in space, as in one plane, be distributed at equal mutual distances. Tetrahedra, the four points of which alone are all mutually equidistant, cannot be packed so as to fill space, as their face-angles to fill one plane.[1] Icosahedral diffusion, with a central sphere, nearly achieves this, but by a cramping of the central point in the ratio 1 : 1·051460···.

Free magnetic needles in water, say five in number, may fall into position either thus :

or thus :

Their energies are a fixed quantity; so that, though they will assume either position, they are stabler in position (*a*), because here, on the whole, the lines are more equidistant; but (*b*) might become equally stable if each needle were a vortex possessing an energy v, capable, under heat and cold, of adapting itself to changed environment by cumulative indraught and outdraught, *i.e.* $v^{\pm\frac{n}{m}}$.

In one plane, equal spheres being equitriangularly arranged, each sphere forms a centre capable of supporting, by surface tension, an equal number of spheres around it. In space, the nearest approach to this perfect equilibrium is by means of the five best-symmetries, or so-called regular solids, whereof three dominate elemental crystals.[2] Alike as to points, faces, edge-lines, and circum-radial lines, these five contain only the factors 2 and 3 (crystalline) and 5 (non-crystalline), greatly complicated, however, by the last of these :

$$\text{Crystalline} \quad : hex\ \sqrt{2:1}\ ;\ tet\ \sqrt{8:3}\ ;\ oct\ \sqrt{4:3}$$

$$\text{Non-crystalline} : ic\ \sqrt{2\left(1-\frac{\sqrt{5}}{5}\right)}:1\ ;\quad do\ \sqrt{2\left(1-\frac{\sqrt{5}}{3}\right)}:1.$$ [1]

Now the problem of the volutional interconversion (on the principle $v^{\pm\frac{n}{m}}$) of the three first ratios 2, 3, and 5, yields to a simple and highly accurate solution,[2] whereas adding the two last, *ic* and *do*, the solution becomes complex; but, on the lines of the simple interconversion, there are contained several approximate interconversions with *ic* and *do*, the errors of which are the precise weights of $H^{1\cdots 4}$ by different syntheses :

$$\left.\begin{matrix} \frac{4}{3} \\ \text{or } oct^2 \\ \text{or } \frac{tet^2}{hex^2} \end{matrix}\right\} = \left\{\begin{matrix} \sqrt[12]{2} \\ \text{or } \sqrt[6]{hex} \\ \text{or } ic \times \text{H (i)} \\ \text{or } \sqrt[9]{\frac{hex^2}{oct^2}} \\ \text{or } ic \times \text{H (ii)} \end{matrix}\right\} \times \left\{\begin{matrix} \sqrt[7]{5} \\ \text{or } \sqrt[7]{3}\ ic \times \text{H}^3 \quad \text{(iii)} \\ \text{or } \sqrt[7]{2}\ ic^2 \times \text{H}^4 \quad \text{(iv)} \\ \text{or } \sqrt[7]{\frac{\text{O}(=16)\times do^2}{ic^4 \times oct^2}} \quad \text{(v)} \end{matrix}\right.$$

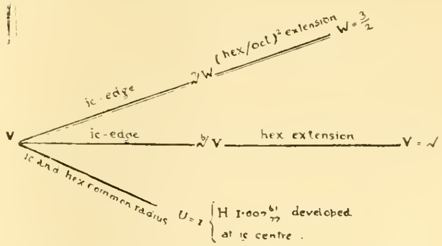
The numbers (i), (ii), (iii), (iv) refer to Morley's four experimental weights of H,[3] which the formula hits precisely :

(i) $H_2 : O$ mean $= 1·00761$	(iii) Gravimetry mean 1·00762
(ii) $H_2 : O$ max. $= 1·00777$	(iv) $H_2 : H_2O$,, 1·00765

Two basal equations are here involved,

$$(4/3)^x = 2^{\frac{x}{12}} \times 5^{\frac{x}{7}} \text{ and } 2^x(5/4)^{7x} = 3^{2x} \times 1·5^{\frac{x}{7}} —$$

7 and 12 being severally the combinable group and series numbers of the table. The main equation (*threes* strong) appears accurate to some 50 decimal points; the secondary (*fives* strong) rather less so. They meet at $\sqrt[7]{1·5} = \sqrt[12]{2}$; with an error of 0·00016, the crux of the hydrogen ranges. Their great accuracy points to a profound numeric and geometric principle. *Hex, hex²/oct², &c., compensation-vortices cannot evolve to their 6th and 9th roots without developing hydrogen, and thereupon compensating* ic, *&c.; and, inversely,* ic, *&c., cannot involve to their 6th and 7th powers without ultimately throwing off hydrogen and compensating hex, hex²/oct², &c.*



(i) The compensation-vortex at the end of the cubic (or tet oct) edge-line, pulls, as required, by $\sqrt{2:1}$ against the circum-cube radius. This crystalline symmetry being disturbed by heat, the vortex unravels or evolves to its 6th root, travelling down the line to the point marked $\sqrt[6]{v}$. It there precisely compensates the *icosahedral edge : circum-*

[1] See Barlow and Pope, Chemical Society Transactions, 1907, vol. xci., p. 1152.

[2] Retgers, Zeitsch. physical Chem., 1894, xiv., 1.

[1] *Tet, hex, oct, ic,* and *do* here stand for the ratios, or the weights compensating the ratios, *edge-line : circum-radius* (*i.e.* the radius of a circumscribed sphere) severally of the regular tetrahedon, cube, octahedron, icosahedron and dodecahedron.

[2] A log-algebraic problem of eight terms unknown, it was soluble only by reference to philosophical considerations anterior to those now discussed.

[3] Morley, confirmed by Thomsen, Keiser, Guye and Mallet. See International Committee's Report. *Chemical News*, February 12, 1897, May 5, 1899, June 11, 1897, and May 12, 1905; or Freund's "Chemical Composition," 1904, p. 220.

radius ratio; but so that there is developed at the icosahedral centre, a deficit or gravitative pull equal exactly to the hydrogen mean weight by $H_2 : O$, viz. 1·00761.

$$ic = 2^{\frac{1}{12}} [= 1·059462 \cdot \cdot] \div 1·00761.$$

(ii) The vortex compensating the ratio of cube-edge to octahedral-edge—*i.e.* $hex^2 : oct^2$—both having a common or equal circum-radius, unravels down the cube-edge to its 7th root, and at $\sqrt{w}$ becomes an icosahedral compensation vortex; the octahedral-edge becomes or equals the icosahedral circum-radius; and the hydrogen pull is developed at the icosahedral centre; but at $H_2 : O$ max. 1·00777. Cases (iii), (iv), and (v), and all the coalition permutations (see below), are to be interpreted like (i) and (ii), though more complex.

In cases (i), (ii), (iii), and (iv) we have severally $H^{1 \cdots 4}$; and, similarly, in the coalition formulæ *ic* or H are never in excess by more than the valency numbers 1 to 4 —1 to 8 in the cross-formula (No. 4).[1] This, probably, is attributable to the multiple radial lines. For we are concerned with powers, not multiples. Each central vortex does not need to pull against the sum of all its surrounding vortices as isolated units, because these latter too are themselves centres, and correspondingly weakened. The contraction of the crystalline ratios under heat is consistent with the entropic or adiabatic phenomena of H_2O; and for many reasons it is believed that the weight deviations are a function of entropy. When (see below) the line is crossed, the signs change, contraction becomes expansion, and along the lines of the *pari passu* increase of exponents, the VD, entropically disturbed, gradually becomes constant.

Morley's ranges are severally $\pm 0·00016$, $\pm 0·00033$, $\pm 0·0007$, and (*means*) 0·00004. By coalition of the fractures of the main formulæ, we derive the following, *in all which formulae, $\pm x$ being high, the mean is attained, and the maxima and minima when $\pm x$ is low; so that the formulae can never transcend the experimental range, and always tend to its means.* (Compare entropy):—

Formula	x high	Range
(1) $5 / 2^{\frac{27-x}{12}} = ic^{x+1} \times H^x$	H = 1·00761	$\pm 0·00033$
$2^{\frac{28+x}{12}} / 5 = ic^x \times H^{x+1}$		$\pm 0·00016$*
(2) $3^{\frac{4}{7}} / 2^{\frac{10-x}{12}} = ic^{x+1} \times H^x$	H = 1·00761	$\pm 0·00004$
$2^{\frac{11+x}{12}} / 3^{\frac{4}{7}} = ic^x \times H^{x+1}$		
(3) $5 / 2^{\frac{17-x}{12}} \times 3^{\frac{4}{7}} = (ic \times H)^x$	H = 1·00761	$\pm 0·00030$
$2^{\frac{17+x}{12}} \times 3^{\frac{4}{7}} / 5 = (ic \times H)^x$		
(4) $5^{\frac{3}{7}} / 2^{\frac{19-x}{12}} = ic^{x+1} / H^{7-x}$	H = 1·00761	$\pm 0·0005$
(5) $2^{\frac{6\pm x}{7}} \times 3^{\frac{3\pm x}{7}} = ic^{2\mp x} \times H^{3\mp x}$	H = 1·00777	$\pm 0·00015$
(6) $5^{\frac{6\mp x}{7}} / 2^{\frac{13\mp x}{7}} = ic^{2\mp 2x} / H^{1\pm 4x}$	H = 1·00765	$\pm 0·00017$
(7) $5^{\frac{6}{7}} / 2^{\frac{7+x}{7}} \times 3^{\frac{3-x}{7}} = ic^{4+x} \times H^{2+x}$	H = 1·00777	$\pm 0·00033$
(8) $5^{\frac{6+x}{7}} / 2 \times 3^{\frac{3+x}{7}} = ic^{4+x} \times H^{2+3x}$	H = 1·00762	$\pm 0·00020$

* $x = 2$.

A comprehensive deduction from the general formula is the following:

$$H\,(1·00761) \times \frac{do^2}{ic^3} = \frac{oct\ 4^2}{hex\ 3^2} = \frac{tet\ 4^3}{hex\ 5^{2}}, \text{ \&c.}$$

Provisionally, upon examination of four out of the eight combinable groups, the elemental weights are found expressible in like terms to these, *i.e. the elemental weights are such that, multiplied into the simple volution of one or more of the symmetry line-ratios, they yield accurately the simple volution of one or more other symmetry line-ratios, each expression having its exact equational variant, like elements yielding to like expression, but not mechanically so* (see *Chem. News*, April 22, May 6, and June 10). This is deduced from the basal-equations with x as $1 \cdot\cdot 8$, the formula not being constructed (or rather discovered) empirically to yield any given weight, but rationally to meet the whole problem of weight compensation. That, x being 1, the H weights were with perfect exactitude obtained, chanced to be a fact almost the last discovered.

Considering the hydrogen solution alone, the rational postulate of vortex compensation for inequidistance (as contrasted with the crude Democritan hard-atom hypothesis) hits precisely—with the odds 100,000 to 1 against each hit—in the four corners of the basal-equation, the four means of hydrogen; and by coalition, all their deviations. *The postulate is thus, on the one element, proved true by the odds* $100,000^4$ (10^{20}) *to* 1.

Corroboration is glimpsed in the spectrum-line ratios.

H. NEWMAN HOWARD.

[1] $H^{1 \cdots 4} + 0, 1, 2, 3$ are virtually $H_{1 \cdots 4}$

Electrical Discharge Figures.

MR. A. W. PORTER gave in NATURE of March 31 (vol. lxxxiii., p. 142) an account of his experiments on electric discharges over photographic plates, made in order to ascertain what is due to the luminosity of the discharge and what to the discharge itself. Knowing that the disruptive discharge carries metallic particles from the electrodes, and that in the silvering of mirrors by the wet processes the silver begins to set at every metallic particle which clings to the surface of the glass because of the action of local couples, I ventured to develop the invisible image of the discharge on a clean glass plate by the silvering solution.

Electrical discharge figure developed by wet silvering process.

The effect was a very striking one; instead of the broad band of the trunk discharge, a clean band was left, surrounded by two sharp, dense lines of deposited silver. The thin ramifications were still visible, but the splendid display of surrounding figures is lacking. The two unsatisfactory paper prints that I send [one is here reproduced] were made from developed plates, and are therefore negatives. It is impossible to get better results now, because the laboratory is closed for the summer holidays.

The acid intensifier for the collodion plates, acting in the same way as the wet silvering mixture, was also tried by me, but the result was worse.

W. LERMANTOFF.

University of St. Petersburg, Russia.

It is necessary to know more concerning the precise conditions under which the images referred to above were obtained before one can discuss them with safety; but they are interesting as apparently indicating that the axis of the trunk discharge *may* be free from metallic particles.

In this connection, however, it must be added that when one directly observes a negative discharge over a photographic plate from an electrode of zinc or magnesium, every line in the fan-like discharge is seen to have the bluish tint characteristic of the metal. Whatever, then, may be the reason for the absence of these fan-like figures from Mr. Lermantoff's images, it must certainly not be attributed to the absence of metallic particles from them.

ALFRED W. PORTER.

An Interesting Occultation.

MAY I direct attention to an interesting phenomenon which will take place on the morning of July 27, viz. the occultation of the star η Geminorum by the planet Venus, the particulars of which are as follows:—

Apparent place of η Geminorum (mag. 3·2–4·2), July 26, R.A. 6h. 9m. 26·6s.; dec. 22° 32′ 6·24″ N. Apparent place of Venus (geocentric), July 26, 14h. 57·7m. G.M.T., R.A. 6h. 9m. 26·6s., dec. 22° 32′ 7·2″ N. Declination at Greenwich, corrected for parallax, 22° 32′ 2·3″. Semidiameter 6·14″. At Greenwich the occultation commences at 14h. 55m., and ends at 14h. 58m. The planet rises at 13h. 43m., and the sun at 16h. 17m.

On the afternoon of July 28, Venus is in very close conjunction with μ Geminorum, the positions of the two bodies at 4h. 27m. being as follows:—

♀. R.A. 6h. 17m. 30·9s., dec. 22° 33′ 58″ N., declination (corrected for parallax) 22° 33′ 53″. μ Geminorum, R.A. 6h. 17m. 30·9s., dec. 22° 33′ 43″. As the semidiameter of the planet is 6·1″, the star will be within about 4″ from the southern limb. This, of course, occurs during daylight, but the planet will be above the horizon at the time. It sets about 6h. 8m.

Dr. Crommelin has kindly looked through these figures and verified them.

ARTHUR BURNET.

52 Prospect Terrace, Hunslet.

Pwdre Ser.

THE curious belief that shooting stars, when fallen to earth, become lumps of jelly may possibly be explained in the following manner:—

The jelly is very probably the plasmodium of a Myxomycete, such as Spumaria or Physarum. The plasmodia occur most frequently in damp weather, but are found in lesser numbers throughout the year. Shooting-stars are also seen at all times in the year, but most plentifully in the autumn. In these islands, the greatest rainfall is also in the autumn months.

Consequently, by a purely fortuitous coincidence, meteors and plasmodia are most plentiful in the latter part of the year, the former because the main meteor swarms, in their annual revolution, cross the earth's track at that time, and the latter on account of the greater rainfall. Two striking phenomena are forced on the rustic attention at the same time, the brilliant display in the sky and the mysterious jelly on the grass. Very naturally the two are considered as causally connected, and so the belief may have arisen. An analogous case is that of "cuckoo-spit," the frothy exudation of the larval frog-hopper, *Philaenus spumarius*, which appears at the time of the arrival of the cuckoo and disappears about the period of the bird's departure.

W. B. GROVE.
R. MILLARD GRIFFITHS.

University Botanical Laboratory, Birmingham.

IN connection with the article on "Pwdre Ser" in NATURE of June 23, it is interesting to find, in Admiral Smyth's "Sailor's Word-Book"—one of the richest repositories of quaint facts and fancies—the term "fallen-star" defined as "A name for the jelly-fish or *medusa*, frequently thrown ashore in summer and autumn."

C. FITZHUGH TALMAN.

U.S. Department of Agriculture, Central Office of the Weather Bureau, Washington, D.C., July 11.

HOUSE-FLIES AND DISEASE.

ALTHOUGH the verification of the belief that the commonest, most widely distributed and truly domestic of insects, *Musca domestica*, Linn., was capable of carrying the germs of certain infectious diseases has been one of the noteworthy accomplishments of medical science in the last decade, it is a mistake to attach all the credit to those who, within the last few years, have removed the idea from the realms of hypotheses into the world of facts.

As early as the seventeenth century, Sydenham associated unhealthy conditions with flies. Lord Avebury, in 1871, regarded flies as "winged sponges spreading hither and thither to carry out the foul behests of contagion." In addition to other early suggestions, Nicholas, in 1873, indicated the possible connection of flies with the dissemination of cholera from a case observed by him in 1850; Raimbert in 1869 experimentally proved that the house-fly and blowfly were able to transmit the anthrax bacillus; Davaine in 1870, and Bollinger in 1874, also showed that the blowfly could carry the anthrax bacillus, an important practical observation. Laveran in 1880 demonstrated the ability of flies to carry the infectious discharge of conjunctivitis in Egypt on their proboscides and legs. All these observers assisted in

FIG. 1.—*Musca domestica*, Linn.

the gradual growth of the belief; but it was in the 'eighties of last century, however, that several investigators adduced more convincing bacteriological proof as to the ability of flies to carry pathogenic and other bacteria. In 1886, Tizzoni and Cattani obtained the cholera spirillum from flies caught in cholera wards. In the same year, Hoffmann found tubercle bacilli in the excreta of flies caught in a room which had previously contained a phthisical patient. Two years later, Celli showed that the typhoid bacillus was able to pass in a virulent condition through the digestive tract of the fly.

Since the above observations, which are selected from many others, were made, it has been repeatedly shown and proved that house-flies are able to carry these and other bacterial and fungal organisms. What has not been demonstrated is the extent to which flies are *not* able to carry such micro-organisms. When the habits of flies are considered, it is not a little remarkable that no serious attention was paid to the possibility of flies having any considerable relationship to the dissemination of disease until within the last twelve years. The excessive mortality from typhoid which occurred in the Spanish-American war was the means of directing the attention of such observers as Vaughan and Veeder to the possible relationship of flies to this disease, especially as statistics showed that water was not a sufficiently important factor in, and was not explanatory of, the typhoid epidemics occurring in certain of the national encampments. Later, in the South African war, the same conditions were present, and enteric fever was responsible for a very heavy death-roll; those who were present directed attention on their return to these conditions, which, as circumstantial evidence, would convince the most sceptical as to the important *rôle* that flies played in the spread of the disease. These conditions are well known now; open latrines swarming with incredible numbers of flies in all stages of development; these latrines frequented by incipient cases of enteric; myriads of flies in the mess tents, defiling all kinds of food, and in many cases distinguishable by the lime which they bore on their appendages from the latrines, as were the typhoid patients in the hospitals also distinguishable by the number of flies clustering about their mouths while in bed.

From the setaceous character of the appendages and bodies of flies it is only to be expected that when allowed to have access to infected material they would be able to carry the bacilli on their appendages, bodies and in their digestive tracts, and the transference of flies from infected substances to culture media are really unimportant experiments compared with those of capturing the flies under normal conditions near sources of infection and determining the presence and identity of the micro-organisms on these insects, as certain investigators have done. It would be found impossible to obtain a specimen of *Musca domestica* which was not carrying bacteria or fungal spores.

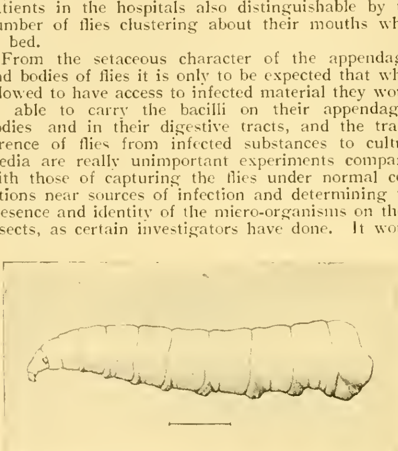


FIG. 2.—Larva of *M. domestica*.

Though externally they may be almost sterile when they emerge from the pupa, the fly after emergence immediately becomes contaminated, and during the remainder of its varied existence serves as a collector and disseminator of any bacterial or fungal organisms with which it comes into contact. One of the most important and convincing experiments is that of Güssow (hitherto unpublished), who obtained thirty colonies comprising six species of bacteria and six colonies comprising four species of fungi from a single fly caught in the living-room of a house and allowed to walk over a culture plate of agar-agar. From a fly caught in the open he obtained forty-six colonies comprising eight species of bacteria and seven colonies comprising four species of fungi. The tracks of a house-fly caught in a household dustbin yielded 116 colonies of bacteria comprising eleven species, and including such species as *B. coli*, *B. lactis acidi*, and *Sarcina ventriculi*, and ten colonies comprising six species of fungi.

Such experimental results render further argument as to the frequency with which house-flies carry bacteria and the spores of moulds and other fungi unnecessary. Flies captured near excremental products are most frequently found carrying bacteria characteristic of the alimentary canal or putrefactive bacteria, and it is only to be expected that should such sources of contamination be infected with pathogenic bacteria, for example, from an incipient case of typhoid or from a typhoid "carrier," the bodies of the flies would become infected. As an instance of this, Hamilton recovered *B. typhosus* five times in eighteen experiments from flies caught in two undrained privies, on the fences of two yards, on the walls of two houses, and in the room of an enteric fever patient, and others have obtained positive results in similar experiments.

The habits of these insects are most perfectly suited for the dissemination of pathogenic bacteria. On one hand, they seek all kinds of excrementous and decaying vegetable and other matter, chiefly for the purpose of depositing their eggs; and, on the other hand, they fly with perfect freedom on to food such as milk, sugar, &c., much of which forms an excellent medium for the deposition of whatever bacteria they may have become contaminated with during their ubiquitous wanderings.

Not only during the summer, but also during the winter months, house-flies, if they are active, normally carry on their bodies and appendages bacteria and the spores of moulds, and Fig. 3 shows an agar slope culture obtained by allowing a fly caught in the writer's laboratory at the end of January, 1910, to walk up the agar slope; the comparatively large number of colonies which developed in the tracks of a single journey can be easily seen.

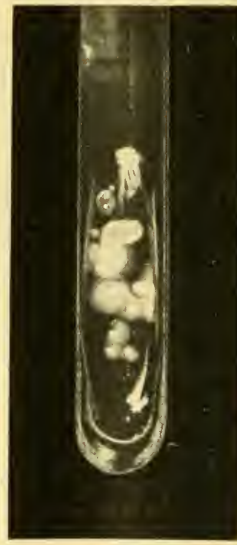


FIG. 3.—Agar-agar Slope culture of bacteria deposited by *M. domestica* in a single journey over the medium.

The eggs of the house-fly are deposited on most decaying vegetable substances, especially if they are in a fermenting condition; the influence of fermentation is of considerable importance; in one instance the maggots developed in germinating wheat. Of all substances they prefer horse manure, and this is most suitable for the development when it occurs in heaps as stable refuse, supplying as it does both moisture and heat, the two great essentials for a rapid development. They will also choose the excrements of man and certain other animals. Newstead found them in such animal and vegetable substances as rotting feathers, flocks, and paper, in which substances, when soiled with excrementous matter, they have also been found by the writer, and such conditions not infrequently occur in refuse heaps. Wherever there are collections of these substances, in such places will flies be found, not only depositing their eggs, but contaminating their appendages and bodies with putrefactive and other micro-organisms which abound there. Ficker and others have shown that typhoid bacilli can pass through the digestive tract of the house-fly and retain their virulence for more than three weeks, but the more recent discovery by Faichne, that flies bred from larvæ which have developed in infected material carry the typhoid bacilli in their digestive tracts, is one of great importance in its practical bearing.

The most important factor which affects the numbers, activity, and potential danger of flies is temperature. Experiments show that at a high temperature the whole life-history can be passed in eight days. Further, it was found that the second generation of flies are able to begin to deposit their eggs as early as the fourteenth day after emerging from the pupa; in short, the second generation of eggs may be deposited in about three weeks after the deposition of the first. Each fly is able to deposit from 100 to 150 eggs in a single batch, and at least six batches are laid during the lifetime of a single female. It is not difficult, in view of these facts, to understand the production of enormous numbers of flies during hot weather, and how the activity and numerical abundance of flies increases with the rise of temperature. During the hot months of July, August, and September flies are most abundant, and it is a significant fact that in those years when the temperature is high during those months, that is, during the third quarter of the year, there is almost invariably a high mortality from typhoid fever and the infantile disease, summer diarrhœa. In connection with summer or infantile diarrhœa, a curve prepared from statistics covering the last twenty years showed, with the exception of one year, that a rise or fall in the number of deaths per thousand living in a large English city was associated with a rise or fall respectively in the temperature.

The relation of flies to summer diarrhœa is practically based on epidemiological and other circumstantial evidence, since the specific cause of the disease has not yet been determined with certainty. Morgan, however, has found a bacillus occurring in a large percentage of the cases of the disease, and the same bacillus has been isolated from flies captured in infected houses. An objection has been made to the idea that the house-fly is a carrier of the cause of summer diarrhœa, this objection being founded on the fact that at the end of the summer the fall in the fly curve follows the fall of the curve representing the diarrhœa mortality, the flies being still more numerous than they were earlier in the season, when the diarrhœa curve was rising. In meeting such an objection it may be pointed out that we are not considering the numerical abundance of the flies in the houses only; it should be remembered that with a decline of temperature the activity of the flies, especially out of doors, which is important in this case, is not so great, even though their numbers may be considerable indoors. With the fall of the temperature, therefore, the possibility of their carrying the infection decreases without a necessarily corresponding decrease in their numbers, and the diarrhœa curve will fall in consequence.

The fly problem, which is more serious in the United States and Canada than in England, is one that may be attacked and solved in cities and towns, provided that the authorities will take the necessary steps. As in districts previously infested with mosquitoes, these insects have been reduced to a negligible quantity by the abolition of their breeding-places or the rendering of the same unsuitable for the larvæ; so also the number of flies and their danger could be lessened very considerably by the removal of their breeding places, by preventing their access to the breeding places, or by treating these with substances noxious to the larvæ or flies. Flies are a public nuisance, and, therefore, to maintain places where flies are able to breed should be made a misdemeanour. Stable refuse should not be left exposed for a longer period than six or seven days in the summer, but should be removed from the vicinity of dwellings or treated with such a substance as chloride of lime, which will prevent the breeding of the flies, the refuse being kept in a closed fly-proof chamber. The presence of mews and stables with their exposed rubbish heaps will always account for the abundance of flies. The household dustbin or other repository for kitchen refuse, unless securely closed or screened and regularly emptied, also forms an excellent breeding ground. Public tips on to which all kinds of organic and decaying matter is deposited produce their flies in myriads; it is invariably found, where actual investigation has been made, that the percentage of cases of zymotic diseases of an enteric nature is abnormally high in the neighbourhood of public refuse tips and depôts where rubbish is allowed to accumulate.

In considering the relation of house-flies to disease, although the one species of fly, *Musca domestica*, usually constitutes from 90 to 98 per cent. of the fly population of houses, certain other species are also found to occur. The lesser house-fly, *Homalomyia canicularis*, has the next place in the scale of frequency, and is generally mistaken by the uninitiated for a young house-fly, on account of its general resemblance. Although both the adult fly and the larva have pronounced structural differences, the habits of the larva and the economic relationships of the fly resemble those of *M. domestica*. The blood-sucking fly, *Stomoxys calcitrans*, is not infrequently mistaken for the true house-fly, which has adopted vicious habits. *M. domestica*, however, is unable to pierce the most delicate skin, and *S. calcitrans*, which frequently enters and is found in houses in the spring and also in the autumn, especially in rural houses, presents considerable differences, the chief being the possession of an awl-like, piercing proboscis, a more robust build, and its coloration. Not infrequently inflammatory swellings, sometimes of a serious nature, result from the "bite of a fly," and such cases are instances of the mechanical transference of such bacteria as the Streptococci from infected material to a healthy human being by a blood-sucking fly. Malignant pustule may be caused by the mechanical transference of the *Bacillus anthracis* by a blood-sucking fly, or it may be by a non-blood-sucking fly, such as the blowfly, *Calliphora erythrocephala*, if the skin is broken to provide entrance for the bacillus.

Wherever there is filth, suppuration, or purulent discharge, flies are invariably attracted, and as they are cosmopolitan in their attentions and no distinguishers of persons, they are potential disseminators of such bacteria as these substances may contain. It is not a question of eradication in the case of this insect; such is impossible. Control and prevention, however, are within the bounds of possibility, and these will be regarded as essential when the facts are more generally realised.

C. GORDON HEWITT.

THE NEXT TOTAL ECLIPSE OF THE SUN.

ON April 28 of next year there will occur a total eclipse of the sun which will begin on the earth generally at 7h. 49·2m. G.M.T., the central phase commencing at 8h. 46·1m. G.M.T. The path of the moon's shadow is restricted for the most part to the equatorial regions, and is confined to the longitudes between Australia and South America, so that as far as Europe or Asia are concerned the eclipse cannot be observed there even in a partial phase.

The actual line of central eclipse commences on the south-east portion of Australia, and passes in a north-eastern direction, crossing the equator in about longitude 154° W. It then sweeps round in an easterly direction, terminating in about longitude 90° W. just off the west coast of Central America. The line thus extends over the full width of the Pacific Ocean, and it is therefore from islands in that ocean that the expeditions which may be sent out will have to make their observations. While there is a great number of islands in this ocean, there are, unfortunately, remarkably few which lie in the narrow band of the totality track. Following the line from west to east, the first that one finds on the Admiralty chart is Tofua, in the Tonga or Friendly Islands. The next that is met with is Vavau, in the same group, and also close to the central line of totality. Much further eastward we reach Nassau, which lies a little to the south of the central line, but well within the central zone, and not far away are the Danger Islands, which are situated to the north, but further away from the central line. Thus, so far as is indicated on the chart, there are only four available points from which observations can be made.

In order to find out the suitability of these islands for eclipse parties, Mr. F. K. McClean determined to make detailed inquiries on this point on his way out to the recent eclipse, travelling from England *via* San Francisco and New Zealand specially to gather this information. Particulars are now to hand, and at his request they are published here so that intending observers may benefit thereby.

With regard to Tofua the information is brief and concise. It is that Tofua is an active volcano and high, and therefore unsuitable. As regards Vavau he says very little, because, as he knows, it is generally recognised as being a good place for observation. He adds, however, that there are hills there several hundred feet in height; that the island is called at by mail steamers; and, finally, that there are many small and low islands in the neighbourhood.

Coming now to Nassau and Danger Islands, these are described as "difficult, but possible by using owner's boat and landing tackle." As observing stations he defines them as "good." The mode of procedure to utilise these islands is suggested by him in the following words:—

A small steamer of several hundred tons (*The Dawn*), belonging to Captain E. F. Allen, runs to both Nassau and Danger. He does the whole of the landing and embarking of copra, &c. This steamer would have to be chartered at approximately 40*l.* per day when under steam and 20*l.* when not under steam. . . . Captain Allen says that he would undertake to get all cases on shore in good condition if they were water-tight, but he cannot undertake to keep them dry. If for any reason he could not land on one island, he could on the other in any reasonable weather conditions.

In most of the Pacific islands the chief difficulties to be met with are confined to the landing and embarking of the *personnel* and material. As many of the islands are fringed with coral reefs, with only small, narrow passages through them, in some cases natural, in others made by blasting operations, considerable skill is required in negotiating the breakers, and special surf boats are usually required. Mr. McClean's advice, therefore, is that it is almost imperative to employ someone accustomed to such work, "as certainly no one unused to the conditions could do it."

Should any of the parties who intend to go out on the occasion of this eclipse wish to locate themselves on some island other than Vavau, then Nassau and Danger Islands are their only alternatives. It is hoped, however, that one or other of these will be made use of, as they are sufficiently distant from Vavau to be subject to different weather conditions should the parties at Vavau be clouded out.

WILLIAM J. S. LOCKYER.

GLACIERS, GOLDFIELDS, AND LANDSLIDES IN NORTH AMERICA.[1]

As an example of organised public research, the U.S. Geological Survey is unparalleled in its activity. Bulletins, professional papers, monographs and reports flow from the Government Printing Office at Washington in a stream that is well-nigh overwhelming to the student who tries to arrest it for systematic examination. Written, or brought by capable editing, to a standard of lucidity that is positively monotonous, well printed, lavishly illustrated, and distributed with enlightened generosity, these publications contain a store of precise information which illuminates every branch of earth-knowledge. The range of subjects which they cover is no longer confined even within

FIG. 1.—Margin of Atrevida Glacier west of Esker Stream. Trees being buried by the ice.

the spacious limits of geology, palæontology, petrology, mineralogy and physiography;—it has overspread into many cognate branches of applied science, such as analytical chemistry, hydraulics, mechanics, engineering, metallurgy and mineral statistics.

The three handsome memoirs before us are good examples of the broad spirit in which the work is carried out; each, while dealing primarily with a particular district, is a notable addition to our knowledge of the continent as a whole; and each finds room for matter likely to be interesting to any educated reader, along with that which appeals directly to the specialist. In the first and third, the physio-

[1] Professional Papers of U.S. Geological Survey. (Washington, 1909.)
(1) No. 64. "The Yakutat Bay Region, Alaska: Physiography and Glacial Geology." By Ralph S. Tarr; "Areal Geology." By R. S. Tarr and Bert S. Butler. Pp. 183; with 37 plates and 10 figures.
(2) No. 66, "The Geology and Ore Deposits of Goldfield, Nevada." By F. L. Ransome, assisted in the field by W. H. Emmons and G. H. Garrey. Pp. 258; with 2 maps, 33 plates and 34 figures.
(3) No. 67, "Landslides in the San Juan Mountains, Colorado, including a Consideration of their Causes and their Classification By E. Howe. Pp. 58; with 20 plates and 4 figures.

graphical study of the subject is made paramount; in the second, petrology, mineralogy and mining receive the fullest treatment.

(1) Of especial interest is the professional paper first on our list, containing the results of Prof. Tarr's recent investigation of the great glaciers in the Yakutat Bay region of Alaska. We may congratulate ourselves, and Prof. Tarr also, on the happy mischance which took him to this region at a critical time in the history of its ice-fields.

Ever since the famous explorations of the late Prof. I. C. Russell, twenty years ago, we have known that where the greatest of these ice-rivers left the mountain valleys and deployed as "piedmont" glaciers on the low ground bordering the ocean, they were characterised by their peculiarly stagnant condition. The anomaly of dense living forests covering their surfaces over large areas where the ice was hidden beneath a thick blanket of moraine was one of the many surprises brought to our knowledge by Russell; and later investigations confirmed the idea that in such cases the ice was truly "dead" and would remain where it was, a waning relic of severer bygone times, until gradually dispersed by liquefaction.

Such was still the state of affairs when Prof. Tarr began his survey-work in the region in the summer of 1905, and he confidently planned a programme for the following year which depended for its fulfilment on the "deadness" of the ice. On his return in 1906 he was naturally astonished to find that all was in a turmoil of change—familiar features obliterated—routes impossible. The "dead ice" in many places had sprung to life again—the plains that had formed the highways of former travel were broken into an impenetrable wilderness of crevasses—the blanket of moraine was sliding out of sight into the yawning chasms—the green forests that covered it were sharing the same fate—the snouts of the glaciers were being thrust forward destructively into the timbered belt surrounding them—the enormously augmented streams issuing from the ice were impassable, and were flinging out huge delta-fans that buried everything in their path; and, altogether, nature in one of her most vigorous moods was enacting a grand transformation scene on the lonely shores of Yakutat Bay. All the eastern portion of the great Malaspina Glacier was a maze of crevasses, and its end—formerly an easy slope—an insurmountable cliff of tumbling ice, trees, and moraine. The Atrevida (see Fig. 1), the Variegated, the Marvine and the Haenke Glaciers were in the same state of rapid disruption; while others, including the Lucia and the Seward, though not so fully aroused, showed symptoms of impending change.[1]

FIG. 2.—View looking west from Hidden Glacier showing the Fosse and the Pitted Plain.

Yet there were other glaciers in the region that had not participated in this energetic outburst, but still kept to the habit of recession which had been regarded as the normal behaviour of all these Alaskan glaciers.

Here, then, was the unexpected problem that confronted Prof. Tarr in 1906 and richly recompensed him for the destruction of his original plans. His solution of it is remarkably simple, and seems to fulfil all the conditions. It is well known that in 1899 the region was affected by a sharp earthquake, which caused displacements recognisable on the coast-line

[1] In the *National Geographic Magazine* for January last Prof. Tarr and Prof. L. Martin give an account of their later visit to the region in the summer of 1909, when further changes were noted. The Lucia Glacier had become unpassable; the Hidden Glacier had undergone the full cycle of change; the Hubbard seemed to be on the eve of great movement; while the four mentioned above as active in 1906 had relapsed into stagnation.

and shook up the famous Muir Glacier so thoroughly that its seaward end was disintegrated, filling Glacier Bay with icebergs that barred out all shipping for some years. Prof. Tarr gathered evidence proving that the earthquake brought down huge avalanches of snow and rock from the mountain-sides into the glacier-basins, and he considers that the sudden accession of material has exerted a thrust which has swept slowly forward as a wave throughout the length of the glaciers. He strengthens his conclusion by showing that, at least in some cases, the unaffected glaciers are those fed from gentler slopes from which avalanches would be less likely.

The explanation raises many knotty points in the still imperfectly understood physics of glacier-movement, while the new facts constitute a very important element to be taken into account in all future discussions of ice-flow. In reading the descriptions we are reminded of the abnormal conditions found by Garwood and Gregory in the Booming Glacier of Spitsbergen (Quart. Journ. Geol. Soc., vol. liv., 1898, p. 207), and of the rapid advance and subsequent recession of the Hispar Glacier in the Karakoram Range (*Geographical Journal*, vol. xxxv., February, 1910, p. 108). Is it possible that a great mass of ice may become suddenly more mobile when its temperature as a whole reaches some critical point short of the melting stage? The glacial geologist could find ready application for some such proposition if it were presented to him with the requisite Q.E.D.

Besides these features of central interest, Prof. Tarr describes many other phenomena that will arrest the attention of the geologist; for example, the rock-channels cut by streams running along the margins of glaciers, which remind us of the old "overflow channels" lately recognised in many parts of Britain and Ireland; the "pitted plains," where morainic deposits have been spread out by streams in great "apron-fans" incorporating hidden masses of ice (see Fig. 2); the sudden slipping of a small mountain-glacier *en masse* from its high corrie into the waters of Disenchantment Bay, causing huge waves that swept destructively on to the land; and the spread of vegetation over the areas abandoned by the ice. His re-discussion of the efficacy of the glaciers as erosive agents should also be read by everyone who has shared in the long debate on this subject. The memoir concludes with a short account of the solid geology of the region, which is of less general moment.

We have scant space in which to deal with the other two memoirs, and must perforce dismiss them summarily.

(2) Mr. F. L. Ransome's monograph describes an area around Goldfield, on the hilly desert-plateau country near the border of south-western Nevada, which has recently sprung into prominence as a gold-mining centre. His historical narrative has a touch of romance in it—vast treasure lying close to the surface, yet passed over again and again by eager prospectors; then, in 1902, discovery—excitement—and disappointment; in 1903–5, renewed search crowned by success; great fortunes rapidly made and lost in the wild boom and its reaction, the feverish activity culminating in a fierce labour dispute which necessitated the calling up of federal troops at the close of 1907; and finally, the consolidation of interests and the systematic ransacking of the ground. It is estimated that the value of the precious metals recovered during the years 1904–7 from this small field was close upon 20,000,000 dollars.

As for its geology, the field is a low dome-like uplift of Tertiary lavas with associated lake-sediments, resting upon a sparingly-exposed foundation of ancient granitic and metamorphic rocks. The ore-bodies, apparently deposited in late-Tertiary times from "acidified" solutions at no great depth, are remarkable alike for their richness and for their irregularity. The structure, origin and mineralogy of the lodes, and the petrology and chemical composition of the rocks are fully discussed, and beautifully illustrated in the plates. In respect to the eruptive sequence, the author finds no proof of the regular order which J. E. Spurr has sought to establish for the lavas of the Great Basin. In criticising this scheme the author remarks:—"To some minds the conformity here shown may appeal as corroborative, but to others, impressed by the scanty representation of the numerous members of the ideal succession in any given locality, the capacity of the scheme for assimilating not only observed sequences, but imaginary ones, raises doubt whether it really represents natural processes" (p. 105). The criticism might be applied to many another ingenious scheme in science.

(3) The San Juan Mountains in south-western Colorado, like most steep mountains of similar structure, have been subject in the past, and are still subject, to extensive landslips. Many examples of these slips, both ancient and modern, are fully described by Mr. E. Howe in the third paper on our list, and are pictured in many fine plates which almost make description superfluous. A massive series of Tertiary volcanic rocks, often carved into huge cliffs, rests on a yielding base of soft Cretaceous shales; and, among the older sedimentary formations, are thick Palæozoic limestones resting on friable shales and sandstones. Attention is particularly directed to the curious "rock-streams" which have their origin in the high cirques; and to the influence of snow banks on the accumulation of talus at the foot of cliffs. The memoir concludes with a somewhat laboured classification of landslides in which foreign examples and their literature are freely cited.

G. W. L.

MOUNTAINEERING IN THE NORTH-WEST HIMALAYA.[1]

ONE would hardly suppose, after reading this simply-told narrative of physical achievements, that the senior member—and shall we say, with Mrs. Workman's permission, leader—of the party among the peaks and glaciers of the Nun Kun group was compelled some years ago to retire from his medical practice on account of ill-health. Evidently, at great altitudes, where the vitality is lowered by insomnia attending deficient oxygenation, and where mental depression and attacks of irresolution follow a disturbed circulation, the successful explorer depends wholly on having his muscles under the complete control of a resolute mind for that last supreme fight against the irresistible instinct to descend to his natural environment. The Arctic explorer can sleep, can eat, and is the better for work to do; the mountain climber handicaps himself by his load of protective non-conductors; his respiratory difficulties are increased when in the only position of rest left to the biped, and every momentary doze through sheer exhaustion is terminated by frantic efforts to avoid the intolerable feeling of suffocation. Anyone who has experienced these troubles, which beset all climbers—even the lucky few who are proof against mountain sickness—will admire the mental as well as the physical qualities of the altitude record-breaker; for, judging by the recent sordid controversy among Arctic ex-

[1] "Peaks and Glaciers of Nun Kun: a Record of Pioneer-Exploration and Mountaineering in the Punjab Himalaya." By Fanny Bullock Workman and Dr. W. H. Workman. Pp. xv+204. (London: Constable and Co., Ltd., 1909.) Price 18s. net.

plorers, "records" have still a market value among geographers.

Although previous achievements of mountain climbers are now eclipsed by the Duke of the Abruzzi's record of 24,853 feet in the Karakorum, the exploration of the Nun Kun group by the authors of this work is likely to remain for long of special interest, on account of the circumstance that Mrs. Workman broke even her own record for women by scaling the Pinnacle Peak of 23,300 feet. The reference to this feat, however, is but a passing incident in the narrative, less drawn-out, in fact, than the accounts of the perky eccentricities of the irrepressible, pugnacious little cock of the poultry-yard—the clown of the party, who, like the indispensable figure among the acrobatic performers of the circus show, "talks all the time," as the Kashmiri *khansamah* remarked.

swadeshi are among those that exemplify new varieties of well-known type difficulties that are invariably "discovered" by non-official travellers in the Indian region; but, in the present instance, the few difficulties faced and overcome are not of the kind which travellers' descriptions often naïvely show to the experienced Anglo-Indian to be due to the travellers' own stupidity and ignorance of local affairs.

The additions to topographical knowledge need not be reviewed; they will be fully appreciated by officers of the Indian Survey Department, who are more conscious than their critics suppose of the shortcomings of their maps in regions which are of little direct concern to their master, the tax-payer, who has as much right to be considered as the sportsman and traveller. The authors made the experiment of taking out six experienced Courmayeur porters under an

View at sources of Hispar Glacier at 17,000 feet. In foreground avalanche-nieve-bed, pinnacles mostly formed from avalanche-blocks. In middle-ground broken, horizontally stratified ice-masses. Behind these ice-wall covered with parallel subsidence-*névé*-ridges orienting with slope. In background southern Hispar boundary mountains. Reproduced with the permission of Dr. W. Hunter Workman and Mrs. F. Bullock Workman. From "Peaks and Glaciers of Nun Kun."

The book is not a mere narrative of travellers' experiences in a little-trodden region; it discusses definite and valuable additions to geographical knowledge; important topographical corrections are made on the Survey Atlas quarter-sheet No. 45 S.W.; one-fifth of the text is devoted to the character and origin of the different varieties of ice prominences on the *névé*-surfaces and glaciers, and on the glaciers below the *névé*-line; the principal part of a chapter is devoted to a discussion of the immediate physiological effects of high altitudes; while the extremely high temperatures in sunlight at high levels and the great diurnal variations are all precisely recorded. Incidents of human interest on the journey are not forgotten—the moral weaknesses of the Kargil coolie and the price of the Wazir's devotion to the cause of

expert guide, to replace the local coolies for work at high altitudes, where muscle alone is of little service, and this innovation has now been imitated by the Duke of the Abruzzi with successful results. The disturbing uncertainty of the malingering coolie being eliminated from the problem, Dr. Workman was able, with his trustworthy porters, to make satisfactory deductions from observations regarding the altitude limitations of human activity; and he shows that, in addition to the special danger of mountain sickness as a precursor of frost-bite, insomnia and the distressing moral and physical sequelæ of imperfect oxygenation may be sufficient alone to fix the stress-limit of the human organism at something distinctly below the greatest Himalayan heights.

The curious *nieves penitentes* first described by explorers in the Andes have been recognised by the authors also in the Himalayan region, though their conclusions have not been completely accepted by other travellers. They, however, bring together in this work observations made in the Nun Kun area during 1906, as well as others made before and since in other parts of the north-west Himalaya, and have a right, consequently, to generalise on the phenomena. The prominences grouped under the name *nieve penitente* are often roughly pyramidal in shape, and generally disposed in rows on snow and ice at altitudes at which the night temperature falls below the freezing point; they are due to the unequal melting of the superficial layers of snow and ice. The authors describe in detail eight varieties of *nieves penitentes*, which, judging by the descriptions given, might have been divided into the following two groups:—(i.) Those that are the outward and visible expression of an internal heterogeneity of physical structure induced in the snow and ice by (1) the scoring action of avalanches with a trend parallel to the dip-slope; (2) the shearing effects of slower subsidence along the slopes; (3) the development of pressure waves by the wind; and (4) the more or less regular fracturing on seracs. (ii.) Those that are due to the disposition of various adventitious covers, such as (5) thin patches of earthy material arranged by the wind, and of a kind facilitating the absorption of the sun's heat with consequent melting of the subjacent ice; (6) heavy rock-masses, which compress and protect the ice, giving rise, by melting of the clean ice around, to the well-known glacial tables; (7) thick layers of earthy material, having a protective effect similar to that of the large rock fragments, but giving rise to differently shaped prominences on account of the disintegration and fall of the marginal parts of the covers; (8) water-covers in depressed areas, where silt is deposited unequally on a previously sculptured surface. These phenomena have been discussed in greater detail by Dr. Workman in special papers published in the *Zeitschrift für Gletscherkunde* and in the *Alpine Journal*.

A notice of this book would not be complete without reference to the remarkably fine photographic plates with which it is illustrated, although the illustrations, specially selected to demonstrate the phenomena of *nieve penitente*, and perhaps the best in the book, are taken from other areas, mainly from the Hispar and associated glaciers, further north-west, in the chiefship of Nagar. One of these is here reproduced.

T. H. HOLLAND.

THE EAST AFRICAN NATURAL HISTORY SOCIETY.[1]

THERE has been founded in British East Africa a society for the study of natural history, and the activities of this society naturally extend to the adjoining Uganda Protectorate. This society recently produced the first number of a Journal, which, it is to be hoped, may run to many volumes if conducted on the lines of its first number. Mr. C. W. Hobley, C.M.G., a prominent official of British East Africa, whose service there dates from the earliest days of the British East Africa Chartered Company, has taken a considerable part in the founding of this local natural history society, and is one of the contributors to the first number of the Journal. Mr. Hobley's work in anthropology, in East African languages, in geology, in the exploration of the aquatic fauna of Lake Victoria Nyanza (it will be remembered that he was the first, or one of the first, to discover in that lake organisms akin to the supposed marine fauna of Lake Tanganyika, thereby lessening the acuteness of that problem), has been so remarkable that his association with the Natural History Society should be productive of interesting results.

[1] The Journal of the East Africa and Ugnada Natural History Society. vol. i., No. 1, January, 1910. (London: Longmans, Green and Co., 1910.) Price 5s. net.

This first number contains a very well-executed coloured illustration of a new species of francolin (*Francolinus hubbardi*). This accompanies an article on the francolins of East Africa and Uganda, which to ornithologists is of real value. The scope of this article also includes the allied genus Pternistes. Mr. Battiscombe gives some new and interesting information regarding the flora of British East Africa. There are several small errors in the nomenclature of this article; *Lobelia johnstoni* is given as *Lobelia johnsonii*; *Kniphofia thomsoni* appears as *K. thompsonii*, and *Musa livingstonii* is given as *M. livingstonia*. The generic name Sanseviera is misspelt—a very common fault in books dealing with Africa. But these are trifling defects in an account of East African botany which is of considerable interest.

The Rev. K. St. A. Rogers writes on East African butterflies. There are notes on the haunts and habits of the elephant on the Guas' Ngishu plateau by Mr. Hoey, and Mr. C. W. Hobley contributes two articles, the more important of which, from the point of view of new information, is that dealing with the Kariandúss deposits of the Rift Valley—deposits which form beds of a mealy, friable rock, amounting perhaps to millions of tons of diatomite. This is a siliceous deposit, principally of organic origin, mainly composed of the skeletons of minute, lowly plants—diatoms or bacillariæ—mere cells of green or brown protoplasm originally, which enclose themselves in a flinty casing fitting together like a box and a lid. Diatoms are, of course, found in fresh-water ponds and salt seas all over the world. Mr. Hobley considers the Rift Valley to have been the scene of tremendous volcanic activity from Tertiary times onwards, and that at one period in its history this enormously long depression in the surface of East Africa was covered by much larger lakes than at the present day. These beds of diatomite are the result both of the existence of these sheets of water and of the neighbouring eruptive volcanoes.

"Picture Suswa, Longenot, and Eburu all periodically in active eruption, and in addition to lava flows ejecting great clouds of volcanic dust and streams of mud mainly composed of siliceous fragments. This is almost certain to have been thus, as is the case in all volcanoes of this kind: the steam tearing its way through the magma which formed the flows of obsidian and trachytic tuffs would naturally blow large quantities into a state of very fine division, and this would be spread far and wide by the wind and also carried into the lakes by the torrential downpours which always accompany volcanic activity. The soda-laden water would dissolve the silica and place it ready for the diatoms to work upon, and with such rich material to build with one can quite see that this form of life could flourish with great luxuriance."

Mr. Hobley considers this diatomite or kieselguhr may be of some economic value. H. H. JOHNSTON.

NOTES.

THE Astley Cooper prize for 1910 has been awarded to Prof. E. H. Starling, F.R.S., for an essay upon the physiology of digestion, gastric and intestinal.

THE Mackinnon studentship in physical sciences has been awarded by the Royal Society for a second year to Dr. R. D. Kleeman for the continuation of his researches on radio-activity; and the studentship in biological sciences has been awarded to Mr. T. Goodey for an investigation of the protozoa of the soil.

THE council of the Royal Society of Edinburgh has awarded the following prizes:—(1) The Neill Prize for the biennial period 1907–8, 1908–9, to Mr. F. J. Lewis, for his papers in the society's Transactions "On the Plant Remains in the Scottish Peat Mosses." (2) The Keith Prize for the biennial period 1907–8, 1908–9, to Dr. Wheelton Hind, for a paper published in the Transactions of the society "On the Lamellibranch and Gasteropod Fauna found in the Millstone Grit of Scotland."

THE U.S. Congress has passed a bill granting 10,000*l.* to establish a biological laboratory for the study of diseases of fish, especially those related to cancer. The station is, says *Science*, to be established under the U.S. Fish Commission.

THE committee of the science section of the Japan-British Exhibition has issued invitations to an inspection of the collections at the White City to-morrow, July 22, at 3.30 p.m.

THE Geneva correspondent of the *Times* announces the death, at sixty-four years of age, of Col. Georges Agassiz, nephew of the famous naturalist. After completing his studies at the University of Lausanne, Col. Agassiz spent several years in America with his uncle in scientific work and researches. Recently he presented to the Cantonal Museum at Lausanne his collection of butterflies, numbering 18,000 rare specimens.

IT is stated that a bill is to be introduced into the French Parliament making Greenwich time compulsory instead of Paris time, which differs from it by about nine minutes. If the bill becomes law, France will thus be brought into line with the zone system of referring time to meridians differing by an integral number of hours from the Greenwich meridian. It is thus not so much a question of one country adopting the time standard of another as it is of France accepting an international system of time reckoning. M. Millerand, Minister of Public Works, has been asked by the French Cabinet to support the proposal to substitute Greenwich time for the time of the Paris meridian when the matter is brought before parliament.

IN the House of Commons on Tuesday, a bill "to prohibit the sale or exchange of the plumage and skins of certain wild birds" was brought in and read for the first time. In introducing the bill, Mr. P. Alden said that the object of his bill is to try to prevent the absolute extinction of a few rare birds. The bill that passed the House of Lords in 1905 prohibited the importation of the plumage of almost all birds. Mr. Alden includes in the schedule of the present bill only a few birds that are on the point of extinction, but which may be saved if this bill, or a bill drafted by the Board of Trade, be passed into law within the next year or two. There is a law in Australia to prevent the export of the plumage of certain rare birds, one of which is the emu, yet last year more than one thousand emu skins were catalogued for sale in London—all smuggled out of Australia. A number of species of humming birds are almost extinct. In Trinidad the number of species has been reduced from eighteen to five. The skins of 25,000 bumming birds have been catalogued for sale in London during the past year.

WE learn from *Science* that the University of Southern California, at Los Angeles, has established recently a marine biological station at Venice, Cal. The station is on the nearest beach to the university, some thirteen miles distant. It comprises an aquarium consisting of forty tanks with running sea water, and a series of laboratories for class work and research. The laboratories, which face the north, are provided with sea water and fresh water. The station is designed to afford: (1) facilities for demonstration to classes studying marine life; (2) opportunity for the students of the university to carry on advanced work in marine biology; and (3) a limited number of research laboratories, some of which are available, without cost, to investigators who are prepared to carry on research work in some of the phases of marine biology.

THE programme of papers and of demonstrations drawn up for the International Zoological Congress, to be held at Graz next month, includes a great variety of subjects. Prof. Boveri promises an address on Anton Dohrn; Prof. Delage will give an account of experimental parthenogenesis. Embryology will be treated by Profs. Lee, Julin, and Hubrecht. The geographical distribution of several groups of animals will be discussed, more particularly the cave-fauna of Carinthia. Prof. Gaupp will deal with the affinities of the Mammalia, Dr. Keller with the origins of domesticated races, and there are also many other memoirs promised that will attract workers in protózoology, genetics, and experimental embryology. The Graz meeting should prove a very successful one.

IT is officially announced that a submarine telephone cable of a novel type was recently laid across the Channel from Dover to Cape Grisnez by the British Post Office, in order to improve telephonic communication between this country and France, and also to determine the limits of possible improvement by the use of a new type, with a view to its application to telephonic communication between places which have hitherto been beyond telephonic range. This is the first cable of the kind laid in tidal waters and across the open sea, although a similar cable was previously laid in the Lake of Constance. The new cable will be brought into regular use as soon as the corresponding French land lines are completed, but the tests so far made have given very satisfactory results. The electrical conditions of submarine cables make telephonic communication through them difficult as compared with such communication carried on over land lines, and any improvement in their efficiency will have a marked effect in extending the distance through which telephonic speech is possible, and this more especially when the cable forms a considerable part of the total length of line through which communication has to be effected. In the case of the new cable just laid, the efficiency has been increased more than three times beyond the value which it would have if it had not been specially treated. This improved efficiency is due to the insertion of "loading coils" in the cable at intervals of one nautical mile. The coils reduce the distortion of the current impulses which correspond to the spoken sounds, and so render the speech more distinct.

IN the fourth number of the fifty-sixth volume of the Smithsonian Miscellaneous Collections Captain F. Schmitter, of the Medical Corps, U.S. Army, publishes a set of rough notes on the customs and folk-lore of the natives of the Upper Yukon, Alaska. It is remarkable that they are partly in the age of stone and partly in that of copper. The hammers which they use to break up bones for cooking and for making arrow-heads are rude lumps of stone, and of the same material are the axes which, at any rate up to quite recent times, they employed for cutting down trees; but their hunting-knives are of bone, ground flat, and sharp on both sides, or of copper welded in a similar fashion. Their chief weapon, the spear, is made by binding a hunting-knife of caribou horn to a pole 6 feet long.

In a paper recently read before the Royal Society of Arts (see p. 58), Captain A. J. N. Tremearne discusses the origin of that remarkable African race, the Fulah or Filani. The view which he finally adopts is that the tribe arose somewhere in the Central Sudan from the union of Berber males with negro women; that with this mixture of race a mixed dialect came into use, combining Berber, Arabic, and Bantu elements. In process of time this mixed race separated from the Berbers and formed various groups, one going east and south, and becoming the Wahuma, another migrating west to Morocco, and a third, moving south, became the Fans. The quasi-Semitic origin of the tribe has produced a spirit of nationality, and some of their legends now connect them with a Jew or Arab progenitor. At present they form the aristocracy of the Hausa States in North British Nigeria and in French territory to the south and west, their head being the Emir of Sokoto. They are a people with great possibilities, and will doubtless take a high place in West Africa when once they frankly accept British and French supremacy.

The Glastonbury Antiquarian Society has arranged for the publication of a work containing a full description of the excavations at the Glastonbury lake-village, by Mr. Arthur Bulleid and Mr. H. St. George Gray, with an introductory chapter by Dr. R. Munro. The work will also contain reports on the human and animal remains, bird bones, botanical specimens and seeds, and metal, by Prof. W. Boyd Dawkins, F.R.S., Dr. C. W. Andrews, F.R.S., Mr. Clement Reid, F.R.S., and the late Dr. J. H. Gladstone, F.R.S. The Glastonbury lake-village is regarded by archæologists as of primary importance in the history of pre-Roman Britain, giving as it does a vivid picture of native life before the arts of Rome penetrated to the west of England. The village is of the crannog type, the habitable area of about 3½ acres, originally in the middle of a mere, including some eighty dwellings surrounded by a border-palisading. The occupation of this area continued long enough to allow 5 feet of peat to accumulate in some parts during the occupation. The village had its origin in the early Iron age, and has contributed largely to our knowledge of the arts and industries of late Celtic times. The editors hope to be able to publish vol. i. of the work upon the excavations before the close of 1910. Vol. ii. will follow as soon as possible after vol. i., and probably within eighteen months. The work will resemble somewhat in style that of General Pitt-Rivers's "Excavations in Cranborne Chase." Any inquiries regarding the work should be sent (with stamped addressed envelope) to Mr. H. St. George Gray, Taunton Castle, Somerset.

The Dominion Museum at Wellington has issued a hand-list of New Zealand birds, including stragglers, and the first and second parts of a hand-list of New Zealand Lepidoptera.

We have received a copy of vol. vi., No. 9, of the University of California Publications in Zoology, containing a preliminary report, by Mr. G. F. McEwen, on the hydrographical work carried on by the Marine Biological Station at San Diego. Work of this nature was the main reason for the foundation of the Marine Biological Association of San Diego, but various causes prevented its being taken up in earnest until the summer of 1908, when the writer of the report before us became a member of the staff of the station, whose duty it should be to take charge for some portion of the year of water-investigations. The work of 1908 consisted of determinations of the temperature and density of the waters of the Bay of La Jolla and the ocean, the area covered lying between 33° 20′ and 32° 30′ N. lat., and extending from the coast to 118° 30′ long. In addition to this, two trips were made to the Cortez Banks, and a third to a point some distance south of Cerros Island. The methods of work and some of the results obtained are recorded in the report.

Some remarkably fine skeletons of plesiosaurians from the Upper Lias of Holzmaden are described by Dr. E. Fraas, of Stuttgart, in vol. lvii. of the *Palaeontographia*. The author directs attention to the rarity of plesiosaurian remains in the German Lias as contrasting strongly with what obtains in the corresponding English formation. The latter indicates that these saurians were relatively abundant in the Liassic seas, although they did not, in all probability, congregate in such large shoals as the commoner species of ichthyosaurs. The majority of the English specimens come, however, from the Lower Lias of Lyme Regis, Street, and Charmouth, an horizon represented by a different type of strata at Holzmaden. Dr. Fraas refers his specimens to *Plesiosaurus guilelmi-imperatoris*, first named by Prof. Dames in 1895, and to a new species of Thaumatosaurus, which it is proposed to call *T. victor*. So perfect are the remains that they admit of restored figures of the skulls of both species being given. *T. victor* was about 10 feet in length, with a relatively small head, short and thick neck, very plump body, slender and nearly equal-sized paddles, and a very short and powerful tail.

In the Bulletin of the Johns Hopkins Hospital for June (xxi., No. 231) Dr. Corson contributes an interesting biography of Sir Charles Bell, who did so much to elucidate the structure and functions of the nervous system, and whose "Anatomy of Expression in Painting" has remained a classic. Dr. Walker describes glandular structures hitherto supposed to form part of the prostate gland in rats and guinea-pigs, which, however, differ entirely in structure from the latter, and the secretion of which coagulates the secretion of the seminal vesicles when mixed with it. This coagulation is produced by a very minute quantity of the secretion, 1 part to about 21,000 parts of the secretion of the seminal vesicles being sufficient to produce the reaction. The active principle presumably belongs to the class of ferments.

It is a pleasure to note the excellent manner in which the natural history of the American State of Connecticut is being worked up, and the results recorded in a series of pamphlets entitled "Bulletins of the State Geological and Natural History Survey of Connecticut." Five geological and five botanical bulletins have been issued, the last (No. 14) being devoted to a catalogue of flowering plants and ferns. A committee of six members of the Connecticut Botanical Society is responsible for the work, which has been compiled with great care. The list enumerates 1481 native and 461 introduced species, besides which 286 varieties and forms are recognised. The Cyperaceæ, Gramineæ, and Compositæ stand out as the largest families. Aster is the largest genus, and also one of the most interesting, as the native species include such useful horticultural types as *laevis, novae-angliae, novi-belgii, ericoides, longifolius*, and the rare *concinnus*; Solidago, another large genus, also provides the original types of some garden plants. The critical genera, Cratægus and Rubus, contribute to the size of the rose family, and the number of Violas is remarkable. Among the ferns, eight species of Isoetes and six of Botrychium are recorded.

The current number of the Bulletin of the Department of Agriculture, Jamaica (vol. i., No. 3), maintains the high standard set by the two previous issues. Mr. R. Newstead contributes a valuable article on the ticks and other blood-sucking Arthropoda of Jamaica, describing their life-history and the methods adopted in attempts to exterminate them. It appears that ticks are most prevalent during the dry winter months, and that relatively few are found during the rainy season. As a rule the ticks infest cattle, but one much dreaded species, Chrysomyia (Compsamyia), attacks man; a case of myiasis thus produced is mentioned. This tick often passes its larval stages in putrid carcases, and is no doubt kept in check by the scavenger work of the John Crows (*Cathartes aura*), which remove practically all traces of carrion from man's habitations. From an article by the Hon. H. E. Cox, it appears that tea is now being successfully grown on the island; the Cinchona strain is used, and yields a tea of mild character similar to the old China teas and without astringency. There is also a useful history of the economic plants of Jamaica by Mr. Harris.

The twenty-second annual report of the Agricultural Experiment Station, Lafayette, Indiana, chronicles several important events in the history of the station. The old buildings having proved insufficient, new ones were erected, and were formally opened during the course of the year. Still more important, however, was the provision of further funds, necessitated by the rapidly increasing demand from the farmers of the State for information on the lines of the work already being done. So strong was the demand that the General Assembly amended the Smith Act of 1905, whereby the station annually receives 25,000 dollars, and increased the State subvention to 75,000 dollars annually, to be expended as follows:—10,000 dollars for the general work of the station, 15,000 dollars for the improvement of the crops and soils of the State, 10,000 dollars for the advancement of the dairy interests, 10,000 dollars for the advancement of live-stock interests, 5000 dollars for the investigation of hog cholera and other diseases, 5000 dollars for poultry problems, and 10,000 dollars for extension work; and the Act concludes:—"Whereas an emergency exists for the immediate taking effect of this Act the same shall be in effect from and after its passage." The extension work includes the distribution of copiously illustrated bulletins dealing with important problems, a number of which we have also received; the provision of special trains to carry lecturers through the country, teaching as they go; attendance at shows, and so on. With such liberal support it is not surprising that much good work is done.

Mr. Robert M. Brown contributes an interesting series of diagrams to the Bulletin of the American Geographical Society (p. 107) showing the maximum, minimum, and average levels of the waters of the Mississippi system at five stations—Hannibal, on the Mississippi; Hermann, on the Missouri; St. Louis, just below the confluence of the Mississippi and Missouri; Cairo, on the Ohio; and Memphis, Tennessee. The varying influence of the different types of rainfall occurring in different parts of the drainage area is very clearly shown.

Mr. H. T. Barnes, Macdonald professor of physics, contributes an interesting paper, with excellent illustrations, to the Proceedings of the Undergraduate Society of Applied Science of McGill University, Montreal, on the problems of winter navigation on the river St. Lawrence. Experience shows that, with Lake St. Peter free of ice, a continuous open channel above that point may be safely predicted, for the river is continually struggling to free itself of its icy burden. Prof. Barnes suggests that it would be quite possible to keep the ice-bridge broken up at the foot of Lake St. Peter and at the Sorel Islands, and that the lake itself could be kept nearly free of ice. One ice-breaker could keep the river clear at the Sorel Islands as well as at Port St. Francis, and this, with one powerful ice-breaker at Quebec, would effectively keep the ship channel open. The ice-problem thus solved, Montreal would inevitably become one of the greatest seaports in the world.

We have received from the author reprints of two papers by Mr. E. A. Birge, published in the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters. In the first Mr. Birge discusses a hitherto unregarded factor in lake temperatures. The heat of the sun is mostly delivered to the surface strata of a lake, and distributed to the depths by various agencies, chief of which is the wind. The efficiency of the wind as a distributing agent is opposed and limited by thermal resistance to mixture offered by the decreased density of the warmed surface water, and Mr. Birge brings forward evidence to show that the effectiveness of this thermal resistance increases as the temperature of the water departs from the temperature of maximum density, and decreases as it approaches 4° C. The second paper contains a review of the evidence adduced by Wedderburn in favour of the existence of temperature seiches in lakes, which leaves the author unconvinced.

Mr. T. S. Ellis has published a pamphlet on "The Winding Course of the River Wye" (Gloucester: Bellows, price 1*s*.), in which he expresses his views on the origin of adjacent river-systems. He regards valleys divided by cols at their heads as having originally formed a continuous channel, the two sections becoming separated when main systems tended to develop on either side. He does not seem to appreciate sufficiently the effects of rain, frost, and continual land-slide action in the cutting back of valley-heads, but represents geologists as attributing the removal of cols solely to erosion by the young streams flowing from them. On p. 9 he comes very near to the bold suggestion of Mr. A. W. Rogers, that a winding rock-ravine may record the original meanders of the river in alluvium at a higher level.

The nature of intermetallic compounds is discussed by Dr. T. Slater Price in vol. iii. of the Proceedings of the Birmingham Metallurgical Society, which has made a somewhat belated appearance. The paper in question was read in January, 1909, and contains a list of 120 of these curious compounds, more of which are described every month. Among the laws of their formation, it is claimed that the metals forming a sub-group of the periodic system do not form compounds with each other, and, further, that any particular metal either enters into combination with all the metals of a sub-group or else it does not form compounds with any of them. Those sub-groups in which there is a change from metalloid to metal, as in the case of As, Sb, Bi, form an exception to the rule. The valencies of the metals in their compounds seldom correspond with the ordinary valencies, only thirty bodies out of the 120 enumerated showing this agreement, and of these, twelve are compounds of antimony, which approaches the metalloids in its characteristics. Among the compounds there are some very remarkable formulæ, for which no explanation is offered. For example, the formulæ $NaZn_{12}$, $NaCd_5$, $FeZn_7$, $NiCd_4$, and $AuSb_2$ have a strange appearance. Among other summaries of the state of knowledge on particular subjects, there are interesting articles by Mr. A. H. Hiorns on copper-nickel alloys, and by Prof. Arnold on the testing of metals.

THE problem of determining the vertical motion of the air during a balloon ascent is complicated by the fact that the balloon itself is in motion. Measurement of the variation of the barometric pressure at the balloon has, however, proved a trustworthy means of determining the vertical motion of the balloon, and the further problem of recording the relative vertical motion of the air with respect to the balloon appears to have been satisfactorily solved by an instrument described by Mr. P. Ludevig in the *Physikalische Zeitschrift* for June 15. It consists of light anemometer vanes which can rotate about a vertical axis. The spindle carries a thin, hollow brass cylinder through which six holes are punched, each pair at opposite extremities of a diameter, two near the top, two near the middle, and two near the bottom of the cylinder. The diameters are inclined at 60° to each other. Light can pass through, say, the central pair of holes when they happen to be in the direct line between a source and a moving strip of photographic paper, and a spot is registered. According to the direction of rotation of the cylinder, the spot next registered may be the upper or lower, and the speed of rotation determines the distance between the spots. An examination of the strip allows the speed of the air with respect to the balloon at any instant to be calculated if the speed of the strip is known.

THE Ontario Government announces that the system organised for the distribution of power from the Niagara Falls will be in operation for the supply of Toronto, London, and St. Thomas by the end of the year. The most distant of these places is about 100 miles from the Falls, and the transmission will be at 100,000 volts. The electrical energy will be bought from the existing Canadian generating stations by the various municipalities, which will effect the distribution by new transmission lines extending over a wide area. By this means cheap power will be available for manufacturing and agricultural purposes, and it is hoped that a network of new tramways will be constructed which will not only improve travelling facilities, but also act as a means of bringing agricultural produce to the towns. A system of distribution of this kind should be of particular value in Canada, seeing that the supply of coal is deficient. The municipalities will not themselves own the tramways, lighting and power companies, but private companies will be formed to effect the final distribution of the power, and the control of the price charged to the consumer will rest with the municipalities in virtue of their ownership of the transmission lines. The cost of carrying out the above scheme will be defrayed by an issue by the Provincial Legislature of bonds redeemable at the end of forty years.

MESSRS. TOWNSON AND MERCER have submitted for our inspection a technical thermometer based on a novel principle. This consists of a metallic bulb containing liquid, and connected by narrow copper tubing with a pressure gauge. The gauge index responds to the variations in pressure of the contained vapour, and this depends upon the temperature of the bulb. The dial of the gauge can therefore be graduated in degrees instead of pressures, and is thus made into a direct-reading thermometer. The indications may, of course, be automatically recorded, as in the case of an ordinary aneroid barometer. The indications depend only upon the temperature of the bulb; they are independent of the temperature of the gauge, *which may be any distance away*, the air in the capillary tubing forming the connecting link which transmits the pressure of the vapour in the bulb. Damage to the bulb or capillary tube does not interfere with the accuracy of the indications; the bulb and tube may, in fact, be twisted or bent in any way which leaves them intact and does not prevent free communication of the vapour pressure. It will be seen at once that the thermometer possesses qualities which no other thermometer of the same simplicity can claim, and the result is that it is rapidly being adopted in works of all kinds where long-distance thermometry is advantageous. For example, in a single cabin of a ship may be dials indicating the temperature in any part of the hold, in powder magazines, coal-bunkers, refrigerating chambers, &c. Humidity is indicated by employing a pair, wet and dry, in the ordinary way. Its use in indicating the temperature of superheated steam has caused it to be adopted by all railways in France and by many other railways on the Continent. These thermometers are made of very various ranges, from $-25°$ C. to $+25°$ C., up to 450° C. to 700° C. This system of temperature indication is known as the "Fournier" system.

THE Journal of the Franklin Institute for June contains an article by E. E. Free on the phenomena of flocculation and deflocculation, a discussion of the mechanics of suspension, a subject of importance in the treatment of sewage, in ore separation, and many other commercial problems. The physical production of light forms the subject of a paper by E. P. Hyde, and is dealt with from the points of view of the laws of radiation and of physiological optics. There are also articles on Brennan's monorail car, the colloid nature of complex inorganic acids, and the Lumière process of colour photography.

THE *Bulletin de la Société d'Encouragement pour l'Industrie nationale* for May contains a paper by J. H. Ricard on the pine forests of the Landes. Full details are given, with numerous photographic illustrations, of the methods now employed for the extraction of the resin (*gemme*), and the extraction of essence of turpentine and rosin from the latter. Figures are given showing the yield of pine wood per hectare, and the proportions of the wood suitable for various uses. The financial aspect of the industry is dealt with fully, and the great advantages of the cultivation of the pine in these sandy districts pointed out.

THE electrolytic conductivity of non-aqueous solutions at low temperatures is the subject of a paper by P. Walden in the current number of the *Zeitschrift für physikalische Chemie* (June 17). Twelve organic solvents were used, tetraethylammonium iodide and tetrapropylammonium iodide being used for the "normal electrolytes," the observations in each case being carried down to the freezing of the solvent. The general result of the work shows that, as with aqueous solutions, the conductivity curve does not cut the temperature axis with a measurable angle; in other words, there is no definite temperature of conductivity.

THE 22,000-ton floating dock for the Brazilian Government is illustrated in the *Engineer* for July 8. This dock has been built by Messrs. Vickers, Sons and Maxim, Barrow-in-Furness, at a cost of 182,700*l.*, and is the largest dock of the kind built as yet in this country. The contract time for delivery at Rio Janeiro was eleven months. The contract was placed on October 4 last, and the dock sections were launched on June 7, 8, and 9. The designs were prepared by Messrs. Clark and Standfield, of London, who have already been responsible for sixty-seven floating docks having an aggregate lifting capacity of 486,691 tons. The present dock is surpassed by the 35,500-ton dock built last year by Blohm and Voss at Hamburg. Its lifting capacity will also be exceeded by two box-type docks now building at Portsmouth and Sheerness for the British Admiralty, which are expected to be ready for service during the autumn of next year.

THE aërial-propeller testing plant at Vickers' Works, Barrow-in-Furness, is illustrated in *Engineering* for July 8. The apparatus consists of a double cantilever, 166 feet in length, the longer arm, at the end of which the propeller under test is mounted, being 110 feet in length. The cantilever is carried on ball-bearings on a cast-iron column, and the propeller is driven from a 100 horse-power electric motor situated in a test house which is arranged on the cantilever near the supporting column. The power is conveyed to the propeller by means of a long shaft passing along the cantilever, and bevel gear. The cantilever may revolve at any speed up to 70 miles per hour at the point of attachment of the propeller. The structure is balanced by a weight on the shorter arm of the cantilever. There is a method of compensating the circular motion of the propeller so that the conditions are similar to those of a ship running in a straight line through the air. The propeller may be run at speeds from 500 to 1000 revolutions per minute, and its speed through the air can be regulated by means of resistance screens. Measurements of thrust, efficiency, &c., are recorded in the observation station. Provision has been made for attaching a gondola to the platform ahead of the propeller, so as to obtain similar conditions to those on an air-ship having the propeller astern of the gondola. With characteristic solicitude for the advancement of science generally, Messrs. Vickers will place the apparatus at the disposal of investigators, so that any type of propellers may be tested.

METEOROLOGISTS, teachers of practical geography, and others will all find Messrs. Aitchison and Co.'s catalogue, Section iv., useful and interesting. It is concerned chiefly with barometers, thermometers, rain gauges, compasses, and pedometers; and the excellent illustrations and clearly arranged letterpress make reference easy and pleasant.

A THIRD edition of Prof. Ch. Moureu's "Notions fondamentales de Chimie organique" has been published by M. Gauthier-Villars, of Paris. The first edition of the work was reviewed in our issue of January 22, 1903 (vol. lxvii., p. 269), and it is only necessary to state that the present volume has been revised and brought up to date.

"AFRICAN MIMETIC BUTTERFLIES" is the title of a monograph by Mr. H. Eltringham which the Oxford University Press is about to publish. Descriptions and illustrations are given of the principal known instances of mimetic resemblances in the Rhopalocera of the Ethiopian region, together with an explanation of the Müllerian and Batesian theories of mimicry.

A VALUABLE supplement of seventy pages, dealing with Japan in all its aspects, was published with Tuesday's *Times* (July 19). Among the numerous important articles we notice in particular those on education, seismology, and volcanoes, by Baron Kikuchi, Prof. F. Omori, and Mr. E. Bruce-Mitford respectively. The publication, as part of a daily newspaper, of such a vast amount of detail and description relating to Japan as is given in the articles and tables is a remarkable enterprise. The supplement contains more information upon the position and progress of Japan than can be found in many books.

A SECOND edition of Prof. Armstrong's book of essays, "The Teaching of Scientific Method and other Papers on Education," has been published by Messrs. Macmillan and Co., Ltd. The first edition was reviewed at length in our issue of January 28, 1904 (vol. lxix., p. 289), and it will be sufficient to direct attention to the additions made in the present volume. Prof. Armstrong has introduced a prefatory essay entitled "Twenty-five Years Later," in which he considers the changes that have taken place in the teaching of science in schools during the period to which his essays relate. He has added two contributions; one, "The Correlation of Mathematical Teaching with other Work in Schools," was part of a report presented to the British Association at its York meeting, and the other, "A Criticism of School Method, with Suggestions for its Improvement," was delivered as an address to the Portsmouth Secondary Education League.

THE following volumes of the "Fauna of British India" series are nearing completion:—Mr. G. J. Arrow's volume on the Cetoniinæ and Dynastinæ is practically ready for publication. Mr. W. L. Distant's volume, an appendix to the Rhynchota, and Canon W. W. Fowler's work on the Cicindelidæ and Paussidæ, with a general introduction to the Coleoptera, are in the press. The remaining volumes which the editor, Mr. A. E. Shipley, with the assistance of Mr. Guy A. K. Marshall, and with the sanction of the Secretary of State for India, has arranged for in this series are:—Volumes on the Orthoptera (Acridiidæ and Locustidæ), Mr. W. F. Kirby; Butterflies (Lycænidæ and Hesperidæ), Mr. H. H. Druce; the Curculionidæ, Mr. G. A. K. Marshall; the Ichneumonidæ, Mr. Claude Morley; the Longicorn Beetles, Mr. C. J. Gahan; the Blattidæ, Mr. R. Shelford; the Helicidæ, Lieut.-Colonel H. H. Godwin-Austen; the Ixodidæ and Argasidæ, Mr. C. Warburton; Leeches, Mr. W. A. Harding; Fresh-water Sponges and Polyzoa and Hydrida, Dr. N. Annandale; the Meloidæ, Mr. Creighton Wellman; the Brachyurous Crustacea, Lieut.-Colonel A. Alcock; and the Nemocera (excluding the Chironomidæ and the Culicidæ), Mr. E. Brunetti.

THE annual report of the Board of Scientific Advice for India for 1908–9 has been received. The attention of the Board has been directed to the fact that the rapid increase in the number of scientific institutions throughout the world is rendering it more difficult to obtain back numbers of the more important scientific periodicals, and that unless efforts are made now to secure complete sets of some of these for India it will be impossible at a later date to establish efficient libraries for the requirements of scientific research in India. The Board, on the advice of a sub-committee appointed to deal with the question, has recommended the Government to maintain "first-class" general reference libraries in Bengal, Bombay, Burma, Madras, the Punjab, and the United Provinces, and "second-class" libraries in large towns like Cawnpore, Mandalay, Nagpur, Simla, and so on. Lists of scientific periodicals which should be maintained in all "first-class" libraries and in "second-class" libraries accompanied the recommendations. The programmes of the various scientific departments of Government for the ensuing year were, after some revision, approved by the Board. In connection with the work of the Meteorological Department, it is proposed to make a series of balloon flights next December, the month chosen by the International Commission in Europe and America for simultaneous experiments on the conditions of the upper air. It is hoped, too, that the publication of the sixty years' records in connection with terrestrial magnetism at Colaba will be completed during the current year. The Department of Agricultural Bacteriology hopes to attack, among other problems, the determination of the chief bacteria characteristic of Indian soils, particularly those taking part in the fixation of nitrogen, the rotting of organic material, and nitrification. In other departments interesting research work is being pursued actively. Very complete reports of the work done during the year 1908–9 in each of the scientific departments is included in the volume; to name a few, that dealing with astronomy and meteorology is by Dr. G. T. Walker, F.R.S.; that in geology by Sir Thomas Holland, F.R.S.; and in geodosy and geography by Colonel S. G. Burrard, R.E., F.R.S. An appendix on the economic investigations conducted at the Imperial Institute, by Dr. W. R. Dunstan, F.R.S., completes the volume.

OUR ASTRONOMICAL COLUMN.

Photographs of Auroræ.—As an abstract from the *Comptes rendus*, we have received from the author, M. Carl Störmer, an interesting note on a photographic method of determining the altitudes of auroræ. The difficulty in obtaining such photographs is, of course, the extreme feebleness and the motion of the light, but, by using a cinematograph lens of 25 mm. diameter and 50 mm. focal length, in conjunction with Lumière's "violet" plates, M. Störmer succeeded in obtaining measurable images, some of which are reproduced in his note. By choosing two stations 4·3 km. apart and arranging for simultaneous exposures, data for determining the altitudes were secured. The four sets of photographs reproduced represent different forms of auroræ seen during March, and also show recognisable stars, so that the parallax of definite points is easily calculated. The heights determined are 166 km., between 50 and 60 km., 190 km., and 120 km. respectively.

Displacement of Spectral Lines at the Sun's Limb.—In spectroscopic determinations of the radial velocities of the various solar layers, a difficulty arises from the fact that various perturbations alter the wave-lengths of the lines considered, independently of the rotation. These subsidiary displacements have been ascribed to two causes, first, the effect of ascending currents in the solar atmosphere, and, secondly, to pressure effects. In order to decide which of these is the disturbing agent, M. A. Perot performed some delicate interferometer experiments which he describes in No. 1 (July 4) of the *Comptes rendus*. In order to determine definitely the exact point of the solar image under observation, M. Perot projected a 36 mm. image on to a copper plate ruled in millimetre squares, and having a circular hole, or a slit, 0·1 mm. broad at the centre; thus only the radiations passing through this definite aperture reached his interferometer and spectroscope. As a result of the experiments, M. Perot deduces, from the form of the curves of relative variation of wave-length obtained, that this relative variation is an effect of pressure, or density, and not of ascending currents.

The Pressure of Light on Gases.—In No. 5, vol. xxxi., of the *Astrophysical Journal*, Dr. Lebedew describes a series of very ingenious and delicate experiments by which he has been able to observe the effect of the pressure exerted by a beam of light on various gases. The apparatus is too complex to describe here, but, in effect, it consists of a small chamber in which the gas under examination is contained, and through which a beam of light can be projected in either direction. The pressure exerted by the light produces an excess of pressure in the gas at the farther end of the chamber, and this acts on a very delicate valve which is suspended on one arm of a torsion balance. From a large number of experiments, in which other variable effects were eliminated, Dr. Lebedew succeeded in establishing experimentally the existence of the translatory force exerted by light upon gases, and also in showing that these forces are directly proportional to the quantity of incident energy and to the absorption coefficients of the gas masses. As these experiments were made with gases at atmospheric pressure, the numerical values determined cannot be applied directly to such excessively tenuous masses as are involved in the case of comets' tails, but they provide a satisfactory basis on which further experimental work in this direction may be founded.

The Determination of Stellar Radial Velocities.—In No. 5, vol. xxxi., of the *Astrophysical Journal*, Prof. Frost publishes a table of corrections to be applied to the previously published list of radial velocities of certain stars of the Orion type. The corrections are necessitated by the re-determination of the wave-lengths of the three silicon lines at $\lambda\lambda$ 4553, 4568, and 4575, for which Exner and Haschek's values were previously adopted. Prof. Frost's new measures give 4552·636, 4567·897, and 4574·791 as the correct wave-lengths, and this involves positive corrections of 7·51 km., 3·48 km., and 7·14 km., respectively, to plates reduced with Exner and Haschek's values.

As Prof. Frost points out, finality in radial-velocity measures is hardly to be obtained; the values must be amended as a greater accuracy in the determination of stellar wave-lengths is attained. Further, in the case of blended lines, such as the double helium line at λ 4472, a variation in the relative intensities of the two lines will considerably modify the results. This is especially effective when the adopted blend is uncertain, as in the case of the blending of lines of different elements which may vary considerably from one stellar type to another. Prof. Frost also publishes the data establishing the variable radial-velocity of Rigel, showing a variation from +1 to +26 km., and states that on one plate a faint component to the line at λ 4472 was measured which gave a velocity of −108 km.; faint components were suspected in other instances.

The same journal also contains some further notes by Prof. R. W. Wood on the determination of radial-velocities with objective prisms. After trying several other media for producing fiducial lines, he tried peroxide of chlorine, which, contained in a suitable cell, appears to answer very well. It gives absorption bands which are very well defined on the red edge, and in his 21-foot grating photographs can be measured to within 0·02 A.U.; with such bands, he suggests, radial velocities, of suitable stars, could be determined to within 2 or 3 kms. Unfortunately, the absorption bands cover most of the hydrogen lines, so that this absorbent could not well be used for first-type stars, although it is possible that λ 4863 and λ 3837 would appear; for other types a peroxide of chlorine screen apparently answers perfectly.

Halley's Comet.—A number of observations are recorded in *Astronomische Nachrichten*, No. 4425, but, in general, they do little more than confirm others previously noted.

Herr G. Müller gives an outline of the observations made, at great altitudes, in Teneriffe, and Herr W. Münch describes the general observations at Potsdam. The spectrographic observations made on May 19, from 4h. 55m. to 5h. 10m. and from 5h. 28m. to 5h. 30m. (M.E.T.), are described by Herr v. d. Pahlen, but no modification of the normal solar spectrum was discovered. The slit covered $3\frac{1}{2}'$ of arc, and two series of six exposures on the predicted positions of the comet on the sun's disc were made, so that a large area of the solar surface was covered without revealing any trace of the comet.

An observation by Dr. Ristenpart, at Santiago de Chile, on July 1 showed the comet as a nebulous mass 1′ in diameter, with no condensation, and with a tail 2° long.

Harvard College Observatory.—In his report for the year ending September 30, 1909, Prof. E. C. Pickering deplores the diminution of 5000 dollars in the income of the Harvard College Observatory, and points out that a disproportionate decrease will have to be expected in the amount of work accomplished. As in previous years, a great number of negatives of stellar regions and stellar spectra were added to the magnificent collection now stored at Harvard, and a number of important discoveries were made from the Draper memorial photographs. Seven meteor trails were found on chart plates, and at Arequipa the spectrum of a very bright meteor was secured. At this southern station the work was sadly upset by unusually bad weather, but, among other things, the spectra of more than 400 stars of magnitudes 5–6 were secured with the 13-inch Boyden telescope.

COLOUR OF THE SEA.

APROPOS of the report (NATURE, March 10) of Lord Rayleigh's lecture dealing with the parts played by reflection and transmission of light in the production of the integral impression of colour on the eye of an observer looking at the sea from the deck of a ship, I should like to be permitted to make some observations on the proper colour of the water of the ocean, as it is a subject which has occupied my attention, off and on, during the last forty years.

During the voyage of the *Challenger* I began to log the colour of the water in February, 1874, when she was working in the neighbourhood of the Antarctic circle. My attention was there directed to it by the frequent and abrupt passage of the ship from water of the clear indigo colour of the ocean of temperate latitudes to the deep olive-green water which is a distinctive feature of these icy regions.

The colour is due to the abundance of diatoms. These are so plentiful and so preponderant that, besides putting their stamp on the surface, they furnish a distinct type of oceanic deposit, the *diatom-ooze*. The green colour of the water is due, not only to the living diatoms, but also, and perhaps to a greater extent, to the excretions of the animals for the subsistence of which the diatoms furnish the ultimate food supply. The crowds of penguins and other birds to be met with in these seas stain all the ice green where they have rested. The water, inhabited by diatoms and affected by diatomaceous débris, has a deep olive-green colour which is characteristic, and this I accepted as one colour-type of the water of the ocean. It is seen best in the water the transparency of which is not interfered with by too great a crowd of the diatoms themselves. Water belonging to this type of colour is not confined to polar latitudes; it is met with in a certain class of homologous districts of the warmer ocean, in tropical and even in equatorial latitudes.

When we quit the edge of the polar ice and steer equatorwards, the surface water assumes a pronounced indigo colour, and this persists until we pass the fortieth parallel. If we start from the equator and sail polewards, the colour of the surface water persists as a pure and brilliant ultramarine until the thirtieth parallel is passed. The passage from the ultramarine to the indigo, and *vice versa*, is usually very rapid, and the area of mixture is restricted. No one who has once sailed in the ultramarine waters of the intratropical ocean and has observed, as well as seen, its colour, can ever mistake any other colour for it. If he has doubt as to whether the water through which he is passing is ultramarine or not, he may be sure that it is not. The ultramarine and the indigo are the two great colour-types to which the mass of the surface water of the deep sea belongs, and, with the olive-green, they make the three fundamental colour-types which are required, and are sufficient for the adequate logging of the colour of the surface water of the ocean.

The water of the Mediterranean belongs to the ultramarine type, but it always appears to me to have a harder tone than the soft and brilliant ultramarine of the intratropical ocean.

With regard to the method of judging the colour of the water, much unnecessary difficulty is made. The first precaution to be observed is to take up a position where the greatest amount of light can reach the eye after passing through the water, and the smallest amount after being reflected from its surface. There is generally little difficulty in accomplishing this on one side or the other of the ship and by looking as nearly as possible vertically into the water.

The *Challenger*, like other men-of-war of her date, was fully rigged, and built for sailing as well as for steaming. When under sail the propeller causes a certain amount of retardation, and to remedy this she was fitted with a "screw-well" into which the propeller could be hoisted out of the water. This proved to be a perfect observation tube for determining the proper colour of the water. Its diameter was about 6 feet; it passed from the upper deck through the captain's cabin on the main deck and the ward-room on the lower deck into the water. Looked into from the deck, the sea water appeared to be enclosed in it as the water is in a well, but with this difference, that the water, by day, was brilliantly illuminated from below. There being no clearance between the surface of the water in the well and the structure of the ship, no light could enter except through the water. No direct sky-light could reach it down the well, because the poop awning, which was practically always spread during the day, completely excluded it. The screw-well was, in effect, an artificial and perfected *Grotto di Capri*, which was carried round the world. It was perfected, inasmuch as there is a passage for boats to penetrate into the grotto from the outside, while the screw-well is entirely shut off. During the whole of the voyage the colour of the water was under observation in this very perfect apparatus.

The statement that the blue colour of the sea is nothing but the reflection of the blue of the sky was at first frequently made, even on days when the sky was completely overcast; a visit to the screw-well, especially on overcast days, never failed to convince the doubter that the water contained in its own mass sufficient colour to account for all that was perceived. When the ship was in green water the view was never advanced that its colour was due to reflection from the sky.

As ships with screw-wells long ago disappeared from the sea, it may not be superfluous to point out that what could be observed in the screw-well was altogether different from what can be seen in the wake of the screw of a modern steamer. While the screw-well was a perfect instrument for gauging the colour of the water, the determination of its transparency was more conveniently made from a boat. Thus in mid-Pacific, with the aid of a "water-glass" to eliminate the disturbing action of ripples, a metal plate measuring only 4 by 4 inches, painted white and not masked by the suspending line, was distinctly seen at a depth of 25 fathoms (45 metres). Beyond this depth it became indistinct, and became invisible at about 27 fathoms, but this was due mainly to its smallness and to its want of steadiness, being attached to the boat, which rose and fell with the swell. At 25 fathoms the plate had a pale ultramarine colour, and its edges were sharply defined. These separated the column of water, into which I looked through the water-glass, into a central column of rectangular section having a depth of 25 fathoms, and into a column, surrounding and contiguous with it, which had a depth many times greater. These columns, being juxtaposed, were placed in the way most favourable for the comparison of their colours. The colour of the central column, 25 fathoms in length, was a pure but pale ultramarine; that of the external and uninterrupted column through which the whole unabsorbed and undissipated part of the sunlight which had penetrated into the water returned to the surface was of the same tone, but of many times greater intensity. Assuming the intensity of the colour to be proportional to the length of the column of water traversed by the light, it is to be concluded that the length of the uninterrupted column which transmitted the more intense colour was many times greater than 25 fathoms. It must be noted that the glass plate forming the bottom of the small tub, which is called a "water-glass," was during the observation completely protected from direct sky-light by my head and the brim of the panama hat which, at that time, I always wore when exposed to the sun.

It has already been said that water of as pure a green as that of the Antarctic occurs in other and warmer districts of the ocean. My attention was first directed to this during the cruise of the *Dacia*, which, although it occupied no more than three weeks, marks an epoch in deep-sea research. A short account of it is given in a paper by me—"On Oceanic Shoals discovered in SS. *Dacia* in October, 1883"—and published in the Proceedings of the Royal Society of Edinburgh, 1885, xiii., p. 748. Perhaps the most remarkable of these shoals was the one which was named the "Coral Patch," in lat. 34° 57′ N., long. 11° 57′ W., the exploration of which, along with that of the tidal currents in the open ocean (Proc. Roy. Soc., 1888, xliii., p. 356), supplied the evidence which definitively established the fact that coral islands are a product of elevation and not of subsidence.

When the survey of this shoal had been completed, in so far as the time at the disposal of a steamer engaged on a commercial mission permitted, a line of soundings was run from the "Patch" to the African coast at Mogador. Independently of the high land which is visible from the sea at a distance of many miles, the approach to the coast is indicated by a fall in the temperature of the water of the sea surface, and a remarkable change in its colour. Outside, the temperature of the surface water was 21° C., and its colour was ultramarine. After sighting the land its temperature fell, at first slowly, then rapidly, and, when at a distance of two miles from Mogador, it was only 16° C. The colour at the same time had become a pure olive-green, which maintained its transparency until close to the shore, where it became masked by the solid matter kept continually in suspension by the mechanical energy of the breaking waves.

The pure green colour of the water and its temperature, so much lower than that which could persist at the surface of the sea in the latitude of Mogador, made me for a moment think that it might be in reality Antarctic water which had found its way, at or near the bottom, into the northern hemisphere, having been diverted first to the west while in the South Atlantic, then to the east after crossing the line. But this idea could persist only for a moment, because the temperature and the density of the bottom water were found to be those characteristic of the bottom water of the eastern basin of the North Atlantic, as shown by the *Challenger* observations, and these are much higher than those of any other ocean.

The low temperature of the water showed that it could not come on the surface from the north or south or west of it, and the only source from which it could come was from below the surface. Deep water comes close to the coast, and the water at 2000 fathoms was found to have a temperature of 2·5° C., so that the supply of cold from this source was adequate, and it was available with a very small expenditure of energy. Arrived at the surface and following the south-westerly drift of the surface water, exposure to the sun raised the temperature of the water and discharged its colour *pari passu*. It was evident that there was here a case of the rising of deep water at the weather coast of an ocean, away from which the prevailing wind was continually driving the surface water.

From Mogador the *Dacia* proceeded to the "Seine Bank," in lat. 33° 47′ N., long. 14° 1′ W., and explored it thoroughly. Among the specimens brought up on the grapnel were masses of dead coral and shells, all having the same green colour. Some of these fragments were preserved in spirit, which quickly assumed the green colour, leaving the shells and coral practically decolourised. I sent the bottle, with the specimens and spirit, to my friend Prof. W. N. Hartley, in Dublin, who was good enough to subject them to spectroscopic examination. He wrote to me on February 15, 1884:—"I have made a spectroscopic examination of the colouring matter you sent me and have no doubt that it is altered chlorophyll. I have got identical wave-length measurements for the absorption band with your liquid and a specimen of very pure chlorophyll dissolved in ether"; and he adds, "there is very little real substance in even a dark green solution."

As the year 1884 belongs now to the remote past, I recalled the matter to Prof. Hartley, and, confirming his previous information, he added:—"I believe my impression at the time was that the chlorophyll was the colouring matter in a living micro-organism, and that these settled upon the shells, but when not deposited they were floating in the sea water." I am obliged to Prof. Hartley for kindly permitting me to use these private communications. Further information will be found in his paper on chlorophyll from the deep sea (Proc. Roy. Soc. Edin., 1885, xiii., 130).

Prof. Hartley's report furnished a remarkable confirmation of my first impression in so far as it showed that the green water of the Mogador coast owed its colour to the same substance as did the diatom-crowded water of the Antarctic, namely, chlorophyll.

In April and May of 1885 I made a coasting voyage from Valparaiso to San Francisco. Excepting the equatorial part, stretching from Cape Blanco to Panama and round the coast of Central America to near Mazatlan, the west coast of the American continent between the fortieth parallels is the weather shore of the Pacific Ocean. All along it cold and green water is met with, in the same way as we have seen to be the case on the Atlantic coast of Morocco. On the South American coast the green water was found to extend, with few interruptions, from Valparaiso, lat. 33° S., to Cape Blanco, lat. 4° 27′ S. As on the Morocco coast, the green colour and the low temperature of the water are found only close to the shore. At a distance of ten miles outside the colour is blue, and the temperature normal for the latitude. There can be little doubt that, as the localities where the green water occurs are geographically homologous, so the substance which produces the colour is generically the same, namely, chlorophyll.

The following particulars are taken from my unpublished journal. The only ports or anchorages where the water was blue were Huasco, lat. 28° 27′ S., temperature of the surface water 14·7° C., and Carizal, lat. 28° 5′ S., temperature 15·1° C. The occurrence in this latitude of blue water with so low a temperature is very remarkable.

At Antafogasta, lat. 23° 39′ S., the water was greenish-blue, and its temperature was 18·0° C. Between this port and Iquique the ship's course took her to a distance of nearly twenty miles from the coast, and there the colour of the water was ultramarine and its temperature 21·2° C. At Iquique the water was quite green, and its temperature 17° C. Between this port and Arica the water was quite green, even at a distance of five miles from the coast, where the temperature was 19·5° C., but on anchoring at Pisagua, lat. 19° 36′ S., the temperature of the water was only 15·2° C. At Arica, lat. 18° 28′ S., the water was equally green, but its temperature was 19·5° C. Arica lies in the angle where the trend of the coast changes from north to about north-west. From Arica the ship made a longer run to Chala, lat. 15° 49′ S., keeping at a distance of fifteen to twenty miles from the coast. Here ultramarine water was met with, its temperature rising to 23·2° C., but even at fifteen miles from this coast some green water was met with having a temperature of 18·8° C. I attributed this to the foggy state of the atmosphere which prevailed. This obscured the sun, and retarded both the heating and the bleaching of the water. In lat. 14° 8′ S., when six miles off shore, the water was quite green, and its temperature 15·1° C. Outside of Callao, lat. 12° 0′ S., the water was green, and its temperature 16·3° C.; in the harbour its temperature was 17·5° C., and its colour a dirty green, turbid and milky with sulphur, smelling strongly of sulphuretted hydrogen, and full of dead fish. Continuing northwards, off Ferrol Islands, lat. 9° 11′ S., the temperature of the water was 16·0° C., and its colour olive-green. At Payta, lat. 5° 5′ S., the temperature of the water was 17·1° C., and its colour a chalky green.

The green and cold shore water ceased abruptly at Cape Blanco, lat. 4° 27′ S., and during the passage round this cape from Payta to the entrance of the Guayaquil River, lat. 3° 9′ S., the temperature of the water rose from 17·1° to 25·2° C. From this locality a pretty straight line was followed across the equatorial current near its source to Panama, lat. 9° 0′ N. During the passage the temperature of the water varied between 25° and 27° C., and it maintained a blue colour throughout. At Panama, however, with a temperature of 27° C., the water was quite green.

A similar occurrence of cold and green water near the shore was observed on the North American coast from Cape San Lucas, at the extremity of the Californian peninsula, to San Francisco. In the equatorial waters which wash the coast from Cape Blanco, lat. 4° 27′ S., to Panama, and thence to Cape Corrientes, lat. 20° 25′ N., long. 105° 43′ W., green water is prevalent along the shore, but its temperature is very high, 28° or 29° C. Further information on this subject will be found in a paper by me on similarities in the physical geography of the great oceans (Proceedings of the Royal Geographical Society, 1886, viii., p. 753).

I will here refer to only one other locality, and that a well-known one, where the weather shore of an ocean is associated with green water of abnormally low temperature, namely, the east coast of North America from Florida to Nova Scotia. The cold and green water which is found on this coast, and lying between it and the western edge of the Gulf Stream, is usually attributed to the Labrador current, which is charged with the duty of bringing cold water from Baffin's Bay as a surface current round Newfoundland and down the coast to Cape Hatteras and even beyond it. The principle was the same as that which moved Humboldt to attribute the cold water, which we have described in connection with the Pacific coast of tropical South America, to a surface current from the Antarctic Ocean. In the paper on similarities, &c., above referred to, I showed that Humboldt's explanation postulated an impossibility. The deeper layers of the water on the coast itself are capable of supplying, as and when required, much more cold than is wanted, and that with the least expenditure of energy. The same is the case with the "cold wall." Besides the south-westerly winds of the North Atlantic, and perhaps independently of them, the Gulf Stream itself, pouring its waters in a stream of great momentum past the American coast and out into the open ocean, performs the function of a colossal jet-pump, carrying water away from the surface and leaving its place to be taken by the other water which can get there most easily. This is the cold water of the deeper layers *in situ*. It is this hydraulic cold-water service which tempers the climate of the eastern States. The labours of the U.S. Coast Survey during the last seventy years have shown that fluctuations, both regular and irregular, occur in the flow of the Gulf Stream. These necessarily react on the supply of cold water drawn from the deep and spread over the continental shelf. Such variations are probably the source of the accidents which occasionally occur and cause the extinction of life over large tracts of shoal water on that coast.

J. Y. BUCHANAN.

REMNANTS OF THE PAST.

MUCH interest attaches to a paper by Mr. R. S. Lull, published in the "Proceedings of the Seventh International Zoological Congress, Boston, 1907" (issued 1910), on the evolution of the horned dinosaurs, or Ceratopsia. Although early ancestral forms are at present unknown, it is probable that the group took origin from an iguanodont stock. The earliest known types are Monoclonius and Ceratops of the Judith River beds, the single representative of the former being the more primitive, and probably ancestral to all the rest. In Monoclonius the orbital horns are much smaller than the nasal one, but in one species of Ceratops the two have become subequal; both genera show large vacuities in the cervical flange of the skull, which was probably internal. Between the Judith River and Laramie formations occur certain marine formations yielding no dinosaurian remains, but in the basal Laramie occur Agathaumas, of which the skull is unknown. Higher up this is succeeded by Triceratops, in which the vacuities in the cervical flange are obliterated, while in the various species may be traced a gradual increase in the size of the orbital at the expense of the nasal horn, the latter becoming almost obsolete in *T. elatus*, while it has disappeared in Diceratops, which forms a side-branch by itself. The remarkable genus Torosaurus of the Upper Laramie, although having developed large orbital horns at the expense of the nasal one, retains the long, straight skull, with a large vacuity in the cervical flange, of the Judith River *Ceratops montanus*, from which it may be directly descended. Physical changes in their environment seem, in the author's opinion, the most probable cause of the extinction of these marvellous reptiles.

In the April number of the *American Journal of Science* Mr. F. Loomis describes the complete skeleton of a new species of the camel-like genus Stenomylus from the Harrison beds of Nebraska. The genus differs from other Tertiary types by the hypsodont character of the dentition. This is considered by Mr. Loomis as an indication that Stenomylus differed from its relatives in habits. The early tylopods of the Protomeryx type probably fed on a mixed diet, while the members of the long-limbed Oxydactylus group may have subsisted on leaves and shoots, both retaining the original brachyodont dentition. Stenomylus, on the other hand, seems to represent a separate branch derived from the ancestral Poëbrotherium, which developed a hypsodont dentition, and took to feeding on hard-stemmed grasses growing on open, arid plains.

Dr. A. E. Ortmann contributes to the April number of the *American Naturalist* an article on the theory that a connection between Africa and South America persisted into the Tertiary. According to the Archelenis theory, as originally proposed by Dr. von Ihering, an ancient connection between the above-named continents was the last remnant of the much greater equatorial land-mass known as Gondwanaland, an area which was broken up at various dates, and remnants of which are represented by Australia, India, Africa, and Brazil. The separation of Brazil from Africa was the final stage in the dismemberment of the old continent, and it is generally considered that this took place towards the close of the Mesozoic epoch. A study of the Tertiary flora of Patagonia has, however, induced Dr. von Ihering to believe that Archelenis persisted into the Tertiary. It is argued, however, that the facts cited by von Ihering really lead to just the opposite conclusion, while the existence of marine Eocene deposits in many parts of West Africa is likewise an indication that the connection between the two continents had ceased. Accordingly, the evidence for a Tertiary Archelenis is considered valueless.

Vol. vii., No. 2, of the University of Colorado Studies is devoted to an account, by several authors, of the results of a scientific expedition to north-western Colorado. In a paper on plant-remains from the Cretaceous of Mesa Verde, Prof. T. D. A. Cockerell describes and figures a fragment of a branch bearing a remarkable resemblance to the Palæozoic lycopods of the Ulodendron type. It really belongs to an araucarian conifer (*Geinitzia reichenbachi*), but its resemblance to lycopods of an earlier period is highly significant in view of the probability of a real relationship between the two groups.

NON-FERROUS METALS.

IN many respects the second volume of the journal of the Institute of Metals marks a decided advance on the first volume—an advance which serves as a healthy sign of the continued growth of the institute. Perhaps the best sign of this advance is the inclusion, in the second volume, of a series of abstracts of scientific and technical literature bearing upon the subjects which come within the scope of the institute. These abstracts fill what has hitherto been a decided gap in metallurgical literature; they are obviously modelled on the very excellent abstracts of the literature of iron and steel which appeared in the Journal of the Iron and Steel Institute while that journal was under the editorship of the late Mr. Bennett Brough. Perhaps the most serious criticism to be offered on these abstracts is that they are of too indiscriminate a character, mere descriptive papers of small permanent interest being accorded equal space with papers of real importance.

The original papers, which, with the discussions, occupy the greater part of the second volume, have already been referred to in these pages on the occasion of the meeting at which they were read. It is satisfactory to find that the discussions show signs of free and vigorous criticism, and that such criticism seems to be accepted by the authors in a kindly spirit, even though[1] at times the criticisms are practically destructive. Thus the first paper (Edwards and Andrew on aluminium-copper-tin alloys) is criticised on the ground that the data published do not afford sufficient insight into the facts upon which the authors base their conclusions. The paper of Prof. Turner and Mr. Murray, on the volume-changes of the copper-zinc alloys, is also challenged as regards the validity of its conclusions on the ground—apparently justified—that the mere measurement of the longitudinal contraction of a casting can give no true insight into the volume-changes which accompany the passage of the metal from the liquid to the solid state. More than eighty pages of the volume are devoted to the paper of Mr. A. C. M. Smith on the elastic breakdown of non-ferrous metals, and although the subject presents certain points of interest, it appears to occupy a good deal more than its fair share of space in a journal not specially devoted to such questions as the best means of measuring elastic constants. The paper, however, shows clearly the narrow limits within which Hooke's law is applicable to such metals as copper and aluminium; the latter appears to be particularly unsatis-

[1] The Journal of the Institute of Metals, vol. ii. Pp. 341. Vol. iii. Pp. xi + 360. Edited by G. Shaw-Scott, Secretary.

factory in this respect, and to carry this property with it into some of its alloys.

The third volume of the same Journal more than maintains the character of the earlier volume; this applies particularly to such papers as those of Bengough and Hill on copper-arsenic alloys, and of Hudson and Law on the phosphor-bronzes, together with the discussions on these papers. Such work must prove of great importance to the advancement of the technology of whole classes of important alloys.

Taken as a whole, the young Institute of Metals may well be proud of the present volumes, although we may hope that greater experience on the part of the editor and of the publication committee will lead to a more satisfactory apportionment of space. The illustrations throughout have been reproduced in a very satisfactory manner, and this applies also to the frontispiece, an excellent likeness of the first president, Sir William H. White, although the portrait of the second president (Sir G. Muntz) is not nearly so satisfactory.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

Examinations for Evening Students.

THE summer meeting of the Association of Technical Institutions was held in Manchester last week. The question of examinations for evening students formed the basis of the discussion at the morning meeting on July 15, when Sir William Mather took the chair. At the present time examinations are held by the Board of Education in science subjects by the City and Guilds in technological subjects, and the Society of Arts in literary and commercial subjects. The London Chamber of Commerce also holds examinations which overlap both those of the Board of Education and the Society of Arts—especially the latter—and there are many other smaller examining bodies.

The Board of Education has for many years held examinations in mathematics, engineering, and building subjects, and in most of the sciences. Each examination is conducted by examiners appointed directly by the Board, and the examinations in each subject are independent, or nearly independent, of those in any other subject. The examiners have no official connection (and in most cases no connection of any kind) with those responsible for instruction in the subjects; and even those on the staff of the Board who come into contact with the teachers and the students—namely, the inspectors—are not systematically consulted, if they are consulted at all. Thus, although the examinations in any given subject may be excellent, and have been valuable in developing a higher standard of work throughout the country, it was the unanimous opinion of those present at the meeting that they are capable of great improvement.

Of late years most technical institutions have endeavoured to develop organised courses of instruction in connection with the important industries, engineering, textiles, building, chemical, &c. For these courses it is desirable that the syllabus in the individual subjects shall be modified to suit the particular course.

So far are the Board of Education examinations in many directions out of sympathy with the work that some speakers at the conference were doubtful whether the Board of Education was the best authority for conducting the examinations; but the meeting as a whole considered it desirable that the advanced work should be controlled by some national examining board in order that there should be a uniformity of standard, and thus the certificates obtained should have a common value; but it was felt that the examinations must be brought more closely into touch with the teaching, and it was resolved:—

"That it be represented to the controlling authorities of the examinations taken by evening students in technical institutions that it is desirable, for the encouragement of systematic courses of instruction and to bring the examinations into closer correlation with technical teaching, that the examining authorities should constitute advisory boards upon which representatives of teaching institutions (including teachers) and of technical and commercial interests should sit.

"That it be the function of such advisory boards to receive and consider the views of persons directly concerned in technical and commercial education, as to examination subjects, syllabuses, and methods of conducting examinations; and to advise the respective examination authorities thereon."

An examination has a two-fold object—to test knowledge and to grant a certificate—and the two are to some extent antagonistic; the first, enabling the student and his teacher to judge of his progress, is probably best attained if the teacher himself conducts the examination. A certificate, however, granted on the examination of an individual teacher, can have no public value, and can only become valuable to the extent to which it attains uniformity. In the earlier stages of instruction the former object is of the greater importance, and therefore in the earlier stages it is probably desirable that the examinations shall be conducted by the teachers. In the latter stages it is more important that the certificates shall have a uniform value, and therefore in these stages it is desirable that the examinations shall be conducted by a national body. Also, in the higher stages, the number of candidates who would be sitting for the examination in any given centre would be comparatively small, and the cost of a separate examination for individual schools in these subjects would be prohibitive except in the very large centres; so that, even if it were desirable that the examinations for the higher work should be conducted by the teachers, the financial burden would be too great in most cases. Thus the following resolutions were adopted:—

"That this association is of opinion that, in the interests of technical education, it is essential that the Board of Education or other national authority shall continue to conduct examinations above Stage 1 Board of Education, and Preliminary Grade City and Guilds."

"That examinations of an elementary character (*e.g.* Stage 1 Board of Education, Preliminary Grade City and Guilds, Elementary Stage Society of Arts) should, in the main, be conducted by provincial boards, local education authorities, or the governing bodies of the institutions; but that, pending the re-modelling of the examination system, the present examining boards should continue to hold these examinations."

Even with the establishment of advisory boards there would still remain the evils arising from the overlapping and duplication of the examinations. At the present time the examinations of evening students begin in April and last well into July, thus destroying the value of the last part of the session for teaching purposes. So long as examining bodies endeavour to arrange that any student may take any subject, it is obvious that the examinations will have to spread over a large period of time. With the establishment of the course system, it will be possible to a large extent to determine beforehand those subjects which a given student will require to be examined in, and thus to concentrate the examinations upon a much smaller number of evenings. So strongly was it felt that the whole system requires a very drastic reform that it was unanimously resolved to ask the Board of Education to appoint a committee to inquire into the working of the present examination systems, including science, technology, and commerce.

Trade Schools and Trade Preparatory Schools.

At the afternoon meeting, a report prepared by the council of the association on the above subject was discussed. The report includes accounts furnished by the organisers of many of the schools which have recently been established in various parts of the country.

It is pointed out that there are two very distinct types of school with entirely different aims; one, which in the report is termed, for want of better title, *Trade Preparatory School*, may be considered a form of secondary school in which the ordinary education is continued, but with a very distinct bias on the technical side. It is assumed that the majority of the boys, though not all necessarily, attending such a school will afterwards be engaged in some trade. The schools differ from the ordinary secondary schools in the large amount of time devoted to various forms of manual instruction. As a rule the curriculum includes English, mathematics, one language, drawing—both freehand and model—science, and workshop practice in wood or metal, or both. The course is, as a rule, intended to last three years for boys from twelve to fifteen years of age.

As so many of the technical institutes throughout the country are only used at present in the evenings, and have their rooms and equipment idle in the daytime, and the staffs of the technical schools are particularly suitable for the type of instruction required, these schools, which have proved exceedingly successful where they have so far been established, may be considerably increased in number in the near future.

Attention was directed to the very strong expressions of approval by employers, the Chamber of Commerce, and trades unions in the case of the trade preparatory school, which is now in its third session at Halifax; and as the boys from these schools pass into employment as apprentices or as improvers, the value of this kind of school is becoming more and more appreciated.

One speaker pointed out the great value of manual instruction to boys and girls right through their school course, and remarked—his remark being applauded by the meeting—that he hoped the board would do its best to encourage this work in every kind of school.

Another speaker said that there are a great many boys to whom the literary subjects of the ordinary school course do not appeal, and to whom the more technical subjects introduced in the trade preparatory schools do appeal very strongly. Thus it is educationally of real advantage to the community that schools should be provided in which boys with a turn for mechanical subjects, but no liking for literary subjects, may have a chance to learn that they have some ability, and may not leave school with the feeling that they are inferior to their fellows because they are unable to distinguish themselves at literary work.

Other speakers referred to the very small grant it is possible to obtain under the board's regulations for this type of school, which is necessarily an expensive one to run owing to the large amount of practical work in the time table. It was felt that the grant should be at least as great as that given by the board to an ordinary secondary school.

Quite distinct in aim from the Trade Preparatory School is the *Day Trade School*, only a few of which are at present in existence. In London there are day trade schools for girls which have proved most successful; a good account of these is included in the report referred to. There are two special trade schools for bakery and confectionery; there are one or two part-time trade schools for boys who are already employed in the trade, the boys being allowed to attend two or three afternoons a week by arrangement with the employers. The best example of such a school is, perhaps, that for jewellers and silversmiths at Birmingham, which is already proving of real value to the trade.

Opinions were somewhat divided as to whether local authorities could be expected to establish schools of this kind, which take the burden of preparation of apprentices off the employers, without substantial financial aid from the employers themselves. It was pointed out that, although none of these schools could decrease the unemployment, they would give boys the chance of entering a useful occupation, and would thereby tend to reduce the number of those who take up so-called "blind-alley occupations."

THE POSITION OF UNIVERSITY EDUCATION IN GREAT BRITAIN.

A BLUE-BOOK has just been published (Cd. 5246, price 2s. 6d.) containing the reports from the universities and university colleges which participated, in the year 1908–9, in the annual grant, now amounting to 100,000*l*., made by Parliament for "University Colleges in Great Britain," and from the three colleges in Wales which received a grant of 4000*l*. each.

This is the sixteenth volume of the reports, and it is by far the most useful on account of the analysis it contains of the position of university education in Great Britain. For several years we have urged in these columns that the Board of Education should bring together the statistical and other information given in the separate reports of universities and university colleges, so that a comparison could be made of the position and progress of the various institutions, and of university education in Great Britain, with that in other countries. Merely to print the reports without any attempt to sum up the particulars they contain, as was done in all volumes previous to the present one, has always seemed to us as unscientific as it would be to record a long series of observations without endeavouring to arrive at conclusions from them. This unpardonable omission has now been remedied, and we have available, for the first time, an instructive abstract of the financial resources and students under instruction of institutions which participate in the Parliamentary grant for universities and university colleges. We give below some extracts from the introductory memorandum signed by Mr. W. Runciman, President of the Board of Education, and abridgements of the tables appended to it.

In the last ten years no fewer than five new universities have been founded in England, but the progress of institutions of older date has been no less marked. In July, 1909, King Edward VII. laid the foundation stone of important new laboratories for the Imperial College of Science and Technology, a college for the highest studies in pure and applied science, which was inaugurated by Royal Charter in July, 1907, and was formed by the union under a single governing body of the Royal College of Science, the Royal School of Mines, and the City and Guilds' Central Technical College. In the following October the new buildings of the University College of South Wales and Monmouthshire were opened at Cardiff, and on that occasion the present King, as Chancellor of the University of Wales, wrote words which apply equally to all the universities of England and Wales when he said, "We must look ahead and endeavour to be ready to meet all the requirements of scientific and intellectual progress. The imperative necessity for higher education and research is becoming more and more recognised."

This encouragement to further effort has been tangibly supported by the Government. Acting upon the report of a special committee of inquiry, under the chairmanship of Sir Thomas Raleigh, K.C.S.I., the treasury, by a minute dated December 18, 1909, made an increased annual grant of 15,000*l*. to the University of Wales and its constituent colleges. Of this sum 1500*l*. has been specially allocated to the Medical School of Cardiff, and another 1500*l*. a year has been assigned to the university itself for the foundation of research fellowships.

The treasury has also made a capital grant of 20,000*l*. towards the cost of the new buildings for the University College of North Wales, Bangor.

State-aid to university teaching would, however, be of doubtful advantage if it did not stimulate private effort and induce benefactors to contribute in the present day as they did in the olden times, to give of their wealth for the support of that higher learning upon which now, more than ever, "the prosperity, even the very safety and existence, of our country depend."

The Board is glad to find that there is no evidence of the springs of private beneficence failing, but rather that the growing national sense of the vital need of universities has impressed many of those, whether individuals or corporations, who are in the position to help. The following are some of the more important gifts made during the last twelve months:—

Sir Alfred Jones, the well-known ship-owner, who died in 1909, and who during his life had founded the School of Tropical Medicine in connection with the University of Liverpool, left to his trustees the sum of more than 500,000*l*. upon trust for such charitable purposes and objects in England (or any British possession on the west coast of Africa) as they may in their absolute discretion think fit. For the guidance of his trustees, however, he made suggestions as to the purposes to which the money might be applied, and amongst them were—the advancement, benefit, or support of education or science, and original research of all kinds in the cause of disease on the west coast of Africa.

Mr. Otto Beit, in December, 1909, gave 215,000*l*. for the endowment of thirty medical research fellowships of 250*l*. a year, each tenable for three years. The fund is to be entirely devoted to the furthering of medical research work, which is to be conducted, with a few exceptions, in institutions allied to London University. The fellowships are open to any man or woman of European descent who is a graduate of any approved university within the British Empire.

The late Dr. Charles Graham, who died in November, 1909, and had been since 1889 emeritus professor of chemical technology at University College, London, bequeathed his residuary estate to London University, to be applied to the promotion of research at University College Hospital Medical School "for the prevention, cure, or alleviation of human disease or suffering." The legacy was estimated at 35,000*l.*

Still more recently, M. Albert Kahn, a well-known French philanthropist, has handed over to a board of six trustees a sum of 4140*l.* to provide for the annual award of two travelling fellowships, each of the value of 660*l.* It is expressly desired by him that the trust shall be permanently associated with the University of London. The fellows, who must travel for at least twelve months, according to an itinerary regulated and prescribed by the trustees, will be elected by the trustees on the nomination of the Vice-Chancellor or other executive head of each of the universities in the United Kingdom, the President of the Royal Society, and the president of the British Academy. M. Kahn has provided funds sufficient for a period of three years, and is prepared at the expiry of that time to endow the fellowships in perpetuity if they should prove to fulfil the objects which he desires.

TABLE I.—UNIVERSITIES AND UNIVERSITY COLLEGES IN ENGLAND AND WALES

Returns of Income, 1908–9

(Figures to the nearest £)

Name of University or College	(1) Fees: Total of all Fees	(1) Fees: Percentage to whole Income	(2) Endowments: Total Amount of Endowments	(2) Endowments: Percentage of total Income	(3) Donations and Subscriptions: Total Amount	(3) Donations and Subscriptions: Percentage of total Income	(4) Grants from Local Authorities: Total Amount. [Fees remitted, as a condition of grants, are shown in brackets]	(4) Grants from Local Authorities: Percentage of total Income	(5) Grants from Exchequer: Total from Exchequer	(5) Grants from Exchequer: Percentage of total Income	(6) Other Income: Total Amount	(6) Other Income: Percentage of total Income	(7) Total: Total Income. [Including Amount represented by Fees remitted.]
England	£		£		£		£		£		£		£
1. Birmingham...	17,176	31·6	8,462	15·5	1,344	2·5	7,081	13·0	15,070	27·7	5,229	9·6	54,362
2. Bristol	6,636	44·3	411	2·7	1,419	9·5	770 (195)	5·2	4,918	33·0	792	5·3	14,946
3. Leeds	14,641	25·9	7,183	12·7	2,285	4·0	15,522 (1,923)	27·5	15,167	26·8	1,765	3·1	56,563
4. Liverpool ...	19,721	27·1	16,198	22·3	4,863	6·7	14,350 (623)	19·7	16,132	22·2	1,334	1·8	72,599
5. Manchester ...	25,141	31·4	24,938	31·1	2,900	3·6	5,250	6·4	19,034	23·7	2,861	3·6	80,124
6. Sheffield ...	6,722	16·4	3,770	9·2	1,522	3·7	16,112 (1,063)	39·3	11,505	28·1	1,379	3·3	41,010
7. London: University Coll.	23,686	42·4	11,066	19·8	3,421	6·1	1,960 (1,781)	3·5	11,250	20·1	4,485	8·0	55,867
8. King's College	26,387	53·4	1,582	3·2	4,473	9·1	4,171 (2,318)	8·4	9,704	19·6	3,077	6·2	49,394
9. Bedford Coll.	8,002	46·8	892	5·2	516	3·0	1,924 (1,672)	11·3	4,944	28·9	819	4·8	17,097
10. School of Economics...	3,741	29·0	115	0·9	2,031	15·7	3,845 (283)	29·8	3,080	23·9	81	0·6	12,893
11. Newcastle: Armstrong College ...	8,172	28·5	2,084	7·2	2,689	9·4	3,020 (608)	10·5	11,996	41·8	719	2·5	28,680
12. Nottingham...	3,287	15·8	572	2·7	252	1·2	7,954	38·3	8,328	40·1	386	1·8	20,779
13. Reading ...	6,602	32·4	2,107	10·3	2,281	11·2	1,875 (273)	9·2	7,112	35·0	402	1·9	20,379
14. Southampton: Hartley Coll.	2,790	22·9	525	4·3	130	1·0	3,869 (564)	31·8	4,765	39·2	71	0·6	12,150
15. Totals—England	172,704	32·2	79,905	14·9	30,126	5·6	87,703	16·3	143,005	26·6	23,400	4·3	536,843
Wales													
16. Aberystwyth	5,937	38·5	484	3·1	1,682	10·9	598	3·8	6,598	42·8	114	0·8	15,414
17. Bangor	3,616	24·7	2,897	19·7	627	4·3	709	4·8	6,672	45·5	136	0·9	14,658
18. Cardiff	7,111	34·6	535	2·6	561	2·7	2,804 (750)	13·6	6,678	32·5	2,865	13·9	20,554
19. Totals—Wales	16,664	32·9	3,916	7·7	2,870	5·7	4,111	8·1	19,948	39·4	3,115	6·1	50,626

Mr. Alexander Elder gave, in 1909, a sum of 20,000*l.* as endowment for a chair of naval architecture in the University of Liverpool, and Mr. W. H. Lever, of the firm of Lever Brothers, Port Sunlight, in March, 1910, made a gift of 91,000*l.* to the same university for the erection of a building in which the School of House and Town Planning could be accommodated, and also the School of Architecture, and for assistance to the School of Tropical Medicine and the School of Russian Studies.

City companies and corporate bodies have also made new contributions to the support of university education during the last year. The Goldsmiths' Company, who had already been generous benefactors of university education in London, made a gift in May, 1909, of 50,000*l.* towards the cost of the new engineering buildings of the Imperial College of Science and Technology referred to above. The Drapers' Company made a further grant of 10,000*l.* to the building fund of the new college at Bangor, to be applied towards the library and museum of the college. The same company make an annual grant of 7000*l.* to the East London College, which has been admitted for the first time this year to share, subject to the fulfilment of certain conditions, in the annual treasury grant made to university colleges. The company also grants scholarships in connection with this college to the annual value of 1555*l.*

The universities have recently shown in other directions that they are conscious of a joint responsibility in their direction of equalising the standards required by the several examining bodies; but there is a general agreement as to the end desired, and the difficulties are chiefly those of means, in both senses of the word. The whole question of examinations in secondary schools is at present under consideration by the consultative committee of the board, and the board hopes that the report of the committee, when presented, will point the way to further progress.

But the national life and the national needs in higher education cannot be confined within the limits of these islands. The growth of important universities in the British dominions beyond the seas, and in the Empire of India, and the rapid improvements in the means of communication, have brought new opportunities and new responsibilities to those who are entrusted with the provision of university education. The necessity for a regular interchange of views, and for the better organisation of relations to the national life. They realise that the tests they severally impose upon students applying for admission to their courses in preparation for degrees must have a profound influence upon the curricula of secondary schools, and that, if a common policy cannot be reached, evil results must ensue to the schools, and so, indirectly, to themselves, from the confusion caused by the multiplicity of tests for which school pupils must be prepared. Important and far-reaching steps have already been taken towards the mutual recognition of their various matriculation examinations, and the northern universities of Manchester, Liverpool, Leeds, and Sheffield have, under their charters, established a Joint Matriculation Board, which conducts a single examination of all candidates for admission to any one of the four universities. Much still remains to be done in the direction of substituting a school-leaving examination based upon the school course for an external test, and in the facilities for advanced study throughout the Empire, has led the Universities of Oxford, Cambridge, and London to issue invitations to the universities of the Empire to a conference to be held in the metropolis in 1912. There can be no doubt that this is the first step towards a closer union and sympathy, which cannot but have the most far-reaching and beneficial effects.

TABLE II.—UNIVERSITIES AND UNIVERSITY COLLEGES IN ENGLAND AND WALES

Returns of Expenditure, 1908–9

(Figures to the nearest £)

Name of University or College	Administration (1)	Percentage of total Expenditure (2)	Maintenance of Buildings, &c. (3)	Percentage of total Expenditure (4)	Remuneration of Teachers Departmental Expenditure (5)	Percentage of total Expenditure (6)	Superannuation (7)	Percentage of total Expenditure (8)	Scholarships (9)	Percentage of total Expenditure (10)	Other Expenses (11)	Percentage of total Expenditure (12)	Total (13)
England	£	%	£	%	£	%	£	%	£	%	£	%	£
Birmingham ...	6,611	10·8	6,105	10·0	37.362	61·3	820	1·4	1,896	3·1	8,128	13·3	60,921
Bristol	1,915	11·6	1,410	8·5	11.570	70·1	967	5·8	271	1·6	363	2·2	16,495
Leeds	4,803	8·8	6,411	11·8	37,701	69·3	1,153	2·1	1,620	3·0	2,674	4·9	54,362
Liverpool	6,996	10·0	7,541	10·8	45,403	65·0	955	1·3	5,986	8·6	2,988	4·3	69,870
Manchester	7,079	8·9	8,858	11·2	49,970	63·2	2,457	3·1	5,014	6·3	5,725	7·2	79,103
Sheffield	4,281	10·5	4,006	9·7	27,858	68·6	586	1·4	1,311	3·2	2,538	6·2	40,580
London: University College ...	3,862	7·4	7,919	15·2	36,007	69·3	500	1·0	1,497	2·9	2,153	4·1	51,938
King's College ...	3,851	7·9	5,793	12·0	33,179	68·8	800	1·6	1,569	3·2	2,965	6·1	48,157
Bedford College...	1,476	9·7	3,508	23·0	9,002	59·0	223	1·5	548	3·6	497	3·2	15,255
School of Economics	2,225	21·2	909	8·6	6,858	65·0	—	—	407	3·8	53	0·5	10,454
Newcastle: Armstrong College (Durham Univ.)	3,412	11·7	2,677	9·2	20,537	70·5	—	—	950	3·2	1,559	5·4	29.136
Nottingham ...	1,182	5·3	2,216	9·8	16,791	74·6	250	1·1	978	4·4	1,088	4·8	22,505
Reading	2,924	14·3	2,470	12·0	13,516	65·9	200	0·9	797	3·9	609	3·0	20,515
Southampton: Hartley College	1,151	10·5	1,555	14·1	7.391	67·3	10	0·09	86	0·8	783	7·1	10,976
Totals—England	51,768	9·8	61,378	11·6	353,145	66·6	8,921	1·7	22,930	4·3	32,123	6·0	530,267
Wales													
Aberystwyth ...	1,819	10·9	1,510	9·1	10,783	64·9	—	—	1,415	8·5	1,085	6·5	16,612
Bangor	1,987	12·9	842	5·5	10,404	67·6	—	—	1,700	11·0	451	2·9	15,384
Cardiff	3,218	15·9	1,995	9·9	13,078	64·6	—	—	657	3·2	1,277	6·3	20,225
Totals—Wales	7.024	13·4	4,347	8·3	34.265	65·6	—	—	3,772	7·2	2,813	5·4	52.221

The present volume of reports deals only with those universities and university colleges which, during the session 1908–9, were in receipt of grants from the treasury, but these grants affect, directly or indirectly, every university in England and Wales, except the two ancient foundations of Oxford and Cambridge.

It has been possible this year, thanks to the hearty cooperation of the universities and university colleges themselves, to prepare the reports upon much more uniform lines than hitherto, and to supplement the audited accounts in each case by an abstract which enables a comparison to be made for the first time of the various sources of income and the main heads of expenditure in the various institutions.

The returns under the different heads of income and expenditure are summarised in an appendix, and this is the first time that a comparative statement has been possible of the sources from which the several English universities and university colleges and the Welsh university colleges draw their income, and of the main headings of their expenditure.

From Table I. it will be seen that the actual total annual income of the English universities and university colleges under review exceeds half a million, some 26 per cent. of which comes from the exchequer, and some 16 per cent. from local education authorities, while 32 per cent. is in the nature of fees of students, and nearly 15 per cent. arises from endowments.

In the case of the Welsh colleges, the total annual income exceeds fifty thousand pounds. Of this total above 39 per cent. comes from the exchequer, and next year, when the additional grant of 13,500*l.*[1] voted for the session 1909–10 comes into account, this percentage will be considerably increased. The local education authorities in Wales contribute about 8 per cent. of the total income, while some 33 per cent. is derived from the fees of students and less than 8 per cent. from endowments.

Table II. shows how the income is expended upon administration, upkeep, and teaching. It will be seen that two-thirds of the whole expenditure is devoted to the remuneration of the teaching staff and the accessories of teaching, while 20 per cent. is expended on administration and in the maintenance of buildings; but this figure is unsatisfactory, because there is no means under the present form of the return by which expenditure upon the provision of buildings and equipment can be separated from maintenance. When this separation can be made, a comparison will be possible of the expenditure of the various institutions upon the main heads of teaching, administration, provision and maintenance of buildings, and equipment; and of each with the expenditure of all. The returns show that each English university and university college, with two exceptions, has a superannuation scheme towards which funds are allocated, and of these two exceptions, one (Armstrong College, Newcastle) has since the date of the return established a satisfactory scheme. The Welsh colleges have at present no superannuation scheme.

Table III. presents an analysis of the returns of students under instruction in England during the session 1908–9, the figures contained in the tables under the various headings being obtained from the information supplied by the authorities of the universities and university colleges concerned. It is certain that this return is not in all respects

TABLE III.—ANALYSIS OF RETURNS OF STUDENTS UNDER INSTRUCTION, 1908–9

Name of University or College	Students preparing for Matriculation (1)	Students preparing for Degree Courses [Over 300 hours] (2)	Degree Courses of less than 300 hours [Law Students in Brackets] (3)	Research or Post-graduate Students (4)	Students in Training to be Teachers (5)	Whole-time Students, *i.e. over* 300 Hours (6)	Part-time Students, *i.e. under* 300 Hours [Evening Students in brackets] (7)	Total Number: Day (8)	Total Number: Evening (9)	Other Students taking Special Courses of Lectures, *e.g.* Teachers, &c. (10)
England										
Birmingham	19	455	18	72	245	756	228	984	—	—
Bristol	21	125	—	19	241	442	413 (287)	568	287	501
Leeds	10	370	55 (12)	54	134	657	508 (233)	932	233	64
Liverpool	—	617	—	112	230	997	147	1,144	—	—
Manchester	48	794	165 (38)	175	252	1,167	618 (199)	1,586	199	400
Sheffield	21	133	18 (6)	31	59	255	1,634 (1,390)	499	1,390	297
London: University College	—	519	—	308	80	1,225	250 (27)	1,448	27	2,500 + 372
King's College	—	520	—	126	108	1,040	732 (381)	1,391	381	800 + 705
Bedford College	19	172	—	28	53	229	128	357	—	—
School of Economics	—	175	—	96	—	274(?)	1,003(?)	274	1,003	—
Newcastle: Armstrong College	—	248	—	9	204	407	999 (781)	625	781	—
Nottingham	18	211	14	5	150	377	1,986 (1,737)	626	1,737	—
Reading	1	90	8	13	113	345	888 (625)	608	625	—
Southampton: Hartley College	10	73	15	4	148	210	498 (484)	224	484	—
Totals—England	167	4,502	293	1,052	2,017	8,381	10,032	11,266	7,147	5,639
Wales										
Aberystwyth	20	439	—	13	144	481	92	573	—	128
Bangor	—	273	—	7	110	293	37	330	—	—
Cardiff	—	463	—	25	191	543	66	609	—	398
Totals—Wales	20	1,175	—	45	445	1,317	195	1,512	—	526

[1] An additional sum of 1,500*l.* a year is payable to the University of Wales as distinct from its Colleges "for an extension of the existing schemes of Fellowships in Arts and Science."

TABLE IV. ENGLAND AND WALES

Annual Grants to University Colleges and to Colleges forming Constituent Parts of Universities, and Grants in aid of Universities for the year ended March 31, 1910

Name of Institution	Board of Education: Grants for Training of Teachers	Board of Education: Grants under Regulations for Technical Schools	Board of Education: Total	Board of Agriculture and Fisheries	Treasury: Grants in aid of University Colleges	Treasury: Grants in aid of Universities	Treasury: Total	Total Exchequer Grants
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
England	£	£	£	£	£	£	£	£
Birmingham University	5,863 (188)	978 (978)	6,841	—	9,000 + 900	2,000	11,900	18,741
Bristol University	5,613	121	5,734	—	4,000 + 700	—	4,700	10,434
Leeds University	3,550 (200)	1,662 (1,317)	5,212	1,000	8,000 + 900	2,000	10,900	17,112
Liverpool University	5,139	915 (915)	6,039	200	10,000 + 950	2,000	12,950	19,204
London University	—	—	—	—	—	8,000	8,000	8,000
,, University College	—	—	—	—	10,000 + 950	—	10,950	10,950
,, Bedford College	200 (200)	—	200	—	4,000 + 700		4,700	4,900
,, King's College	1,498	299	1,797	—	7,800 + 800	—	8,600	10,397
,, School of Economics	—	—	—	—	500 + 650	—	1,150	1,150
,, Imperial College of Science and Technology	—	—	24,970	—	—		—	24,970
,, East London College	—	1,708 (748)	1,708	—	500	—	500	2,208
Manchester, the Victoria University	7,754 (75)	622 (622)	8,376	—	12,000 + 2,000	2,000	16,000	24,376
Newcastle-on-Tyne, Armstrong Coll., in the University of Durham	4,574	1,802 (710)	6,376	1,350	6,000 + 700	—	6,700	14,426
Nottingham University College	2,650	1,156 (337)	3,806	—	5,000 + 700	—	5,700	9,506
Reading University College	3,165	713	3,878	1,000	3,400 + 500	—	3,900	8,778
Sheffield University	1,942	3,328 (901)	5,270	—	5,000 + 700	2,000	7,700	12,970
Southampton, Hartley University College	3,404	544 (123)	3,948		2,250	—	2,250	6,198
Total	45,352 (663)	13,848 (6,651)	84,170 (76,856)	3,550	$\underbrace{86,950+11,650}_{98,600}$	18,000	116,600	204,320
Constituent parts of Universities								
Bristol, Merchant Venturers' College	—	1,848 (575)	1,848	—	—	—	—	1,848
London, Goldsmiths' College	6,847	1,868	8,715		—	—	—	8,715
,, Day Training College (Holborn)	3,867 (75)	—	3,867	—	—	—	—	3,867
,, St. Mary's Hospital Medical School	—	1,037 (1,037)	1,037	—	—	—	—	1,037
Wye, S.E. Agricultural College	—	63	63	1,000	—	—	—	1,063
Manchester Municipal School of Technology	—	10,635 (2,605)	10,635	—	—	—	—	10,635
Total—England	56,066 (738)	29,299 (10,868)	110,335 (98,729)	4,550	98,600	18,000	116,600	231,485
Wales								
Wales, University of	—	—	—	—	—	4,000 + 1,500	5,500	5,500
Aberystwyth University College of Wales	3,542		3,542	1,000	4,000 + 4,000	—	8,000	12,542
Bangor University College of N. Wales	2,865	—	2,865	1,250	4,000 + 4,000	—	8,000	12,115
Cardiff University College of S. Wales and Monmouthshire	4,553	396 (315)	4,949	—	4,000 + 5,500	—	9,500	14,449
Total—Wales	10,960	396 (315)	11,356	2,250	$\underbrace{12,000+13,500}_{25,500}$	$\underbrace{4,000+1,500}_{5,500}$	31,000	44,606
Total—England and Wales	67,026	29,695	121,691	6,800	124,100	23,500	147,600	276,091

complete. It is encouraging to note that the total number of whole-time students is increasing, and that students are more and more taking advantage of the facilities now provided for research and for work of a post-graduate type.

It will be seen that the total number of day and evening students in attendance at the universities and university colleges in England (excluding Wales) in receipt of treasury grant exceeds 18,000, but that the number of whole-time students is only some 8,300, and the number of whole-time matriculated students preparing for degrees slightly more than 4500, of whom 1230, or 27 per cent., are students in training under the regulations of the Board of Education for the training of teachers for elementary schools. If to these 4500 are added the 1052 post-graduate and research students, we have a rough measure of the amount of university education, in the strict sense of the term, which is being given by the universities and university colleges under review.

The percentage of students in training under the regulations of the Board of Education for the training of teachers for elementary schools to the number of whole-time students in the case of three of the institutions concerned exceeds 50 per cent., while there are three other institutions in which it exceeds 30 per cent.

Table III. shows that the total number of whole-time students in the Welsh colleges exceeds 1300, of whom no fewer than 1175 are whole-time matriculated students preparing for degrees. Of these, 437, or about 38 per cent., are students in training under the regulations of the Board of Education for the training of teachers for elementary schools. There are also 45 post-graduate and research students.

Further appendices are added with the view of setting out the amount of financial assistance given to university education from the exchequer. Table IV. shows the annual grants to universities and university colleges and to the colleges which form constituent parts of universities, whether from the treasury, from the Board of Education or from other Government departments.

Table V. shows the amount of the grants in aid for "University Colleges in Great Britain," given by the treasury for several years since funds were first appropriated to this purpose by the vote of 15,000*l.* set down in the Civil Service estimates for the year 1889–90.

TABLE V.—GRANTS IN AID FOR "UNIVERSITY COLLEGES IN GREAT BRITAIN"

—	Treasury Minute of July 1, 1889	Treasury Minute of June 2, 1897, sanctioning Grants for 1897–1902	1904–5: Treasury Minute of Dec. 28, 1904	1904–5: Treasury Minute of Mar. 8, 1905	1905–7: Treasury Minute of July 18, 1905	1905–7: Treasury Minute of Mar. 23, 1906	1909–10: Treasury Minute of July 9, 1907	1909–10: Treasury Minute of Mar. 23, 1910
	£	£	£	£	£	£	£	£
Birmingham	1,400	2,700	4,500	700	9,000	850	9,000	900
Bristol	1,200	1,200	2,000	700	4,000	850	4,000	700
Leeds	1,400	2,200	4,000	700	8,000	850	8,000	900
Liverpool	1,500	3,000	5,000	700	10,000	850	10,000	950
Manchester	1,800	3,500	6,000	700	12,000	850	12,000	2,000
Sheffield	1,200	1,300	2,300	700	4,600	850	5,000	700
London: University College ...	1,700	3,000	5,000	700	10,000	850	10,000	950
,, King's ,, ...	1,700	2,200	3,900	700	7,800	850	7,800	800
,, Bedford ,, ...	—	1,200	2,000	700	4,000	850	4,000	700
,, School of Economics ...	—	—	—	—	—	—	500	650
Newcastle-on-Tyne: Armstrong College	1,200	2,200	3,000	700	6,000	850	6,000	700
Nottingham	1,400	1.500	2,900	700	5,800	850	5,000	700
Reading	—	—	1,700	650	3,400	825	3,400	500
Southampton: Hartley Institute	—	—	1,700	650	3,400	825	2,250	—
Dundee	500	1,000	1,000	—	1,000	—	1,000	—
	15,000	25,000	45,000	9,000	89,000	11,000	87,950	11,150
			54,000		100,000		99,100	

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A BILL "to require that in public elementary schools instruction shall be given in hygiene, and to girls in the care and feeding of infants," was introduced in the House of Commons on Tuesday, and read for a first time.

THE council of the Junior Institution of Engineers, in conjunction with the council of the Society of Engineers, has arranged for a course of six fortnightly lectures on "The Law relating to Engineering," to be delivered by Mr. L. W. J. Costello. The first lecture will be given on October 10.

THE annual meeting of the Midland Agricultural and Dairy College will be held on Monday, July 25, when the report on the year's work will be presented. The Right Hon. Earl Carrington, K.G., president of the Board of Agriculture and Fisheries, will address the meeting, and present the diplomas and certificates gained during last session.

IT is announced in *Science* that Cornell University has been made residuary legatee of the estate of the late Dr. Goldwin Smith. It is reported that the value of the bequest will exceed 200,000*l.* From the same source we learn that by the will of Mr. Frank W. Collendar, Tulane University will receive 13,000*l.* for the Sophie Newcomb College, and that Mrs. Ida A. Richardson, who during her lifetime gave generously to various departments of the university, has left 5000*l.* to the Medical School.

AT the summer graduation ceremony at Aberdeen University on July 13, Principal Smith announced that the Chancellor of the University, Lord Strathcona, has just given to the university a sum of 10,000*l.* towards the endowment of a chair of agriculture. The interest on this money, along with the annual revenue of the Fordyce lectureship on agriculture and rural economy, and the 450*l.* a year in the charge of the governors of the college for the same purpose, will enable the university to secure the services of a thoroughly competent authority on the subject.

THE suggestion has been made that a scholarship should be established at the Imperial College of Science and Technology as a memorial to the late Mr. C. S. Rolls. It is proposed that the scholarship should be devoted especially to the engineering side of aëronautics. It would be difficult to find a more fitting memorial than such a scholarship, which would enable properly trained young men to engage in aëronautical research, to perpetuate the memory of an engineer who devoted his life to the development of various branches of applied science.

A short vacation course on oceanography (hydrography and planktology) will be held at Port Erin Biological Station, Isle of Man, in the first half of next month. We understand that there is still room for about four more persons in the laboratory. Applications for admission should be sent to Mr. H. C. Chadwick, Curator, Biological Station, Port Erin, Isle of Man. Prof. Herdman will give an opening lecture on the history and present position of oceanographic investigation; he will also deal in one or two following lectures with quantitative plankton methods, the distribution of the plankton, and its bearing on fishery questions. Prof. Herdman will also conduct some demonstrations of methods of investigation at sea, and will discuss some of the problems and results of plankton investigation. Dr. W. J. Dakin will give lectures and demonstrations dealing with the following matters :—History of quantitative methods; hydrographical apparatus as used at sea, and general work in the laboratory; the periodicity of the plankton; the most important plankton species—phyto- and zoo-plankton—of the Irish and North Seas, and the sea as a nutrient fluid. Dr. H. E. Roaf will deal with the following :—Respiration of marine animals; metabolic processes in animals; carbon-dioxide determination; and oxygen determination.

In the course of an address at the Holborn Restaurant, London, on Monday, Mr. Haldane remarked that the Royal Commission on University Education in London, of which he is chairman, will consider the subject with reference to the Empire. There are vast possibilities of the various parts of the Empire, with their different industries, their different methods for training people for the great battle of life, coordinating their systems of university training in such a fashion that we in the metropolis may accomplish our part, and they may do their specialised parts, so that we may have an educational system in which the student may proceed from place to place, and in which we may have the sense of a unity in the great conceptions of the mind as well as in more material things. Germany has vast organising capacity, a splendid educational system, and a genius for organisation which Mr. Haldane wishes we possessed at home. If we were the equals of Germany in the kind of education which bears so closely upon commerce, and if organisation with us were developed on the same plane to which it is developed in Germany, we need not have much fear for the future. But there need not be much fear for the future, because these very things—organisation and education—are being advanced among ourselves with strides which were wholly unfamiliar a short time ago. We have added nine universities in the last twelve or thirteen years to those which we had before; we have developed our school system enormously; our technical system has gone on; and there is a life and an energy in the people which, with the individual capacity of the members of the race, gives us every prospect of holding our own.

One of the best results of the Education Act of 1902 was to place the administration of education in all its grades in the hands of one committee for each area. That this course has led to the prevention of much overlapping, the encouragement of coordination, and economical management is to be gleaned from a study of the annual report of the Education Committee of the city of Manchester for the year 1908–9. The report runs to nearly 350 pages, and constitutes a splendid record of what public spirit and persistent endeavour can accomplish in the provision of educational facilities in a great manufacturing town. It is possible to refer only to one or two of the many points of interest in the report. We notice with pleasure an increase of 110 individual students attending the day departments of the Municipal School of Technology, bringing the total, including manual training students, up to 823. The work of the principal evening departments of the school is now organised in group courses of instruction ranging over five years, and leading to the diploma of the school, with the title of associate. The work of the special day course for engineering apprentices has now entered upon its seventh year. It is designed to give instruction to selected apprentices employed in engineering works, and candidates for the course are nominated by their respective firms, and they are required to give evidence of a satisfactory knowledge of mathematics and mechanical drawing. The students attend for eight hours on one day a week for forty weeks, and it is found that they are able to obtain a more extended and satisfactory course than the evening classes are able to afford, and the evenings are left free for the preparation of home work and for necessary reading. A similar course is held for apprentice plumbers. Numerous tests have been carried out in the school during the year for manufacturing firms in the city and surrounding neighbourhood, and the staff has been able to accomplish a large amount of research work.

SOCIETIES AND ACADEMIES.

Edinburgh.

Royal Society, June 20.—Prof. Cossar Ewart, F.R.S., vice-president, in the chair.—A. D. **Ross** and R. C. **Gray**: The magnetism of the copper-manganese-tin alloys under varying thermal treatment. The alloys prepared contained 14, 16, 18, 30, 38, and 48 per cent. of tin, the remainder, copper and manganese, being in the ratio of 7 to 3. At 15° C. these alloys gave in field 100 intensities, which were equal, respectively, to 55, 77, 82, 0·4, 96, and 1. Thus the 38 per cent. alloy forms a group by itself, marked off from the group of lower percentages by the 30 per cent. alloy, which has very small susceptibility. The critical temperatures varied from 225° C. to 275° C. In the case of the 38 per cent. alloy, the critical temperature was 225°, on cooling from which the alloy regained its magnetic quality, but when heated to 330° C. it did not regain its magnetism on cooling. Many other results were detailed in connection with thermal treatment of various kinds.

July 4.—Sir William Turner, K.C.B., president, in the chair.—Sir William **Turner**: Morphology of the manus in *Platanista gangetica*, the dolphin of the Ganges. Ten specimens of the manus in this species had been examined and compared with the corresponding organ in Hyperoodon and Mesoplaton. On account of fusion, the five carpal bones typically represented in Hyperoodon were reduced to four in Platanista, the fourth and fifth corresponding to the ring and little finger being united. In some cases the radial was found fused with the first carpal bone. The paper gave a full, detailed account of the morphological similarities and dissimilarities among these related forms.—Prof. Alex. **Smith** and A. W. C. **Menzies**: A static method for determining the vapour pressures of solids and liquids, and the vapour pressures of mercury. In the former paper the authors described a modified form of their "isoteniscope," in which, by adjusting the pressure under a fixed temperature, they were able to measure vapour pressures with great accuracy. Previous determinations of the vapour pressures of mercury at different temperatures showed considerable discrepancies. They had accordingly carried out a series of measurements of the pressure of this vapour between the temperatures of 255° C. and 450° C.—J. W. **M'David**: Specific volumes of solutions of tetrapropylammonium chloride. Dilute solutions had a density less than that of water, passing through a minimum as the solution became stronger. The position of this minimum depended on the temperature, occurring, for example, with a 5 per cent. solution at 0° C., and with a 20 per cent. solution at 56° C.—Dr. A. Louise **M'Ilroy**: The development of the germ cells in the mammalian ovary, with special reference to the early phase of maturation. The research was carried out with the view of determining the maturation processes which take place in the germ cells, and also to obtain evidence of the origin of the stratum granulorum. It was found that the cells matured inwards from the periphery. The capsular epithelium on the surface of the ovary was derived from the oogonia, and was differentiated at a very early stage. It had no function other than protective. Mitosis occurred among the oogonia, and also among the primary oocytes of the reticular stage. The growth of the stroma and germ cells was mutually correlated throughout the development of the ovary. The follicle cells were derived from the oogonia, and not from the stroma, cells, the latter being only supporting and vascular. The paper contained many other important details, partly supporting, partly correcting, the conclusions of other workers.—Dr. Thomas **Muir**: The theory of wronskians, recurrents, and all other less common special forms of determinants up to 1860.

PARIS.

Academy of Sciences, July 11.—M. Émile Picard in the chair.—A. **Lacroix**: General consequences to be drawn from the study of the petrographic constitution of Tahiti. The author shows the presence of granitoid rocks in this island to be of some importance, since no analogous rock has yet been found in Polynesia.—Sir William **Ramsay** and Robert Whytlaw **Gray**: The density of the radium emanation. After two years' efforts, the authors have constructed a balance sensible to a half-millionth of a milligram, and by means of this have arrived at 220 as the mean value of the atomic weight.—Édouard **Heckel**: The action of cold and anæsthetics upon the leaves of *Angraecum fragrans* and the green husks of Vanilla. As a practical deduction from these observations, it would appear useful, in order to diminish the time necessary for the industrial extraction of vanilla, to submit it first to the vapour of sulphuric ether for 5 or 8 hours, afterwards drying by the usual processes.—P. **Puiseux**: The origin of the "cirques" and angular outline of the lunar crevasses.—G. **Millochau** and H. **Godard**: Observations on Halley's comet from the Pic du Midi Observatory.—E. **Study**: The "Géométrie des feuillets" of MM. R. de Saussure and R. Bricard.—Arnaud **Denjoy**: The continuous and the discontinuous.—L. **Amaduzzi**: The variation of the appearance of a discharge with the variation of the distance of explosion.—Ettore **Cardoso** and Georges **Baumes**: Critical constants of acetylene and cyanogen. The authors find the mean values to be: acetylene, $t_c=35{\cdot}5^\circ$ (308·5 abs.), $p_c=61{\cdot}5$ atmospheres; cyanogen, $t_c=128{\cdot}3$ (401·3 abs.), $p_c=59{\cdot}6$ atmospheres.—A. **Lafay**: The average pressures supported by a body maintained in a current of air of irregular velocity.—P. **Carré**: Researches on the fixation of trioxymethylene by magnesium derivatives of homologues of benzyl bromide.—M. **Vandernotte**: The brookite of an albitic syenite from the neighbourhood of Ernée.—E. **Gourdon**: Two deposits of zeolites in the Antarctic.—Leclerc Du **Sablon**: The ascent of sap. It is shown that the mechanism of the ascent is independent of the height of the trunk, and that water has no more difficulty in rising to the top of a tree of 300 metres than a plant of some decimetres.—M. **Radais** and M. **Sartory**: Rendering a rabbit immune from the poison of mushrooms.—A. **Magnan**: A certain law of variation of the liver and the pancreas among birds.—Marcus **Hartog**: A new force: mitokinetism.—A. **Perrier**: The combustion of acetaldehyde by lower vegetable organisms.—J. **Winter**: The quantity of secretion contained in a given gastric liquid.—M. **Doyen**: The use of thermo-electric baths without alteration of normal tissue. The author describes successful experiments based on the fact that cancerous poison cannot resist a temperature of 55° C., while normal tissue supports a temperature of 58°–60°.—M. **D'Arsonval**: Remarks on the previous paper.—A. **Briquet**: The succession of cycles of erosion in the Franco-Belgian district.—Henri **Mémery**: Remarkable coincidences between the variations of sun-spots, and the temperature variations at Paris, Bordeaux, and Pau during the winter and spring of 1910.

CAPE TOWN.

Royal Society of South Africa, March 18.—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. R. **Marloth**: Some further observations on the biology of Roridula. *Roridula dentata*, commonly called the fly-bush, is a shrub 1 to 4 feet high, growing on the mountains near Tulbagh and on the Cedar mountains. As the leaves are provided with many stalked glands, which secrete a very viscid fluid, numerous insects adhere to the leaves and perish there, hence the shrublet is universally considered to be an insectivorous plant. Experiments, however, have shown that the fluid secreted by the glands does not possess any digestive properties, and that it is quite different from the fluid secreted by droseraceous plants. The fluid is a kind of balsam, and probably affords protection to the plant against the attacks of creeping animals, such as snails, caterpillars, earwigs, &c., and the capturing of other insects is merely accidental, and of no advantage to the plant. *Roridula dentata* and *R. Gorgonias*, the only two species of this genus, are consequently to be excluded from the list of insectivorous plants.—Dr. T. **Moir**: The absorption spectrum of oxygen and a new law of spectra. The AB and *a* lines of the solar spectrum, which are due to absorption by terrestrial oxygen, have each a complicated rhythmic structure. The author has discovered an algebraical formula whereby each line can be calculated from a fundamental, the differences being directly proportional to the squares of the first fifteen or sixteen integers. The agreement is practically in all cases within the observational error. The oxygen molecule is shown to be very slightly unsymmetrical.—Dr. L. **Péringuey**: Notes on some bushmen. The small, elf-like bushman was legendary, with all the concomitants of the legend. If careful comparison of the description of the old authors such as Sparrman, Barrow, and Burchell with the remnants of that so-called bush race was made, it would be found that such physical peculiarities in male or female of which the authors spoke were most accurately described. Yet the skull of the brother of one of the females exhibited came within the measurements assigned to Hottentots. This was another proof of the conclusion arrived at by Shrubsall that the Hottentots and the so-called bush people are closely allied, whereas the akin race, "Strand Looper," show more differentiation.

CONTENTS.

	PAGE
A Standard Treatise on Physics	65
Flower Pollination	66
Practical Work for Electrical Laboratories. By Prof. Gisbert Kapp	67
Ancient Hindu Chemistry. By T. K. R.	68
An Encyclopædia of the Sciences	68
Our Book Shelf	69
Letters to the Editor:—	
Experimental Study of Fulgurites. (*Illustrated.*)—Prof. R. W. Wood	70
Ooze and Irrigation.—Rev. Hilderic Friend	70
The Sterilisation of Liquids by Light of very short Wave-length.—Prof. Theodore Lyman	71
Elemental Weight Accurately a Function of the Volution of Best Space-symmetry Ratios. (*With Diagram.*)—H. Newman Howard	71
Electrical Discharge Figures. (*Illustrated.*)—Prof. W. Lermantoff; Prof. Alfred W. Porter	72
An Interesting Occultation.—Arthur Burnet	73
Pwdre Ser.—W. B. Grove and B. Millard Griffiths; C. Fitzhugh Talman	73
House-flies and Disease. (*Illustrated.*) By Dr. C. Gordon Hewitt	73
The Next Total Eclipse of the Sun. By Dr. William J. S. Lockyer	75
Glaciers, Goldfields, and Landslides in North America. (*Illustrated.*) By G. W. L.	76
Mountaineering in the North-west Himalaya. (*Illustrated.*) By Sir T. H. Holland, K.C.I.E., F.R.S.	78
The East African Natural History Society. By Sir H. H. Johnston, G.C.M.G., K.C.B.	80
Notes	80
Our Astronomical Column:—	
Photographs of Auroræ	86
Displacement of Spectral Lines at the Sun's Limb	86
The Pressure of Light on Gases	86
The Determination of Stellar Radial Velocities	86
Halley's Comet	86
Harvard College Observatory	86
Colour of the Sea. By J. Y. Buchanan, F.R.S.	87
Remnants of the Past	89
Non-ferrous Metals	89
The Association of Technical Institutions	90
The Position of University Education in Great Britain	91
University and Educational Intelligence	96
Societies and Academies	97

THURSDAY, JULY 28, 1910.

PLANETOLOGY.

The Evolution of Worlds. By Prof. Percival Lowell. Pp. xiii+262. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 10*s*. 6*d*. net.

ONLY by the minutest study of that which is can finite man of a finite epoch hope to draw even the roughest sketch of the antecedent, or form the vaguest speculations as to the ultimate; the truth of the sketch and the soundness of the speculation increase or decrease in proportion to the knowledge acquired by the observer. Therefore we welcome a volume in which Prof. Lowell sets out a scheme of evolution which embodies a proper sequence of congruities and is based on the results of years of careful observation.

Planetology is defined as the astronomy

"which deals with the evolution of worlds. It treats of what is general and cosmic in that evolution, as geology treats of what is terrestrial and specific in the history of one member of the class, our own earth."

On these lines Prof. Lowell develops a scheme of evolution wherein the observational evidence wrested from what is, leads to the speculations as to what was and what will be.

The matter originally formed the subject of a university course of lectures, but a larger public demanded it, and hence the present volume.

There are seven chapfers in which the probable life-histories of a planet and of a planetary system are vividly portrayed, and a perusal of the first, "The Birth of a Solar System," impresses very forcibly the idea how finite is man, how infinite matter and time. The inception of a new system is but the death-knell of its predecessor.

The problem of the birth was solved when Goodricke, the deaf mute of York, divined the cause of Algol's demoniacal winkings—a dark sun; on this is based the whole story. The descriptions of a number of Novæ support the statement that cataclysms are not unknown, and, by several lines of reasoning, the production of spiral nebulæ—the matrices of new worlds—is shown to be the result. The planetesimal hypothesis is probably now too well known to call for further elaboration here of Prof. Lowell's story of the birth, but before proceeding to the second chapter he draws a wonderfully awful picture of the conditions which would precede and attend the incursion of a second dark body, which, by its powerful perturbative action, would once more produce chaos from our present orderly system.

In the second chapter we are given descriptions of the existing proofs of this cataclysmic birth. The existence of myriads of meteors in interplanetary space, their common motions, and their likeness to terrestrial material, are cited as evidence of a common origin in one rotating mass. The mathematics for this—mathematics being "a precise reasoning appli- usually to the discovery that a pet theory will not work," but more fruitful in this instance—are, with other more or less profound items, relegated to a series of notes at the end of the book. The physical evidence for this common origin reaches a climax with a statement of the varying densities of the planets; those torn off earlier by the tidal stress are less dense because they formed the upper layers of the parent dark body. Thus the hydrogen envelopes of Neptune and Uranus, demonstrated by Dr. Slipher's spectrograms, are evidences of primogeniture.

In the chapter on inner planets, many old "facts" are reorganised, on the evidence of the careful observations made at Flagstaff, and, as they have not yet appeared in their new forms in the ordinary text-books, their statement here is a useful addition to astronomical literature. Among others, the correction to the diameter of Mercury, so dramatically confirmed, independently, by Newcomb, is an example of the value of such careful attention to observing conditions and observations as has been paid at Flagstaff. Students of astronomy will also experience a feeling of relief that the rotation periods of Mercury and Venus now appear to be placed beyond question. The following description of Mercury is so characteristic of Prof. Lowell's graphic style as to be worth quoting:—

"Two antipodal hemispheres divide the planet, the one of which frizzles under eternal sun, the other freezes amid everlasting night."

The persistent observations at Flagstaff also dispelled the idea of a cloud-covered Venus, replacing it by a diaphanously-clad body on which the strong winds sweep up enough dust to account for the planet's high albedo. The radial streaks depicted on the accompanying drawing of the planet are supposed to be "runs" produced by winds which have consistent, and persistent, directions. An interesting suggestion is that the "earth-light" sometimes seen on Venus's dark limb is but a darkened vision of the ice which for countless æons has been hoarded up on that side of the planet which never sees the sun. "Monotony eternalised" is Prof. Lowell's apt description of the Mother of Loves.

It is with something like a shock that the reader finds but about a page and a half devoted to Mars; but the author opines that he has already treated adequately of the subject elsewhere. Phobos and Deimos are dealt with, however, and, according to Prof. Lowell's observations, they are larger than hitherto supposed; he gives 36 miles and 10 miles as their probable, respective, diameters. The dilatation of "Fear" and "Panic" by observations made at the Flagstaff Observatory may not appear to some conservative tenants of "facts" as a novelty.

Coming to the minor planets, evidence is cited to show that Olbers's theory of an exploded planet is untenable, and that this congeries of fragments represents what would have been a planet had not the giant Jove prevented the agglomeration. By plotting the major axes of their orbits in the form of a spectrum band, the wave-lengths scale being replaced by one of astronomical units, Prof. Lowell shows how commensurability of period with the period of Jupiter has determined the location of the asteroids. The variability of magnitude exhibited by minor planets is accepted as evidence of dissymmetry, and this, in turn, is taken as evidence for the initial cataclysm as described. Torn by tidal stress, the dark sun was disrupted while still solid, the dissymmetry showing that the asteroids have never been in a fluid state.

Jupiter as a semi-sun is discussed at some length, its albedo of 0·75, as compared with Muller's 0·72 for clouds, being ascribed as possibly due to intrinsic light; the same explanation is offered for Saturn's albedo of 0·78. Jupiter's independence of the sun—its belts of cloud are apparently not affected by the rotation or revolution of the planet—serves as an illustration of the earlier condition of the earth, and other planets, before the advent of the sun-sustained period.

Of Saturn and Uranus but little is related, but the story of Neptune's discovery is told at some length. Rather more stress than usual is laid on Prof. Pierce's demonstration that Galle's discovery was a lucky accident. The problem solved by Leverrier and Adams was capable of three solutions, and it was but by chance that they attacked the right one.

"Congruities" is the keynote for the chapter on the formation of planets, and Prof. Lowell urges that incongruities, discovered since Laplace's time, have killed the nebular hypothesis. He then marshals the mutually-sustaining facts in support of the planetesimal hypothesis. By curves showing the masses of the planets relative to their solar distance, and others demonstrating the analogies of satellites and primaries in their departures from the common plane, he shows that the congruities, on this hypothesis, are perfect—to-day; future discoveries may necessitate further steps.

Having thus brought us to the formation of planets as discrete bodies, the author proceeds to outline the probable history of the finished sphere. On the one hand, we have the physical development, the cracks and cataclysms which formed our geographical features along lines necessarily different from those obtaining on Mars, or any other world; on the other is the chemical development, "as universal as the universe itself." Evidence that darkness was spread over the face of the earth is gleaned from many quarters, all showing that our planet was a sunless forcing-house; this was the self-sustained age. Then the earth cooled, the dense cloud covering condensed, admitting sunlight, and we arrived at the sun-sustained epoch which we still enjoy. Here the story of evolution is exceedingly interesting, especially that dealing with the Ice age. Probably the statements will be criticised by some geologists, but the author's substitute for what he terms their "astrocomico" suggestions is none the less attractively stated. The extraordinary ellipticity of the orbit, to account for the Glacial epoch, is rejected, and is replaced by one in which excessive evaporation and precipitation, producing polar ice-sheets of great thickness, play a great part. It is also shown that the glaciation was restricted to well-marked raised areas, such as Norway, Scotland, Labrador, Keewatin, &c., and was nothing more than a natural terrestrial phenomenon; observations of Mars show that, at the present time, the polar highlands retain their covering of snow for some time after the general melting of the cap has separated them from the main body of it.

In the last chapter the "Death of a World" is discussed, and the possible modes of extinction examined. It may be by collision with a dark sun, but, failing that, it is inevitable by the action of tidal friction and the diffusion of water and atmosphere. Collating the facts gleaned from the previous study of the several planets, it is shown that there is a more or less orderly sequence culminating in the present condition of our own satellite. *Sans* season, *sans* day and night, *sans* water and *sans* atmosphere, the worlds will await the quickening which can only come by the advent of a cataclysm such as is described in the earliest chapters.

The printing and illustration of the volume are beyond criticism, although the paper is rather heavy, and with its graphic language, its sustained interest, and clear story, the book is sure to appeal to the general reader who would learn more of the past, and of the probable future, of our earth and its fraternity.

WILLIAM E. ROLSTON.

NATURE-STUDY.

(1) *The Nature-Study Idea. An Interpretation of the New School-movement to put the Young into Relation and Sympathy with Nature.* By L. H. Bailey. Third edition, revised. Pp. ix+246. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 4*s.* 6*d.* net.

(2) *Man and Nature on Tidal Waters.* By Arthur H. Patterson. Pp. xvi+315. (London: Methuen and Co., 1909.) Price 6*s.*

(3) *Tommy's Adventures in Natureland. A Nature Story for Boys and Girls.* By Sir Digby Pigott, C.B. Pp. xvi+180. (London: Witherby and Co., 1909.) Price 2*s.* 6*d.* net.

(4) *Animal Romances.* By Graham Renshaw. Pp. vi+206. (London: Sherratt and Hughes, 1908.) Price 7*s.* 6*d.*

(1) PROF. L. H. BAILEY is well known as a botanist who believes in the practical and educational value of his science, and he has shown himself on many occasions able to give good reasons for the faith that is in him. In the present volume he discusses, in a lively and unconventional fashion, the true inwardness of "nature-study," which is not science, nor knowledge nor facts. "It is spirit. It is an attitude of mind. It concerns itself with the child's outlook on the world." "It would be better if it were called nature-sympathy." We do not think that professional educationists will quite agree with Prof. Bailey in associating all the pædagogical virtues with nature-study (for many of them may be expressed in the study of history, for instance), but most who have any sympathy at all with studying the world around us will agree with the sound educational sense which the book expresses. In a breezy and interesting fashion he discusses how nature-study may be taught, the school-garden, the rural-school problem, the teacher's outlook on nature, and about half a

hundred particular inquiries, some of which are very quaint, *e.g.* "Now that there are so many nature-books, how shall I choose the most useful one?" or, already, "Is nature-study on the wane?"

(2) Mr. Arthur H. Patterson has added a fourth volume to his series of east-coast books, and it is welcome, for the author writes with a light touch of the business of man and beast on the tidal waters of East Anglia. He describes at first hand much that is of interest regarding punt-gunning, decoying, snipe shooting, smelt fishing, shrimping, eel catching, and so on, and gives us delightful glimpses of the bird-life in particular. There is a great deal of fisherman's gossip in the book, but it is wholesome, open-air gossip, now and then cutting into the circle of the sciences.

(3) Sir Digby Pigott's nature-story for boys and girls is a sequel to "The Changeling," in which the author worked out, in a manner that pleased many, the idea of a child who was at one time a rook, at another a bee, at one time a fox, and at another a wild goose, and in due course a swift, a mole, and a short-eared owl. The author seeks to get young folks into close quarters with the real life of wild creatures, introducing them, through "Tommy's" adventures, to fur-seals and skuas, walruses and peregrines, and even to the dodo and "Archæopterix." We find the book a little too informative, but it is kept, on the whole, commendably simple, and we doubt not that it may be useful for those children who really enjoy getting at things in this curiously circuitous fashion. The notes seem to us to be an artistic mistake.

(4) Dr. Graham Renshaw's natural-history essays are well known and justly admired, but he has excelled himself in the sequel, which deserves its title of "Animal Romances." With the help of more than a score of peculiarly interesting and artistic photographs, he has succeeded in giving us living pictures of many wild animals in their natural setting—giraffes ("the dream creatures," "the aristocrats"!) Grevy's zebras ("the Horses of the Sun"), elephants ("the giants"), hippopotamus ("Behemoth"), and so on. He stays longest in Africa, but he takes us also to the Andes, to the Antarctic ice, to Tasmania, and elsewhere, and is always a lively guide. There is plenty of science in his nature-pictures, but there is poetry, too, and his book is literature of high quality.

TECHNICAL CHEMICAL ANALYSIS.

Technical Methods of Chemical Analysis. By Prof. George Lunge. English translation, edited by Dr. C. A. Keane. Vol. i., parts i. and ii. Pp. xxiv + 996. (London: Gurney and Jackson, 1908.) Price 2*l.* 12*s.* 6*d.* net.

A BOOK which covers such a wide ground as Prof. Lunge's "Technical Methods of Chemical Analysis" is by no means easy to review. No one chemist, for example, is likely to be practically conversant with all the branches of analysis which are dealt with, and, recognising this, the author has, as is usually the case in similar works, obtained those who have specialised along certain lines to undertake the writing of such sections.

One of the difficulties to the reader of books like this is that to some extent it is a dictionary of methods, and it is sometimes a little bewildering to know which of many methods given for the analysis of one special substance is the best to employ. It is consequently not a book for the ordinary student, but one for the experienced worker, although even he will require to bring his critical faculty into play. The book is well written and is interesting to read, and those who study it will find it to contain quite an extraordinary amount of information which is by no means only analytical. The sections on clay and on clay wares, earthenware, and glazes are, for example, most interesting to read, even if one has no intention of carrying out the analysis. We like the arrangement of the section on potassium salts; first, all the methods employed are given in detail, and then the applications of these methods to special cases, such as analysis of Stassfurt salts, manures, beet ashes, and so on.

That the book is of the utmost value in the laboratory—in fact, almost indispensable—we can vouch, as since its publication it has been in constant use, and it is rarely that, within the scope of this volume, we have not obtained the information desired.

In conjunction with this volume an extremely useful little handbook of 260 pages, called "The Technical Chemist's Handbook," has also been issued. It is in limp cover, and of such a size that it can be carried in the pocket. Nearly 100 pages consist of tables, comprising, among others, factors for calculating gravimetric analysis, specific gravities, boiling points, tension of aqueous vapours, and weight of sheets of metals; there are, in fact, thirty-nine useful and valuable tables. The special part which follows deals with methods of analysis under various headings. To take an example at random, "III. Saltcake and Hydrochloric acid; A. Salt, B. Saltcake, C. Chimney-testing, D. Testing of the Gases in the Hargreaves Process, E. Hydrochloric acid." It should be mentioned that beside the thirty-nine tables referred to there are further tables in the special part, for example, the specific gravities of hydrochloric acid.

Dr. Lunge and Dr. Keane are to be congratulated on the issue of this volume, the one for writing it and the other for so ably editing the English edition. We hope that it will not be long before vols. ii. and iii. are ready.

BRITISH FOSSILS.

Palaeontographical Society. Vol. lxiii., 1909. (London: The Society, and Dulau and Co., Ltd.,

THE sixty-third volume of the Palæontographical Society's monographs contains instalments of works already in progress, and the council announces its desire, so far as possible, of completing these before commencing new monographs, for which they have received numerous proposals.

Prof. S. H. Reynolds continues his monograph of the British Pleistocene mammalia, here dealing with the Canidæ, comprising the wolf, the fox, and the Arctic fox. This part is illustrated by six plates, and there are a number of text-figures and tables of comparative measurements which should prove useful, but nothing calls for special notice except the determination of the problematic *Lycaon anglicus*, Lyd., as a somewhat abnormal wolf, a conclusion which seems justified by the evidence now available.

For our knowledge of the Palæozoic fishes of the family Palæoniscidæ we are mainly indebted to the researches of Dr. R. H. Traquair, who continues his account of the British Carboniferous members of the family, describing the genera Acrolepis, Nematoptychius, and Cycloptychius; the last three of the seven plates illustrate the genus Rhadinichthys, which will, presumably, be described in the next part. The predaceous habits of the larger Palæoniscidæ are shown by a specimen of *Nematoptychius greenocki*, with the remains of a good-sized Acanthodes in the abdominal cavity, and another point of some interest to which Dr. Traquair directs attention is that in round-scaled Palæoniscidæ (Coccolepis, Cryphiolepis, &c.), the scales on the upturned portion of the tail always preserved their original angular form, as they do even in the modern Chondrosteans. The probable explanation is that the markedly heterocercal tail of these fishes was a powerful organ of propulsion, and that no sacrifice of strength could be made to gain increased flexibility; the Palæoniscidæ were strong swimmers with wide gill-openings, differing in their manner of life from the more sluggish Crossopterygians and Dipnoans, with their restricted branchial apertures, paddle-like paired fins, and diphycercal or hetero-diphycercal tail.

In the fifth part of his monograph of the fossil fishes of the English Chalk, Dr. A. Smith Woodward concludes the Teleostomes and commences the Chimæroids. Lophiostomus and Neorhombolepis are described as highly specialised Eugnathids, but of most importance is a very full description, accompanied by a restoration, of the Cœlacanthid *Macropoma mantelli*. Our knowledge of the Crossopterygian fishes of the order Actinistia is gradually becoming more complete; it is now some years since Dr. Smith Woodward made the interesting discovery that the pectoral fin was supported by a series of four hour-glass-shaped pterygials, exactly as in typical Teleosts, and in the present case he has elucidated many details of cranial structure.

Mr. Henry Woods gives another instalment of his elaborate monograph of the Cretaceous Lamellibranchs of England, describing the Solenidæ, Saxicavidæ, Pholadidæ, Teredinidæ, Anatinidæ, Pholadomyidæ, Pleuromyidæ, Poromyacidæ, and Cuspidariidæ. Several new species are included, and the preparation of the synonymy of some of the others must have been no light task.

The Palæontographical Society spares no expense in order to ensure that its monographs are properly illustrated, and the present volume contains twenty-nine plates, ten of which are assigned to Mr. Woods's memoir; the beautifully executed reproductions of English Cretaceous fishes, drawn by Mr. A. H. Searle to illustrate Dr. Smith Woodward's monograph, call for special mention. Indices to the Cretaceous Cephalopods and the Jurassic Belemnites, described many years ago, conclude the volume. C. T. R.

COMPARATIVE PHYSIOLOGY.

Handbuch der vergleichenden Physiologie. Edited by Hans Winterstein. Band ii., Physiologie des Stoffwechsel; Physiologie der Zeugang. 1st and 2nd fasciculi, pp. 1 to 320; 3rd fasciculus, pp. 321 to 482 of the first half of the 2nd volume; 4th fasciculus, pp. 1 to 160; 5th fasciculus, pp. 161 to 304 of the 2nd half of the 2nd volume; 6th fasciculus, pp. 483 to 658. (Jena: Gustav Fischer, 1910.) Price 5 marks per fasciculus.

THERE are being published in Germany just now a number of important works of a biological nature, in which eminent investigators are collaborating to produce a more or less exhaustive presentment of their special branches of knowledge. The fasciculi are published at short intervals as they are ready, and not necessarily in the sequence in which they will ultimately be bound together. The present work is the latest example of this method of publication, and the growing science of comparative physiology is receiving its due share of attention. The editor, Prof. Hans Winterstein, has an ambitious programme before him, and hopes to complete the work in four volumes. The list of selected collaborators contains the names of some of the best known of modern investigators; the majority of these are Germans, but the names of Fredericq, of Liége, Carlson, of Chicago, Tigerstedt, of Helsingfors, Bottazzi, of Naples, and Godlewski, of Cracow, also occur upon the title-page.

The fasciculi at present to hand will all ultimately be found in one or other of the two parts into which vol. ii. is to be divided. The first three fasciculi and the sixth are occupied with a single article from the pen of Prof. W. Biedermann, of Jena, and it deals with the digestion and assimilation of nutriment in the various classes of organisms; the article includes the consideration of plant as well as of animal life, so the term comparative is used in the widest sense. The article is left to be finished in future issues.

The fourth fasciculus is devoted to an interesting monograph by Prof. Léon Fredericq on the secretion of protective substances, in which we have an account of such materials from the nematocysts of protozoa up to the more elaborate means of defence found in the vertebrata; this includes an account of toxins, antitoxins, and the numerous other substances included in a general study of the vast subject of immunity. The monograph overlaps into and nearly fills the fifth fasciculus also, which concludes with the commencement of an article by Dr. R. Burian, an authority well qualified to deal with the subject allotted to him, namely, excretion.

The enterprise of our German brethren is to be admired in the conception of such a monumental work, and the preliminary fasciculi hold out the best promise for its future successful realisation.

W. D. H.

OUR BOOK SHELF.

Light and Sound: a Text-book for Colleges and Technical Schools. By W. S. Franklin and Barry Macnutt. Pp. viii + 344. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 5s. net.

IN writing a text-book, an author generally chooses definitely between two methods of exposition: he either writes a small book, and confines his attention to the most elementary parts of the subject treated of; or else he writes a more pretentious work, in which most branches of the subject receive adequate attention.

The authors of the text-book now under review have followed a middle course. The fundamental principles of Sound and Light are discussed with great care, and numerous practical applications of these principles are described; for the explanation of complicated phenomena, the student is referred to more advanced text-books. The book opens with a very thoughtful exposition of the wave theory, illustrated by reference to water waves, sound waves, and waves in an elastic solid; and the subject of Light is developed wholly in accordance with the wave theory. Numerous optical instruments, including the standard forms of photographic lenses, are described and illustrated; and a clear but necessarily incomplete theory is given of the defects of lenses, and their compensation. Considerable attention is devoted to the subject of photometry and illumination; technical students should carefully study the chapter devoted to this part of the subject. The fundamental facts of polarisation are explained clearly and well.

In connection with sound, the simple phenomena, which are generally discussed in elementary text-books, are dealt with concisely. A very interesting chapter is devoted to the theory of music, and an account is given of Sabine's researches on the audibility of sound in rooms of various sizes; here, once more, technical students will find much to interest them. Altogether the book should prove very useful.

E. EDSER.

Kraft: das ist animalische, mechanische, soziale Energien und deren Bedeutung für die Machtentfaltung der Staaten. By Prof. Dr. E. Reyer. Zweite Auflage. Pp. xvi + 471. (Leipzig: W. Engelmann, 1909.) Price 8 marks.

Soziale Mächte: als Ergänzung der Arbeit über "Kraft." Same author and publisher. Pp. 111 (1908.) Price 1.60 marks.

THE first edition of Dr. Reyer's "Kraft" was noticed at length in NATURE (vol. lxxviii., p. 660) shortly after publication, and to that notice we must refer the reader for details as to the scope of the work. The present, second, edition has been somewhat extended, but does not appear to have been rewritten to any considerable extent, and it retains all the faults of the earlier issue. The same lack of orderly arrangement distracts the reader, the same lack of references renders the work almost valueless to the serious student, and the same absence of "the scales and the names of the plotted quantities" continues to characterise the diagrams. The bibliography remains remarkable both for its inclusions and its omissions, and it still contains even the two remarkable entries to which attention was directed in the notice of the first edition —"Produktion and consum. of timbre in forein countries (blue book)," and "Statesman's yearbook, Statist. Abstracts (mit statistischen Tabellen)"—the latter entry apparently confusing the "Statesman's Yearbook" with the "Statistical Abstracts."

The title of the second volume named above is, at the present date, misleading. When first published—the title-page bears the date 1908, although the cover is dated 1909—the title may have been correct, for the volume is apparently a supplement to the *first* edition of "Kraft." It is not supplementary to the second edition, but a mere reprint of pp. 339–447. In these pages Dr. Reyer considers such matters as migration, wages and conditions of labour, the struggle for better conditions of life, personal energies and their contributions to civilisation.

Notes on the Electric Smelting of Iron and Steel. By Dr. W. F. Smeeth. Bulletin No. 5, Mysore Geological Department. Pp. vii + 136; maps. (Bangalore: Government Press, 1909.) Price 2 rupees.

ELECTRIC steel melting and refining is now an established industry, but the electric smelting of pig-iron from the ore has recently entered on a new phase, namely, the commercially successful. The writer has had given to him, in confidence, figures of costs in connection with an electric furnace making charcoal pig-iron, with permission to mention the facts without the figures. It is clear that under conditions where the fuel is charcoal, and is becoming increasingly scarce and expensive, so far as can be judged from experience with a furnace of commercial size working for months, the smelting of high-grade ore into charcoal pig-iron is proving profitable. Only the balance sheet is a safe guide, but this test is about to be applied on quite a large scale.

The present bulletin embodies the technical portions of a report prepared by Dr. Smeeth at the request of the Government of the Maharajah of Mysore. A short description of the Stassano furnace is given, and details of several charges of steel made in the furnace in 1908 from pig-iron and scrap with the usual additions. Chapter iii. contains details of an attempt to make high-quality steel, carbon 0·2 to 0·3 per cent., in the Stassano furnace from very impure ore, a serious task. The author calculates that to produce steel from the ore, the electric furnace will require only about one-third of the amount of charcoal necessary for smelting with fuel furnaces, but (p. 45) "The sulphur is high (0·24 per cent.) and renders the steel quite unfit for use." Trial C showed a better analysis, but the mechanical test given by the steel was not good. In part ii. of the bulletin, materials and costs at Mysore are considered, and the opinion is expressed that the manufacture of steel castings, steel forgings, railway tyres, and even rails could be carried on successfully there, and at a profit. The author evidently has courage. A folding geological map of the Bababudan iron-ore area is enclosed in a pocket on the cover.

A. McW.

Psychism. By M. Hume. Pp. 157. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., n.d.) Price 2s. 6d. net.

MRS. HUME begins with a curious and rather incoherent theory respecting the "Trinity of Man" (Matter, Intelligence, Force; or, in another aspect, Reason, Intuition, and Soul), but she becomes decidedly interesting when she proceeds to describe her own experiences. These have been visions, dreams, or other phenomena by which a warning of an impending event—*e.g.* the death of a friend at a distance—has been conveyed. The agency is believed by the author to be her own subconscious self, which possesses clairvoyant and other powers. The theory propounded closely approaches that of the leading investigators in these domains, but we would suggest that the terminology of Myers is preferable to that of T. J. Hudson, who, moreover, is an unsafe guide, being apt to rear a large structure of theory on a small or insecure foundation of fact. The book is well written and nicely got up.

J. A. H.

LETTERS TO THE EDITOR.

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

Antarctic Pycnogons.

One of the most remarkable and unexpected zoological results of recent explorations in Antarctic seas has been the discovery of Pycnogonida (so-called "sea-spiders") having five instead of the usual four pairs of legs. Soon after the return of the *Discovery* expedition, Mr. T. V. Hodgson described *Pentanymphon antarcticum*, and a little later he had the good fortune to find, among the collections of the Scottish National Antarctic Expedition, the long-forgotten *Decolopoda australis* described by Eights more than seventy years ago. A second species of Decolopoda was added by Prof. E. L. Bouvier from the collections of the French Antarctic Expedition in the *Français*. The most surprising circumstance connected with this remarkable departure from what had been regarded as the normal structure of the Pycnogonida was that it appeared in two genera by no means closely related to each other, but, on the other hand, not dissimilar in general structure from other "normal" genera. Thus Pentanymphon is indistinguishable, except in possessing an extra pair of legs, from Nymphon, while Decolopoda is only a little more divergent from Colossendeis. From the point of view of phylogeny, two explanations of these conditions may be offered. Most authorities, for example, Prof. Bouvier and Prof. D'Arcy Thompson (in the "Cambridge Natural History"), adopt the view that the ten-legged condition is the primitive one, and has been retained by the most primitive members in two divergent branches of the group. The other explanation, first suggested by Prof. G. H. Carpenter and advocated by the present writer (*Science Progress*, April, 1909), is that the decapodous condition is a recent development, appearing independently in the two cases.

Prof. E. L. Bouvier has just announced (*C. R. Acad. Sci.*, July 4) a very important discovery which shows that the zoological possibilities of the Antarctic seas are far from being exhausted. Among the collections obtained by Dr. Charcot's recent expedition in the *Pourquoi Pas?* is a representative of a third genus of decapodous Pycnogons, and, strange to say, it appears to be quite unrelated (within the limits of the group) to the other two. *Pentapycnon charcoti* is a near relative of Pycnogonum, hitherto regarded as the most highly specialised of all Pycnogonida. Further, just as Pentanymphon is accompanied by species of Nymphon, and Decolopoda by Colossendeis, so Prof. Bouvier finds that Pycnogonum, hitherto unknown from Antarctic seas, is represented by a new species alongside of Pentapycnon at the South Shetlands.

Prof. Bouvier regards this discovery as quite in accordance with his views as to the evolution of the Pycnogonida. He believes that the group has evolved from a decapodous stage in which at least the chief divisions, represented by Pentanymphon, Decolopoda, and Pentapycnon, were already differentiated from one another, and he supposes that the suppression of the posterior legs has occurred independently at least three times with very little accompanying variation in other characters.

No doubt Prof. Bouvier will justify these views in greater detail when he comes to publish his final report on the Pycnogonida of the *Pourquoi Pas?* At first sight, however, the discovery of Pentapycnon would seem to weigh heavily on the side of Prof. Carpenter's hypothesis. While Pentanymphon is at least as primitive as Nymphon, and even Decolopoda can be admitted, without much difficulty, as a reasonably primitive form, no student of the Pycnogonida will question that Pycnogonum is one of the most highly specialised members of the group, and the only single character that Prof. Bouvier can find to place Pentapycnon on a lower level of specialisation is the presence of additional genital apertures, about which he speaks somewhat doubtfully. The fact that all three genera are found only in one restricted geographical area is also against the idea of their being survivors of a primitive group, for it can hardly be supposed that the Pycnogonida underwent practically the whole of their evolution in the Antarctic seas, and only became distributed over the rest of the globe when they had reached nearly the final stages of family, and even generic, differentiation. It seems much more probable (though the like has not yet been suggested for any other arthropods) that some mysterious influence of environment in these Antarctic regions has, so to speak, upset the stability of the octopodous condition and led to the independent appearance of an additional somite and pair of legs in several unrelated families.

It is to be hoped that the British expedition now on its way to the Antarctic may obtain material for throwing light on this problem.

W. T. Calman.

A New Italian Orchid.

The enclosed photograph represents, I believe, a species of Italian orchid which has not before been discovered. M. H. Correvon, who is, I suppose, the greatest living authority on the European orchids, considers it "seems to be out of the way of species known." When first I found it, I believed it to be *Serapias triloba*, but, having studied various authorities, I have since come to the conclusion that I was wrong. They all agree that the lip of triloba is crenulated, but in my specimen there is no sign of that Triloba is considered to be a hybrid between *Serapias lingua*

and *Orchis papilionacea*; although the ground was covered with the former, I could not find a vestige of the latter in the whole of that district.

Also, the authorities only give the Riviera as the habitat of triloba, whilst I found my plant in mid-Italy, near Florence. In my plant the sepals and petals are each very distinct and separate, not joined into a cap, as in all the other varieties of Serapias.

It may possibly be a cross between *S. lingua* and *O laxifolia*, but, even so, it differs much from that pictured in Barla's book. It is a somewhat striking plant, as the flowers are very large in comparison to the rest, both the labellum sepals and petals being a very vivid shade of colour between pink and purple, the former a little darker.

W. Herbert Cox.

Centre of Gravity of Annual Statistics.

The principle of taking the centre of gravity of annual rainfall is free from objection, but Mr. Cook's method (Nature, March 31) is mathematically incorrect. Annual statistics should not be plotted on a straight line, but round a circular ring in accordance with the probable etymology of the term (*annus, anulus*).

For rainfall in India, results of some value may be obtained by Mr. Cook's method, because practically the whole of the precipitation takes place during the summer months. Heavy falls at the beginning or end of the year would entirely throw the calculation out, as was shown by Mr. Watt in the issue of April 14. In countries such as England and Scotland, where the rain is fairly evenly distributed throughout the year, the centre of gravity, as determined by Mr. Cook, will nearly always lie between 6 and 7, although its true position may be anywhere from 0 to 12.

If the monthly rainfalls be plotted round a disc arranged like a clock-face, and then the moments be calculated about rectangular axes passing through the centre of the disc, a series of simple calculations gives the true position of the centre of gravity.

It is best defined by means of an angle, α, measured clockwise from XII, and a distance, a, expressed as a fraction of the radius. The latter is a measure of the unevenness of the distribution of the rainfall. If equally distributed throughout the year, $a=0$; if very unequally distributed, a approaches 1. If the angle α be divided by 30°, a figure is obtained corresponding to Mr. Cook's C.G. But as the true position of the monthly rainfall is at the middle and not the end of the month, 0·5 must be deducted from this figure to obtain D, the date in months corresponding to the true centre of gravity. Mr. Cook omitted to make this correction.

In the tables below this method has been applied to two stations in southern India, selected at random:—

Bangalore.

Month	Mean rainfall inches	Moment about horizontal axis	Moment about vertical axis	Moment by Cook's method
I	0·06	0·05	0·03	0·06
II	0·22	0·11	0·19	0·44
III	0·72	0	0·72	2·16
IV	1·19	−0·60	1·03	4·76
V	4·53	−3·92	2·26	22·65
VI	3·13	−3·13	0	18·78
VII	4·13	−3·58	−2·06	28·91
VIII	6·00	−3·00	−5·20	48·00
IX	7·11	0	−7·11	63·99
X	6·74	3·37	−5·84	67·74
XI	2·61	2.26	−1·30	28·71
XII	0·39	0·39	0	4·68
Year	36·83	−8·05	−17·28	290·88
a		0·513		
α		245°		
D		7·67 (August 20)		
"C.G."				7·90
"C.G." corrected				7·40

Kolar.

Month	Mean rainfall inches	Moment about horizontal axis	Moment about vertical axis	Moment by Cook's method
I	0·16	0·14	0·08	0·16
II	0·04	0·02	0·04	0·08
III	0·50	0	0·50	1·50
IV	1·32	−0·66	1·15	5·28
V	3·34	−2·90	1·67	16·70
VI	3·13	−3·13	0	18·78
VII	3·36	−2·91	−1·68	23·52
VIII	4·16	−2·08	−3·61	33·28
IX	5·10	0	−5·10	45·90
X	5·50	2 75	−4·77	55 00
XI	3·17	2·75	−1·58	34·87
XII	0·81	0·81	0	9·72
Year	30·59	−5·21	−13·30	244·79
a		0·467		
α		248°		
D		7·78 (August 23)		
"C.G."				8·00
"C.G." corrected				7·50

It will be seen that the results are not very different from those obtained by Mr. Cook's method, and the difference is constant, at any rate for these two stations (0·28, 0·27). But for English stations very different results would be obtained. The constants have also been calculated for the three imaginary cases suggested by Mr. Watt:—

	A in.	B in.	C in.
I	3	0	12
II	3	0	4
III	3	0	2
IV	3	6	0
V	3	6	0
VI	3	6	0
VII	3	6	0
VIII	3	6	0
IX	3	6	0
X	3	0	2
XI	3	0	4
XII	3	0	12
Year	36	36	36
"C.G."	6·5	6·5	6·5
D	—	6·0	0
a	0	0·644	0·830

It will be seen that D and a, together with the total rainfall for the year, entirely define the distribution, whereas the "C.G." calculated by Mr. Cook's method throws no light upon it.

This method of specific gravities can, of course, be used for other annual statistics, such as barometric pressures and temperatures. In the latter case, the figures for a would depend upon the zero of temperature selected, and would consequently be different for the Centigrade and Fahrenheit scales. It would perhaps be more satisfactory to take the mean annual temperature of the station as zero. The figures for D would not be affected by the choice of scale.

The applicability of the method is not confined to meteorology, but may be used for any phenomenon which varies with the time of the year, *e.g.* vital statistics or railway receipts. A. MARSHALL.

Waverley Cottage, Naini Tal, India, June 14.

Present Meteoric Displays.

THE Perseid shower appears to have come into play rather earlier than usual this year, for I saw four meteors presumably directed from it on the nights of July 11 to 13. These meteors were of the usual streaking class, and formed a radiant at about 16°+50°, which agrees fairly well with the correct place of radiation at the end of the second week in July. This year I found meteors decidedly rare at the epoch named, but the skies were not very favourable, and twilight very strong.

By the time these lines appear in print the moon will only slightly interfere with observation, and a clear sky will show many meteors, for at the end of July the Aquarids, as well as Perseids, are generally plentiful; and there is no danger of confusing the members of the two streams, since their radiants are widely distant from each other. The Aquarids shoot slowly upwards in long flights from a radiant low in the southern sky, while the Perseids are directed in rapid courses from a radiant in the N.N.E.

On July 29–31 an observer may generally expect to see at least twenty meteors per hour, and especially after midnight, when the number visible usually exhibits a very marked increase, the radiants of both the Perseids and Aquarids taking up a more favourable position for the distribution of their meteors as the night advances.

It is to be hoped that all the brighter meteors and bolides will be individually recorded this year. The stars of Draco, Cassiopeia, Cepheus, Andromeda, Pegasus, Cygnus, and other constellations afford a ready guide for the accurate registry of meteor-flights, and such data will possess an enduring value as a means of furthering our knowledge. W. F. DENNING.

Pwdre Ser.

THE following letter, which I received last winter, may possibly throw some light on the questions raised by Prof. Hughes in his paper on "Pwdre Ser" in NATURE of June 23:—

"*Allegheny, December* 4, 1909.

"DEAR PROFESSOR SCHLESINGER,—

"Referring to the falling meteor of which my husband made mention at your lecture last evening, the facts are as follows. One evening some years since my father, Mr. Joel Powers, while walking on Lawrence St., Lowell, Massachusetts, saw a brilliant shooting star or meteor flash downward through the atmosphere, striking the earth quite near him. He found it upon investigation to be a jelly-like mass, and almost intolerably offensive in smell. I have often heard my father allude to this event, which greatly interested him, he being a close observer and an extensive reader.

"Respectfully yours,
"ELLEN M. ADAMS."

While I am of the opinion that the mass found by Mr. Powers had no connection with the meteor that he saw, it may be well to put this piece of evidence on record in view of Prof. Hughes's paper.

FRANK SCHLESINGER.

Allegheny Observatory, July 12.

THE ETHNOLOGY, BOTANY, GEOLOGY, AND METEOROLOGY OF GERMAN AFRICA.[1]

SOME time ago, reviewing a scientific treatise on German South-west Africa and the adjoining regions I ventured to make the remark in this journal that Germany deserved to be allowed to take under her control still more of the undeveloped portions of the earth's surface, provided she continued by the direct action of her Government to enrich the world's store of knowledge as she has been doing with her African and New Guinea researches during the last ten years. The present "Mitteilungen" support this exordium; they are of high scientific value.

There is, firstly, a separate volume by Dr. Weule on his ethnographical observations in the south-east parts of German East Africa. Here, for the modest sum of three shillings (three marks), one gets a splendidly illustrated work of first-rate importance on a section of Bantu Africa. "Ergänzungsheft Nr. 2" is a dissertation by Prof. Dr. Carl Uhlig on the cartography of the German portion of the Rift Valley region of equatorial East Africa, with an appendix on the orthography of place-names in Masailand, &c., by Dr. Bernhard Struck. Part i. of Band xxii. deals with the journeys in 1905–6 of Franz Seiner in the still very little explored country between the Kalahari Desert and the Upper Zambezi (especially the valleys of the Okavango, Kwando, and Omuramba rivers); part ii., with the glaciers of Kilimanjaro, the rainfall and meteorology of the Cameroons and of German South-west Africa; part iii., likewise with the exploration of the upper parts of Kilimanjaro, the rainfall of Togoland, and the geography of Ponape Island; and part iv., with the volcanoes recently active on the Cameroons Mountains, the rainfall and meteorology of the Cameroons and of the Logone River (Shari district), the Paresis Mountains of South-west Africa, and the meteorology of the German possessions in the Pacific. The space, however, which is attributed in this collection to the German oceanic territories is so small that no further allusion to them need be made (other than to praise very cordially the extremely interesting map of Ponape Island in the Carolines Protectorate), and we might proceed at once to discuss the valuable additions to our knowledge of Africa contained in these six sections of the scientific reports attached to the Deutschen Kolonialblatte.

Dr. Weule's work in East African anthropology has already been made known to English readers by Miss Alice Werner in a translation of his more "popular" account of his travels and in various papers in the Journal of the (British) African Society. It was remarked in one or other of these publications that Dr. Weule's work was a little impaired by his apparent unacquaintance with his subject before embarking on this expedition to East Africa. Had he studied more the numerous works in German and in English dealing with the native tribes of the southern portions of German East Africa and of British Nyasaland, he would have avoided a certain *naïveté* of discovering what had already been made known and a few blunders into which he had fallen through a lack of comparative knowledge; also that his orthography of native names was a little old-fashioned (in its German rendering) and divergent from the methods of spelling adopted long ago by German and British philologists and travellers.

These criticisms are less applicable to the volume under notice, "Wissenschaftliche ergebnisse meiner ethnographischen Forschungsreise in den sudösten Deutsch-Ostafrikas"; though the orthography still irritates and the many painstaking quotations of native speech in the dialects of Yao and Makua would have been the better for careful revision with German or British experts. (They tend to incorporate too much the Swahili words of some intervening interpreter.) But the greater part of this book is interesting and valuable to the ethnologist. The illustrations which accompany it are deserving of unstinted praise. Photographically (for the most part) and by clever draughtsmanship, Dr. Weule depicts the physical types of the Wa-mwera, A-makua, Wa-yao, Wa-makonde, Wa-matambwe, and Wa-ngoni peoples of the Ruvuma basin; their costumes, ornaments, and hideous self-inflicted deformities (such as the monstrous "pelele," or lip-disc, worn by nearly all the women in this region); their houses and methods of building; their graves, fetish-huts, granaries, cooking arrangements, doors, wooden locks and keys, pottery-making, metal-work, bark-cloth felting, basket- and mat-making, salt-straining; their weaving of cotton cloth and remarkable wood carving and calabash engraving. Indeed, he reveals a new chapter in negro art by his illustrations of their statues in wood, their clay dolls, their sculptured birds, Rhynchocyon insectivores, pigs, monkeys, and dogs; their most artistic carved snuff-boxes, amulets, powder-boxes, spoons, and stools. (As regards the last it is interesting to note the striking resemblance in shape and design to those of the south-eastern basin of the Congo.) One arises from this survey (and after reading the accompanying text) convinced that with due encouragement some section of the negro race is going to astonish the world yet in design and sculpture.

Then there are the extraordinarily ingenious traps, snares, and pitfalls, all most clearly and yet picturesquely illustrated. Elephants are sometimes killed by the falling of a heavily-weighted harpoon from a lofty tree-branch or scaffold which they release by the displacing of a cord; the larger antelopes similarly discharge arrows or assagais into their own bodies; the smaller quadrupeds dislodge in their passage a heavy beam which falls and crushes them. There are springes and nooses for the capture and strangling of beasts and birds, and cages for catching them alive; rat-traps and hyena-traps. All these display an ingenuity, a neat-handedness, and an unconscious knowledge of dynamics very remarkable in people still living ostensibly as semi-savages. One realises in studying Dr. Weule's work how it was that, although the fossil remains of *Homo primigenius*—and the negro stands higher as a subspecies of *Homo sapiens*—exhibit an osteology approximating slightly to the anthropoid apes, yet the brain capacity of any type of the genus Homo is almost of necessity an average

[1] Mitteilungen aus den Deutschen Schutzgebieten, &c. Ergänzungsheften Nr. 1, pp. x+150+Tafel 63; und 2, pp. iv+63. Heften i. bis iv., Band xxii. Edited by Dr. Freiherr von Danckelmann. (Berlin: Ernst Siegfried Mittler und Sohn, 1909.) Price 3 marks each.

minimum 1100 c.c.[1] to enable anything like a man to compass the degree of thought and reflection necessary to adroit use of implements and the contriving the death or capture of their prey.

Dr. Weule goes very fully into the boy and girl initiation ceremonies among the tribes above-mentioned. He seems to have omitted none of the details of these rites, all of which, whether excessively obscene, prophylactic, or rudely moral, are yet instinct with a certain feeling of natural religion: that is to say, they are performed not for their incidental lubricity but with the intention of making the girls good wives and mothers and the boys vigorous husbands and faithful members of the clan. Still, as regards the young women, native therapeutics[2] are entirely at fault, and the missionaries are quite right in believing and teaching that these "Unyago" ceremonies are in reality detrimental to health and morals.

having long ago named all the leading features of the landscapes, Dr. Bernhard Struck (the well-known philologist) contributes an article on Masai place-names and on the correct orthography of African words. It is, indeed, a pity that all civilised nations cannot agree to adopt a uniform phonetic alphabet for such purposes. Of course, the basis for such a system is best found in the Lepsius standard alphabet, with certain slight changes. As Lepsius was a German, one would think that the Germans would agree with us in adopting his system. But no: there are two schools at present in the Fatherland: one that sticks to the old-fashioned German extravagance in consonants—the *dsch, tsch, ä* for *e*, doubled *s's*, *s* for *z* plan—still used by Dr. Weule; and the over-particular new German linguists and geographers who fatigue and dishearten the average student with their meticulousness in spelling, their accents, diacritical

FIG. 1.—Young Makonde Women. Reproduced from *Mitteilungen aus den deutschen Schutzgebieten*.

The elaborate dances and their meanings, the strange dancing masks, the birth, marriage, death, and burial ceremonies are all described in detail, and a good deal of this information is absolutely new. Altogether Dr. Weule has made an important contribution to our knowledge of the still primitive Bantu tribes of the Ruvuma country, and incidentally has supplied some charming pictures of this great East African river; first studied by Livingstone in the vain hope that it might prove to be a water-route to Central Africa.

Prof. Uhlig's cartographical information on the German end of the Rift Valley is an important addition to our geographical knowledge of this somewhat desolate part of East Africa, a region, however, which is coming into such importance for the salts, phosphates, and sodas of its evaporating lakes that the British are building a branch railway to tap its products from the north. The human population is scanty, and consists mainly of Masai; and the Masai

and elliptical marks, their circumflexes, dots, underlinings, and other cabalistic signs. Why cannot all the world agree to confine itself to such a phonetic alphabet as that adopted and used by the great German explorer in the service of the British Government—Henry Barth? In the humble opinion of the reviewer Barth's system is about perfect in accuracy and simplicity. It is, of course, founded on the alphabet devised by Lepsius.

Another important piece of African research is Herr Seiner's journey of exploration in that still little explored country bounded by the Upper Zambezi on the east, the Kunene River on the north-west, and the Kalahari desert on the south, the region separating the Bechuana peoples from the Herero stock (Ama-herero, Ovambo, &c.), and the Herero from the Zambezian peoples (Ba-luyi, Basubia, Batonga, &c.). The hydrography of this region is still an unsolved problem. There is, first of all, the isolated basin of Lake Etosa in north-east Damaraland; then come the questions of the Ngami-Botletle-Makari-kari system, the real destination of the waters of the immense

[1] The cranial capacity of the Neanderthal skull was about 1500 c.c.
[2] Such as in the artificial hypertrophy of the *labia minora*.

river system of the Kubango (Okavango)-Kuito-Omurambo and Kwando. These rivers discharge the bulk of their waters into the remains of an ancient sea, of which the Haiñoma-Selinda-Mashi swamps, the network of the Tauche streams, Lage Ngami, the Botletle River, and the Makari-kari salt-pans are the vestiges; but by two separate overflows—the Mashi-Linyanti river-swamp and the Tamalakane outlet of Ngami—the surplusage of the Okavango waters (the drainage of eastern Angola) finds its way to the Zambezi above the gorge of Kasungula. But the complete elucidation of this puzzle still awaits the results of an extremely accurate survey in which the most careful attention will be given to questions of level. Did this once huge South-west African freshwater sea, when at its fullest, discharge its waters seawards through the Limpopo; or did it pierce the hills at Kasungula (some distance above the Victoria Falls) and thus united what is now the Upper Zambezi with the Gwai and the Kafue, and so create the Zambezi as we know it to-day? Herr Seiner's journey was singularly interesting because of his careful studies of plant-distribution. In this region meet the desert flora of the Kalahari and South-west Africa, the steppe flora of so much of irregularly watered tropical Africa, and the rich forest and swamp flora of West Africa. Seiner traces the approximate limits of each phytogeographical region: the southernmost boundary of the baobab tree, of the bulging-stemmed Hyphæne palm (*H. ventricosa*), of the high-timber forests of West African affinities, and the thin, low-growing woods of Copaifera and Burkea.

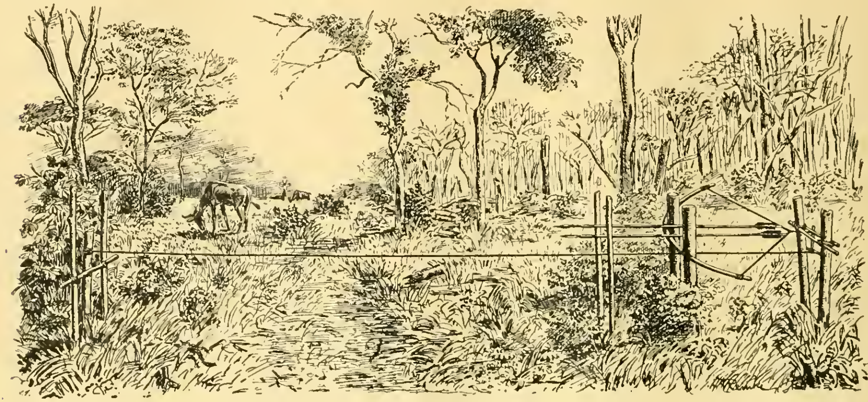


FIG. 2.—Arrows set to be discharged automatically by animals, Usagara. Reproduced from *Mitteilungen aus den deutschen Schutzgebieten.*

Another noteworthy point in this exploration was the additional light it threw on the distribution of the Bushman-Hottentot peoples. It had been known since the journeys of Serpa Pinto that a quasi-Bushman race of red-skinned hunters extended northwards from the Kalahari desert almost to the southwesternmost limits of the Congo basin; but the conclusions of Pinto were rather based on fancied physical resemblances than on language. Dr. Passarge—the German explorer who has made several journeys through the Okavango basin—added to our information, and now Seiner extends our knowledge of these people, speaking click languages, to the Kwando River and almost to the Upper Zambezi. The specimens of Bushman speech collected by Seiner and Passarge enable these travellers to divide the

FIG. 3.—The Kibo Crater of Kilimanjaro. View from the base at a distance of 3932 metres. Reproduced from *Mitteilungen aus den deutschen Schutzgebieten.*

northern Bushmen into two groups—that of the Kaukau of southern Damaraland and that of the Ngami, which would include the click-using peoples as far north as the Kwando River. Between the two groups there is very considerable linguistic difference, though there exist equally undeniable affinities. In Herr Seiner's photographs, however, only two examples of so-called Bushmen are recognisable as such, the remainder (though their language was "Bush") are obviously true negroes, and must be the result of hybrids ancient and modern with the true negro stock, as exemplified by the recent Bantu invaders (Bechuana and Zambezian) and the Berg-Damara. Seiner classifies the Zambezians as "Bantu," and the Bechuana as a class apart. There is no justification for this distinction. The Bechuana tribes are just as much "Bantu" in languages as the Zambezians, though some of them have obviously absorbed a good deal of Bushman blood during the last twelve or fifteen hundred years.

The descriptions and beautiful pictures of the Kilimanjaro glaciers (in parts ii. and iii. of Band xxii.) are of the highest interest; so also are the equally careful, illustrated reports on the "volcanelli" (if one may coin a word to describe the lesser craters which break out on the mass of a huge volcano) of the Cameroons. This article, by Dr. Otto Mann, describes the renewed activities of the Cameroons volcanic mass in 1909. H. H. JOHNSTON.

CORDITE.

THE recent discussion in Parliament on our supplies of cordite and our productive capacity for this type of smokeless powder has naturally directed public attention to these important questions. The production of a smokeless powder was ever the dream of the military strategist, and with the discovery of gun-cotton the conclusion was hastily arrived at that the ideal propellant was found, only to be rudely dissipated by numerous serious disasters. Gun-cotton for many years resisted all attempts to render its combustion sufficiently under control for it to be adopted as a propellant, yet to-day it is the basis of the smokeless powders of all nations. Its early failures were entirely due to the retention in the nitrated cotton of the physical characters of the parent cotton, for even after reduction to an extremely fine state of division during the process of manufacture, the fibrous nature of the cotton persisted. Success has only been attained by the destruction of this fibre, and the smokeless powders of all nations may be classed either as simple gelatinised gun-cottons in which soluble nitrocelluloses have been gelatinised by treatment with an ether-alcohol mixture, or as nitrocellulose-nitroglycerine colloids, in which the nitrocellulose employed may be of the soluble variety, as in ballistite, or the insoluble (true gun-cotton), as in the case of cordite.

The introduction of blasting gelatin by Nobel (1875), consisting of some 90 per cent. nitroglycerine with 10 per cent. of soluble nitrated cotton in a gelatinised form, was the first step towards the production of powders of the cordite type. The high percentage of nitroglycerine rendered blasting gelatin unsuitable for use in guns, but by incorporating the two constituents in equal quantities, Nobel gave to the world the first successful smokeless powder of this class, ballistite. Cordite was the outcome of the work of a committee presided over by the late Sir Frederick Abel, and was patented a year later than ballistite, in 1889. The essential difference between ballistite and cordite is that whilst the former contains soluble nitrocelluloses, cordite contains the insoluble or tri-nitrocellulose. This change in the character of the nitrocellulose employed entailed the introduction of acetone in the manufacture of cordite. Soluble nitrocotton and nitroglycerine can be thoroughly incorporated under proper conditions in the presence of water without the aid of any solvent, but the ingredients of cordite can only become perfectly incorporated in the presence of a mutual solvent. It is essential that the solvent shall be sufficiently volatile to permit of its removal at reasonably low temperatures from the finished powder, and acetone, which boils at 56° C., fulfils all the conditions best.

It is important to note that nitroglycerine is the only explosive containing an excess of oxygen, all nitrocelluloses being theoretically deficient in this element to give complete combustion of carbon to carbon dioxide and hydrogen to water. There are therefore admirable theoretical grounds for the incorporation of these two explosives with each other. The total change in physical characters of both nitroglycerine and nitrocellulose brought about entirely alters the character of their explosion; singly, both constituents are beyond control once combustion is started; gelatinised together, combustion is regularly progressive throughout the mass, an essential condition for a propellant.

The earlier form of cordite consisted of nitroglycerine, 68 per cent.; nitrocellulose, 37 per cent.; vaseline, 5 per cent. It was soon found that serious erosion took place in the guns, and Sir Andrew Noble showed this to be due to the rapid motion of the gaseous products at very high temperature. Since the temperature is a function of the nitroglycerine content, combustion to carbon dioxide taking place to greater extent with its accompanying higher calorific intensity, it followed that reduction of the nitroglycerine would lower the temperature of the products and lessen the erosion. This led to the introduction of modified (M.D.) cordite of the following composition:—Nitroglycerine, 30 per cent.; nitrocellulose, 65 per cent.; vaseline, 5 per cent.—practically a reversal of the former proportions of the chief ingredients. The introduction of the vaseline was made to overcome metallic fouling in the gun, arising from surfaces of metal in practically a clean condition rubbing against each other as the projectile moved outward. The vaseline decomposition products provided just the slight lubrication needed. It has performed another important office, little thought of on its introduction, in acting as a "stabiliser" in the cordite.

In the manufacture of cordite, the gun-cotton employed is thoroughly dried at a temperature of 40° C., and is then mixed by hand with the proper proportion of nitroglycerine, the mixture being finally passed through a sieve. The "paste" obtained is transferred to an incorporating machine of an exactly similar type to that employed in a machine bakery, except that temperature control is arranged for, and there worked into a thorough dough with the requisite quantity of acetone. The first kneading occupies about three and a half hours; then the vaseline is added and a further kneading for a similar period takes place. "Cordite dough," in which every trace of the fibrous character of the gun-cotton has disappeared, results, and this dough is then shaped into the finished threads, cords, or rods by pressure through suitable dies. As the thinner makes pass from the press they are wound on drums, thicker qualities being cut into suitable lengths as they pass out on an endless band. The acetone remaining must now be removed by drying in suitable rooms at a temperature of 110° F. The removal of solvent from the larger sizes of all smokeless powders offers considerable difficulty owing to their horny nature; the odour of acetone is readily detected in freshly ground cordite after long storage.

Naturally the detection of products which may indicate decomposition actually occurring or likely to occur is important, and for this purpose Abel's heat test, first introduced for gun-cotton about 1875, is employed for cordite. The test depends on the liberation of iodine from potassium iodide by the action of nitrogen peroxide, the principal decomposition gas. The ground explosive is heated to 180° F. in a tube, and the time noted for discoloration of the test paper to a certain standard tint. The question at once suggests itself, Does the test show decomposition products which were present in the explosive, or have they resulted from heating during the test, or both conditions acting together? Very divergent opinions are held as to the value of the Abel test as an indication of the stability or "life" of gelatinised explosives. Certainly a powder giving a bad test must be regarded with suspicion, but it is obviously not an easy matter to fix a time limit for a test which is subject to adverse criticism.

One of the most important considerations with any explosive is its stability. The question naturally arises, Is the molecular arrangement in such substances as nitrocellulose and nitroglycerine stable under ordinary conditions of temperature? Their explosive properties depend entirely on molecular rearrangement, which is practically instantaneous when detonation occurs. Certainly slow decomposition occurs in most nitro-compounds of the explosive class at temperatures not greatly above the normal with the production of oxides of nitrogen, and it has been shown that these oxides act catalytically on the explosive; in other words, their effect becomes cumulative and may lead to ignition. In order to avoid this catalytic action, "stabilisers" have been introduced in many explosives, substances capable of absorbing these nitrogen compounds. As already mentioned, the vaseline in cordite appears to perform this useful function.

THE SHEFFIELD MEETING OF THE BRITISH ASSOCIATION.

FOR the last few months the various committees dealing with the local arrangements for the meeting of the association have been hard at work and the general outlines are settled. The hardest task, perhaps, has fallen to the lot of the hospitality committee in finding accommodation for the large number of visitors expected, the city being notorious for its small hotel accommodation. A first list of hotels and lodgings is now ready, and members should lose no time in engaging rooms. To meet the expected demand, the committee has arranged for the two training colleges' hostels for women to receive members, the larger one for gentlemen, with a limited number of married people in an annexe, and the University Hostel for single ladies. The list may be obtained from the secretary of the hospitality committee, Mr. J. Wortley, George Street, Sheffield.

The reception-room will be at the Cutlers' Hall. Here, in addition to the various rooms and offices usually associated with the reception-room, will be a large luncheon-room, giving, close at hand, sufficient accommodation to prevent the pressure and overcrowding so prevalent in many previous meetings. The Cutlers' Hall is conveniently situated in the centre of the city, close to the tram termini, and the various section rooms are grouped round it, all within a radius of 400 yards, with the exception of that of physiology, which, for evident reasons, is better placed in the University. The president's address, and the popular lectures by Prof. Stirling (types of animal movement), Mr. Hogarth (new discoveries about the Hittites), and Mr. C. T. Heycock (the Saturday evening lecture to operatives), will be given in the Victoria Hall.

The first evening reception will be at the Town Hall, by the Lord Mayor and Countess Fitzwilliam. The Weston Park is to be the central scene of the second on Tuesday, September 6, at which about 4,000 guests are expected. The University lies along the east side of this park, and the Mappin Art Gallery is in it on the west. Advantage has been taken of this to have a combined reception by the University and the local committee. The Chancellor and the Duchess of Norfolk will receive one category of guests at the University, and the Earl and Countess Fitzwilliam another in the Art Gallery, but the two will really form a combined conversazione, with an evening garden-party in the park. One of the features of the latter will be a military tattoo with torches after dark. Afternoon garden-parties for the whole association will be given by the Lord Mayor at his seat at Wentworth, and by the local committee in the Botanical Gardens, whilst a number of smaller garden-parties will be given on other days. Arrangements have been made for visits to more than twenty works, covering the chief staple trades of the city. In the University also the various furnaces in the metallurgical department will be run on different days to illustrate that feature in the University curriculum.

Saturday, September 3, will be devoted to excursions to the Derwent Waterworks, to Chatsworth, Welbeck, and Clumber, where members will be entertained respectively by the Dukes of Devonshire, Portland, and Newcastle, also to Haddon, Roche Abbey, and Bolsover Castle. The neighbourhood is so rich in picturesque scenes that there will be ample scope for members to arrange private excursions, such as to the Peak Caverns, the limestone dales, Buxton, Matlock, Wingfield Manor, or even further afield, to York, Lincoln, or Newark Castle, and Southwell Minster.

A local handbook of 500 pages has been compiled under the editorship of Dr. Porter, with the assistance of a large number of local experts, containing a large amount of interesting matter, scientific, historic, and local. During the meeting the University will hold a congregation for the purpose of conferring honorary degrees on the president and other eminent scientific men attending the meeting.

PROVISIONAL PROGRAMMES OF SECTIONS.

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCE).—The address of the president (Prof. E. W. Hobson) will be delivered at 10 a.m. on Thursday, September 1. Two discussions are under arrangement. On Monday, September 5, there will be a joint discussion with Section G on the principles of mechanical flight, to be opened by Prof. G. H. Bryan; and on Tuesday, September 6, Dr. C. Chree will open one on atmospheric electricity. The section will meet with Sections G and B on Friday, September 2, to participate in the discussion on the report of the gaseous explosions committee, and in papers to follow dealing with combustion. Several papers have been already promised to the section, but the programme is still incomplete.

SECTION B (CHEMISTRY).—The feature of the programme is the joint discussions with other sections. These are:—Friday, September 2, with Sections A and G: Subjects of general interest; in particular, combustion. Monday morning, September 5, with Sections I and K: Respiration; afternoon, with Section L: The neglect of science by commerce and industry. Reports will be presented by Prof. W. A. Bone, on combustion; Dr. J. V. Eyre, on solubility.

Papers on a fourth recalescence in steel, Prof. Arnold; the provident use of coal, Prof. H. E. Armstrong; influence of chemical composition and thermal treatment on the properties of steels, Prof. A. McWilliam; ferro-silicon, Dr. S. Monckton Copeman; corrosion of iron and steel, Dr. J. N. Friend; the crystalline structure of iron at high temperatures, Dr. Rosenhain; allotropy or transmutation? Prof. Howe; the molecular weight of radium emanation, Sir Wm. Ramsay and Mr. R. W. Gray. Papers from the Sheffield University Chemical Department: Formation of tolane derivatives from *o*- and *p*-chlorobenzylchloride, Dr. J. Kenner and E. Whitham; sulphonic derivatives of chloro- and nitrochlorotoluene, Dr. J. Kenner and Prof. W. P. Wynne; an instance illustrating the relative instabilities of the trimethylene ring as compared with the tetramethylene ring, Dr. J. F. Thorpe; three physical chemical papers dealing with viscosity and molecular association, W. E. S. Turner (in conjunction with C. L. Peddle and E. W. Merry).

Agricultural Subsection of Section B: Sugar beet growing, Sigmund Stein and G. L. Courthope, M.P.; nitrogen fixation, Prof. Bottomley and J. Golding; various: cost of a day's horse labour, A. D. Hall; cost of Danish dairy farming, Christopher Turnour; effect of town atmosphere on vegetation, Dr. Crowther; scientific problems in live stock breeding, K. J. J. Mackenzie. Joint meetings (1) with Economic and Statistical Section: The magnitude of error in agricultural experiments; scientific method in experimental work, Prof. H. E. Armstrong; experimental error in feeding trials, T. B. Wood and A. B. Bruce; experimental error in field trials, A. D. Hall and E. J. Russell; experimental error in milk analysis, S. H. Collins; experimental error in plant analysis, R. H. Berry; (2) with the Geological Section, *Soil Surveys (Agricultural)*: Survey of Kent, Surrey, and Sussex, A. D. Hall and E. J. Russell; survey of Norfolk, Mr. Newman; "Teart" land of Somerset, C. T. Gimingham; (3) with the Zoological Section: Part played by organisms other than bacteria in soil fertility, E. J. Russell and H. B. Hutchinson.

Section C (Geology).—Thursday, September 1, 10.0: The Joredale Series and its equivalents elsewhere, Cosmo Johns; the Palæozoic rocks of Cautley (Sedbergh), Dr. J. E. Marr and W. G. Fearnsides; the graptolitic zones of the Salopian rocks of the Cautley (Sedbergh) area, Miss O. R. Watney and Miss E. G. Welch; pleochroic halos, Prof. J. Joly. 11.30: Presidential address by Dr. A. P. Coleman; mountain temperatures and radium, Dr. C. H. Lees; outlines of the geology of northern Nigeria, F. D. Falconer; notes on the geology of the Gold Coast, W. Parkinson; the geological significance of the nickel-iron meteorites, Cosmo Johns. Friday, September 2, 10.0: Joint meeting with Section E (Geography): (1) Papers on local geography and geology, (*a*) the local geology, Cosmo Johns; (*b*) the local geography; (*c*) the marine bands in coal measures of south Yorkshire, H. Culpin; (*d*) the Maltby deep boring, W. H. Dyson. (2) Joint discussion on the economic products of Sheffield as affected by the structure of the district. Paper by Prof. McWilliam on the metallurgical industries in relation to the rocks of the district. (3) Regional surveys. Paper by T. Sheppard on the Humber during the human period. Monday, September 5, 10.0: Seismological report by Dr. J. Milne; thrust masses in the western districts of the Dolomites, by Mrs. W. M. Ogilvie-Gordon; on the geology of Cyrenaica, Prof. J. W. Gregory; on the geology of Natal, Dr. F. H. Hatch. 12.0: Joint discussion with subsection Agriculture on soil surveys. Tuesday, September 6, 10.0: Discussion on the concealed coalfield of Notts, Derbyshire, and Yorks. Papers by Prof. P. F. Kendall and Dr. Walcot Gibson; two papers by Ernest Dixon; (1) Kilauea and its lessons, (2) some volcanic phenomena in New Zealand, Dr. Tempest Anderson.

Section D (Zoology).—Address by the president, Prof. G. C. Bourne; mitokinetism and the electrocolloid hypothesis, Prof. Marcus Hartog; semination in *Calidris armarica*: a key to some problems regarding its migratory movements during the breeding season, Prof. C. J. Patten; some experiments and observations on the colours of insect larvæ, Prof. Garstang; a cytological study of artificial parthenogenesis, Dr. Edward Hindle; avian coccidiosis, Dr. H. B. Fantham; relation of regenerative and developmental processes, Dr. Jenkinson; first results from the Oxford anthropometrical laboratory, Dr. E. H. J. Schuster; development of the pectoral girdle in *Acanthias vulgaris*, Dr. H. W. Marett Tims; a paper dealing with some sex problems, Geoffrey Smith; Dr. Gadow will give the afternoon lecture on coral snakes and peacocks.

Section E (Geography). Presidential address, Prof. A. J. Herbertson; cotton-growing within the British Empire, J. Howard Reed; the Uganda-Congo Boundary Survey, Major R. G. T. Bright; the river systems of Nigeria, Dr. J. W. Falconer; the alluvium of the Nile, Capt. Lyons; the homeward voyage of the *Nimrod*, Capt. J. K. Davis; Prince Charles Foreland, Dr. W. S. Bruce; the geology and metallurgical industries of the Sheffield district, joint meeting with Section C.

Section G (Engineering). Presidential address, Prof. W. E. Dalby: (1) the testing of lathe tool steels, (2) a new method of testing the cutting quality of files, Prof. Ripper; experiments on aëroplanes, W. A. Scoble; accelerometers, H. S. Wimperis; optical determination of stress, Prof. Coker; laws of electro-mechanics, Prof. S. P. Thompson; the electrification of the Brighton Railway, Philip Dawson; heat insulation, F. Bacon; report of the gaseous explosions committee; joint discussion on combustion with Section B (Chemistry); joint discussion on aërial flight with Section A (Mathematics and Physics).

Section I (Physiology).—Thursday, September 1: Presidential address, Prof. A. B. Macallum; the mechanism of reflex standing and walking, Prof. C. S. Sherrington. Friday, September 2: Discussion on prevention of caisson disease, to be opened by Dr. Leonard Hill. Monday, September 5: Joint discussion with Sections of Botany and Chemistry on biochemistry of respiration. Tuesday, September 6: Joint discussion with Section of Education on speech. There will be the usual reports of committees, and the following papers have been promised:—The relation of light perception to colour perception, Dr. Edridge Green; the combination of poisons with the contractile substance of cardiac muscle, Dr. H. M. Vernon; (1) the inorganic composition of the blood of vertebrates and invertebrates and its origin, (2) the inorganic composition of the blood serum of the laboratory frog in spring, (3) further observations on the localisation of potassium salts in animal and vegetable cells, Prof. A. B. Macallum.

Section K (Botany).—A joint discussion between the Botanical, Chemical, and Physiological Sections, on the biochemistry of respiration, Dr. F. F. Blackman and others to take part; a new method of estimating the opening of stomata, Dr. F. Darwin; the paths of translocation of sugars from green leaves, S. Mangham; (1) two synthetic genera of Filicales, (2) note on *Ophioglossum palmatum*, Prof. Bower; the pollen chambers of fossil and recent seeds, Prof. F. W. Oliver; the morphology of the ovules in Gnetum and

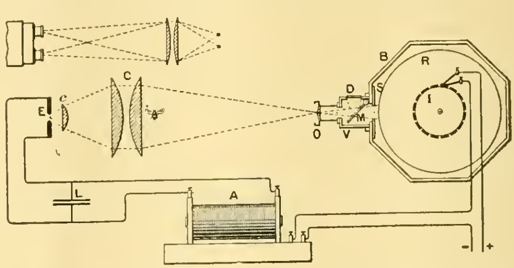
Welwitschia, Mrs. Thoday; further observations on the fossil flower, Dr. M. C. Stopes; chromosome reduction in the Hymenomycetes, Harold Wager; the sexuality of *Polystigma rubrum*, Prof. V. H. Blackman; telophases and prophases in Galtonia, Prof. Farmer and Miss Digby; a cytological paper, Dr. H. C. J. Fraser; the zoospores and trumpet-hyphæ of the Laminariaceæ, Dr. Lloyd Williams; plant distribution in the woods of north-east Kent, M. Wilson; the absorption of water by leguminous seeds, A. S. Horne. Papers are also expected by Prof. F. E. Weiss and others. The semi-popular lecture will be given this year by Prof. F. O. Bower; subject, sand dunes and golf links.

SECTION L (EDUCATIONAL SCIENCE).—The president for the meeting is Principal H. A. Miers, and his presidential address will be delivered on Thursday morning, September 1. It is intended to give up the whole of Friday, September 2, to the subject of educational research, and the meeting will be a joint one with the Anthropological Section. Prof. J. A. Green, of Sheffield, the secretary of a committee which has been investigating the mental and physical factors involved in education, will present a report on the present position of educational research at home and abroad. Dr. Gray will also present a report on behalf of a committee of the Anthropological Section on methods of observing and measuring mental characters. It is hoped that Prof. Münsterberg, of Harvard, will open the discussion, which promises to be an important one. Dr. Lucy H. Ernst, Prof. Lippmann, of Berlin, Dr. Kerr, the principal medical officer of the London County Council, and several members of his staff, Prof. C. S. Myers, Dr. T. P. Nunn, and Dr. Rivers, of Cambridge, amongst others, have signified their intention to take part, and reports will be presented, by the investigators, of serial observations on school children and others which have been conducted in London, Liverpool, Sheffield, Wolverhampton, and elsewhere. On Monday morning, September 5, Mr. J. G. Legge, Director of Education in Liverpool, will open a discussion on handwork and science in elementary schools. On Monday afternoon there will be a joint discussion with the Chemistry Section on the neglect of science in commerce and industry. Mr. R. Blair, the Education Officer of the London County Council, will open the discussion, and Prof. Bovey, Principal E. H. Griffiths, Sir William Tilden, and others have promised to take part. On Tuesday morning, September 6, the subject of open-air studies in schools of normal type will be taken up. There will be papers by Mr. J. E. Feasey, of Sheffield, Mr. G. G. Lewis, of Kentish Town, and Prof. Mark R. Wright, of Newcastle-on-Tyne, will read a paper on a training college under canvas. On Tuesday afternoon a joint meeting will be held with the Physiological Section for the discussion of voice production. Dr. A. A. Gray, Mr. H. H. Hulbert, Principal Burrell, of Isleworth, Prof. Wesley Mills, Mr. W. H. Griffiths, and others, will contribute papers.

THE ULTRA-RAPID KINEMATOGRAPH.

A RECENT number of *La Nature* (April 30) contains a very interesting account of the latest work of the Marey Institute. By means of the new instrument, the ultra-rapid kinematograph invented by M. Bull, sharp stereoscopic kinematograph views may be obtained of such extremely rapid movements as, for instance, the flight of a fly or the breaking of a soap bubble. With the ordinary kinematograph the photographic film moves discontinuously, being arrested at the moment of each exposure. While this is simple enough at moderate speeds, it would be quite impossible where the exposures are at the rate of 2000 a second, and the mean speed of the film 4000 cm. a second. These are the figures that are necessary for the study of insect flight, and these are attained in the new instrument. With such a speed the movement of the film must be continuous, and a sharp image is possible only if the exposure does not exceed 1/400,000 second, and for this the electric spark gives a light of sufficiently short duration.

The apparatus is shown diagrammatically in the figure. R is a wheel 34·5 centimetres in diameter, which may be turned at a high speed by means of an electric motor. It carries two long strips of photographic film to receive the stereoscopic images. On the same axis, but outside the octagonal light-proof case, is fastened an interrupter, I, of fifty-four strips of copper, which serve to make and break the primary circuit of an induction coil fifty-four times every turn, or 2000 times a second. The secondary of the induction coil is connected with a pair of spark-gaps, E, arranged in series, the electrodes being of magnesium to increase the light. The arrangement of the two gaps and their relation to the optical system are shown in plan (but reversed, left for right) in the upper left-hand corner of the figure. A condenser, L, is connected to the wires leading to the spark-gaps. The optical system is made clear by the figure, but the lenses are made of quartz and Iceland spar instead of glass, so as to be transparent to the actinic rays of short wavelength for which glass is opaque. A mirror, M, throws the pair of images on a ground-glass screen, D, or, on being turned up out of the way, it leaves a clear passage for them to be formed on the films. In order to prevent the photographs from being spoilt by multiple exposure, two shutters of thin steel, actuated by springs, are released electromagnetically one after the other, the interval being the duration of one turn of the wheel.



The movements photographed are determined as to time by fine wire prolongations of the prongs of a tuning-fork of 50 ~ a second, which are photographed at each successive exposure, and as to distance by a divided glass scale, which equally appears in every picture. It is, of course, necessary to ensure that the fly or other insect shall traverse the field of view just at the time that exposure is made. There is no difficulty in causing the creature to fly in the right direction, as a window is sufficient to determine the line of flight. One method by which M. Bull releases the fly at the right moment is by holding it in electromagnetically-operated forceps, which are relaxed by the same current which starts the first shutter. This works well enough with ordinary flies, but hymenoptera and some other insects hesitate and only make their flight after the exposure is completed. For such cases, M. Bull encloses them in a glass tube with a very light mica door, which is moved by the insect in its flight, and which, making a contact, sets the shutter mechanism in action.

In order to study the movements represented on the films, which in nature are far too rapid to be followed by the eye, it is merely necessary to pass them through an ordinary kinematograph, making some fifteen exposures a second instead of the 1500 or 2000 a second employed in taking the photograph, and then the movement, 100 or more times as slow, will be seen, and in many cases easily followed. Where a still greater slowing is required, M. Bull arranges to make the film appear stationary for a much larger proportion of the whole interval than is usual, and then only two or three views a second are sufficient to give an apparently continuous movement. C. V. BOYS.

THE TOTAL SOLAR ECLIPSE, MAY 9, 1910.

THE following two communications from Port Davey, dated May 7 and 9 respectively, complete the account of Mr. McClean's expedition to Tasmania. In spite of the trying weather conditions, a very complete installation of instruments was successfully erected, but, as previously reported, clouds prevented their use during the eclipse.

The photographs accompanying the report were taken by Mr. H. Winkelmann, and the three here reproduced have been selected to illustrate the setting up of some of the instruments.

Port Davey, May 7, 1910.

"The weather since April 27 was execrable until May 4, and was not good until the following afternoon. Continuous gales, heavy rains, and floods made progress absolutely impossible, and no trustworthy tests were made before May 4. The ground became a quagmire, and the instruments were covered with rust, in spite of paraffin and oil. Rain got into the concave grating slide-holder, and the cloth began to peel off. The cœlostat mirror was badly discoloured, in spite of coverings of Japara and Willesden canvas. The siderostat mirror was also permanently fogged and slightly spotted, and in the morning, on uncovering (when possible), was covered with moisture. In addition to this, the ground shook at every footstep, and everything vibrated. The barricades proved very useful in protecting the instruments from the wind, which was so strong that during the gusts it was impossible to walk against it. On several days no coverings could be taken off, and work was at a standstill. The *Wainui*, which came in on May 1, had to take refuge in Schooner Cove on the other side of the Bathurst Channel until the following day. Our boat, which had to go over to pick up Mr. Short, from Sydney, and his instruments, could not get back, and we had to cross behind Mundy Island and land : mile across country from our camp, leaving the boat in a cove until the next day.

"On May 4, however, there were a few intervals of sunshine during the afternoon, and on May 5 the afternoon was fairly bright after a drizzling morning, while May 5 was cloudless and with a gentle breeze from the east, and much progress was made. The instruments fed by the siderostat were in accurate position, and some trial photographs were taken with the concave grating spectrograph which on development proved to be good in every way.

"Mr. Short, who arrived on May 1, has decided to feed his five-foot camera from an auxiliary mirror from the siderostat, as, with the wind that is likely to occur, it would not be steady on the equatorial mount, and on this mount have been placed his telephoto and Worthington's camera, as the latter could not be run correctly with his clock.

"Considerable difficulty had been found in driving the siderostat after about 3.15 in the afternoon, and a device had been put up to help the mirror cell arm round after that time. Owing to bad weather, no complete examination had been possible until May 7, when the mirror and cell were removed, and it was found that one of the balance-arm bearings had not sufficient play to allow the rollers to continue in contact with the cell. Filing down was tried, but there was not sufficient material to do this fully, and so the bearing was reversed. This gave considerable improvement, but before the time at which eclipse would occur it was found that the rollers reached

FIG. 1.—Beginning the erection of the instruments on Hixson Point.
Figures from left to right—J. Brooks, F. K. McClean, A. Young, S. Dowsett.

the end of their slot, and greater power was required to drive them up the slope. Having no tools for continuing this groove, arrangements were made for a weight to be attached upwards to the cell arm, and this was found to answer; but considerable dangers of irregular drive are present in this method. An attempt was made to work the slow motions from the concave grating spectrograph, but, owing to the distance, no good results were obtained, and Mr. Dowsett was therefore placed in charge of the siderostat to follow instructions from the spectrograph, where the large image on the slit gives a quick idea of any movement either in right ascension or declination.

"Drills commenced on May 6 both separately and generally. The allocation of the instruments to the members of the party has been arranged as follows:—

Siderostat ... ... S. G. Dowsett

Instruments fed by siderostat.

Concave grating spectrograph ...	F. K. McClean
De la Rue coronagraph	A. Wilson
Short 5-ft. ,, ...	J. Short

Instruments fed by cœlostat.

16-ft. coronagraph	J. Brooks
42-in. spectrograph	H. Winkelmann
Telephoto	H. Winkelmann
Steward (dismounted)	E. Jeffs

FIG. 2.—Setting up the 21-inch Siderostat
Figures from left to right—A. Young, F. K. McClean, S. Dowsett, J. Brooks, J. Worthington.

Equatorial.

Short's equatorial mount carrying telephoto & Worthington camera and	J. Worthington
Time caller	A. Young

"Owing to the resilient nature of the ground, it was found advisable not to allow anyone to move about, and shutters were fitted to the 16-foot and De la Rue coronagraphs, which could be worked from the dark-slide ends. Winkelmann, who has two instruments in his charge, has only a step or two to make, and it is impossible to prevent him moving. In the following programme for the eclipse, the times mentioned are standard time (ten hours east), as given by Dr. A. M. W. Downing, F.R.S., and also local time at Pyramid Rock in the entrance to Port Davey, which is long. 145° 55′ E. and lat. 43° 22′ S. As the position of the observatory is long. 146° E. and lat. 43° 20′ S., the eclipse will start a little later, and finish a trifle earlier. The time was again checked on May 6 by Messrs. Brooks and Young, and the chronometer error found."

(Here follows a large table showing the exposures to be made in the various instruments. This is omitted here.)

"*Port Davey, May* 9, 1910.

"Rain commenced on the afternoon of May 8, and continued steadily all through May 9. No drills were possible. On the night of May 8 the dark slides were filled, and all were taken up to the observatory on the Monday afternoon, and, in spite of the rain, the instruments were made ready; but exposures were limited to one slide, which was opened at 5 seconds and closed at 200. There was a tremendous downpour during the eclipse, but it cleared a little afterwards. During totality there was a stretch of bright sky on the western horizon, and soon after sunset the clouds dispersed and a bright, starry night followed.

"Immediately after eclipse the barricades were pulled down and the ground prepared for the final packing."

Since the receipt of the above communications both Mr. McClean and Mr. Young have arrived home. They have both suffered from the effects of the hard work and inclement weather, and the former is still in the doctor's hands. While Mr. McClean has had considerable experience in roughing it, he describes his recent work in Tasmania as the most trying that he has yet had to contend with. Nevertheless, his keenness for eclipse work is by no means damped, for he is now looking forward to the eclipse of next year, which will be visible from islands in the Pacific Ocean, and is already commencing arrangements to observe it.

WILLIAM J. S. LOCKYER.

JOHN B. CARRUTHERS.

WE regret to have to record the death, at the early age of forty-one, of Mr. J. B. Carruthers, assistant director of agriculture in Trinidad. Mr. Carruthers only took up his new appointment last autumn, and with characteristic enthusiasm entered at once very energetically upon the task of making himself familiar with his fresh surroundings. The possibilities of rubber cultivation was the principal subject to occupy his attention, and to this end he visited most of the chief estates in Trinidad. Thence

FIG. 3.—Adjusting the Cœlostat.
J. Brooks on the left, F. K. McClean on the right.

he proceeded to Tobago—the dependency of the larger island—and here prosecuted his work under very adverse climatic conditions, with the result that on returning to Trinidad he was prostrated with a severe attack of malaria. After some four weeks' illness complications ensued, and he passed away on Sunday, July 17, from septic pneumonia following an operation.

John Bennett Carruthers, born in 1869, was the younger son of Mr. William Carruthers, F.R.S., until recently the keeper of the Botanical Department of the British Museum. He was educated at Dulwich College, the Royal School of Mines, and Griefswald University, Prussia. During this period appeared his first botanical contribution, "The Cystocarps of Some Species of Callophyllis and Rhodymenia" (Journal Linn. Soc., xxix., 77–86), and "The Canker of the Larch" (Journal Roy. Agr. Soc., 1891, Ser. iii., vol. ii.). A period as demonstrator in biology at the Royal Veterinary College, London, was followed by his appointment as professor of botany at Downton College, Wilts. Soon, however, he transferred his energies to the tropics, where his chief work was done.

In 1898 Carruthers went out under the joint auspices of the Ceylon Government and the Planters' Association to investigate a disease of cacao-trees. He proved successful, not only in ascertaining the cause of the disease, but in the frequently more difficult task of finding an effective remedy practicable under estate conditions. His successful work was recognised by his appointment in 1900 as mycologist to the Government of Ceylon and assistant director of the Royal Botanic Gardens.

In these days, when we regard a mycologist as necessary to any well-equipped agricultural department, it may come to many as a surprise that Carruthers's appointment, only ten years ago, was the first of its kind. He worked in Ceylon for five years, and in 1905 took up the directorship of the newly-formed Department of Agriculture for the Federated Malay States. Here he remained until he was invited to fill the Trinidad position, where it was expected that his special knowledge of cacao rubber and plant sanitation would prove of great value. These hopes have unfortunately been frustrated by his untimely death, but in the short space of time which intervened he initiated several important projects, and so recently as May contributed two papers to the Brussels International Congress on Tropical Agriculture and Colonial Development, whilst an account of rubber in Trinidad appears in the last issue of the *Trinidad Agricultural Bulletin*, of which he was joint editor.

Carruthers possessed the happy gift of "getting on well" with people, and officials and planters in many parts of the world, the members of the Royal Society of Edinburgh, the Linnean Society, the Association of Economic Biologists, the West India Committee, and a wide circle of friends unite in regretting his loss.

NOTES.

SIR E. RAY LANKESTER has been elected a foreign associate of the Paris Academy of Sciences in succession to the late Prof. Robert Koch.

THE following men of science have been elected foreign members of the Royal Society:—Dr. Svante Arrhenius, Dr. Jean Baptiste Édouard Bornet, Dr. Paul Ehrlich, Prof. Vito Volterra, and Dr. August Weismann.

A REUTER telegram from Wellington states that a new crater is in eruption near the dormant geyser of Waimangu (Rotorua), and is ejecting mud and pieces of rock. Its proximity to the volcano of Tarawera renders the outbreak significant.

MR. JOHN RAMSBOTTOM has been appointed an assistant in the Department of Botany, British Museum. Mr. Ramsbottom was lately exhibitioner of Emmanuel College, Cambridge, and Robert Platt biological research scholar, Victoria University, Manchester. He will devote himself to the fungi.

IN the course of a reply to a question asked in the House of Commons on Monday with reference to the Advisory Committee on Aërial Navigation, Mr. Asquith said that a further report of the committee will be laid before Parliament within a few days. Captain Murray Sueter, R.N., representing the Admiralty, and Mr. Mervyn O'Gorman, superintendent of the Balloon Factory, have been appointed additional members of the committee. The total approximate cost of the committee to the present date is 10,000*l*.

THE property in the centre of the Cheddar Cliffs, on which the quarry occurs that has caused much disfigurement to the gorge, has been purchased by the National Trust. Certain existing contracts, which expire in 1912, will be performed exclusively from the loose stone lying fallen in the quarry. No further blasting will take place. The National Trust hopes that by the purchase of this property the cliffs have been secured from all danger of further spoliation. The immediate and pressing danger to the finest part of the gorge arising from the vibration caused by blasting has now been stopped.

ACCORDING to a communication from Mr. J. T. Jenkins, published in the *Field* of July 23, there is reason to believe that the fur-seals on the Pribilov and other islands of the North Pacific are in imminent danger, if not of extermination, at all events of being so reduced in numbers as to be no longer of any commercial value. It will be remembered that the Anglo-American Commission of 1896 insisted upon the repression of pelagic sealing, and it was eventually agreed that, while this was to be absolutely prohibited to Americans, it would be permitted to British subjects only outside a sixty-mile limit from the Pribilovs. The Japanese were, however, no party to the arbitration by which this was arranged at Paris, and their vessels have for the last few years been actively engaged in pelagic sealing around the Pribilovs immediately outside the three-mile limit. In 1907 Canadians had fifteen vessels engaged in pelagic sealing, which took 5240 skins, while in 1908 there were eight vessels, which secured 4452 skins. On the other hand, the Japanese had thirty-six vessels in 1907 and thirty-eight in 1908, of which the respective takes were 9000 and 13,197. If the latter rate of killing be continued—especially when it is recalled that the great majority of seals killed in the open sea are females—it will not be many years before the herds will be practically annihilated. The case is one where international action is urgently demanded, and that at an early date.

AN article upon the character of King Edward VII. in the current number of the *Quarterly Review* gives much interesting information upon the early life and training of the late King. Queen Victoria and the Prince Consort appear to have considered the minutest details of the physical, intellectual, and moral training of their son, who was to become our King. The German blood and upbringing of the Prince Consort led him to attach great importance to thoroughness of educational training, while letters and notes "record the Queen's anxious solicitude that no boyish longing for excitement should interfere with the Prince's 'adherence to and perseverance in the plan both of studies and life' laid down by his father." Every hour of the young Prince's time was mapped out by his governors and preceptors; and it is not surprising that under this high-pressure system, and without the stimulus of competition, the Royal pupil did not reach the lofty standard always before the mind of the Prince Consort. Every book was placed before the boy as a task, and the subjects in which he received instruction appear to have been presented in their driest form. Had more reasonable educational methods been adopted, and the Prince's individuality been considered instead of making it subservient to scholastic ideas, there would have been no occasion for the expressions of disappointment at his want of studious reflection. He was an acute observer, and could learn better from things than words. Even in his early days his teacher said of him that he was "learning almost unconsciously from objective teaching much which, I think, could never have been taught him subjectively"; and this capacity was his characteristic through life. While at Edinburgh as a lad of eighteen, he attended Lord Playfair's lectures on the composition and working of iron ores, and he never altogether forgot them. "They imparted to him a certain liking for practical science and its votaries which he never wholly lost." His interests were practical rather than academic, and his brilliant success as Prince of Wales and King was achieved not so much by his studies with tutors as in spite of them.

We regret to announce the death of Mr. J. Ellard Gore, the well-known amateur astronomer, who did much to popularise astronomical science. While in the Public Works Department in the Punjab, he interested himself in scientific studies, and the result was the publication of "Southern Stellar Objects" (1877). From that date he was a voluminous writer on the descriptive side of astronomy, and his works have been welcomed on account of the general accuracy of his facts and the enthusiasm which his writings inspired. On double stars, variables, and planetary markings he was regarded as an authority. One of his noteworthy works was his share in the volume of astronomy which he wrote in the "Concise Knowledge" series in collaboration with Prof. Fowler and the late Miss Clerke. He was also well known for his translations of several of Flammarion's works.

The processes of pottery-making as it appears in prehistoric interments in Europe is well illustrated by two contributions in *Man* for July, in which Mr. N. W. Thomas and Capt. A. J. N. Tremearne describe the methods in vogue in South and North Nigeria respectively. In neither district is the wheel used, the vessel being built up out of flattened ribbons of soft clay over the neck and shoulders of an old broken pot. Capt. Tremearne heard of, but did not witness, a still ruder method, in which the clay is shaped for the body of the pot in a hole in the ground, the upper portion being subsequently added in the way already described.

Much discussion has arisen regarding the date of the narrow cultivation terraces known in England as lynchets, and some authorities, like Dr. Mackintosh and others, have gone so far as to deny that they are artificial, asserting that they are merely natural raised beaches. Their contiguity to Neolithic and Bronze-age camps certainly lends much support to the view that they represent a form of prehistoric agriculture. Mr. W. A. Dutt, in *Man* for July, quotes an account of similar constructions in Abyssinia from Capt. Stigand's "To Abyssinia through an Unknown Land." The close analogies presented by these to the English examples are clearly in favour of the view that they are the work of a primitive race.

An interesting phase of lacustrine culture is described in a monograph by Mr. S. A. Barnett, on the Klamath Lake and Modoc Indians of north-west California and southern Oregon, contributed to vol. v. of the Memoirs issued by the University of California. This specialised culture is largely based upon the use of the tule reed for hut-building, basketry, and other purposes. Their food is procured from the lakes on the shores of which they dwell, and for this purpose they use a peculiar duck arrow, fishing and bird nets, hooks of bone, and dug-out canoes. Stone implements, such as mullers, mortars and pestles, or mauls, are in common use. But many of these are relics of earlier Indian tribes, and their gradual disappearance before a culture based upon the use of metals is shown by the fact that they are now largely used as charms in medicine and gambling. A man, for instance, will take a large obsidian knife or spear-point, and, after reciting a charm, will place it under the mat on which a game is being played to ensure good luck. Fire is procured with a drill consisting of a piece of dry willow root twirled in a base block of cedar wood, for which purpose the canoe paddle is very commonly used.

Under the editorship of Messrs. W. M. Webb and E. S. Grew, *Knowledge* is much improved in general appearance, and, if we may judge from the July number, in the character of its contents. In one of the articles, the Rev. T. R. R. Stebbing urges that the gender of all generic names in zoology should be regarded as masculine, mainly on account of the difficulty of deciding as to the true gender of many of the terms now in use.

We have been favoured with a copy of the report of the Danish Oceanographic Expedition during the winter of 1908–9, under Dr. J. Schmidt, published in *Geografisk Tidskrift* (20, B.H. vi., 1910, pp. 243–55). The area surveyed extends from Iceland through the North Sea on the one hand, and along the eastern border of the Atlantic on the other, into the Mediterranean as far east as Greece. The report is illustrated with bathymetric tables of temperature and salinity in different parts of the area, and likewise with a chart of the isotherms and "isohalines" on the two sides of Gibraltar. The dissimilarity between the distribution of isothermal and isohalic areas in the latter region is very striking and curious.

Determinate evolution in the colour-pattern of "lady-beetles" forms the subject of an elaborately illustrated memoir by Mr. R. H. Johnson, published by the Carnegie Institution of Washington (Publication No. 122). Ladybirds, to give these beetles their ordinary name, were selected for the purpose of this investigation on account of their abundance, the facility with which they can be reared in confinement, their distribution, and the circumstance that they were recently, and perhaps still are, in an active state of evolution. Members of the leaf-eating epilachnine group were chosen for special study as being easier to rear than the aphid-eating forms. As regards the object of the colouring of the Coccinellidæ, the author accepts the view that it belongs to the warning, or aposematic, type. No single pattern can at present be recognised as forming the ancestral type, and it is evident that Eimer's laws of pattern-development are inapplicable to the present case. "Natural selection, if at all active, is principally conservative of the spotted pattern. In spite of this, determinate variation, largely actuated by the effect of the environment on the germ-plasm, and probably preponderance as well, have accomplished marked evolution of the pattern from this condition. Evolution proceeds by waves as well as by even flow and by mutation in different characteristics at different times."

IN the *Scientific American* of July 2, Mr. W. L. Beasley describes, with large-size illustrations, the method employed in the American Museum of Natural History, New York, of mounting the skins of large mammals on specially prepared models, or "manikins," which in some cases are based on clay statuettes of living specimens. After being roughly modelled, the manikins are carefully finished by artists, and the skins fitted upon them, the method being illustrated in the case of an East African zebra, or bonte-quagga, and a hippopotamus. The article specially relates to the collection of large mammals obtained by the expedition to East Africa under Mr. Roosevelt. The director of the museum, Dr. Bumpus, has planned a comprehensive and striking exhibition of African mammals, to be, in due course, displayed in the buildings under his charge. The main part of this exhibit is destined to be shown in a series of new halls about to be added to the west wing of the museum, but some specimens will be used to fill gaps in the existing series. The cost of the additions to the building is to be defrayed by Mr. Samuel Thorne, who has already done much for the museum. Unless funds are forthcoming for the addition of a new north-west wing to our own Natural History Museum, that institution will be altogether beaten by New York in the show of big-game animals.

THE July number of the *Selborne Magazine*, with which *Nature Notes* is now incorporated, contains an abbreviated report of the lecture delivered by Mr. J. Buckland on June 17, at the annual meeting of the Selborne Society, on the traffic in feathers and the need for legislation in connection with the same. To the same issue Mr. Buckland communicates an illustrated article on illegal practices in the feather-trade, dealing especially with India. It is pointed out that, in 1903, the Indian Government prohibited the exportation of the skins and feathers of birds, except those of domesticated species and ostriches, together with natural-history specimens. This prohibition, according to the author, is, however, to a great extent evaded by feathers being shipped as cow-hair, horse-hair, or silk material. One such consignment of "cow-hair" was opened by the custom-house officers at the London Docks in 1908, and found to contain more than 6000 paraquet-skins; but as these were not contraband, they were, after some delay, handed over to the consignee. Further investigation proved that, during a previous period of eight weeks, no fewer than twenty-three cases of bird-skins had been landed in London under false declarations. The author sums up as follows:—"A vast number of the feathers which are used in the millinery trade in Great Britain are able to be brought into her ports only by means of false declarations, which are a direct evasion of the law, and which declarations are made deliberately for the purpose of deceiving ship captains and the customs authorities of the countries from which the feathers are shipped."

THE fourth part of Bulletin No. 82 of the Entomological Bureau of the U.S. Department of Agriculture is devoted to an account, by Mr. W. B. Parker, of the life-history and the means of controlling the hop flea-beetle (*Psylliodes punctulata*), which has of late years done much damage to hops in British Columbia. The species, which is widely distributed over the northern United States, and ranges into southern Canada, normally feeds on rhubarb, sugar-beet, and a few other plants, and was not known as a serious pest until a few years ago, when it began to devastate the hop-gardens in certain parts of British Columbia. When hop-cultivation commenced in the Chilliwack Valley in 1894, the beetle was noticed, but did little harm until 1903, when it appeared in force. From 1904 until 1908 the numbers of these insects gradually increased, attaining their maximum in the year last named. "As soon as the hops began pushing through the ground, the beetles were observed swarming around the vines, giving the soil in the immediate vicinity a black metallic appearance. These swarms of flea-beetles devoured the hop-shoots as fast as they appeared, and in places where the vines were a foot or more on the string the attack was so severe that in a few days the field looked as if it had been burned. The infestation resulted in a loss of about 75 per cent. of the crop."

THEORIES of life we have in plenty; it is somewhat a novelty to come across a pamphlet in which we have a theory of death propounded ("Das Altern und der physiologische Tod." By M. Mühlmann. Published by G. Fischer, Jena. Price 1.20 marks). The occurrence of physiological death is comparatively rare; most human beings die of accident, under which term disease is, of course, included; very few pass unscathed from such accidents, and die of simple old age, a gradual slowing down and final stoppage of life's machinery. But when it does occur, Dr. Mühlmann's theory is that it is due primarily to changes in the nerve cells, and that the run-down of the other organs is produced secondarily by changes in the ruling system of the body, the nervous system. Moreover, this degenerative change, which becomes evident to the microscope as a formation of pigmentary and lipoid granules, begins quite early in life; from one point of view, therefore, it is a form of growth which produces death, and considerable importance is laid by the author upon granules in cells as an essential protoplasmic constituent. The *brochure* contains many interesting data, such as the rate of growth of the different organs in various periods of life, and this, together with his views on the phenomena of regeneration, will amply repay careful perusal.

A NUMBER of the *Bulletin du Jardin Impérial Botanique*, St. Petersburg (vol. ix., part ii.), is devoted to a paper on lichens by Mr. A. N. Danilov, in which he adduces morphological evidence opposed to the theory of a mutually advantageous symbiotic union of alga and fungus. In the summary the author states that his results confirm the evidence of Peirce and Schneider with regard to the close investment of the algal gonidia with a net of hyphal threads, and the complete absorption of the contents of the gonidial cells.

ARISING out of a demand from members of the Manchester Microscopical Society for specimens illustrative of marine zoology, a quarterly publication, the *Micrologist*, has been initiated by Messrs. Flatters, Milborne, and McKechnie, of Manchester, which will contain directions for manipulations of such specimens, and thereby take the place of instructions that would otherwise be required. The specimens will be issued quarterly with the journal, and mounted preparations will also be available for purchase.

A NEW volume—the fifth—of the Circulars of the Royal Botanic Gardens, Ceylon, opens with a report on the tea plots at the Peradeniya experiment station, and subsequent numbers deal with "Rubber in the Early Days" and a visit to a rubber factory. In the last named, Dr. J. C. Willis gives an account of a visit to the large factory in Hanover. With regard to the tea experiments, the chief point is the proved value of green manuring, for which purpose *Erythrina spp.* (Dadap) and *Crotalaria striata* were found to be most suitable.

The exhibition at Shepherd's Bush has naturally created an interest in the methods and craft of "Japanese gardens." Judging from an illustrated article in the July number of *Irish Gardening*, a typical and most successful example of such a garden has been laid out at the Tully nurseries, Kildare, which to those interested would certainly repay a visit. It is explained that such gardens are purely pleasure resorts, and therefore the practice displayed therein is entirely distinct from the methods adopted in ordinary and agricultural gardens, in which the Japanese are fully alive to the value of intensive cultivation.

The first three numbers of the current volume of the Bulletin of the American Geographical Society contain a detailed examination of trade routes in the economic geography of Bolivia, by Prof. Isaiah Bowman. The author deals at length with the resources and population of Bolivia in relation to the natural features of the country, and concludes that, in spite of the fact that 90 per cent. of Bolivia drains to the Atlantic and 10 per cent. is interior basin drainage with no outlet whatever to the Pacific, nevertheless, geographical position and the distribution of resources and climate are here equally powerful factors with topography. The Atlantic slope, and not the Pacific slope, is, and will long remain, the back door to Bolivia; for the section of the country in which the population is found looks to the Pacific, and the first essential of all the trade routes is a short line to the coast.

Mr. W. Joerg examines the present state of our knowledge of the tectonic lines of the northern part of the Cordillera of North America in a paper published in the Bulletin of the American Geographical Society (p. 161). Basing his discussion chiefly on the summary contained in the final volume of Suess's "Antlitz der Erde," the author suggests the recognition of the Alaskides, as a separate province of major rank, as a subdivision of the Cordillera. This would give three divisions: the northern Cordillera or Alaskides, the central Cordillera, and the southern Cordillera or Lower California and the Mexican Highland. The boundary between the first and second would be the zone of coalescence, and between the second and third the depression along Salton Sink, the Gila, and the Rio Grande.

The director-general of Indian observatories has issued a memorandum, dated June 9, on the meteorological conditions prevailing before the south-west monsoon of 1910 (June to early October). Dr. Walker has pointed out that the rainfall in India brought by this monsoon is apparently affected by previous conditions over a large part of the earth's surface, and that it is only when these are strongly favourable or otherwise that a definite forecast is justified. One of the many favourable signs is, as a rule, the prevalence of high barometric pressure in South America and of low pressure in the Indian Ocean prior to the period of the monsoon. At Buenos Aires pressure was in excess in March, April, and May last, but in the Indian Ocean conditions appeared to have been, on the whole, slightly unfavourable. From these and other factors specified in the memorandum the inferences drawn are that there appears to be no cause for expecting a large excess or defect in the total amount of monsoon rainfall. The rains are likely to be less steady than usual, especially those due to the Arabian Sea current. Rainfall due to the Bay current is likely to be, on the whole, more plentiful by comparison with the normal than that due to the Arabian Sea current.

At the international meteorological conference at Innsbruck (September, 1905) Prof. Hellmann stated that the important question of the comparison of the barometers of the various meteorological institutes had engaged the attention of several conferences, but had not been solved in a satisfactory manner. Dr. Köppen also pointed out that so long as the differences between barometric standards are unknown, discontinuities arise when isobars are drawn for large areas. The conference finally arranged that the necessary work involved by such comparisons should be subdivided among the chief institutes, and the result of the part undertaken by the Prussian Meteorological Office is contained in one of the useful papers by Dr. Hellmann in the report of that institute for 1909. The comparisons of the standards at the central offices of the various German and some foreign systems show that at some stations (especially Potsdam and Zürich) the barometers agreed closely with the Berlin instrument, while others showed ± differences of appreciable amount, the greatest being 0·246 mm. (nearly 0·01 inch). The larger differences are thought to be due to the mercury having become unclean; at all events, the results have justified the expense and care bestowed upon the somewhat laborious work.

We have received separate copies of several papers by Prof. S. Lussana, of the University of Siena, which have appeared recently in *Il Nuovo Cimento*. One of them deals with the coefficients of compressibility and of dilatation with temperature of certain pure metals and alloys. The coefficients were measured by means of a dilatometer containing the material enclosed in a metal case. The change of volume was measured by the change of resistance of a platinum wire in the capillary tube of the dilatometer as mercury was forced along the tube by the contraction of the material. The values obtained allow the difference between the specific heats at constant pressure and temperature, respectively, to be calculated. For pure metals the difference increases as the temperature rises, but for alloys it in general decreases. In nearly all cases it decreases with increase of pressure. The bearing of Prof. Lussana's work on the improvement which has been introduced into the law of Dulong and Petit by the substitution by Prof. Richarz of the specific heat at constant volume for that at constant pressure will be obvious to our readers.

In an article on the renewal of sulphated storage cells, reproduced from the *Electrical World* in the *Electrical Review* for July 1, Mr. J. O. Hamilton describes a method of dealing with such cells which has proved very successful at the Kansas State College. If on test the efficiency of a cell sinks to 50 per cent. or lower, the plates are removed and washed thoroughly with distilled water. They are then placed in a cell containing a 2 to 5 per cent. solution of caustic soda in water, and the charging current sent through the cell in the usual way. If the sulphate on the positive plate does not disappear in the time of the ordinary charge, and the solution gives an acid reaction with litmus paper, more caustic soda must be added to the solution, and the charging continued until the plate has the usual chocolate appearance. The plates should then be removed from the soda solution, well washed, replaced in the sulphuric acid solution, and the charging continued until gassing begins. Many cells have had their efficiencies raised from 25 to 75 per cent. by six hours' charge, and Mr. Hamilton considers that any cell which will still hold together will well repay treatment by this method.

Terrestrial Magnetism and Atmospheric Electricity for June contains an article by Dr. L. A. Bauer and Mr. W. J. Peters in which the complete magnetic results of the first cruise of the *Carnegie* are given. After an extensive series of tests of the vessel at Long Island, it was found that a determination of any magnetic element could be made on it with an absolute accuracy not far behind that attained by experienced observers on land. This conclusion was confirmed by further observations made at Falmouth at the end of the trip across the Atlantic. The observations made at sea show that the present charts of the Atlantic require revision, as they show compass variations which are in many cases more than 1° in error, and in some cases more than 2°. These errors appear to have been introduced by the application of a correction for secular variation at points at which no determinations of that quantity had been made. A further paper by Mr. E. Kidson deals with the observations of electrical conductivity and of radio-activity of the atmosphere made during the cruise. The conductivity was determined by means of a Gerdien apparatus, and always proved low in the neighbourhood of land, and persistently higher for positive than for negative electricity. At night the conductivity appears to be nearly constant, and about double what it is during the day. It will be seen that these observations are likely to render some modifications of the current theories of atmospheric electricity necessary. The radio-activity was determined by the negatively charged exposed wire method, the decay of activity of the wire being observed by means of an electroscope. It appears to be due to radium emanation and to be derived from the land.

A "SHORT History of the Academy of Natural Sciences of Philadelphia" has been prepared by Dr. Edward J. Nolan, recording secretary and librarian, and published by the academy. This sketch of the academy's activities is to be regarded as preliminary merely to a detailed history to be issued in connection with the proposed celebration of the centenary of the academy in 1912. The academy accomplishes its work in four departments—the library, the museum, the publication office, and the department of instruction and lectures. The library, exclusively for reference, now contains about 60,000 volumes, almost entirely on the natural sciences; in many respects it is the most important collection of the kind in America. It is claimed for the academy's museum that it is one of the most important in existence. The vertebrate animals number about 130,000 specimens, 12,000 being mammals, 60,000 birds, 20,000 reptiles, and 40,000 fishes. The insects are estimated at nearly 400,000 specimens, and the shells at a million and one-half. There are in the cases 50,000 specimens of fossils, 30,000 minerals, 20,000 pieces of archæological material, and more than 600,000 preparations of dried plants. The remaining departments are equally extensive and enterprising. The academy has twice received appropriations from the State legislature, 4000*l.* in 1905 and 30,000*l.* in 1908.

A VALUABLE supplement to the meteorological observations undertaken by the University, Manchester, has been described by Messrs. Hayhurst and Pring under the title "Examination of the Atmosphere at Various Altitudes for Oxides of Nitrogen and Ozone," in the Journal of the Chemical Society. Previous estimates of the amount of ozone have ranged from 0·01 to 31·6 milligrams per cubic metre for the minimum quantity found, and from 0·03 to 158·0 for the maximum quantity, figures which appear to indicate a range of experimental error in the ratio of 3000 to 1. The very high values found by several observers are no doubt due to the catalytic action of oxides of nitrogen upon potassium iodide solutions exposed to air, whereby a mere trace of oxide may act as a "carrier" of oxygen to an indefinitely large quantity of iodide; the similar action of sunlight in promoting oxidation of the iodide is also important as a further source of error. In the experiments now described, air was blown through bulbs containing potassium iodide either at ground-level or attached to kites or balloons; the bulbs were protected from light, and the presence of ozone was inferred, not from the mere liberation of iodine, but from the production of alkali and iodate. When this criterion was employed, it was found that whilst oxides of nitrogen were present in variable proportions, the amount of ozone at ground-level and at altitudes up to 8000 feet was less than 0·003 mg. in 1 to 10 cubic metres, or less than 1 part by volume in 4,000,000,000 parts of air. At very high altitudes, up to ten miles, small amounts of ozone were detected, the quantity found averaging 0·04 milligram in 0·1 to 0·3 cubic metre of air, or 1 part in 3,000,000 to 9,000,000 by volume. These experiments are of value as showing that the presence and merits of ozone in the fresh air of sea and country are as much a matter of fiction as the substantial excess of oxygen which was discovered by over-zealous investigators prior to the researches of Cavendish; in fact, the only method of enjoying the effects of atmospheric ozone appears to be by ascending in a free balloon, which bursts and descends as a parachute after rising to a height of several miles.

COMMENTING on the Bournemouth Aviation Meeting, *Engineering* for July 22 remarks that perhaps the most interesting feature of the meeting from the technical point of view is the fact that all the best performances were done with aëroplanes fitted with the Gnome rotary engine. In fact, it seemed as if no machine which was not fitted with this engine had any chance of success. All engines of other types appeared to give trouble, and not to be able to furnish the desired power for any long time at a stretch. In some cases the trouble was hot bearings, especially big ends. In others the engine appeared simply not to be able to maintain its power, and, after flying a short distance, it could not sustain the machine in the air. The performances of the English engines were disappointing.

A NEW book by Dr. Berry Hart, of Edinburgh, entitled "Some Phases of Evolution and Heredity," will be issued very shortly by Messrs. Rebman, Ltd.

WE have received from Messrs. Friedlaender, 11 Karlstrasse, Berlin, a copy of the third part of a catalogue of entomological books and papers, this being devoted to Lepidoptera; also a catalogue of books on natural history, sports, travel, &c., offered by Mr. B. H. Blackwell, 50 Broad Street, Oxford.

MESSRS. SWAN SONNENSCHEIN AND CO., LTD., will issue shortly a companion volume to Dr. Theal's "History of South Africa," to be entitled "The Yellow and Dark Skinned People of Africa." This will contain a summary of all that is included in Dr. Theal's "History and Ethnography of South Africa" (3 vols.), and is especially intended for the use of ethnographical students.

THE latest addition to the series of "Savants du Jour," published by M. Gauthier-Villars, of Paris, deals with the life and work of Prof. Émile Picard, of the University of Paris. Prof. Picard was born in Paris on July 24, 1856, and his biography, as here written by M. Ernest Lebon, shows a growing regard from his school-days for algebra and mathematical analysis, which eventually led in 1897 to his appointment to the chair in these subjects in the University of Paris. The list of Prof. Picard's works and papers on mathematical subjects occupies a very large part of the memoir, which also contains an appreciation of his work by Prof. Henri Poincaré, delivered in 1888 in presenting him with the grand prize of the Paris Academy of Sciences for Mathematical Science.

The first issue of a new annual, entitled "The Green Book of London Society," has been received. Its subtitle describes the volume as a directory of the Court, of society, and of the political and official world, including celebrities in art, literature, science, and sport, with many other subjects of current interest. The editors of the compilation are Mr. Douglas Sladen, who, it will be remembered, compiled "Who's Who," and Mr. W. Wigmore. Under science are given lists of some men of distinguished eminence in the London scientific world, with the researches and discoveries which have made them famous; the most important scientific and engineering institutions; and some of the chief scientific periodicals. The book runs to 487 pages, and is published by Messrs. J. Whitaker and Sons, Ltd., at 5s. net.

The sixth edition, revised, of Dr. Bernard Dyer's small handbook on "Fertilisers and Feeding Stuffs: their Properties and Uses," has just been published by Messrs. Crosby Lockwood and Son, price one shilling net. Short descriptions have been added of the two new fertilisers—nitrate of lime and calcium cyanamide—in which atmospheric nitrogen is fixed, but the practical disadvantages of their use are pointed out. Of the former Dr. Dyer remarks:—"It has a serious practical disadvantage in its deliquescent property, which makes it necessary to sow it immediately the air-tight packages in which it is sent out are opened, and it cannot be conveniently sown in moist weather." Calcium cyanamide is also unpleasant to sow. Dr. Dyer's book is a manual from which practical farmers can obtain many useful hints as to profitable procedure in fertilising the soil for different crops and feeding the stock. The text of the Act of 1906, referring to fertilisers and feeding stuffs, is printed in full, together with the regulations of the Board of Agriculture and Fisheries for the protection of farmers from the supply of adulterated materials.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in August:—

Aug. 2. 11h. 18m. Moon in conjunction with Venus. (Venus 4° 8′ S.).

8. 9h. 11m. Minimum of Algol (β Persei).

9. 6h. 26m. Moon in conjunction with Jupiter 2° 34′ S.

10. 12h. 46m. Venus and Neptune in conjunction. Venus 0° 27′ N.

11—13. Maximum of August Perseid display. Radiant 44 + 57°.

14. Venus. Illuminated portion of disc = 0·889.

16. Saturn. Major axis of outer ring = 43·21″. Minor axis = 13·51″.

25. 5h. 46m. Moon in conjunction with Saturn. Saturn 1° 18′ S.

27. 14h 11m. to 14h. 54m. Moon occults τ Tauri. (Mag. 4·3).

28. 10h. 53m. Minimum of Algol (β Persei).

30. 11h. Mercury at greatest elongation, E. 27°.

Subjective Phenomena on Mars.—In No. 4427 of the *Astronomische Nachrichten* M. Antoniadi returns to the discussion of the objective reality of the dark band seen circling the Martian snowcap. He previously directed attention to the fact that this band was not visible on photographs of the planet, and suggested that its appearance during visual observations was simply an effect of contrast. This argument was weakened by the possibility of photographic "spreading" in the sensitive film being sufficient to account for the obliteration of the dark band. But M. Antoniadi now points out that on the photographs taken with yellow screens during the last opposition, the caps are no more intense than the "continental" areas, and from this he suggests that "spreading" is negligible. Yet the dark band is not to be found on these photographs, and therefore, if the premises are true, it appears that its visibility in visual observations is only a subjective phenomenon.

The Genesis of Various Lunar Features.—In the *Comptes rendus*, No. 2 (July 11), M. Puiseux discusses the probable origins of the circles and of the angular outlines of lunar crevasses shown in the polar regions of the moon on the concluding sheets of the great photographic atlas of the moon published by the Paris Observatory. He points out that many of the circles appear in chains, of two or more, parallel or perpendicular to the meridian. Where two of these circles intersect, the point of junction is marked by a small crater or a considerable elevation, and M. Puiseux believes that this is evidence against Faye's theory that the *bourrelets* were formed by repeated periodic overflowings which filled in the circle. Such differences of level as are now revealed would be incompatible with this theory. On the same plate (lxvi.) is seen a number of circles aligned on, or across, a meridian, and joined by a high, narrow ridge, and M. Puiseux considers that these are evidence against the meteoric bombardment theory.

Near the northern pole the geometrical contours of circles are exceptional, and angular features predominate. The ridges here are found to be in echelon, and M. Puiseux considers that the sharp angles were formed where previous ejecta prevented the eruptions from following the general line of weakness to which, however, the subsequent eruptions returned, thus producing the echelon form.

Halley's Comet.—A preliminary account of the observations made by an expedition which journeyed to the Pic du Midi to observe Halley's comet is given in No. 2 of the *Comptes rendus* (July 11) by MM. G. Millochau and H. Godard.

Arrangements were made to photograph, regularly, the comet and its spectrum, but they were sadly interfered with by bad weather. No spectrograms were secured, but several good photographs were taken with a Zeiss "astroplanar" lens having a large field. The photograph secured on May 29 showed a bright condensation, detached from the nucleus, which at 2° from the head became broader, and was prolonged some 8° into the tail. The photograph of May 31 shows a secondary nucleus at a distance of 17″ from the primary.

A long summary of the numerous observations made at different places during the passage of the comet is published in the July number of the *Bulletin de la Société astronomique de France*, and is illustrated by a number of drawings and photographs.

The Gnomon in Ancient Astronomy.—All who are interested in the early days of astronomical observation will find an article by M. Jules Sagaret, published in No. 17 of the *Revue scientifique*, full of interest. M. Sagaret discusses at length the *rôle* played by the gnomon in the observations made by the ancient Chinese, Babylonians, Egyptians, &c., for the determination of time and season, especially of the solstices, and shows that in a vertical bamboo rod the Chinese of about the second century B.C. found a, comparatively, very effective astronomical instrument.

The Leeds Astronomical Society.—The Journal and Transactions of the Leeds Astronomical Society for 1909 (No. 17) shows that this society is endeavouring to popularise the study of astronomy with its wonted vigour. In addition to numerous interesting papers read by members at the meetings of the society, there are a number of reprints of popular articles contributed to various publications. Among these are articles on current phenomena contributed by Messrs. Whitmell, Scriven Bolton, and Ellison Hawks, and a series of articles by Mr. Elgie which appeared in *T.P.'s Weekly* over the pseudonym "F.R.A.S."

RECENT WORK OF GEOLOGICAL SURVEYS.[1]

IV.—THE UNITED STATES.

THE United States Geological Survey frequently assists research by publications in which definite subjects are dealt with from a comprehensive point of view. The Bibliography of North American Geology for 1906 and 1907 was issued in 1909. A bibliography of Archæan and Algonkian geology, divided up under the various States, is given in Bulletin 360 (pp. 940, 1909), in which Messrs. Van Hise and Leith review the pre-Cambrian geology of North America. As the title shows, Canada is included, and the summaries given of published work make this volume welcome in every library of scientific reference. Bulletin 364 (1909) is by Messrs. Darton and Siebenthal on the Laramie basin in south-eastern Wyoming. The name Casper formation is proposed (p. 13) for Carboniferous limestones and sandstones resting on pre-Cambrian rocks on both sides of the Laramie Range. The Laramie beds, over which much discussion has arisen, may be represented by the highest sandstones and shales of the Cretaceous Montana series, and an unconformity, now widely recognised, occurs between this series and the Cainozoic beds (pp. 35 and 43). The Laramie question, it may be observed, has been recently discussed by Mr. Whitman Cross (Proc. Washington Acad. Sci., vol. xi., 1909, p. 27), who proposes the name Shoshone Group for the beds elsewhere styled Laramie, but lying above the unconformity. The coloured geological map in the memoir, and the illustrations, show well the character of the broad valley of the Laramie, with its floor 7000 feet or more above the sea, and gneissic hills rising some 3000 feet higher on the east and west (Fig. 1). Interesting contrasts are afforded in a great variety of strata, especially where Oligocene sands form level ground in hollows of the Archæan rocks of the Laramie range.

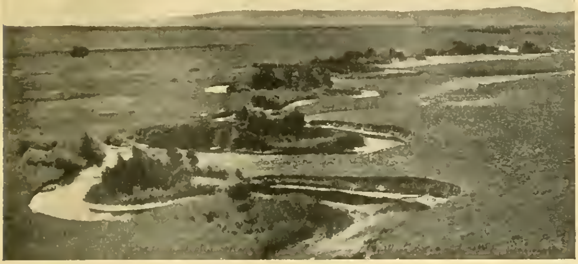


FIG. 1.—Alluvial flat of Rock Creek Valley, Laramie Basin, looking towards the Pre-Cambrian hills.

Mr. D. F. MacDonald, in Bulletin 384, carries us up to the old rocks of the Canadian border in the extreme north of Idaho, where a large series of strata exist that are presumably of pre-Cambrian age. Mr. J. S. Diller (Bulletin 353) describes the Taylorsville region at the north end of the Sierra Nevada in California, and to the south-east of the great cone of Shasta. Compression of the Jurassic and older sediments occurred here in early Cretaceous times; the present Sierra region began to rise, and the Great Basin slipped away from it along faults (p. 108). Though the sea, as happened in so many other areas, returned during the Upper Cretaceous epoch, it did not dominate the new mountains; soon after, it became excluded altogether. Elevation continued in the Eocene, and gold-bearing gravels streamed down until the end of the Pliocene, when great warping took place, accompanied by faulting. Hence (p. 110) interesting changes in the drainage-lines occurred, and old valley-floors are traceable that undulate up and down, with bulges rising 1000 feet high across the former courses of the streams. In describing the volcanic rocks, which are of various ages, from Silurian to Pliocene, the author uses the terms meta-rhyolite and meta-andesite for types much altered from their original condition (p. 81). The famous Lassen Peak volcano lies a little outside the area now described.

Mr. W. T. Lee (Bulletin 352) has explored a part of western Arizona, where the Colorado River emerges from the Grand Canyon and runs southward, forming the State boundary. Fine examples of consolidated, and probably Quaternary, conglomerates and gravels, weathered out into huge bluffs, are given in the plates. The author describes the erosion of valleys that went on in Cainozoic time (p. 58), accompanied by faulting; then followed the great uplift of the plateau, and renewed excavation by the streams, the Colorado being now driven to carve out the Grand Canyon. The gravel deposits in the broad Detrital-Sacramento valley to the south are 2000 feet thick, and are believed to have been deposited after the erosion of the canyon. The obstacle that checked the southward flow of the river down this valley may have been a barrier of comparatively modern basalt, and the formation of a nearly flat cone of deposition above it allowed the river to wander westward and to start new excavation along its present course (p. 65). During this next epoch the alluvial conglomerates were eroded into their present fantastic outlines (Fig. 2). The history of the southern valleys, here somewhat modestly presented, must clearly be taken into consideration when we review that of the more famous plateau-region to the north. The coloured geological map, inserted, according to the present useful practice, in the memoir, enables one to follow the arguments, as well as the travels, of the author. It will be noted that the excavation of the Grand Canyon is here transferred from Cainozoic to early Quaternary times.

FIG. 2.—Bluff of eroded Quaternary Conglomerate, mouth of the Virgin River, Arizona.

Mr. Lee also describes the "Manzano Group" of marine red sediments in the Rio Grande Valley of New Mexico (Bulletin 389, 1909). Mr. G. H. Girty deals with the palæontology of these strata, which are now ascribed to the Upper Carboniferous (p. 38). Red beds were deposited in the Rocky Mountain region from Lower Carboniferous to Jurassic times. There seems here a suggestion of the continuity of the bright colour conditions that influence tropical and semi-tropical strata at the present day. The

[1] Continued from vol. lxxxiii., p. 234, April 21.

fauna includes numerous new species, and a new molluscan genus, Manzanella, allied to Nucula, is established (p. 75). The stratigraphical simplicity introduced by this systematic piece of work may be realised from the previous reference of the beds to Permian, Triassic, and Jurassic series (p. 11).

Mr. L. M. Prindle's account of part of the Yukon-Tanana region in Alaska, extending nearly to the Arctic Circle (Bulletin 375, 1909), is interesting for comparison with Canadian work, and has also an economic value. The lignites of the "Kenai formation" are placed, with other "Arctic Miocene" deposits, in the Eocene (p. 26). Our old friend *Corylus MacQuarrii* appears in the flora, which may, of course, prove ultimately to be Oligocene.

Professional Paper 61 (1909), by Mr. W. W. Atwood, describes the glacial history of the Uinta and Wasatch Mountains, which lie to the east of the now desiccated area of the Great Salt Lake of Utah. Here "it is certain that there were at least two ice epochs separated by a long interglacial interval" (p. 92). Lake Bonneville sediments rest upon the earlier drift, and are overlain by the later drift, and support is given to Gilbert's conclusion that "the inter-Bonneville epoch of low water was of greater duration than the time that has elapsed since the final desiccation." The correlation of glacial advance with lake-extension is interesting in connection with the association by Messrs. Davis and Huntington of pluvial flood-gravels in Central Asia with the growth of ice upon the highlands. Mr. Lee, in his Arizona bulletin, referred to above, seeks to connect epochs of erosion in the Colorado basin with those of high water in Lake Bonneville, so that we may now realise a good deal of "the face of the earth" as it appeared soon after Pliocene times, from the Wyoming border down to the Gulf of California.

Mr. G. H. Girty's memoir on the fauna of the Caney shale of Oklahoma, in which cephalopods are prominent (Bulletin 377, 1909), will interest students of Carboniferous zoning. Professional Paper 58 (1908), a quarto of 652 pages, is by the same author, on the Guadalupian fauna of New Mexico. The Guadalupe mountains are formed of marine limestones and sandstones, the Capitan Limestone in the upper part yielding a scarp reminding one of Tyrol. A large Fusulina, *F. elongata*, is abundant in the higher beds. The fauna as a whole furnishes a localised type (p. 28), and differs from the Upper Carboniferous and Permian faunas of the eastern and most of the western States, while it is younger than beds styled Permian in Kansas. The Guadalupian series is compared most nearly with the Fusulina Limestone of Palermo (pp. 35 and 50), and it is urged that the beds may possibly be younger than the European Permian, although truly of Palæozoic age. New genera of lithistid sponges and calcisponges are described. Attention is especially directed to the bryozoan species grouped under Domopora, as indicating Mesozoic affinities, and throughout the memoir discussions arise which must be considered by workers on Permo-Carboniferous horizons. In Professional Paper 59 (1909) Mr. W. H. Dall describes the Miocene of Astoria and Coos Bay, Oregon, including some Oligocene forms from the Aturia beds. Reprints of rare papers on Cainozoic strata of the Pacific coast are usefully given as appendices. Mr. True (p. 143) contributes an account of the Miocene sea-lion, *Pontolis magnus*, which has interesting alliances with *Eumetopias jubata*, still living in the district. The plates of fossils are of exceptional beauty, and include whorl-like groups of a singularly large Crepidula.

The Survey has also issued numerous bulletins on economic geology, among which may be mentioned those on the granites of Massachusetts, New Hampshire, and Rhode Island (No. 354); on the Great Falls Coal Field of Montana (No. 356), where the Carboniferous strata contain gypsum and the Lower Cretaceous sandstones contain valuable seams of coal; on the Book Cliffs Coal Field of Colorado and Utah (No. 371), where the coal is in the higher beds of the Upper Cretaceous; on the iron ores of southern Utah (No. 338), where igneous intrusions have introduced iron salts into limestone, and where the petrographic observations of the geological surveyor (p. 86) have a special bearing on future exploration; and on magnesite in California (No. 355), from which it appears that this mineral is in special demand for refractory bricks and for the production of carbon dioxide, the residue being more valuable than lime. Bulletins 328, 335, 337, and 345 deal with mineral resources in Alaska. In the first of these (p. 151) the famous beach-placers of Nome are described, which were practically exhausted, with great profit, in two years. In No. 335 the level Bering Glacier, a companion of the Malaspina, and also in part forest-clad, is described and illustrated (p. 46). No. 337, by Mr. Prindle, should be read in connection with No. 375, by the same author, noticed above. Professional Paper 62 (1908), by Messrs. Ransome and Calkins, describes the ore deposits of the Cœur d'Alène district, Idaho. The post-Glacial gravels (p. 77) are in this case referred to the epoch of the dwindling and recession of the ice, which was here localised in cirques and valleys. Lead, silver, zinc, copper, and gold are worked, and the district produces more lead than any other in the United States. The labour-wars in the district, waged with dynamite and rifles, show that the difficulties have not been all due to geological structure. The rich lead-silver ores, ranging through 4000 feet of contorted Algonkian rock, are believed to represent emanations from a great batholite (p. 137), which is represented by its uppermost intrusions (monzonite) at various points.

The papers on water-supply issued by the United States Survey are well known by their brown covers, and usually contain matter of geological as well as of economic importance. Two of them have been recently noticed in NATURE (vol. lxxxii., p. 379). No. 223 (1909), by Mr. F. G. Clapp, on the underground waters of S. Maine, includes a coloured geological map and useful illustrations of joint-structures in granite, diorite, and slate. In No. 221 (1909) Mr. C. A. Fisher describes the Great Falls region of Montana, where the Missouri is still fresh and vigorous, and liable to considerable additions when the snow melts off the mountains to the west. The destruction of forests by fire on these high slopes has further increased the risks of flooding. The copious water-supply is now being utilised for a system of irrigation-canals in the somewhat arid plains to eastward. In No. 220 (1908) Mr. G. A. Waring records a piece of pioneer work in southern Oregon, where no good topographical map previously existed. The country reminds us of N.W. Europe in Triassic days, with its large shallow lakes, liable to dry up at times, and at others to extend their boundaries, so as to find outlets and swell the diminished streams. Goose Lake has thus been known to flow over southward into Pit River. It receives, in all probability, a considerable supply from subterranean sources (p. 42). The problem of the region, of course, lies in the alkali-lands, where sodium chloride, sulphate, and carbonate may be brought to the surface during irrigation, the carbonate being much the most injurious. Sodium carbonate not only blackens the surface of stems and roots just below the surface, whence its name "black alkali," but also deflocculates the soil. References are, of course, made to the bulletins issued by the U.S. Department of Agriculture, and this memoir shows a promising correlation between the work of the Geological Survey and of the Bureau of Soils.

No. 225 (1909), by Mr. W. C. Mendenhall, continues the history of the Salton Sea, from its disastrous formation by the drawing in of the Colorado River in 1905 (see NATURE, vol. lxxv., p. 501) to the closing of the gap by the energy of the Southern Pacific Railroad early in 1907. If the work holds, it is estimated (p. 40) that the great lake will have disappeared by evaporation in 1925, to the detriment of the users of ground-waters in the valley to the north-west. This valley, and the Colorado Desert generally, were once occupied by the head of the Gulf of California. The surface of the Salton Sea had fallen to 200 feet below sea-level early in 1907. A remarkable water-line, 40 feet above sea-level, is traceable round the bluffs, and is attributed (p. 18) to an important predecessor of the Salton Sea, formed before the Colorado took up its present course across its delta (Fig. 3). In this rainless region it is estimated that such indications, often accompanied by deposits of calcium carbonate, have lasted through a thousand years. The same author describes, in Paper 222 (1908), the conditions of the San Joaquin Valley, California, and urges the importance of small farming with individual hard work, as carried out by the Italian immigrants, in opposition to the characteristically American "desire to get rich overnight, to control large holdings, and to avoid personal labour." The warning is also true in regard to English agriculturists in South Africa, and may in time become applicable even to the enormous prairie-lands of Canada.

The Geological Survey of New Jersey, in its annual report for 1908 (1909), records its continued cooperation with the Survey of the United States. In a paper on the building-stones of New Jersey, the rocks are excellently illustrated by coloured photographs of polished surfaces, as well as by views of the buildings constructed from them.

FIG. 3.—Old water-line above west side of the present Salton Sea, California.

The annual report of the Iowa Geological Survey for 1908 has been received in 1910, and is mainly occupied (pp. 21–687) by a comprehensive series of papers on the coal-deposits of the State. The peat bogs and their flora are described in the concluding papers.

G. A. J. C.

REPORTS OF METEOROLOGICAL OBSERVATORIES.

THE *Meteorological Service of Canada* (1906).—This report extends to nearly 650 quarto pages; the geographical position, and height above sea where known, of the numerous stations in operation in that year are given, also hourly observations at Victoria, Winnipeg, Toronto, and Montreal. From a monthly chronicle of weather conditions it would appear that, generally speaking, temperature was above and rainfall below the normal. Temperatures exceeding 100° and below −50° were, as usual, recorded at many stations, the highest being 107°, at Point Clark, Ontario, and the lowest −65·5°, at Dawson City, Yukon. The absence of maps, the impracticability of comparing data contained in various tables, and the frequent practice of separating rainfall and depth of snow, render it somewhat difficult to obtain a general idea of the characteristics of the year over such a vast area beyond that given by the chronicle referred to. For this purpose the excellent summaries in the *Monthly Weather Review*, although based chiefly on telegraphic reports, are more convenient. The weather predictions were very successful; the general total percentage of fulfilment (including partial verifications) varied from 81·3 in November to 92·4 in July, the average being 86·3 per cent.

Toronto Observatory (1907).—The results of the meteorological and seismological observations for the year are interesting and valuable. In the annual summary the results are compared with the means for the last sixty-eight years. The mean temperature of 1907, 44·2°, was practically normal; mean of maxima, 51·6°, of minima, 36·7°. The absolute maximum was 88·8°, in July (highest on record, 99·2°); absolute minimum, −10·0°, in January (lowest on record, −26·5°). The highest solar radiation was 112·3° (June); lowest night radiation, −13·9° (January). The annual rainfall was 25·56 inches (normal, 26·88 inches); depth of snowfall, 52 inches (normal, 66 inches). Rain fell on 100 days and snow on forty-seven days. Bright sunshine was recorded on 1921 hours, being 43 per cent. of the possible amount.

Bombay and Alibag Observatories (1909).—The equipment of these institutions is very complete; the routine operations, which include terrestrial magnetism, meteorology, seismology, and astronomical observations, so far as these relate to time-keeping and signalling, are carried out with great minuteness and regularity. The annual rainfall was 71·22 inches, being 3·94 inches below the normal (1873–96); the mean temperature was 78·9°, 0·5° below the average. Milne's seismograph registered fifty-three earthquakes; great disturbances occurred on April 11, June 3, July 8, and October 21. The table representing the magnetic character of each day shows there were 149 calm days, 182 days of small, and 34 days of larger disturbance. The mean declination was 1° 0′ 16″ E.

Helwan Observatory (1909).—The magnetic observations made during the year have been published in pamphlet form by the Egyptian Survey Department. The tables include mean monthly values of the various elements, and hourly deviations from the mean. The mean annual results were:—westerly declination, 2° 49·2′; dip, 40° 40·4′; horizontal force, 0·30031 (C.G.S. unit); vertical force, 0·25804. A list is given of the maximum and minimum values of the elements during fifteen of the principal disturbances with a daily range of more than 100 γ in the horizontal intensity (γ=0·00001 C.G.S. unit). The greatest disturbance was recorded on September 25 (to which we have already referred as regards Kew Observatory). At Helwan the range of horizontal intensity was >585 γ (the curve extending below the limit of the photographic sheet), vertical intensity 237 γ, declination 38′. The range of horizontal intensity in most of the cases quoted was from three to four times that of the vertical intensity.

Royal Prussian Meteorological Institute (1909).—The increasing work during the year was much hampered by the loss of Dr. Sprung and Dr. Kremser, and by the consequent changes in the re-organisation of the staff. The institute has now established observations of earth temperature at some of its principal stations, and the results will be published weekly for the benefit of agriculturists. The rain stations (exclusive of ordinary meteorological stations) now number 2637, and the thunderstorm stations 1482. The Potsdam Observatory has greatly increased its activity in respect of atmospheric electricity and other useful researches. Dr. Hellmann points out that a considerable improvement has been introduced in the "Statistical Correspondence" issued for many years by the Statistical Bureau (now the Landesamt), of which the institute was formerly a department. Beginning with January, 1909, that publication has doubled its size, and includes, as an appendix, under the title of "North German Weather Report," monthly observations from forty-three stations supplied by the institute, with a chart showing the distribution of rainfall. The report contains several interesting short discussions, in continuation of the practice introduced in the previous year; we have already referred to one or two of them.

The Deutsche Seewarte (1909).—This report is divided into two parts:—(*a*) general part, containing interesting particulars relating to the staff, the agencies for the supply of instruments, &c., the observers on land and at sea, together with other details; (*b*) reports of the chiefs of the different departments. By looking through these an idea is gained of the great variety and importance of the work performed under the superintendence of the Seewarte. They include (1) oceanography and maritime meteorology; in addition to such work as sailing directions and ordinary meteorological charts, daily synoptic weather charts of the North Atlantic and adjacent coasts have for many years been issued in conjunction with the Danish Meteorological Institute, and these furnish invaluable data for studying the sequence of weather conditions over western Europe. (2) Verification of nautical, meteorological, and magnetic instruments, both at the Seewarte and at the agencies, of which there are twenty-two, and the determination of the deviation of compasses in iron ships. (3) Weather telegraphy; in addition to a very wide distribution of weather telegrams and storm warnings, this branch superintends the agricultural weather service between May and September, and conducts experiments from time to time on the possibility of making profitable use of wireless telegrams from ships in the Atlantic. (4) Other branches deal with the testing of chronometers and watches, the collection of materials referring to coasts and harbours for the benefit of navigators, the collection and publication of observations at distant stations, &c. The investigation of the upper air by means of kites is carried out daily when weather permits, and the results telegraphed at once to various services; in the summer half-year the ascents are made at 6h. a.m., and in other months at 8h. a.m.; the altitude attained generally reaches or exceeds 2000 metres.

The Sonnblick Observatory (1909).—The results of meteorological observations made at the summit of the Sonnblick, 10,187 feet above sea-level, show that the mean temperature for the year was 18·0°; the highest monthly mean was 33·6°, in August (the only month with mean above freezing point); absolute maximum, 48·2°. The month with lowest mean temperature was February, −3·1°; absolute minimum, −23·4°. The total annual precipitation amounted to 61·65 inches, on 233 days; most of this fell as snow; rain only occurred on eighteen days, and hail on three days. Fog was prevalent on 271 days, the least being in January. As in previous years, the report includes observations and interesting details relating to some other mountain observatories and to upper-air research.

Norwegian Meteorological Institute (1909).—The observations and results are published in two volumes:—(1) Meteorological Year-book: The principal tables include hourly readings for Christiania, daily observations for twelve stations, monthly and yearly summaries for sixty stations. (2) Rainfall (and Snow): Daily observations are given for 200 stations, monthly and yearly results for 476 stations, and normal values for the years 1876–1905. The volumes have appeared in the same form for many years, and contain valuable and trustworthy data for an area extending as far north as latitude 71° in the Arctic Ocean. The yearly rainfall varies considerably, according to locality; the isohyets for 1909 range from 1000–2000 mm. and upwards along the Atlantic coast, with closed areas of 3000 mm., while near the Swedish borders the lines vary from 400–800 mm. and upwards. The methods of measuring both rain and snow are explained, with illustrations of the gauges.

The Southport Meteorological Observatory (1909).—Every effort is made to render this report as interesting and complete as the important position of the establishment on the eastern shore of the Irish Sea warrants. Fifteen carefully prepared tables show the principal results obtained there and at the subsidiary stations at Marshside and Barton Moss; rainfall returns at nine other stations in the district, and a useful tabular comparison between the year's values of temperature, rainfall, and sunshine at sixty health resorts and ten large towns in Great Britain are included in the report. The outstanding feature of the year was the remarkable coldness of the summer months, due to unusual prevalence of cold polar (N.W.–N.E.) winds, while at other times the centres of depressions frequently passed to the southward of Lancashire, producing miserable, gloomy weather. The mean temperature of the year was 47·4°, 0·8° below the average; the highest shade temperature was 78·4°, on May 21, the lowest 18·0°, on December 21. The greatest daily range was 33·6°, on May 20, and the least 2·0°, on February 4. The annual rainfall amounted to 35·72 inches, 2·82 inches above the thirty-five years' average. In December precipitation amounted to 5·94 inches, which Mr. Baxendell states was unprecedented, being nearly 3 inches above the mean; but for this the annual amount would barely have equalled the normal.

Falmouth Observatory (1909).—The important meteorological and magnetical work performed by this institution has been carried out with great assiduity during the year. The observations are supplied to the Meteorological Office (from which it receives an annual grant of 250*l.*), to the National Physical Laboratory, and other organisations. An event of special interest during the year was the visit of the magnetic survey ship *Carnegie*; the scientific staff of the vessel was furnished with valuable data in connection with the proposed magnetic survey of the Atlantic and Pacific Oceans. The results of the "climatological" observations (taken for the Royal Meteorological Society) show that the mean maximum temperatures were 46·4° in February, 69·6° in August; absolute maximum 80·0°, in August (the highest in that month for twenty-eight years). Mean minimum, 36·8° in March, 55·3° in August; absolute minimum, 26·4°, in February. The annual rainfall was 37·6 inches, nearly 4½ inches below the normal. Some interesting details are given of the great magnetic storm of September 25, which disorganised the telegraphic system of this country and parts of the Continent. The mean value of magnetic declination for the year was 17° 48·4′ W.

Observatory Department of the National Physical Laboratory (1909).—This report shows that the useful work of the observatory to which it refers continues to expand; this is especially noticeable in the verification of instruments (exclusive of watches and chronometers), the total number being 41,318, nearly 11,000 more than in the previous year, and including 25,861 clinical thermometers. The meteorological observations call for no special remark; the automatic records are tabulated for each hour, and are published in detail by the Meteorological Office, as one of its principal observatories. The chief magnetic disturbances took place on January 3, 30–31; March 19, 28–29; May 14, 18; September 25, 30; and October 19; the most remarkable was that of September 25 (see NATURE, September 30, 1909). As in previous years, a table is given of the magnetic elements at a number of observatories, and reports of the results at Falmouth and Valencia. The largest seismic disturbances occurred on January 23 (earthquake in Persia), July 30 (earthquake in Mexico), and October 20–21. An account of the work at the affiliated observatory at Eskdalemuir, Dumfries, N.B., is included in the report; we note that some useful researches on atmospheric electricity and on solar radiation are being carried out there.

In our issue of June 23 we referred to the important changes that were being carried out in connection with the control of the two observatories at Richmond and Eskdalemuir.

SCIENCE AT THE JAPAN-BRITISH EXHIBITION.

THE arrangement of the British Science Section at the Japan-British Exhibition differs considerably from that of the Franco-British Exhibition. At the latter exhibition a separate annexe was set aside for science which made it comparatively easy to arrange the exhibits uniformly; but although the building was close to the entrance, the majority of the public passed it by and went straight through to the grounds. The fact is, the average man is rather afraid of anything called scientific, and unless he is brought to examine such an exhibit unawares is very apt to fight shy of it. Yet it was noticeable that those who did go into the building, even if they had no scientific knowledge, found a great deal to interest them, and frequently stayed a considerable time.

This year the Science Section is housed in the upper galleries leading from the Uxbridge Road entrance into the grounds. Consequently, all who go to the exhibition by that entrance, and the majority do, must pass through the Science Section. The exhibits are more broken up than in the Franco-British Exhibition; but this is rather an advantage than otherwise, as it takes away the museum appearance of the exhibit. Another advantage to the public is that there are two special attendants, who are able to explain the exhibits to the public in an intelligent manner. It has also been decided that certain members of the Science Committee shall give short lectures on special subjects in a portion originally intended for a bandstand, which has been curtained off; whether they will attract and keep an audience remains to be seen.

Science is so diversified, and its scope so enormous, that it is not possible to give in the space of a short article a comprehensive account of the exhibit which has been collected. Of course, it must be understood that the exhibit is not comprehensive in the sense that it covers the whole range of scientific research; but what it does do is to give to those unacquainted with scientific work an idea as to what is actually done by those engaged in scientific study. The Agricultural Section will be of interest to almost everyone; the South-eastern Agricultural College at Wye exhibits some most interesting specimens and preparations showing the various insects, mites, and eelworms which are injurious to crops and stocks, and in some cases even harmful to man. The largest section is that dealing with the enemies of fruit trees and bushes, because the damage done to these is enormous, and has received a great deal of attention. There are, for example, specimens of the various aphides, green and black fly. The insect pests of the hop are also fully illustrated, one of the aphides being the most important, or rather, from the grower's point of view, the most disastrous. It was very prevalent in 1909, and is calculated to have cost the hop-growers in England 120,000*l.* in combating the attacks of this insect.

Astronomy is well represented, the section comprising a large number of old astronomical, nautical, and horological instruments. Examples are shown of the peculiar wooden Davis quadrant employed by the navigators in the time of Elizabeth for the determination of latitude. The Royal Astronomical Society shows, among other things, a reflecting telescope made by Sir William Herschel; also a sextant, formerly the property of Captain Cook. The transparencies of photographs of the southern heavens made by Mr. Franklin-Adams seem to attract considerable attention, and are indeed worthy of it. The Solar Physics Observatory exhibits a large number of photographs of stellar spectra taken with different instruments. There are also photographs of ancient British stone monuments which Sir Norman Lockyer has investigated and shown their astronomical connection.

The history of fire-making, illustrating the gradual evolution of the match, is very interesting, and is probably one of the most complete exhibits of its kind which has ever been shown. The exhibit includes fire drills, tinder, pistol tinder-box, and a brass fire piston. In order to operate this latter a little tinder was placed in a small cavity at the end of the piston; the piston was then rapidly compressed, and the sudden compression of the air caused sufficient heat to ignite the tinder. Optical, electrical, and chemical methods are also illustrated, and one of the first friction matches, made by John Walker, of Stockton-on-Tees, is shown.

One of the largest sections is oceanography; this section is mainly designed to show the progress of oceanography within the past forty years. Before the *Challenger* expedition in 1870, very little was known as to the depths of the ocean, and there was practically nothing known about the ocean beds. Specimens of the method of sounding are shown, also recording thermometers for ascertaining the temperature of the ocean at any depth. The series of hydrographical charts shown are intended to illustrate the process of construction of a chart from a sheet of blank paper until it is printed and is ready to be issued to the fleet. There is a very complete exhibit of compasses, which comprises specimens used in H.M. ships from 1705 to the present day. In the days when very little iron was used in the construction of ships, the errors of induced and permanent magnetism were very slight, but with the construction of iron vessels alterations had to be made in the construction of the compasses, and specimens of these compasses are shown.

Biology is very well represented; there is an interesting series of photographs illustrating the origin of the domestic breeds of horses. An exhibit of particular interest is one of the parasites which cause grouse disease, also a series of charts illustrating the method of systematic research into the conditions of life in the sea, which is the only true method for any attempt to improve the fishing industry. There are also interesting specimens illustrative of the parental care of fish. One fish carries its own eggs in its mouth, while another has an abdominal pouch like that of a kangaroo, in which the young seek refuge; but there is so much to see and so many things one would like to mention that we must pass forward with the words go and see, as there is very much more of interest.

The chemistry exhibit ranges from artificial silk to sections of ships' propellers, showing the erosion produced on different alloys. There is the handsome exhibit of nickel produced by the Mond process, oils from all over the world collected by Sir Boverton Redwood; an original example of mauve, electrochemical preparations, pharmaceutical products, and preparations of dye products from the University of Leeds.

The Physics Section is very representative, and includes apparatus in connection with mechanics, heat, optics, electrical measuring instruments, and telegraphy and telephony. The electric micrometer of Dr. P. E. Shaw is shown, which, by means of a train of levers, an electrical contact, and a telephone, enables movements of 100,000,000th inch to be detected. A seismograph is shown, and in connection with it records of earthquakes taken in London and the Isle of Wight. Much attention has of late been devoted to rubber testing and its mechanical properties; in this connection the hysteresis rubber-testing machine of Prof. Schwartz is shown. Under heat, there is a model of the calorimeter used by Joule in his work on the mechanical equivalent of heat, and near by it the most recent example of the Boys calorimeter for testing the calorific value of gases. Electrical instruments make an exceedingly fine display, amongst which may be mentioned Dr. Drysdale's potentiometer for measuring alternating and direct currents, the Duddell twisted strip ammeter, and a number of X-ray apparatus.

In the Geological Section there are some specimens of volcanic rocks from Antarctica, obtained during the recent South Polar Expedition of Sir Ernest Shackleton. The rocks were collected on Ross Island by Dr. Priestley, and consist principally of lavas belonging to the type known as kenyte. The important subject of geological surveying and mapping is exhibited historically, one of William Smith's maps of nearly a century ago being exhibited by Mr. F. W. Rudler.

Under arithmetic and mathematics, models of surfaces and of crystals are shown; also the calculating machine of the late Charles Babbage, electrical machine for solving equations, and electromagnetic device for solving equations.

It has only been possible to direct attention briefly and imperfectly to the scope of the science exhibit, but this will perhaps serve to give an idea to those interested in science and cause them to visit and examine it in detail. In conclusion, mention should be made of the anthropological exhibit, an interesting feature being that a small space has been set aside for the actual taking of measurements, so that certain particulars of those attending the exhibition can be taken and data added to the large collection already obtained. F. M. P.

THE PROGRESS OF CANCER RESEARCH.

THE annual meeting of the general committee of the Imperial Cancer Research Fund was held at the Royal College of Surgeons on July 20, Mr. A. J. Balfour being in the chair. Sir William Church presented the annual report, and gave an able exposition of its most salient features.

The Duke of Bedford, who has been a strong financial supporter of the fund from its foundation, was elected president. Mr. A. J. Balfour moved a vote of thanks to the members of the various committees, and to Dr. Bashford and his staff. Mr. Balfour's remarks were mainly directed to the layman, and have received such wide publicity in the daily papers that we need not quote them in full, well as they will bear quoting. Mr. Balfour emphasised the progress made since he presided in July, 1903, and directed attention to the caution characterising the statements emanating from the laboratory, urging the need for patience upon the public, the members of which are not always able to comprehend that the slow progress made by scientific methods is the only progress that can legitimately be expected. Mr. Balfour emphasised the fact that heredity has been shown to be not of main importance, meaning thereby, we infer, that the congenital germ-theory of cancer has been discarded for good, in view of the facts elicited by the Imperial Cancer Research Fund on the association of cancer with peculiar irritants in human races practising peculiar customs, and in some animals.

Emphasis may be laid upon this point; in India, draught-cattle are liable to cancer at the root of the left horn, not of the right horn; cancer of the skin of the abdomen is only frequent in the Kashmiris who wear the "Kangri," or charcoal fire-basket; cancer of the floor of the mouth is only frequent in women who chew betel-nut. Surely these peculiar incidences of cancer are not due to a different distribution of congenital germs in the right than in the left horn of cattle, or in the abdominal skin of Kashmiris other than that in other races, any more than is betel-nut cancer due to a peculiar accumulation of congenital germs in the mouths of those women who chew betel-nut. All these forms of cancer could almost certainly be greatly diminished if the parts attacked were not irritated.

Advance in knowledge must yield information regarding other more obscure forms of cancer. Another point emphasised by Mr. Balfour was his belief in the reasonableness of expecting that the cure and prevention of the dissemination of transplanted cancer, as announced in the report, foreshadows similar achievements for original cancer, although perhaps so much may not be attained in his lifetime.

The other business was purely formal.

The report itself states that King George has consented to become Patron of the Imperial Cancer Research Fund in succession to His late Majesty King Edward VII., who was so largely responsible for its inception, as well as for inciting the modern crusade against cancer, and who in July, 1901, when opening the congress on tuberculosis, stated:—"There is still one other terrible disease which has, up till now, baffled the scientific and medical men of the world, and that is cancer. God grant that before long you may be able to find a cure or to check its course, and I think that to him who makes the discovery a statue should be erected in all the capitals of the world."

The appeal which the investigations of the Imperial Cancer Research Fund make to students throughout the world is exemplified by the number of foreign voluntary workers attracted to its laboratories. They have flocked to them from Germany, Italy, Belgium, Norway, Austria-Hungary, Roumania, the United States, Holland, and Japan, and many now hold independent appointments abroad. Thus the British national investigations on cancer may be said to have fulfilled their immediate purpose in that the English school of cancer research commands world-wide confidence, which we hope will be confirmed and extended by the director's necessarily technical report, from which we give below extracts of a few important passages. The report makes no pretence to appeal to the man in the street who wishes to know if the cause, the cure, or the means of preventing cancer have been discovered. Nevertheless, to all with "inside" knowledge, the progress made by the indirect method of attack—by the intelligent sapping and mining of hitherto unassailable citadels—must appear full of encouragement for the future.

Cancer in Vertebrates.

Much additional information has been obtained on the occurrence of cancer in lower vertebrates. It is gratifying to record that the systematic investigation of cancer in the animal kingdom has found numerous adherents both at home and abroad. Particular attention has been devoted to the incidence of the disease in cattle and in mice. While in mice the phenomena are presented in miniature even in their most advanced stages, in cattle they are demonstrated on a magnified scale as compared with man, although the universal minuteness of the early stages is independent of the size of the animal. In the course of the past six months, ninety cases of malignant new growths in cattle were obtained from a single abattoir. The histological types comprise the majority of the forms met with in man.

Breeding Experiments bearing on Heredity and Contagion.

The advantages of using short-lived animals for studying the possible influence of heredity were pointed out in 1903. The breeding experiments which have been in progress for five years have yielded a material of nearly 2000 animals of known age and ancestry. Of these, 700 females attained the age of six months or more. In them, seventy-five cases of cancer of the mamma have appeared spontaneously. This material is very complete as regards diagnosis of the disease, age, pedigree, and other important data, and it is now sufficiently large to permit of the most exact analysis of the influence of ancestral constitution on the liability of mice to spontaneous cancer of the breast. Analysed so as to bring out the liability to cancer according as the young were born before or after it appeared in the mother, the figures show a higher incidence in those born before the mother developed the disease. Since the conditions necessary for contagion were present, the opposite result would have been obtained had any analogy existed between cancer and the recognised infective diseases.

Constancy and Variability of Tumour Cells.

Tumours growing in a living animal can be protected from all outside influences, and, when propagated in large numbers of young mice of the same strain, the conditions are as constant as it is possible to provide. In these circumstances, it would not be surprising, on the one hand, if tumours showed little or no departure from the features they exhibited at the outset of propagation; on the other hand, it would not have been surprising if tumours widely different in character had tended all to approximate to a common type, in response to the unvarying nature of their environment. What has actually come out is both interesting and instructive, in that it shows that the tumour cells possess a relative constancy in their general biological properties, but, at the same time, exhibit an inherent tendency to vary in spite of the constancy of the environment, and therefore apparently for reasons independent of it. Each tumour preserves its individual features, and if there be variation, then the variations likewise are individual. The constancy may be very perfect, so that strains of the same tumour propagated separately for three and four years remain indistinguishable in all their properties. On the other hand, the variations arising may be so great and of such constancy that strains propagated separately from the same mother-material would not be suspected to have any relation to one another if submitted to one ignorant of their life-history.

In former years we have pointed out that an increase in the rate of growth, or in the percentage of successful inoculations, does not necessarily imply a fundamental biological alteration finding expression in an accelerated rate of proliferation of the tumour cells, but may be explained by the selection of particular cells adapted to the conditions of growth, and, consequently, the survival and proliferation of a larger number of such cells. That is to say, these two phenomena may be explained by an increase in the dose of the cells able to grow. The evidence for the acquirement of new properties by tumour cells is very much stronger when one observes the occurrence of morphological alterations which become of relative constancy, such as the disappearance—or latency—of their typical characteristics in the case of squamous-celled carcinoma, the disappearance of acinous structure in the case of glandular carcinoma, the derivation from cubical epithelium of epithelial cells which, if their previous history had not been known, could not have been distinguished from those of a spindle-celled sarcoma. In other cases, the change is made manifest by the alterations taking place in the supporting connective tissue and blood-vessels, so that tumours which at one time exhibited dilated blood-vessels lose this character. Biological alterations occur without evident morphological expression, *e.g.* some tumours at the commencement of propagation, after an initial exuberant growth, disappear in a large proportion of cases, whereas after the propagation is prolonged, a large percentage of the implantations grow progressively. The opposite phenomenon may also be observed, and tumour strains which grew progressively at the outset of propagation may later be found very liable to disappearance. A tumour which grows well only by the implantation of intact grafts, *i.e.* if the tissue structure is preserved, can be adapted to transplantation as a cell emulsion, and again brought back to its original condition.

Of the twenty-nine tumours of the mamma that have been propagated in the laboratory for more than two years, as many as sixteen have shown departures from the features they exhibited at the outset, these departures affecting the degree and nature of the histological differentiation, the percentage of successful inoculations, the rate of growth of the resulting tumours, the relative proportions of progressively growing tumours and of tumours which undergo spontaneous absorption after transitory growth, the susceptibility of the tumour to method of transplantation, to dose, to race, to age, and to the influence of induced immunity.

Thirteen tumours have shown a relative constancy of their structural and biological characters.

Of the sixteen variable tumours, nine have varied from the primary condition in both respects. Two have shown biological variations without histological change, and five have altered in microscopical characters without noticeable modification of their biological behaviour. On the whole, therefore, histological character is less constant than biological behaviour.

The relative constancy, but still more the variability which the tumour cells exhibit during propagation, throws indirect light of the most suggestive kind upon the nature and the manner of the development of cancer. The variability in a constant environment, during propagation, allows one to infer that corresponding variations may take place while the cells are under the influence of the particular environment provided by the animal in which the tumour developed spontaneously. The environment of the cell will depend on the individuality of the animal, and, with the progress of life, distinctions between one animal and another may become more and more marked. This inference accords with what has been said above on the ease with which auto-transplantation is effected and the difficulty with which transplantation can be effected to another individual, and therefore also with the fact that all cancerous mice do not exhibit an equally suitable soil for tumours in general.

These spontaneous variations of the parenchyma cells of tumours during propagation suggest that we have here a repetition, in a minor degree, of the cellular processes responsible for the primary transformation of non-cancerous into cancerous tissue; just as cellular changes occurring during propagation may transform within a brief space of time an acinous growth into a solid one, or a slow-growing tumour into one rapidly proliferating, so in the tissues prior to the development of a malignant new growth the responsive proliferation of cells may pass into the progressive, independent proliferation of cancer.

Experimental Sarcoma.

In this connection it may also be well to refer again to the production of sarcoma under experimental conditions from what have been the non-malignant connective tissues of carcinoma. Not the least significant aspect of the origin of sarcoma by the transformation of the stroma of transplantable carcinomata is the rarity of its occurrence. Two only of our strains have exhibited it, and the conclusion seems warranted that in these cases the parenchyma is possessed of peculiar properties. In one of our strains the change occurred only in a small number of animals, and the whole process, from the first indications of sarcomatous changes in the stroma to the substitution of the carcinomatous elements by pure sarcoma, took place slowly, and was only completed after several successive transplantations. In the other strain, the transformation was much more frequent, took place more rapidly, and the disappearance of the carcinomatous element may be complete in one transference. In spite of these differences, the parallelism between the histological pictures in the two strains is extremely close, and leaves no doubt of the essential similarity of the processes involved. The stimulus exerted by the carcinoma cells on the stroma must be different in these two strains from that exemplified by the other transplantable tumours, otherwise every transplantable carcinoma should end in sarcoma, as it has, indeed, been asserted they might do. A fairly long duration of the stimulus exerted by the carcinoma cells without cessation of their proliferation seems to be necessary, and the first steps of the process are always localised in an extremely minute area of what are often large tumours. The parallel to the circumscribed origin of squamous epitheliomata arising in areas subjected to chronic irritation in man (chimney-sweeps' cancer, paraffin cancer, Kangri cancer) does not require to be insisted on further, since it has been emphasised in previous years.

Immunisation.

It is now possible, under given experimental conditions, to prevent a secondary transplantation, *i.e.* artificial metastasis, taking place for certain tumour-strains. This result has been obtained by inserting between the primary and secondary transplantations an inoculation of a very rapidly growing tumour showing only transitory growth, as the following sample experiment shows. Of twelve mice, already bearing progressively growing tumours and treated in the manner described, the secondary inoculation was successful in three only, and then the tumours were very much smaller than in the control consisting of thirteen mice, of which ten developed new progressively growing tumours on secondary inoculation. A similar result can be obtained by the implantation of tumours growing much more slowly and liable to spontaneous absorption, as well as by an inoculation of normal mouse-tissue. By similar methods the growth of the primary transplanted tumour may be greatly hindered, can be brought to a standstill and the animal cured, in circumstances under which the disease would certainly have progressed, and where the possibility of the occurrence of spontaneous cure can almost certainly be excluded. Thus the control of *transplanted* cancer has been brought within the region of probability.

These achievements must not be confounded with successful vaccination against spontaneous cancer arising, or against infectious disease. Animals perfectly protected against the repeated inoculation of cancer may develop tumours of their own—an observation often confirmed. Still more emphatically do we warn against applying to the human subject the methods which, after long perseverance, have enabled us to arrest the growth, and even to cure, animals of transplanted tumours that were well established, and also to render animals resistant to a secondary inoculation, *i.e.* to dissemination and metastasis formation.

The immunity reactions to transplanted cancer are throughout clearer and more easily studied than are those of spontaneous cancer. The problems presented by spontaneous tumours are more delicate and elusive. The methods effectual in normal animals against primary inoculation with transplantable tumour, which, as mentioned above, also arrest the growth of growing transplanted tumours and prevent successful re-inoculation in suitable circumstances, have been without action on the continued growth of the twenty-five spontaneous tumours on which they have been tested, have failed to prevent recurrence or dissemination, and have not yet prevented a successful re-inoculation of the spontaneously affected animal with its own tumour. The investigations must go on until a higher degree of resistance can be obtained in this way, or it may be that an entirely different method must be sought. The expectation of ultimate success seems a fair inference from the results obtained with transplanted tumours which reproduce all the phenomena of growth and dissemination of spontaneous tumours, and from the rare but undoubted cases in which temporary arrest of growth or total disappearance have occurred in spontaneous tumours.

The prospect is made the more hopeful by the discovery of a method whereby an animal can be immunised by means of one of its own tissues against a primary inoculation of a tumour transplanted from another animal. This, again, is a very different matter from immunising an animal against its own tumour. Nevertheless, it illustrates how much that was previously unsuspected is being revealed, as step by step advances are made into yet unexplored regions. Inquiries into the effects which the several tissues of the body may have, either singly or in combination, in inducing protection are being made.

Chronic Irritation and Cancer.

A practical result arises out of the association of various forms of irritation with the development of cancer in sites where more obscure influences can be excluded, especially from what has been ascertained on the incidence of cancer in native races practising peculiar customs, and on the incidence of cancer in some animals. Experiment has emphasised this relation, and has thrown light upon the mechanism which makes the irritation effective, leading to similar consequences, although the irritants themselves have nothing in common. Recent legislation is thereby justified in the interest of workers employed in circumstances exposing particular parts of the body to chronic irritation of peculiar kinds. In 1903–4 the feasibility of obtaining more accurate information of the incidence of cancer in different occupations was before the Statistical Sub-committee. The progress made since renders such an investigation still more urgent to-day. It must not be supposed, however, that cancer has been proved to be always the result of irritation. The *mediate* influence of irritation has only been defined more closely than ever before.

MANGANESE MINING IN INDIA.[1]

THE many uses of manganese in the arts were known long before the metal had itself been recognised. It has been used since prehistoric times as a colouring material, and by primitive Indian smiths as a flux and as an alloy for hardening iron and bronze; and its power as an oxidiser now renders it one of the most important of disinfectants, and a valuable chemical reagent. The metal has an interesting, but uncertain, history; the origin of the name is doubtful, but it appears to have been first used in the sixteenth century as a variant of magnesium, from which it had not been separated; and even after its recognition as a distinct metal by Gahn in 1774, Bergmann still called it magnesium, though the name manganese, derived from magnésie by the reversal of two letters, had already been used.

Manganese is one of the most widely distributed of the metals. According to Mr. F. W. Clark it forms one-thousandth of the earth's crust, and is the fifteenth of the elements in quantitative importance. Mr. Fermor, accepting the number of mineral species as 1000, reports that no fewer than 130 to 140 of them contain manganese as an essential constituent. The manganese minerals are especially conspicuous, as they are mostly found in decomposed rocks upon the earth's surface; and as manganese salts are easily dissolved, the metal is a common constituent in the ash and latex of plants, and is found in the blood and tissues of many animals. According to Penrose, the proportion of manganese to iron in the human body is said to be as 1 to 20.

The increased use of manganese as an alloy has led to a more active search for its ores, with the result that the once important manganese mines of the south of England have been closed owing to the discovery of much larger supplies abroad. The manganese mines of India, according to native traditions, supplied ores to the Phœnicians, and the local smiths faced their anvils and hammers with manganese steel, which they knew as kheri. It was not, however, until 1892 that India began to produce manganese ores for export, with the small contribution of 685 tons. The ores are abundant in India, especially in the Central Provinces and in the States of Hyderabad and Mysore, and as the deposits are on the surface, and can be worked by shallow quarries, the Indian output increased rapidly until, for the years 1890–1906, it was second only to that of Russia. In 1906, and possibly some later years, India has taken the front place as a producer of manganese ores. The other countries in order of yield are Brazil, Spain, Turkey, Chile, France, Greece, the United States, and Japan, while large quantities of manganiferous iron ores are raised in the United States, Germany, and Greece.

The manganese ores of India have frequent but short references in geological literature, but little was known certainly about them until after the discovery of their economic importance. They have now been carefully investigated by Mr. L. Leigh Fermor, of the Geological Survey of India, and he has issued the result of his studies in a monograph that forms a most important addition to the geology and mineralogy of manganese. The Indian mines have added several new species of manganese minerals, amongst which the most important are hollandite, the crystalline form of psilomelane, and two new species characterised by their striking pleochroism—juddite, a manganese pyroxene, and blanfordite, the corresponding amphibole. Mr. Fermor also introduces new names for two manganese garnets, grandite, an abbreviation for grossular-andradite, and spandite, for spessart-andradite. Commercially, the most important of the Indian species are braunite and pyrolusite, which together produce 90 per cent. of the output.

Mr. Fermor's memoir includes a detailed account of the manganiferous minerals. The chemical composition of the various species is re-considered, and the complexity of many of them is shown by the elaborate general formulæ, by which alone they can be adequately represented.

The Indian manganese ores are mainly found in the pre-Cambrian rocks, though some interesting deposits of secondary economic importance occur in the laterites. The chief ores are associated with a varied series of igneous rocks, which Mr. Fermor groups as the kodurite series. They range from acid to ultra-basic varieties, all characterised by being rich in manganese and manganiferous minerals. Mr. Fermor describes in detail the petrography of this interesting rock series. The kodurites are apparently intrusive—though the evidence for this fact is described as incomplete—into two series of Archean gneisses. The first series consists of calcareous gneisses and the second of the metamorphic gneisses, which have been described by Mr. J. T. Walker as the kondalite series.

As usual with manganese deposits, the Indian mines are still shallow, and the deposits are probably very limited in depth; for they have been formed by chemical processes that only take place near the surface. They are generally due to the replacement of rocks by solutions containing manganese. Mr. Fermor reports that many of the deposits

[1] Memoirs of the Geological Survey of India. Vol. xxxvii The Manganese-Ore Deposits of India. By L. Leigh Fermor. Part i., Introduction and Mineralogy. Pp xcvii+231. Part ii., Geology. Pp. 232–405. Part iii., Economics and Mining. Pp. 406–610. (Calcutta: Geological Survey, 1909.) Price 3 rupees each.

are not more than 50 feet deep, and none has yet been proved to continue below 300 to 500 feet. The future of manganese mining is limited by some of the same factors as iron mining, owing to the limited range of the ordinary oxide ores. The mines are still open quarries, from which the ore can be very cheaply produced. Mr. Fermor's monograph concludes with a comparatively elementary statement regarding the methods of mining and the economics of the industry. More precise information as to labour costs and efficiency would have been of interest. The rates of pay are from $2\frac{1}{2}$ to 7 annas a day for men, $1\frac{1}{2}$ to 4 annas for women, and from 1 to 3 annas for children; the efficiency must be very low if it may be judged by dividing the annual output of the different mines by the number of people recorded as engaged in them. The native miners appear to insist on more holidays than Welsh colliers, without having the same excuse.

Owing to the present great activity in Indian manganese mining, the known deposits there cannot last very long. Mr. Fermor in 1907 estimated that the supplies would be worked out in from thirty to fifty years. Now, in spite of some additional discoveries of ore, he is disposed to reduce even that short limit; and he earnestly warns India that it is adopting a wasteful policy in the reckless export of manganese, which will have to be purchased from other countries for the manufacture of ferro-manganese when India works its enormous supplies of iron ores. Owing to the possibility, however, of the discovery of fresh deposits and of the invention of new processes that may supplant manganese, it is not proposed to impose legal restrictions on the export of the ore. J. W. G.

THE STRUCTURE OF CRETACEOUS PLANTS.

HITHERTO our knowledge of the structure, as distinguished from the mere external appearance, of Mesozoic plants has been for the most part limited to the older floras, in which only the earlier types, such as ferns, cycadophytes and conifers, are represented. From the Upper Cretaceous, the epoch when the now dominant angiosperms first overspread the world, little structural material has been available until lately, if we except the petrified wood of palms, which has long been known and is of the utmost interest.

At the present time new facts of great value are coming in from two principal sources—from the researches of Drs. Hollick and Jeffrey on the lignites of the eastern United States, and from the work of the authors below cited on the petrifications from northern Japan.

The specimens described in the present paper, which must be regarded as only a first instalment of the work, were among those collected by Miss Stopes on her recent expedition, undertaken with the assistance of a grant from the Royal Society, and helped in every possible way by the Government and universities of Japan. Eighteen types are described—not a large number, but quite enough to make a good beginning. The number of species with structure preserved is not very large, even in the best known fossil floras. We think, however, that the authors in their comparison somewhat underestimate the richness of the English Carboniferous flora in admitting only about seventy structural species; 100 would be nearer the mark.

The flora investigated is a mixed one, the eighteen species including one fungus, three ferns, eight gymnosperms, and six angiosperms; such proportions are quite unusual, the angiosperms commonly being dominant if they appear at all.

Only a few of the most important forms can be referred to here. Among the ferns, *Schizaeopteris mesozoica* bears the characteristic sporangia of Schizæaceæ, Aneimia being the nearest genus. Of the gymnosperms, *Niponophyllum cordaitiforme* may be either a leaf or a leaflet; if the former, it may be a belated member of the ancient Cordaiteæ; if the latter, it may be akin to the Bennettiteæ. *Yezonia vulgaris*, with a cypress-like habit, has a very peculiar structure, the small adpressed leaves containing numerous vascular bundles. If, as there is reason to suspect, the cone *Yezostrobus Oliveri* was its fruit, the plant appears to represent a type intermediate in certain respects between Cycadophyta and Coniferæ.

Cunninghamiostrobus yubariensis shows a clear affinity with the recent Cunninghamia, while *Cryptomeriopsis antiqua*, so far as vegetative characters can decide, comes near the familiar Cryptomeria of modern Japan.

Among the fossils referred to angiosperms, *Saururopsis niponensis* shows an anatomical structure similar in some ways to that of Saururus, an ally of the peppers. Some readers may perhaps ask if it is quite certain that this plant is an angiosperm, and may even think of a possible comparison with Ophioglossaceæ. In the meantime, the authors' suggestion is at any rate tenable. It is interesting that the commonest angiosperm in these rocks, *Sabiocaulis Sakuraii*, appears to show the nearest affinity with the native climbing plant *Sabia japonica*.

The most sensational discovery, however, is that of a three-celled ovary of the type of Liliaceæ, for this is the first case in which any angiospermous fructification has been found fossil with its structure preserved. A perianth or bract is adherent to the lower portion of the ovary, making it partly inferior. It is curious, if somewhat disappointing, to find that this ancient flower appears to have been already so advanced as to give no clue to its ancestry.

In many cases diagrammatic text-figures are used very advantageously to supplement the photographs (sometimes a little obscure) which form the bulk of the illustrations.

The authors' concluding remarks suitably sum up the results so far attained:—"These new fossil plants, then, seem to be an interesting community, consisting of a mixture of old and new types, of higher and lower plants mixed in nicely balanced proportions: a community, which in some respects, at any rate, one could have hardly imagined from the fossil remains hitherto available from the Epoch."[1]

[1] "Studies on the Structure and Affinities of Cretaceous Plants." By Dr. Marie C. Stopes and Prof. K. Fujii. Phil. Trans. Royal Society, Series B, vol. cci. Pp. 90; plates 9. (Royal Society, 1910.)

ARCHÆOLOGICAL AND ANTHROPOLOGICAL INVESTIGATIONS IN ARKANSAS AND LOUISIANA.[1]

MR. CLARENCE B. MOORE in 1908–9 investigated the mounds and cemeteries of the valley of the Ouachita, a river that rises in central western Arkansas and flows south-easterly into the State of Louisiana; its lower course is the Black River, which joins the Red River, a tributary of the Mississippi. The more striking remains are earthenware vessels of very varied forms and different colours. The most common form of decoration consists of the original surface of the vessel being left in scroll bands and round or oval discs, the interspaces being generally filled up with parallel lines or cross-hatching. The accompanying figure illustrates a superb bottle, $8\frac{1}{4}$ inches in height, which has a coating of red pigment of superior quality, through which is incised a beautiful combination of discs and running scrolls in a field of parallel lines which emphasise the design; possibly the incised lines were accentuated with white pigment, but no trace of this remains. The technique of some of the vessels from Glendora is superior to anything of the kind hitherto met with outside the Lower Mississippi region.

The excavations were confined almost entirely to land that was, or had been, under cultivation. When the aborigines selected dwelling sites along rivers subject to overflow, they naturally chose high ground; and later, when Europeans selected land to clear for cultivation, they were similarly influenced, especially as much of this land had been enriched by aboriginal deposits. It is needless to say that the report is illustrated in that sumptuous manner which characterises Mr. Moore's publications.

The value of the memoir is enhanced by a very careful study, by Dr. Aleš Hrdlička, of the skeletal remains discovered by Mr. Moore. This constitutes a welcome contribution to the craniology and osteology of the American Indian, and we hope it will be followed by similar studies by the same anatomist. Dr. Hrdlička, in an attempt to determine the amount of prognathism, made use of the

[1] "Antiquities of the Ouachita Valley." By Clarence B. Moore (Journal of the Academy of Natural Sciences of Philadelphia, 2nd series, vol. xiv. part i., 1909).

basi-facial angle, a measurement which was independently arrived at by Dr. Rivet (*L'Anthropologie*, xx., 1909, pp. 35, 175). The majority of the crania exhibit one of the two main forms of artificial deformation, *i.e.* occipital flattening, or cradle-board compression, and fronto-occipital flattening ("flat-head" deformation). Each variety predominates in, but is not limited to, a certain type of people, thus indicating an exchange of customs.

The predominating type is that of the brachycephals, who range in stature from moderate to well developed, with good, though not pronounced, muscular development. They were probably the people among whom prevailed, and who communicated to their neighbours, the intentional fronto-occipital deformation. The other type, less well represented, indicates Indians of stature and strength similar to those of the people just mentioned, but with oblong, mesocephalic to dolichocephalic skulls. They were, in all probability, remnants of a relatively large local strain of dolichocephals mixed with the more numerous round-headed people. The physical characters of these people approach, on the one hand, those of the more northerly tribes of Missouri, Illinois, and parts of Tennessee and Kentucky, and, on the other, those of the more westerly and south-westerly tribes, represented in northern Texas

Bottle from Glendora, Ouachita Valley, La.

and especially by the oblong-headed type among the Pueblo Indians. The prevalent occipital flattening of the skull would point likewise to a connection with the south-west and the north-east. In addition, a few crania from these two States resemble very closely the subtype of the eastern Algonquians. A. C. Haddon.

THE TABULATION OF VITAL STATISTICS.

Attention has so often been directed in these columns to the desirability of the adoption of more scientific methods in our Government departments that it gives us pleasure to notice the paper which was read by Dr. T. H. C. Stevenson before the Royal Statistical Society on June 21. Dr. Stevenson was appointed last year Superintendent of Statistics in the General Register Office for England and Wales, and his paper on suggested lines of advance in English vital statistics is, in effect, an outline of all the changes which it is proposed shortly to introduce in the mode of compilation of the vital statistics issued from that office, and of the mode in which it is proposed to compile certain tables in the census reports, more especially those relating to the new data to be obtained in 1911 (see Nature for April 7, p. 152).

That a civil servant should, with the approval of his official superiors, submit for criticism to a scientific society, before their final adoption, a statement of changes which it is proposed to introduce is, we believe, a course wholly without precedent, and deserves the warmest commendation. Taken in conjunction with the acceptance by the Registrar General, Mr. Bernard Mallet, of many of the suggestions made by the Statistical Society for the improvement of the census, the course augurs well for the thoroughly scientific spirit in which his office will be conducted.

The matter of Dr. Stevenson's paper is too detailed for abstraction in these columns, but it may be noted that it is intended in future to tabulate vital statistics by administrative instead of by registration districts, and that the data as to number of children which will be obtained at the next census will be tabulated, not only for different occupations of father, as suggested in the article in this journal to which reference is made above, but also by the number of rooms occupied or the number of servants employed, so as more clearly to distinguish the different social strata. It is also proposed to introduce the card-system for vital statistics and for census work, and to use mechanical methods for sorting and counting the cards. The frankness with which Dr. Stevenson points out difficulties and asks for suggestions is one of the most pleasing features of a paper on which he can be unreservedly congratulated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Entrance scholarships have been awarded at Bedford College for Women (University of London), as follows:—Pfeiffer scholarship in science (value 50*l.* a year for three years) to Miss W. R. Smyth, of the North London Collegiate School; Henry Tate scholarship in science (value 50*l.* a year for three years) to Miss F. M. Lunniss, of the Cambridge and County School.

With the view of securing uniformity in the statistics concerning higher education, the Carnegie Foundation for the Advancement of Teaching has issued, as Bulletin No. 3, a series of standard forms for financial reports of colleges, universities, and technical schools. The forms as they are published are the result of a prolonged inquiry concerning the practice of universities and colleges in the United States in the rendering of public financial statements of their receipts and expenditures. The object of the forms is to make it easy for students of education and others to answer the questions, What is the total income of a given institution for the year? What is its annual expenditure? What are the assets at the end of the year? The forms may be commended to the attention of officials who are responsible for preparing balance sheets and other statistics in connection with universities and colleges in this country.

Mr. Sidney Ball, fellow and senior tutor of St. John's College, Oxford, and Prof. I. Gollancz, professor of English at King's College, London, have been elected the first fellows of the English foundation of the A.K. travelling scholarships. It may be remembered that these fellowships, each of the value of 660*l.*, were recently founded in this country by Mr. Albert Kahn, of Paris, to enable the fellows to travel round the world. The object of the founder is that persons selected from the first rank of those engaged, in whatever way, in the education of the nation may become better qualified to teach and to take part in the instruction and education of their fellow-countrymen. The trustees are the Lord Chancellor, the Lord Chief Justice, the Speaker, Lord Avebury (nominated by the founder), and the principal of the University of London (Dr. Miers), the last-mentioned being honorary secretary to the trustees. The affairs of the trust are administered at the University of London.

The current issue of the *Reading University College Review* contains several articles of interest. An editorial discusses the American faith in universities. The institution and development of universities, each of which is wholly dependent upon a particular State, is, the writer maintains, the most conspicuous activity that has of late been shown in America. The American recognises more and more that university life, under favourable conditions, can give a training in comradeship and personal character which is one of the best preparations for efficient citizenship. He wants, too, the best knowledge—useful and technical—because without it he knows he cannot have the right kind of citizens. Prof. H. N. Dickson contributes an essay on higher education and commerce, and points out that those universities and colleges which are able to provide instruction of the higher kind in commercial subjects are steadily increasing in number. An address delivered by Prof. A. L. Bowley last May on progress and leisure is also included.

IN reply to a question asked in the House of Commons, Mr. Lloyd George has informed Mr. Duncan Miller that he is not prepared to propose any additional grants to the Scottish universities during the current financial year beyond the sum of 21,000*l.* included in the Supplementary Estimate issued on July 13, but as regards the future he has expressed willingness to sanction, subject to certain conditions, a further addition to the existing grants, provided that suitable schemes of expenditure can be submitted by the authorities of the several institutions concerned. For the current financial year the total grants in aid to Scottish universities and their allocation will be :—

	Grant under Universities (Scotland) Act, 1899	Grant under Education and Local Taxation Account (Scotland) Act, 1892*	Grant from Votes, Class 4. Sub-head I.	Supplementary Estimate	Total
	£	£	£	£	£
St. Andrews	6,300	4,500	—	4,000†	14,800
Dundee University College	—	—	1,000	—	1,000
Glasgow	12,180	8,700	—	6,250	27,130
Aberdeen	8,400	6,000	—	4,500	18.900
Edinburgh	15,120	10,800	—	6.250	32,170
	£42,000	£30.000	£1,000	£21,000	£94,000

* Payable from the Local Taxation (Scotland) Account.
† Includes £1,000 for Dundee University College.

FOLLOWING an order of the House of Commons, the Board of Education has issued a return by each county council in England and Wales, except London, of the rates levied for elementary education, and of the rate levied for higher education. So far as higher education is concerned, it is interesting to notice that Glamorganshire is most highly rated for this purpose, the rate being $3\frac{1}{4}d.$ in the pound, and bringing in 43,030*l.* Eleven counties levy a rate of 2*d.* or more, but less than 3*d.* They are, in order :—

	Rate *d.*	Amount raised £
Yorks : West Riding	2·97	92,948
Cardigan	2·88	2,647
Monmouth	2·73	13,074
Denbigh	2·46	6,096
Merioneth	2·31	2,049
Herts	2·13	14,853
Cheshire	2·12	30,746
Westmorland	2·10	3,771
Flint	2·10	3,636
Pembroke	2·10	2,813
Salop	2·00	11,131

A number of counties levy a smaller rate than a halfpenny in the pound ; these are Devon, Dorset, Hereford, Lincolnshire (three divisions), Notts, East Suffolk, West Suffolk, East Sussex, and the North Riding of Yorkshire. The Holland division of Lincolnshire raises nothing for higher education ; the Kesteven division raises 10*l.* only, Hereford 35*l.*, East Suffolk 58*l.*, and Dorset 100*l.* Two counties only raise more than 50,000*l.*, namely, the West Riding, 92,948*l.*, and Lancashire, 65,082*l.*

A SCHOOL of aviation is to be established near London in memory of the late Mr. C. S. Rolls. A sub-committee of the Aërial League has had the scheme under consideration, and its cost for the first year is likely to be 2500*l.* The primary aim of the school will be to provide training in aëroplane manufacture and flight, and to obtain a class of men grounded in the subject from beginning to end, including such laboratory and theoretical work as funds and the gifts of apparatus may permit. The laboratory will be open for the use of students from technical institutions already providing elementary classes in the theory of flight, and also for public demonstrations in order to spread an interest in aëronautical science. Men who have undergone courses of training in engineering schools, and competent engineers and mechanics, will be eligible as students. The practical work of students will be directed to securing machines offering greater stability and trustworthiness, lower power and fuel consumption, diminished capital cost and expense of maintenance, and a higher factor of safety than the apparatus now used. In order that an early start may be made, two machines are to be bought at once, and the students will build all further machines, and also those of selected inventors whose ideas are judged to be worthy of construction and practical trial. The funds will be administered by an independent committee of management, including practical men of science. Mr. Patrick Y. Alexander has offered to equip the proposed laboratory with the necessary practical apparatus. The new institution will probably be called the Rolls Memorial School.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 18.—M. Émile Picard in the chair.—P. **Villard** and H. **Abraham** : The existence of two explosive potentials ; a reply to a recent note of M. Amaduzzi. The authors state that their original intention was to bring forward a theory of the silent and continuous discharge, characterised by luminescence at the anode, based in accordance with the modern hypotheses as to the passage of electricity in gases.—L. **Maquenne** and E. **Demoussy** : The toxic qualities of certain salts towards green leaves. The salts of ammonium are shown to be specially dangerous in this respect, while calcium chloride and sea salt have very little effect.—A. **Laveran** and A. **Pettit** : The forms of endogenous multiplication of *Haemogregarina sebai.* Observation in this organism shows for a given species a great variety in the multiplication cysts, both in dimensions and number of merozoites, such that it is necessary to beware of assuming the existence of different species too readily.—Joannes **Chatin** : The variations of structure of the sclerotic among vertebrates.—Ch. **Platrier** : A problem of rational mechanics and its application to the theory of propulsive helices.—Ernest **Esclangon** : The passage of the earth through the tail of Halley's comet.—M. **Schulhof** : Some remarks on the inequalities of the longitude of the moon.—Jules **Drach** : The logical problem of the integration of differential equations.—Serge **Bernstein** : The equations of the calculus of variations.—Sigismond **Janiszewski** : The geometry of cantor lines.—L. **Zoretti** : The notion of a line.—Jean **Chazy** : A differential equation of the third order which has its critical points fixed.—René **Garnier** : A class of differential equations the general integrals of which have their critical points fixed.—Witold **Jarkowski** : Some theorems on "sustainers."—A. **Tanakadate** : A photographic study of the current of air produced by the movement of a helix.—E. **Mathias** and H. Kamerlingh **Onnes** : The rectilinear diameter of oxygen. Experiments in the case of oxygen give an affirmative answer to the question whether the deformation of the surface when the critical temperature is lowered leaves intact its rectilinear form.—A. **Perot** and J. **Bosler** : The theory of the luminescence of the mercury arc *in vacuo.*—A. **Tian** : The action of ultra-violet rays on gelatine. These rays destroy jellies, causing their liquefaction or solution, thus forming a contrast to the action of the same rays in coagulating albumen.—G. A. **Hemsalech** : The relative periods of calcium rays in the spark of self-induction. Experiments of this character provide useful indications in the analysis of bodies containing unknown impurities.—

H. **Buisson** and Ch. **Fabry**: The electric arc in an atmosphere of feeble pressure.—M. **Rouch**: Observations of atmospheric electricity made on Petermann Island during the stay of the Charcot expedition.—William **Duane**: A photographic method of registering α particles.—M. **Barre**: Sulphate of thorium. The author finds that sulphate of thorium in aqueous solution shows a specific resistance and a freezing point entirely in agreement with the laws of Bouty and Raoult. Measurements also of conductivity and freezing point of solutions containing 1 per cent. of potassium sulphate show the existence of a double salt.—F. **Bodroux**: The action of some ether salts of monobasic fatty acids on the mono-sodium derivative of benzyl cyanide.—Marcel **Guichard**: The absorption of iodine by solid bodies. The fixation of iodine by the surface of a solid is a specific property, and the author gives a list of a number of substances showing this behaviour.—M. **Gard**: Binary hybrids of the first generation in the genus Cistus and Mendelian characters.—B. **Sauton**: Influence of iron on the formation of the spores of *Aspergillus niger*.—Pierre **Marty**: New observations on the fossil flora of the Cantal.—Eugène **Collin**: A determination of the nature of the wick of a Punic lamp. The author believes the fibres to have been undoubtedly of flax.—Rémy **Perrier** and Henri **Fischer**: Some particular points in the anatomy of molluscs of the genus Acera.—MM. **Jammes** and **Martin**: The *rôle* of the chitin in the development of nematode parasites.—Henry **Penau**: The cytology of *Endomyces albicans* (P. Vuillemin).—Amédée **Delcourt** and Émile **Guyénot**: The possibility of studying certain Diptera in a definite medium.—Charles **Nicolle** and E. **Conseil**: Experimental reproduction of exanthematic typhus by direct inoculation with human virus.—M. **Lucet**: The presence of Spirochetæ in a case of hæmorrhagic gastro-enteritis in a dog.

Cape Town.

Royal Society of South Africa, June 15.—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. A. **Theiler**: Note on *Anaplasma marginale*, a new genus and species of the Protozoa. This Anaplasma is transmitted by ticks, and it is a noteworthy fact that the incubation time by tick transmission is much longer than that after inoculation of the animal with blood; in the experiments carried out it varied from fifty-five to seventy-five days. Blood of an immune animal is infective; such an animal forms the reservoir of the virus. This is a peculiarity of the piroplasma diseases, to which group Anaplasmasis also belongs. Dr. Theiler's opinion is that Anaplasmasis is probably the disease which the farmer has hitherto called "gall sickness." Up to the present four different parasites are, in South Africa, found in the blood of immune cattle, and they can all be transmitted by the inoculation of the blood and by ticks.—Dr. R. **Gonder**: The development of *Piroplasma parvum* (Protozoa) in the various organs of cattle. The author suggests an explanation of the fact that the blood of animals suffering from East Coast fever injected into healthy animals does not transmit the disease. It is possible, he thinks, that the blood contains forms which can develop in the tick, and which, when injected, die. Concerning the place of the East Coast fever parasite in protozoology, he thinks the proposition justifiable to separate it from Piroplasma, and to substitute a new generic name, "Theileria," as suggested by Bettencourt.

FORTHCOMING CONGRESSES.

August 1–6.—International Congress of Entomology. Brussels. Chairman of Local Committee for Great Britain: Dr. G. B. Longstaff, Highlands, Putney Heath, S.W.

August 1–7.—French Association for the Advancement of Science. Toulouse. President: Prof. Gariel. Address of Secretary: 28 rue Serpente, Paris.

August.—International Congress of Photography. Brussels. Correspondent for United Kingdom: Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

August 2–7.—International Congress on School Hygiene. Paris. General Secretary: Dr. Dufestel, 10 Boulevard Magenta, Paris. Hon. Secretaries for Great Britain: Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.

August 15–20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Prasidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

August 18–26.—International Geological Congress. Stockholm. General Secretary: Prof. J. G. Andersson, Stockholm 3.

August 29 to September 6.—International Union for Cooperation in Solar Research. Mount Wilson Solar Observatory. British Member of Executive Committee to whom inquiries should be addressed: Prof. A. Schuster, F.R.S., Victoria Park, Manchester.

August 31 to September 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

September 4–7.—Swiss Society of Natural Sciences. Bâle. Secretary: Dr. H. G. Stehlin, Museum of Natural History, Augustinergasse, Bâle.

September 8–14.—International Congress of Americanists. Mexico City. General Secretary: Sr. Lic. D. Genaro Garcia, Museo Nacional, Mexico, D.F.

September 13–15.—International Congress of Radiology and Electricity. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussels. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyrood, Ealing, W.

September 18–24.—German Association of Naturalists and Physicians. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drummstr. 25–29, Königsberg.

September 27–30.—International Physiological Congress. Vienna. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. B. Starling, University College, London, W.C.

October 6–12.—Congrès International du Froid. Vienna. Correspondent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cannon Street, E.C.

CONTENTS.

	PAGE
Planetology. By William E. Rolston	99
Nature-study	100
Technical Chemical Analysis	101
British Fossils. By C. T. R.	101
Comparative Physiology. By W. D. H.	102
Our Book Shelf	103
Letters to the Editor:—	
Antarctic Pycnogons.—Dr. W. T. Calman	104
A New Italian Orchid. (*Illustrated.*)—W. Herbert Cox	104
Centre of Gravity of Annual Statistics.—A. Marshall	104
Present Meteoric Displays.—W. F. Denning	105
Pwdre Ser.—Prof. Frank Schlesinger	105
The Ethnology, Botany, Geology, and Meteorology of German Africa. (*Illustrated.*) By Sir H. H. Johnston, G.C.M.G., K.C.B.	106
Cordite	109
The Sheffield Meeting of the British Association	110
The Ultra-rapid Kinematograph. (*With Diagram.*) By Prof. C. V. Boys, F.R.S.	112
The Total Solar Eclipse, May 9, 1910. (*Illustrated.*) By Dr. William J. S. Lockyer	113
John B. Carruthers	114
Notes	115
Our Astronomical Column:—	
Astronomical Occurrences in August	120
Subjective Phenomena on Mars	120
The Genesis of Various Lunar Features	120
Halley's Comet	120
The Gnomon in Ancient Astronomy	120
The Leeds Astronomical Society	120
Recent Work of Geological Surveys. IV. (*Illustrated.*) By G. A. J. C.	121
Reports of Meteorological Observatories	123
Science at the Japan-British Exhibition. By F. M. P.	125
The Progress of Cancer Research	126
Manganese Mining in India. By J. W. G.	128
The Structure of Cretaceous Plants	129
Archæological and Anthropological Investigations in Arkansas and Louisiana. (*Illustrated.*) By Dr. A. C. Haddon, F.R.S	129
The Tabulation of Vital Statistics	130
University and Educational Intelligence	130
Societies and Academies	131
Forthcoming Congresses	132

THURSDAY, AUGUST 4, 1910.

CHRISTIAN TOPOGRAPHY.

The Christian Topography of Cosmas Indicopleustes. Edited, with Geographical Notes, by E. O. Winstedt. Pp. x+376+xiv plates. (Cambridge: University Press, 1909.) Price *12s. 6d.* net.

THE "Christian Topography" of Kosmas Indikopleustes is a very peculiar work. As a monument of literary style it is precious, for it shows us what terrible rubbish, what wandering and discursive twaddle, people were already writing in the sixth century, when the mental degeneration of the Middle Ages (more properly called the "Dark Ages") had hardly yet set in. As a geographical landmark it is also precious, for the author, twaddlemonger as he was, went to various parts of the East beyond the ken of the ordinary man of the time, and his descriptions of the Somali coast, of Coromandel, and of Ceylon, which he apparently visited himself, in the sixth century, are in the highest degree interesting and valuable. Finally, as a work of unintentional humour, it is beyond price. Of course, the humour of it would not be apparent to all, and it is perhaps irreverent (to the sixth century, which is now somewhat venerable) to direct the reader's attention to this feature of this peculiar work. Yet, since the editor himself indulges in a hearty laugh over the poor old "Christian Topographer," perhaps the reviewer may be allowed to do so too. At any rate, he sins in the most authoritative company, and if the editor treats his subject (as Mr. Winstedt does) something after the style of Mark Twain and the Yankee at the Court of King Arthur, the reviewer must not be censured if he frivolously suspects the Syndics of the Cambridge University Press of having produced a humorous book.

For, really, Mr. Winstedt's introduction to Kosmas is pitched in rather too humorous a tone. Such a quotation as "they didn't know everything down in Judee" (p. 15) is a fault of taste, and one can imagine the bewilderment of a French or German scholar at such an unintelligible sentence as "when he can momentarily get free from the obsession of his King Charles' head—the 'great cosmographer Moses'"! (p. 9). Mr. Winstedt presumably intended this book to be of use to international science, but if so, why has he so ill-advisedly interlarded his otherwise most learned and interesting introduction with comic relief only comprehensible to Englishmen or Americans who know their Dickens and Mark Twain?

Kosmas is funny enough of himself without any editorial attempt to make him funnier by means of jarring modern jests, and Mr. Winstedt may be permitted to enjoy, as he does without spoiling things, the good man's explanation of why the Creation took six days when the Deity could *ex hypothesi* have done it at a single *coup* if He had liked; the reason is that the angels were such weak-minded creatures that if He had created everything all at once they would not have understood it at all, so He took six days about it for their sake, in order that they might fully comprehend how it was done. This, of course, in all seriousness and devoutness. But it shows how weak-minded people were themselves already becoming as early as the sixth century. To a civilised man of three centuries before, the idea would have seemed as comic as it does to us.

The stupidity of the Dark Ages is already in full blast in the mind of Kosmas the Indian-farer.

"What scholar (as the editor quotes from Marion Crawford's 'With the Immortals') has not laughed at the idea of Kosmas, the Alexandrian, that the sun retired behind a mountain to spend the night? And that the earth, the ocean, and the fabulous mountain were all included and enclosed in a luminous oblong box of the exact shape of the tabernacle of Moses?"

He undoubtedly had Moses "on the brain" (though we demur to the use of the expression "King Charles' head" in a scientific work); for him Moses was the "great cosmographer." Religious preconceptions and misunderstood texts were jumbled up in his mind with fragments of the old knowledge and the results of his own travel experiences to produce this extraordinary farrago which he called "Christian Topography," a title which, as the editor says, is excellent, "as it cannot possibly convey any particular meaning to anybody." Photius calls the book a commentary on the Octateuch. It

"might as well be called that as anything else, since Cosmas quotes and comments on a considerable portion of the Octateuch. That, however, was not the main object of his work. His intention was to refute the theory that the earth was round, and to prove that Moses' tabernacle in the wilderness was a model of the universe."

This was his theory, which he illustrated from his own travels, and it is the account of the travels that forms the serious interest of the book to us nowadays as giving a most interesting account of the East in the sixth century, and invaluable information as to the geographical ideas of the time. Kosmas observed the habits and customs of the peoples he visited, and noted the animals and plants of their countries, with care. He also drew pictures of the latter, in which undoubtedly he gave some freedom to his imagination. These pictures, copied and re-copied, have come down to us in the later MSS. of his book, no doubt, somewhat changed *en route*, but still characteristic. Several of them are reproduced by Mr. Winstedt. The picture of a man picking coco-nuts (plate xiv) is especially interesting. Pictures of his weird conception of the universe are, of course, given (plate vi), and the diagram by which he sought to throw contempt upon the horrid theory of Antipodes. The way in which the men of the Middle Ages resolutely set themselves to abjure and ban the theory of spherical worlds, which their civilised ancestors had already promulgated, is curious and characteristic. Kosmas quotes Scripture at length against the wicked pagans who believe in a round world, and his further quotation from Athanasius's "Festal Letters" in support of the current Christian view has chanced to be the means of preserving to us almost all that survives of the Greek text of that work.

Another thing of value that has been preserved in the "Christian Topography" is the text of two important historical inscriptions which he copied at Adulis, the modern Zulla. One of these was set up by officers of Ptolemy Euergetes, and commemorates that great king's conquests in the East; the other was added by a local king of the Axumite dynasty, probably in the second century A.D., to chronicle his conquests in Abyssinia. Historians have to be grateful to the "Christian Topographer" for the preservation of these two documents, and also for the valuable information which he gives us here and there as to the history of his own time. Thus he copied the Adulite inscriptions at the request of Asbas, the Axumite governor, who had been ordered to send copies of them to his master, King Ellatzbaas, who was just then about to set out on his famous expedition to Arabia against Dhu Nuwâs, king of Himyar, which was so brilliantly successful. This was about the year 525 A.D. He gives us also invaluable information as to the great spread of Christianity in the East by the sixth century, especially in Persia and India.

The book, therefore, was fully worthy of an adequate English edition, and, having made our *caveat* as to certain blemishes in dealing with the comic side of the subject, we can say that the editor has done his work well, especially, no doubt, upon the textual side.

TROPHOBLAST AND THE EARLY DEVELOPMENT OF MAMMALS.

Die Säugetierontogenese in ihrer Bedeutung für die Phylogenie der Wirbeltiere. By Prof. A. A. W. Hubrecht. Pp. v+247. (Jena: Gustav Fischer, 1909.) Price 7 marks.

IT is now twenty years since Prof. Hubrecht published, in the pages of the Quarterly Journal of *Microscopical Science*, his classic researches on the trophoblast and allantoic placenta of the hedgehog, *Erinaceus europaeus*. This work, along with the investigations of Eduard van Beneden and M. Duval, may be said to have revolutionised our knowledge of the placental phenomena in the mammalia. By it new light was thrown on the egg-cleavage, the so-called gastrulation, and, especially, on the mode of origin and the nature of the "fœtal membranes," the chorion (trophoblast), amnion, and allantoic placenta. For the Dutch investigator this was the starting-point of a long period of painstaking researches into the placental conditions of diverse mammals, and of these the present work is an author's translation of the English version, published (November, 1908) in the journal containing his earlier results.

So long ago as 1894, under the title "Spolia nemoris," an appetising account was given of the wonderful array of material of mammalian development, which, in the Dutch East Indies, had either been collected personally or obtained and sent to Utrecht by others. We do not recall any similar journey in quest of embryological material which has been attended by such remarkable success in enlisting, and retaining, the altruistic help of so many different collectors. Other embryologists remember, to their sorrow, the failure of attempts to increase their collections by the aid of others and amateurs. This vast material, much of it of rare and interesting species of mammals, has served as the basis of Prof. Hubrecht's researches, and with great generosity he has placed it at the service of other investigators in the Zoological Institute of Utrecht. The limits of space assigned to this notice allow only a general reference to the work before us.

What is *trophoblast?* The word and the thing may be described as the main theme of the work, even though it treats also of the egg-cleavage, germinal layers, allantoic placenta, and the descent of mammals. According to Hubrecht, trophoblast is a specialised portion of the outer layer, the epiblast, of the embryo, and he identifies it more particularly as equivalent to that portion of this layer which in amphibians, for example, forms the outer or covering layer. This latter, admittedly, takes no share in the formation of embryonic structures, and it, and trophoblast also, is regarded by Hubrecht as larval and transitory in character. On the other hand, another mammalian embryologist, Mr. Richard Assheton, has recently again urged the view that trophoblast is in reality a derivative of the inner layer or hypoblast. Apart from other considerations, this identification is, in our opinion, negatived by the circumstance that nowhere in the animal kingdom is the hypoblast known to be formed, as is the trophoblast, as a product of the first cleavages of the egg. Prof. Hubrecht's own recognition of its embryonic epiblastic nature (that it is really a part of "the embryo") seems to be disproved by his own researches on Tupaja. Of the eight products of the egg-cleavage here, seven are destined to become trophoblast, while out of the eighth the whole of the embryo, including presumably its epiblast, is unfolded. If the two foregoing objections be valid, the explanation of the nature of trophoblast must be sought elsewhere, for as yet no one has had the temerity to suggest the remaining alternative, the third germinal layer or mesoblast, as its source of origin.

The truth is, as so often happens in embryology, far too little account has been taken of physiological considerations. The trophoblast arises early in development, and never takes part in the formation of embryonic organs, but instead thereof it eats and erodes its way into the uterine wall, and in doing this it destroys the epithelial lining and much besides. If this happens to be in a tubal (oviducal) gestation, the erosion is finally through the oviduct, with sudden and often fatal hæmorrhage into the abdominal cavity. A mass of cells, trophoblast, which can do this, and in the absence of a normal embryo may become the most deadly form of cancer, chorio-epithelioma, can have no nutritive import for the embryo, as its name falsely implies, nor by any stretch of the imagination can it be assigned to either epiblast or hypoblast, for there is nothing in embryology to indicate that embryonic epiblast or hypoblast possesses this property of eroding and destroying maternal tissues. It is not intended as a reproach to the author, or in depreciation of the immense value of his published researches to science, when this lack of information on the physiological and biochemical side is insisted upon. In fine, like so much in embryology, these researches would appear to fall short of their object in that they ignore the foundations and principles, and even the existence, of a science of stereochemistry, founded so long ago as 1860 by Pasteur for chemists—and biologists. In his two lectures "On the Asymmetry of Naturally Occurring Organic Compounds," Pasteur wrote:—

"Who can foresee the organisation that living matter would assume if cellulose were lævo-rotatory instead of being dextro-rotatory, or if the lævo-rotatory albumens of the blood were to be replaced by dextro-rotatory bodies? These are mysteries which call for an immense amount of work in the future, and to-day bespeak consideration in the science."

Trophoblast, which, by means of its intracellular ferments, pulls down the living "lævo-rotatory albumens of the blood," cannot itself be made up of such bodies, but by all the canons of stereo-chemistry must consist of dextro-rotatory ones. B.

PLANT-LIFE IN THE BALKANS.

Die Vegetationsverhältnisse der Balkanländer (Mösische Länder). By Prof. Lujo Adamović. Pp. xvi+567; with 49 plates, 11 text-figures, and 6 maps. (Leipzig: W. Engelmann, 1909.) Price 32 marks.

THIS bulky volume on the vegetation of the Balkan district is the eleventh in the series of monographs of plant geography, edited, under the title "Die Vegetation der Erde," by Profs. A. Engler and O. Drude. The district includes Servia, Bulgaria, East Rumelia, North Thracia, and North Macedonia, and the volume therefore forms a companion one to Dr. Beck von Mannagetta's account of the vegetation of the Illyrian district, comprising the western part of the Balkan peninsula, which formed the fourth volume of the same series.

In an introductory chapter, Dr. Adamović gives a sketch of the history of the botanical exploration of the Balkan territory. This began in earnest with the work of Josef Pančić on the flora of Servia (1846–88), which has been supplemented by that of numerous other botanists, especially of Dr. Adamović himself, who has worked continuously from 1890 onwards. The bibliography includes a long list of papers.

The subject-matter of the book falls under four sections. The first is a sketch of the physical geography of the area, in which chapters are devoted to the orographic, hydrographic, geognostic, and climatic conditions respectively. Climatic conditions are regulated by the position of the area under consideration, in the interior of a broad peninsula bordered only by small seas, while in the south high mountain ranges—the Rhodope system in the south-east and the Dinaric system in the south-west—hinder the approach of warm winds, and in the north the cold northern winds find a free entrance. Three climatic zones are recognised—(1) the West Mœsic, which stretches westward from the two mountain systems just mentioned, and is characterised especially by the prevalence of northerly and easterly currents; a cold winter is followed by a cool and damp spring, a fairly warm summer, and usually a warm and fairly long autumn; (2) the East Mœsic zone, to the north of the Balkan range, characterised by easterly currents and a climate similar to that of southern Russia; and (3) a southern zone, including almost the whole of East Rumelia, Thrace, the southernmost part of "Alt Servia" and North Macedonia, which has a climate approaching that of the Mediterranean region.

The second section deals with the vegetation, and is divided into three parts, in the first of which, "Œcological Factors," the author discusses the influence on the plant-life of external influences. Such are the so-called tectonic factors—disposition of land, mountain, plain, and valley, difference of exposure and the like, composition of the soil—chalk, serpentine, volcanic sand, or salt. A good deal of matter of general biological interest is included in the chapter dealing with climatic factors and the effect of many animals and plants themselves on the vegetation. The remainder of the section is an account of the various plant-formations; these are arranged under two heads, representing the two great constituents, those characteristic respectively of the Mediterranean and Central European floras. Under the former are included the "Ornus-Mischlaubwald," the mixed deciduous forest which forms a characteristic highwood on the hilly and submontane districts of the Balkan peninsula; the diversity and abundance of its constituents render it comparable with no other European formations. Here also is the horse-chestnut-formation and the pseudo-maquis, the latter analogous to the evergreen bush-formation or maquis of the Mediterranean area, but adapted to a necessarily shorter vegetative period; the most frequent and widely distributed element of the pseudo-maquis is *Juniperus oxycedrus*, while the arborescent *Juniperus excelsa*, the box, and *Phillyrea media* are characteristic elements. These and other formations comprise the arborescent and bush vegetation, besides which is a series of steppe, rock, salt-marsh, aquatic, meadow, cultivated land, and other formations. The third and largest portion is an account of the plant-formations of a Central European type, the submontane woods of oak, sweet chestnut, and black pine, the mountain woods of fir, pine, spruce (*Picea omorica*), birch, and beech, the bush-formations, the rock, steppe, meadow, marsh, and aquatic formations, and, finally, the subalpine and alpine.

In the third section the author suggests zonal arrangements, both horizontal and vertical, of the two great type-groups of the vegetation; and in the fourth and last section attempts to trace the developmental history of the flora by a consideration of the fragmentary evidence afforded by the plant remains from successive geological strata.

A notice of Dr. Adamović's exhaustive and painstaking survey of the vegetation of the Balkan area would be incomplete without an appreciation of the plates, most of which are reproduced from photographs taken by the author. A. B. R.

MATHEMATICAL TEXT-BOOKS.

(1) *Elements of the Differential and Integral Calculus.* By Prof. A. E. H. Love, F.R.S. Pp. xiv+208. (Cambridge: University Press, 1909.) Price 5s.

(2) *Plane Trigonometry. An Elementary Text-book for the Higher Classes of Secondary Schools and for Colleges.* By Prof. H. S. Carslaw. Pp. xviii+293+xi. (London: Macmillan and Co., Ltd., 1909.) Price 4s. 6d.

(3) *Elementary Projective Geometry.* By A. G. Pickford. Pp. xii+256. (Cambridge: University Press, 1909.) Price 4s.

(4) *A First Course in Analytical Geometry, Plane and Solid, with Numerous Examples.* By C. N. Schmall. Pp. viii+318. (London: Blackie and Son, Ltd., 1909.) Price 6s. net.

(1) THIS book is founded on lectures delivered by Prof. Love at Oxford to students of applied sciences. The object, both of the book and of the lectures, is to encourage the study of the Calculus amongst a wider circle than has been commonly the case hitherto. To quote from Prof. Love's preface:—

"The principles of the Differential and Integral Calculus ought to be counted as a part of the heritage of every educated man or woman in the twentieth century, no less than the Copernican system or the Darwinian theory. In order to make a beginning no previous knowledge of mathematics is needed beyond the most elementary notions of geometry, a little algebra, including the law of indices, and the definitions of the trigonometric functions."

The more difficult theorems on limits which are needed have been proved with considerable detail, but the proofs are placed in appendices so as to avoid discouraging the beginner. The most novel of these is the very complete and satisfactory discussion of the length of an arc of a circle (App. v.); but it seems a pity that the same method was not carried on (in App. vi.) to obtain the limits of sin α/α and tan α/α (as α tends to zero) instead of following the more intuitive method which is given in most text-books.

With the aim and methods of Prof. Love's book we are in hearty sympathy; our sole criticism would refer to the difficult problem of treating the logarithmic function, about which opinions will probably always differ. In conclusion, we may refer to the welcome practice of reducing definite integrals to numbers, in suitable cases, instead of stopping at analytical formulæ; it is very instructive to beginners to compare the result of such a calculation with the value found from a graph, by estimating its area roughly.

(2) The earlier part of this book is based upon lectures delivered by Prof. Carslaw to first-year pass classes, first at Glasgow and afterwards at Sydney. Very good graphs of the trigonometrical functions, direct (pp. 60–2) and inverse (pp. 205–8), including the less familiar functions, such as sec x and sec ^{1}x, will be found in the book; and a set of four-figure tables is given at the end of the book. While welcoming the spread of these tables, it seems a pity that more modern tables (in tenths and hundredths of degrees) were not used instead of Bottomley's forms.

The second part of the book, on analytical trigonometry, is less completely handled, proofs of the more difficult theorems (such as the power-series for sin x and cos x, the product for sin x) being outlined only, without any attempt at rigorous investigations.

A few notes of difficulties may be added, in view of later editions. In discussing the limit of sin θ/θ as θ tends to zero (§ 92) it is assumed that the length of a circular arc is less than the sum of the tangents drawn at its extremities. Although this assumption is natural enough in a purely intuitive discussion, yet, after having given an arithmetic definition of length in §§ 89, 90, it would be only reasonable to deduce the theorem in question from the definition.

When discussing the solution of trigonometrical equations, it seems strange that no use is made of the substitution $t=\cos\theta+i\ \sin\ \theta$; and the more so since all the examples solved in the book (§ 136) can be more easily treated by this substitution than by any other.

In § 148 the convergence of the series $\Sigma a_n \cos n\theta$, $\Sigma a_n \sin n\theta$ is treated graphically by the aid of a spiral polygon. This method is interesting on account of its applications in physical optics, leading up to the graphical treatment of diffraction-integrals by a smooth spiral curve (such as Cornu's spiral); but it is not quite obvious where the geometrical discussion introduces the condition $a_n > a_{n+1}$. It would be helpful to give an algebraical treatment as well, following the classical methods of Abel and Dirichlet, from which the essential character of the condition $a_n > a_{n+1}$ is at once evident.

Prof. Carslaw's book may be heartily recommended to anyone wishing for a good knowledge of elementary trigonometry, together with a first introduction to more advanced methods.

(3) It is not easy to estimate the effect which a geometrical text-book will produce on a beginner; and we have had no opportunity of testing this particular book in actual teaching. But on a first reading the arrangement adopted seems less satisfactory than in several existing books: in a course on *projective* geometry, the method of *projection* should take a prominent part, and not be left until the last chapter in the book. There is a tendency also to give a variety of proofs of theorems which are really all special cases of one general theorem (such as Pascal's or Brianchon's), and this helps to make the book longer, without making it any easier to read.

Two details may perhaps be criticised: the idea of *involution* is introduced very early, before defining projective ranges on the same line; but in actual teaching it is generally found easier to define involution as a special type of homography. Also the pole-locus of a line with respect to a system of four-point conics is called the *nine-point* conic, instead of the *eleven-point* conic; the latter term is now generally adopted, and the reason for the change is not obvious.

It seems to us that there is some need for a book on projective geometry which makes occasional use of analytical methods—in fact, a book written more on the lines of the second half of Salmon's "Conics"—and a really useful addition would be some plates of drawings, on a fairly large scale, showing the actual construction of conics by means of pencil and ruler, in various ways.

(4) There is but little to distinguish the present

text-book from those in common use already. We note the usual unfortunate preference for the equation $y=mx+c$ to represent a straight line, instead of the homogeneous form $lx+my+n=0$. As a natural consequence, we find the equations $y=mx+\sqrt{(a^2m^2+b^2)}$, $y=mx+a/m$, for the tangents to an ellipse and parabola respectively; and we are still left to wonder why no teacher has the courage to write an elementary text-book which uses the tangential equations $a^2l^2+b^2m^2=n^2$, $ln-am^2=0$.

The chief innovation consists in a short chapter (xii., pp. 241–57) on higher plane curves, such as the cissoid, conchoid, lemniscate, cycloid, and some of the simpler polar curves; but as no Calculus is used, nearly all their more interesting properties have to be omitted, and it seems doubtful if the mere tracing of the curves is of sufficient interest to justify their introduction here. We should have preferred to see this space devoted to an extension of the chapters on solid geometry, which occupy only 30 pages, and are too brief to be of much service to beginners.

T. J. I'A. B.

SCHLICH'S MANUAL OF FORESTRY.

Schlich's Manual of Forestry. Vol. ii.: Silviculture. By Sir Wm. Schlich, K.C.I.E., F.R.S. Fourth edition, revised. Pp. ix+424. (London: Bradbury, Agnew and Co., Ltd., 1910.)

THIS book is a decided advance on the first edition of Schlich's "Silviculture," and a considerable amount of new matter has been added.

Probably the original intention of Schlich's "Manual" was to provide a text-book on the general principles of forestry adapted to the needs of Indian and Colonial forest officers. While this object is still met, the author has evidently made an effort (and we think successfully) to adapt the work better to British needs than was the case in earlier editions.

To accomplish this successfully is not perhaps the easy task many might imagine. It is true the principles of forestry are the same over all, but details in practice must of necessity vary, and climatic differences also tend to modify the relative silvicultural value of various species of trees for any country, or even for districts of a country.

The book is divided into four parts: part i. deals with what the author designates "The Foundations of Silviculture." Here we have a full discussion of such matters as climate, soils, effects of forest vegetation on locality; development of forest trees; character and composition of woods; advantages and disadvantages of mixed woods; and rules for forming pure and mixed woods. The various silvicultural systems are also described in detail.

Part ii. is concerning the "Formation and Regeneration of Woods." Fencing, soil preparation, sowing, planting, and tree nursing management are fully treated. Under this head also the various modern methods of natural regeneration are described.

Part iii. deals with the tending of woods throughout the various stages, from early youth to maturity.

Of part iv. ninety pages are devoted to a brief discussion of the silvicultural characters of British forest trees. Under the convenient title of "British Forest Trees" the author includes several recently introduced species, some of which are certainly of doubtful utility for British conditions, as, *e.g.*, American *Black Walnut* and *Black Cherry*. He wisely refrains, however, from definitely recommending such species for general planting.

The book is well illustrated. Although some of the illustrations are necessarily diagrammatic in character, they are none the less valuable to students on that account.

Schlich's "Silviculture" continues to hold its own as one of the chief standard works on the subject, and should be in the hands of all students of forestry.

J. F. A.

GENERAL BIOLOGY.

General Biology: a Book of Outlines and Practical Studies for the General Student. By Prof. James G. Needham. Pp. xiv+542. (Ithaca, N.Y.: The Comstock Publishing Co., 1910.) Price 2 dollars.

WE have long felt that if biology is ever to take the place which it undoubtedly should in our educational system, there will have to be some radical reform in the manner in which it is taught, or perhaps it would be more correct to say in the selection of those portions of the subject which are to be taught. The type-system, excellent as it is in many respects, has had far too much influence on biological curricula, and the over-specialisation in zoology and botany has resulted in a general neglect of those general principles which are the life-blood of both. Fortunately, signs are not wanting of a widespread striving towards a more rational treatment of the subject, and in this respect the Americans appear to be taking the lead. The work before us, modestly described by its author as "A Book of Outlines and Practical Studies for the General Student," strikes us as being delightfully refreshing and original. Its scope is, perhaps, almost too comprehensive. There are only seven chapters, but they are very long ones. In the first, the interdependence of organisms is illustrated by the relations between flowers and insects; galls, and the relation between ants and aphids. The second deals with the simpler organisms, illustrated by typical algæ and protozoa. The third is devoted to organic evolution, with a brief account of the animal and vegetable series and the general principles of the subject. The fourth discusses inheritance; the fifth the life-cycle; the sixth the adjustment of organisms to environment; and the seventh the responsive life of organisms.

A leading feature of the book is a set of practical exercises at the end of each chapter. These are extraordinarily varied and interesting, and well calculated to impart a real vitality to the subject, though perhaps some of them, such as the observations on the internal metamorphosis of insects, are rather too specialised.

The illustrations are excellent and to a large extent novel, and the portraits of Schultze, Pasteur, Von Baer, Linnæus, Agassiz, Darwin, Leeuwenhoek, Mendel, and Aristotle help to keep the interest from flagging.

The author states in his preface that the book exists for the sake of the practical studies contained in it, and certainly any student who works conscientiously through these can hardly fail to acquire a very sound knowledge of the problems of general biology, and if his work in this direction is supplemented by an equally thorough study of the more special aspects of either zoology or botany his elementary biological training will leave little to be desired. A. D.

OUR BOOK SHELF.

Catalogue of British Hymenoptera of the Family Chalcididae. By Claude Morley. Pp. vi+74. (London: Printed by Order of the Trustees of the British Museum (Natural History); Longmans and Co., B. Quaritch, Dulau and Co., Ltd., 1910.) Price 3*s.* 6*d.*

Some years ago the Entomological Society of London commenced a "General Catalogue of the Insects of the British Isles," of which, however, only six parts were published, between the years 1870 and 1876, as follows:—Neuroptera, by R. McLachlan; the Ephemeridæ, by Rev. A. E. Eaton; Hymenoptera Aculeata, by F. Smith; Hymenoptera: Chrysididæ, Ichneumonidæ, Braconidæ, and Evaniidæ: by Rev. T. A. Marshall; Hymenoptera: Oxyura, by Rev. T. A. Marshall; and Hemiptera Heteroptera, and Homoptera, by J. W. Douglas and J. Scott. No more appeared; and, of course, those already issued are now somewhat out of date, especially those on parasitic Hymenoptera, largely through the exertions of C. Morley and F. Enock. Since then, however, the Tenthredinidæ, Siricidæ, and Cynipidæ have been monographed by P. Cameron in four volumes issued by the Ray Society; leaving only the Chalcididæ, as the last family of Hymenoptera of which we had no recent compendium of the British species.

The preparation of the present catalogue was undertaken by Mr. Claude Morley, so well known for his work on the British Ichneumonidæ, and edited by Mr. C. O. Waterhouse. Though published by the Trustees of the British Museum, it is practically uniform with the Entomological Society's catalogues already mentioned.

There is little doubt that the order Hymenoptera is the largest of all the seven great orders of insects, and the Chalcididæ, including a large number of small species, almost all parasitic (a very few, however, are believed to be plant-feeders), is by far the largest family. Mr. Morley enumerates 148 genera and 1424 species; and although many of them may probably prove to be synonymous, these will probably be far more than counterbalanced by fresh discoveries when the family is at all adequately known. A great number of species were described by Walker, both in magazines and in separate publications; and to work out his species satisfactorily would be a work of many years. But the best preparation for such an undertaking is a carefully compiled and approximately complete reference catalogue, as the work before us appears to be.

How to Keep Hens for Profit. By C. S. Valentine. Pp. ix+298. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* 6*d* net.

This is a well illustrated volume of some three hundred pages. A portion of the material, as the preface points out, has already appeared in the *New York Farmer.* The bulk of the work, with the exception of a chapter devoted to the Indian runner duck, deals with the breeding and management of the "American hen." The reader will have gathered that the book has been produced on the "other side," but there is much that is of interest to our own countrymen. Government aid, problems of improvement, and many amusing stories of the three-hundred-egg hen, are all dealt with, and now the development grant is in sight several of the hints given might be well worthy of consideration.

The most instructive chapters for the would-be poultry-keeper are those that deal with "Handling the Chicks," "Expensive Accidents," "Diseases," and "Runner Ducks." The book is furnished with an excellent index, and in many ways may be a useful adjunct to the library of the man who keeps poultry for utility purposes only in contradistinction to the breeder of exhibition stock.

The Prince and his Ants (Ciondolino). By Vamba (Luigi Bertelli). Translated from the fourth Italian edition by S. F. Woodruff, and edited by Vernon L. Kellogg. Pp. x+275. (New York: H. Holt and Co., 1910.) Price 1.35 dollars net.

A fairy tale of three children, who wished to become insects to escape doing their lessons. The two boys wished to be an ant and a cricket, and the girl to be a butterfly. The present volume relates the adventures of the boy who became an ant, among different species of ants, and afterwards among bees. At the end of the book he meets his sister as a caterpillar, and another volume is promised giving her adventures as a butterfly. The book is well illustrated, and the account of insect life appears to be fairly accurate.

The Thames. Described by G. E. Mitton. Pp. 56. *Windsor Castle.* Described by Edward Thomas. Pp. 56. *Shakespeareland.* Described by Walter Jerrold. Pp. 63. All pictured by Ernest Haslehurst. (London: Blackie and Son, Ltd., 1910.) Price 2*s.* net each.

In noticing the first three volumes to be published in this series, the opportunity was taken to praise the beauty of the illustrations and the interest of the text. The present additions are quite up to the standard set in the earlier books. Though evidently not intended to serve any serious educational purpose, the volumes will form very acceptable gift books, and will soon become popular in this capacity.

A Manual of Geometry. By W. D. Eggar. In two parts. Part i., pp. xiii+160; part ii., pp. x+178. (London: Macmillan and Co., Ltd., 1910.) Price 2*s.* each part.

Many teachers will welcome the re-issue in two parts of Mr. Eggar's "Manual of Geometry." Part i. will prove of particular value just now, since it covers the work specified in the memorandum issued by the Board of Education on the teaching of geometry to beginners. It may be said that the first part deals with the subjects of Euclid, Book i., and the second with those of Euclid, Books ii. to vi.

The South Devon and Dorset Coast. By Sidney Heath. Pp. xvi+445. (London: T. Fisher Unwin, 1910.) Price 6*s.* net.

The latest addition to Mr. Fisher Unwin's "County Coast Series" will form a delightful companion for the visitor to the country lying between Poole on the east and Plymouth on the west. Mr. Heath's miscellany of historical, topographical, and archæological details relating to Devonshire and Dorsetshire is as informative as it is interesting, and the illustrations, which number nearly sixty, make the volume very attractive. There is little doubt that the book will become a favourite with residents in the delightful part of England with which it deals.

LETTERS TO THE EDITOR.

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

X-Ray Spectra.

It was shown by Barkla and Sadler (*Phil. Mag.*, February, 1907, and October, 1908) that many elements, when subject to a suitable beam of X-rays, emit a homogeneous beam of secondary X-rays of penetrating power characteristic of the radiating element. One of the writers (Barkla, Proc. Camb. Phil. Soc., May, 1909) showed that various groups of these characteristic radiations exist, and that each element most probably emits a line spectrum of X-rays, each line moving to the more penetrating end of the spectrum, with an increase in the atomic weight of the radiating element. For no single element, however, was the homogeneity of more than one radiation proved, or the penetrating power accurately determined. As all the principal phenomena accompanying the transmission of X-rays through matter are determined by the spectra of the constituent elements, it became a matter of considerable theoretical interest to confirm the theory by demonstrating the homogeneity of various radiations from some particular element. The writers therefore chose several of those elements the characteristic radiations of which were expected to be well within the range of penetrating power comparatively easy to experiment upon.

First, by using a penetrating primary beam, a mixture of the various secondary radiations characteristic of a particular element was obtained. After absorbing the softer constituents, a homogeneous beam of the penetrating secondary X-radiation belonging to Group B was left, its homogeneity was proved, and the coefficient of absorption in aluminium determined.

In order to isolate one of the more absorbable constituents, a very "soft" primary beam was used—too "soft" to excite the radiation of Group B just referred to. After the effect of the scattered radiation was determined by separate experiment and eliminated, this secondary X-radiation was also found to be homogeneous, and its absorption was determined. This radiation belonged to Group A.

Thus two of the lines of the spectra of antimony, iodine, and barium were determined. The following values of λ/ρ are the results of the most accurate measurements so far made (λ is defined by the equation $I=I_0e^{-\lambda x}$ in transmission through aluminium of density ρ):—

Sb : (Group B) 1·21 ; (Group A) 435
I : (Group B) 0·92 ; (Group A) 306
Ba : (Group B) 0·8 ; (Group A) 224

A more absorbable radiation belonging to Group A has also been found to be emitted by silver in addition to the penetrating radiation of Group B, thus accounting for what appeared to Mr. Sadler (*Phil. Mag.*, March) to be an exception to the law connecting the emission of secondary corpuscular and secondary X-radiations emitted by an element.

There is indirect evidence of other spectral lines besides those of Groups A and B. Whether or not the radiation, more absorbable than that of Group A—in hypothetical Group X—has the properties of ordinary X-rays is a question to be decided experimentally.

C. G. BARKLA.
J. NICOL.

King's College, London, July 29.

Pwdre Ser.

In case no other reader of NATURE should do so, may I direct Prof. McKenny Hughes's attention to a paper by M. Melsheimer on "Meteorgallerte," published in the *Jahresber. d. westfäl. Provinzialver. f. Wissensch. u. Kunst* (Bd. xxxvi., 1907–8, Münster, 1908, pp. 53–5), an abstract of which appeared in the *Centralblatt f. Bakteriologie* (Abt. ii., Bd. xxvii., Nos. 10–12, p. 237), published on June 22 of this year? The author appears to have paid attention to these masses of jelly, which are to be found in winter on meadows and other open places, for a period of years, and has come to the conclusion that they are the swollen oviducts of frogs. Herons eat female frogs in winter, and the oviducts become mixed in the crop with fish remains, which may become luminous. The contents are thrown up undigested, and become gelatinous when moistened. It is also possible that the heron may, during flight, discharge the gelatinous mass in a luminous condition, and hence the idea that the jelly is of meteoric origin.

GEO. H. PETHYBRIDGE.

Royal College of Science, Dublin, July 4.

THE PRESSURE OF LIGHT.[1]

THE earliest attempts to detect the pressure of light were made in the eighteenth century. The corpuscular hypothesis was then almost universally accepted, and to the believers in that hypothesis the idea that light should exert a pressure upon a body against which it fell was perfectly natural. Regarding the atoms and molecules of a luminous surface as a battery of minute guns firing off a continuous stream of still more minute shot—the corpuscles—they inevitably supposed that any body bombarded by the shot would be pressed back. Many experiments were made to detect this bombardment by directing a powerful beam of light on to a delicately suspended disc, sometimes in air at ordinary pressures, sometimes in a vacuum, but with quite inconsistent and inconclusive results. They were met with the disturbances which still beset experiments on light forces—disturbances partly due to convection in the surrounding gas, and partly due to the radiometer action which Sir William Crookes discovered and investigated a hundred years later.

According to the corpuscular theory, the pressure sought should be equal to twice the kinetic energy of translation per unit volume in the beam used. If the earlier experimenters had known the principle of the conservation of energy and the mechanical equivalent of heat, they would no doubt have measured the energy of the beam, and would then have found that the pressure to be looked for was far too minute for detection by the apparatus which they employed.

With the abandonment of the corpuscular theory and its replacement by the wave theory, the idea of pressure of light disappeared, for the form which the wave theory took at first did not suggest a pressure, and it was not until 1874 that a definite and exact theory of light pressure was given by Clerk Maxwell. According to his theory of stresses in the medium, both electric and magnetic tubes of force press out laterally. If, then, light waves consist of electric and magnetic tubes of force transverse to the direction of propagation, these tubes should press on any surface against which they impinge, and the pressure should be equal to the energy in unit volume of the light. Maxwell calculated that the pressure which should be exerted by full sunlight amounted to about 1/23000 of a dyne per sq. cm.

Twenty-five years later Prof. Lebedew succeeded in detecting and measuring the pressure. He allowed the concentrated rays of an electric lamp to fall on a thin blackened platinum disc delicately suspended in a vacuum so high that there was probably no convection, and even the radiometer action was comparatively small. By the ingenious device of using discs of different thickness with radiometer action proportional to the thickness, he was able to calculate the force acting on an infinitely thin disc on which there would

[1] Based upon the Bakerian lecture on "The Pressure of Light against the Source; the Recoil from Light," by Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, delivered at the Royal Society on March 17.

be no radiometer action. He measured the energy of the beam by its heating effect, and the mean of his results showed a pressure of very nearly the amount required by Maxwell's theory.

At the same time, Profs. Nichols and Hull were working at the subject. They used air pressures of one or two centimetres of mercury, that peculiar region of pressure where convection nearly ceases and where radiometer action has scarcely begun. They allowed the beam to fall on a silvered disc, thus obtaining a double pressure—that of the incident plus that of the reflected beam. To eliminate the action of the surrounding gas they made use of the fact that the light pressure has its full force the instant the beam falls on the surface, while the convection and radiometer actions only slowly develop as the disc gets heated. Nichols and Hull, therefore, only allowed the beam to fall on the disc for a short time—six seconds, a quarter period of the suspended system—and thus they eliminated the gas disturbances. They measured the energy of their beam by determining its heating effect, and the observed pressure was found to agree with Maxwell's theory to within 1 per cent.

When a beam of light, then, falls normally on an absorbing surface, it presses against it with a force per sq. cm. equal to the energy density. It is giving momentum to the surface at this rate. The beam is therefore a carrier of momentum. The waves of light carry momentum, momentum forward in the direction of propagation, just as surely as if they were material corpuscles; and on either theory the momentum given per second is equal to twice the *kinetic* energy per unit volume, since in the waves we may assume that the total energy is half kinetic and half potential.

If we trace back this momentum it must have been put into the train of waves at its source, at the luminous surface from which they issued. The waves are there acquiring forward momentum. The source is losing forward momentum, or is gaining backward momentum. That is, the source is being pressed back with a force per sq. cm. equal to the energy density in the issuing waves. Thus, if the total energy emitted by one sq. cm. in one second is R, and U is the velocity of propagation, we have the pressure given by

$$p = \frac{R}{U}.$$

It is here assumed that all the energy is emitted normally to the surface. If, however, the surface is emitting in all directions according to the cosine law, it is easily shown that the effect of the spreading round the hemisphere is to make

$$p = \tfrac{2}{3}\frac{R}{U}.$$

The pressure against the receiver is a proved experimental fact independent now of any particular hypothesis which we may adopt as to the nature of light; and it does not appear possible to avoid the conclusion that the momentum revealed in that pressure against the receiver was derived from the source.

The experiment which we now describe has been made to detect the starting of the momentum from the source. It should be manifested as a back pressure, a recoil of the emitting body from the light, or radiation, which it sends forth.

The most direct method would, no doubt, consist in suspending a disc black on one side, silvered on the other. Inside the disc should be a coil of wire, and this coil should be heated by a current introduced through the suspension. The heat would be given out as radiation by the black surface, and hardly at all by the bright surface, with the result that the black surface should be pushed back. But the experimental difficulties in the way of such a direct method appear insuperable. The disc was, therefore, heated by allowing radiation to fall upon it and to be absorbed. This heat issued again as radiation, and it is the back pressure of this issuing radiation that had to be detected.

The nature of the action to be looked for may be seen by considering an ideal case in which we allow a beam with energy P per cubic centimetre to fall normally in a perfect vacuum in turn on each of four discs, the front and back surfaces of these discs being respectively as in Fig. 1, where B represents a fully absorbing or "black" surface, and S a fully reflecting or non-radiating surface.

When the radiation falls on an absorbing face, as in the case of either of the discs (1) and (2), the temperature of the disc rises until a steady state is reached in which emission equals absorption. We may suppose that the discs are so thin that the two faces are sensibly at the same temperature. If we did not take into account the pressure due to issuing radiation, or if we only considered the initial effects before heating took place, the pressures on the first two discs would be P in each case, due to the incident beam alone, and on the last two would be 2P, due to the sum of the incident and reflected beams. We should have, therefore,

(1)	(2)	(3)	(4)
P	P	2P	2P

But when a steady state is reached, the discs (1) and (2) must be giving out as much radiant energy as they receive. The first disc gives out equal amounts

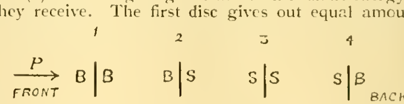


Fig. 1.

on the two sides, producing equal and opposite pressures. All the radiation from the second disc is given out at the front side, and is equal in energy to that of the incident beam. Assuming this emitted radiation is distributed according to the cosine law, the pressure resulting from it is easily shown to be $\frac{2}{3}$P, so that the total pressure on this disc is $\frac{5}{3}$P.

Since there is no absorption by discs (3) and (4), we still have the pressures 2P; hence we have now

(1)	(2)	(3)	(4)
P	$\frac{5}{3}$P	2P	2P

In a real case these results are modified in two ways:—

(1) By the possession of some small reflecting power by surface B, and of some small absorbing and radiating power by surface S.

(2) By an inequality of temperature between front and back surfaces conditioned by the energy which is carried through from front to back to be radiated thence. The vacuum is not perfect, and there is radiometer action due to the residual gas, which, owing to the inequality of temperature, is not the same on the two sides. This is probably the only way in which gas action is sensible, for the effects due to ordinary convection and conduction in the residual gas are negligible.

In the final form of the experiment each disc consisted of a pair of circular cover glasses, 1·2 cm. in diameter and about 0·1 mm. thick, between which was squeezed a layer of asphaltum also about 0·1 mm. thick, the temperature being first raised sufficiently to render the asphaltum molten. Such a compound disc appears to be perfectly opaque, and its surface is extremely black and little diffusing.

The reflecting surface was made by depositing a silver film on the outside of the compound disc by means of the discharge from a silver kathode in an exhausted receiver.

Four holes the size of the discs were cut in a plate of mica ABCD, the centres of the holes being at the corners of a 2-cm. square (Fig. 2). The discs were fixed in these holes by a minute amount of celluloid varnish. Below the mica plate were the two observing mirrors M_1, M_2. This system was suspended by a quartz fibre G, 9 cm. long, in the centre of a glass flask of 16 cm. diameter. The upper end of the quartz fibre was fixed to a brass collar H, held by friction in the neck of the flask.

The exhaustion of the flask was carried out to a very high degree, but an account of the method adopted and the precautions taken is here unnecessary. In the final stage of the process the residual gas was absorbed by a charcoal bulb kept surrounded by liquid air, which was boiled off continuously at a reduced pressure of about 2 cm. of mercury, for several hours before, and during the whole of the measurements.

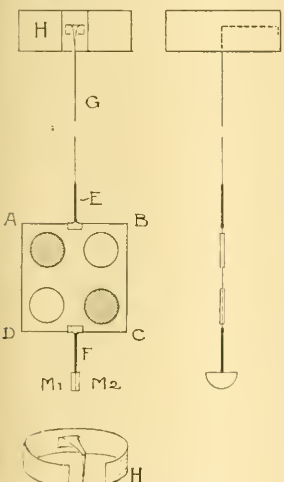


Fig. 2.

The source of light was an Ediswan 50-volt "focus lamp," which was fed from accumulators. By a suitable arrangement of achromatic lenses a uniformly illuminated image of a circular diaphragm was focussed on the disc to be worked with. The flask was mounted on a turn-table, so that by rotation through 180° experiments could be made on the reverse sides of the discs.

For reading the deflections the image of an electric lamp on a millimetre scale at a distance of 113 cm. was used, the deflection being read to 0·2 mm.

As the mean of a number of determinations we have the final values (in scale divisions) for the pressures on the four discs:—

BB	BS	SS	SB	
16·1	22·3	28·7	28·0	(Observed)

A determination of the energy of the beam was made by allowing it to fall on a blackened disc of silver and observing the initial rate of rise of temperature by means of a constantan-silver thermoelectric junction soldered to the disc. The energy was found to be 33×10^{-6} ergs per cm. length of the beam used. This would be the force in dynes on a fully absorbing surface. Had the BB disc been fully absorbing the beam should have deflected it 13·6 scale divisions. Assuming that the asphaltum disc reflects 5 per cent. and the silver 95 per cent. of the incident beam—an estimate which cannot be seriously in error—it can easily be shown that the deflections of the four discs should have been:—

BB	BS	SS	SB	
14·3	22·0	26·5	26·1	(Calculated)

The general agreement of these values with the observed values given above appears to afford satisfactory evidence for the existence of the recoil effect. In the case of the BB disc, however, there is a marked difference between the observed and calculated values, and this discrepancy is probably to be ascribed to residual radiometer action. There was reason to suspect that this action was not sufficiently reduced to make it quite negligible, and it was obvious that this disc should be more affected than the others by radiometer action, as the difference in temperature between the two sides of the disc is greatest in that case.

The forces due to light are so small, and the disturbances due to convection are relatively so great, that we cannot expect to find any effects due to light pressure here on the surface of the earth surrounded by a dense atmosphere. But out in interplanetary space, where the vacuum must be far higher than anything to which we can attain, the light forces may have uninterrupted play, and in the course of ages they may produce great effects; but even then only small bodies will be seriously affected. Take, for instance, a sphere; the pressure of sunlight upon it varies as the square of the radius, and the mass as the cube of the radius. Thus the acceleration produced is inversely as the radius for spheres of the same density. The whole pressure of sunlight upon the earth is only a forty-billionth part of the sun's gravitative pull. If we reduce the radius the pressure becomes more important in proportion, and on a sphere of one forty-billionth of the radius of the earth—or 16×10^{-6} cms. radius—and of the earth's density, if diffraction did not come into play, the pressure of sunlight would balance gravitation. Still smaller spheres would be pushed away.

But turning to the case of bodies somewhat larger than those in which gravitation is neutralised by light-pressure, bodies for which gravitation is still much greater than the light pressure, we will now consider an effect on them due to the pressure of radiation against the source. Let us suppose that a small spherical absorbing body is circling round the sun. It is receiving radiation from the sun on its bright half, transmuting it to heat, and then giving out this energy as radiation again all round. If the sphere is sufficiently small—say of 1 cm. diameter or less—it will be practically of the same temperature throughout, a small difference of temperature from front to back sufficing to carry through the energy which it radiates from the dark half. It virtually receives from the sun on its diametral plane, and it radiates out from its whole surface, which is four times as great. So that its rate of radiation per sq. cm. is one-fourth the solar radiation per sq. cm. passing the sphere. But we suppose that the sphere is moving round the sun. As it moves forward it crowds up the waves in front and opens out the waves behind it. It follows, then, that in consequence of the motion, the pressure is slightly greater against the radiation emitted in front, and slightly less against the radiation emitted behind. The negative acceleration, or retardation, works out to be

$$-\frac{S}{4a\rho}\frac{v}{U^2}$$

where S is the solar stream of radiation, a the radius of the sphere, ρ its density, v its velocity, and U the velocity of light. As the sphere moves against this resisting force its energy is gradually abstracted, and it tends to fall into the sun.

If a sphere 1 cm. in diameter, and of the density of the earth, is moving round the sun at a distance equal to that of the earth, it will fall in about one mile in the first year. If it continues to describe a nearly circular spiral, it will fall in less and less each revolution, but the revolutions take less and less time, and in equal times it will fall in more and more. Such a sphere will reach the sun in something of the order of 45,000,000 years. But the rate of falling in is inversely as the radius, so that a sphere 1/1000 cm. in diameter will fall in 1000 miles in the first year, and will reach the sun in 45,000 years.

There is no doubt that there are such bodies in our system. We have clear evidence of their existence when they perish as shooting stars in our atmosphere. Also there seems no way to avoid the conclusion that they are all spiralling in to the sun and will ultimately reach him unless their career is cut short by some intervening planet. How, then, are we to account for their existence in our system to-day? Whatever limit we may assign to the age of the earth as a habitable globe, we must assign to the sun some vast number of millions of years, vast enough to have allowed him long ago to draw to himself all the specks of dust in his system. How is the supply renewed? Is interstellar space inhabited by scattered meteorites? Are they brought in by comets which have become disintegrated? And so light pressure raises once more an old and still unsolved problem.

A NEW TRYPANOSOME PARASITIC IN HUMAN BEINGS.[1]

THE terrible mortality caused by sleeping sickness in Africa, and the knowledge that this deadly disease is caused by a species of trypanosome, has directed the attention of the general public, as well as of scientific and medical men all over the world, to these blood-parasites. The frequent occurrence of trypanosomes in the blood of vertebrate animals of all classes has long been known to zoologists, but this fact was regarded as little more than a scientific curiosity until Bruce, scarcely fifteen years ago, showed that a species of trypanosome, since named after him (*Trypanosoma brucii*), was the cause of the dreaded tsetse-fly disease of domestic animals in Africa, and followed this up by his discoveries, in the present century, with regard to the nature and transmission of sleeping sickness.

No little sensation was created, therefore, when it was announced by Chagas about a year ago[2] that he had discovered a new species of trypanosome, named by him *Trypanosoma cruzi*, in human blood in Brazil. A full account of this parasite, its development, and mode of transmission, has now been published by Chagas, with numerous illustrations, and it proves to be a form no less interesting from the purely zoological than from the medical standpoint.

The manner in which this parasite was discovered is remarkable. Chagas found that in the province of Minas Geraes the houses, especially the thatched huts of the poorer classes, were infested by bugs (Fig. 1) of the species *Conorhinus megistus*, voracious blood-suckers of large size and nocturnal habits, responsible for much loss of sleep, as well as of blood, to the unfortunate inhabitants. Some of these bugs were collected and brought to Rio de Janeiro, where they were dissected and examined in the laboratory of the Instituto Oswaldo Cruz, and were found to contain in their digestive tracts numerous flagellate organisms resembling in form and structure the genus Crithidia. When such bugs were allowed to feed on experimental animals, namely, marmosets (*Callithrix penicillata*) and guinea-pigs, they infected them with trypanosomes, to the effects of which the marmosets succumbed in about two months, the guinea-pigs in five to ten days. After this surprising result, Chagas returned to Minas Geraes and examined the blood of human beings in the zone infested by the bugs, and found several cases of human beings infected with similar trypanosomes. Thus the course of the discovery of this parasite has been the exact opposite to that of the progress of our knowledge of sleeping sickness; there the disease was thoroughly known long before it was found to be caused by a trypanosome, then the mode of transmission was discovered, and the complete life-cycle of the parasite has not yet been worked out; here the transmitting insect was first known, then the parasite itself was discovered, and, last of all, it was found to occur in human blood, with the result that the life-cycle of the trypanosome has been investigated in considerable detail, but very little is known of its effects in their clinical aspect.

The few cases of infected human beings observed by Chagas have not been followed out by him to their end as yet. He finds the effects of the parasite to be most marked, however, in children, amongst whom it appears to cause severe mortality. The chief symptoms are anæmia, œdema, general or localised, enlargement of the lymphatic glands and of the spleen, and functional disturbances, especially of the nervous system, leading in some cases to imbecility. A tendency to arrest of development, resulting in pronounced infantilism, was also noticed. According to information collected, the fatal termination of the disease was frequently attended by convulsions, regarded locally as the cause of death, and sometimes by dropsy in the last stages.

FIG. 1.—*Conorhinus megistus*, Burm., ♀.

The life-cycle of the parasite, as described by Chagas, shows some peculiarities not yet known in any other species of trypanosome. In the vertebrate host it exhibits three phases, which may be termed conveniently the adult, the multiplicative, and the growth phase respectively.

In the adult phase, the organism is free in the blood-plasma, and has the typical trypanosome-structure (Fig. 2, *a*). It shows, however, a dimorphism which Chagas regards as sexual. One form, regarded as male, is more slender, with a larger kinetonucleus and a more elongated trophonucleus; the other, regarded as female, is broader, with smaller kinetonucleus and rounded trophonucleus.

These adult trypanosomes in the peripheral blood were never observed to multiply by fission, a fact which the author seems to consider remarkable, doubtless from the standpoint of studies upon pathogenic trypanosomes, though it may be pointed out that the same is true of the common trypanosomes of vertebrate animals, especially those of birds and fishes. Chagas has discovered that the multiplication takes place by a process of multiple fission or "schizogony" in the lung. Hence he founds provisionally a new genus, Schizotrypanum, for this species. It remains to be seen how far such schizogony is peculiar to this parasite. The only salient difference between the multiple fission of *Schizotrypanum cruzi* and that of the common *Trypanosoma*

[1] "Nova tripanosomiaze humana." By C. Chagas. Memorias do Instituto Oswaldo Cruz I., 1909. Pp. 159–218; plates ix–xiii and 10 text-figures. (Portuguese and German text.)

[2] See the Bulletin of the Pasteur Institute for May 30, 1909, p. 453.

lewisi of rats, is that in the latter the flagellum is retained, as a rule, and in the former is always lost, during the process. In *S. cruzi* there appears to be an alternation between periods of multiplication with schizogony in the lungs, with adult free trypanosomes occurring sparingly in the blood, and periods in which the peripheral blood contains numerous trypanosomes. In the case of experimental animals, it was found, as a rule, that at the time of death trypanosomes were very scanty in the blood, while schizogony was proceeding actively in the lung.

The trypanosome, when about to undergo multiplication, first throws off the flagellum and undulating membrane; it may or may not lose its kinetonucleus at the same time. It then curls up (Fig. 2, *b*), and contracts into a rounded mass, the schizont (Fig. 2, *c*), after which the trophonucleus and the kinetonucleus, also, if present, divide each three times to form eight small nuclei of one or both kinds (Fig. 2, *d*). The protoplasmic body then divides up within its own skin (periplast) into as many parts, termed by Chagas merozoites (Fig. 2, *e*). Each merozoite contains either a single trophonucleus, or a kinetonucleus in addition. The generation with a persistent kinetonucleus is regarded by Chagas as male, that without

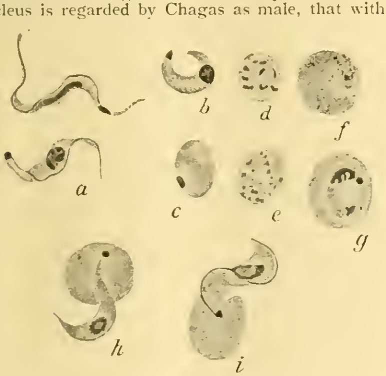


FIG. 2—*a–i*. Phases of *Schizotrypanum cruzi* in vertebrate blood. *a*, the two forms of the adult trypanosome, "male" (upper) and "female" (lower), from human blood; *b*, preparations for schizogony; *c*, schizont; *d*, division of the nucleus of the schizont; *e*, division of the schizont into eight merozoites; *f*, merozoite in a blood-corpuscle; *g*, intra-corpuscular phase in late stage of growth; *h*, similar phase escaping from the corpuscle, the flagellum not yet formed; *i*, similar phase, the flagellum in process of formation.

any such body as female. Although the author insists on interpreting these and other differences as sexual, it should be noted that no sexual behaviour has been observed in any part of the life-cycle of the parasite.

The tiny merozoites are stated to escape singly from their envelope and to penetrate into red blood-corpuscles (Fig. 2, *f*), in which they grow into the adult form (Fig. 2, *g*, *h*). In those merozoites which are without a kinetonucleus, this body arises by division of the single nucleus present. The flagellum and undulating membrance appear to be formed when the organism is full-grown, sometimes not until it has escaped from the blood-corpuscle (Fig. 2, *h*, *i*). It is remarkable, however, that Chagas does not figure any intracorpuscular phases intermediate in size between the very smallest and those which are practically full-grown; and it must be said that many of his figures of the later growth-phases are not at all convincing as to the parasite being really within the corpuscle.

With completion of growth and liberation from the corpuscle, the adult phase of the free trypanosome is reached.

On the ground that *Schizotrypanum cruzi* differs from all known trypanosomes in undergoing multiplication by schizogony, and in the possession of an intracorpuscular phase, Chagas regards it as a form connecting the trypanosomes and the Hæmosporidia (malarial parasites and allied forms), and supporting the union of these two groups in systematic classification. This view raises questions which cannot be discussed in a brief space.

By experiments on the transmission, Chagas found convincing evidence that the parasite goes through a developmental cycle, with a minimum duration of eight days, in the bug. Until this cycle is complete the bug is not infective. It is a point of great interest that, while bugs collected in human dwellings and bugs fed in the laboratory on infected marmosets transmitted the infection, he was never able to render bugs infective by feeding them on infected guinea-pigs. Chagas is of opinion that a certain condition of the parasite is necessary to produce infectivity in the bug, and that the requisite conditions are furnished by the blood of human beings or marmosets, but not by that of guinea-pigs. Experiments to prove transmission of the parasite through the egg of the bug gave entirely negative results in all cases.

Phases in the development of *Schizotrypanum cruzi* in the invertebrate host are described by Chagas from bugs bred in the laboratory and fed on infected animals. The parasites begin to undergo a change in the stomach of the bug about six hours after feeding (Fig. 3, *a*, *b*, *c*); they lose their flagellum and contract into rounded forms which multiply actively by fission (Fig. 3, *d*). After a period of multiplication, the rounded forms become pear-shaped, and develop a flagellum at the pointed end (Fig. 3, *e*, *f*); thus are produced flagellates of the Crithidia type (Fig. 3, *g*, *h*), which pass on from the stomach into the intestine, and there multiply rapidly by fission. As a result, the intestine becomes peopled by a swarm of crithidial forms, the characteristic condition of the infected bug. In a few instances Chagas found trypanosome-like flagellates in the body-cavity and the salivary glands (Fig. 3, *i*), and he regards these trypaniform individuals as the last phase in the development of the parasite in the bug, that is to say, as the form in which the parasite is inoculated into the vertebrates by the invertebrate host.

It should be noted here that the three principal forms which the parasite assumes in the bug, namely the rounded, crithidial, and trypaniform types, are found by Chagas to occur also in artificial cultures on blood-agar, and to succeed each other in the same order. This parallelism indicates that these forms represent the natural developmental cycle of the parasite in the invertebrate host; that the rounded and especially the crithidial forms represent the multiplicative phase whereby the parasite establishes itself in the bug, while the trypaniform individuals represent the propagative phase destined to infect new hosts. Chagas, however, interprets the facts observed in a different manner. He regards the crithidial forms as the end-product of an atavistic degeneration of the parasite, a mere culture-phase which does not develop further, and is of no importance for the transmission to the vertebrate host and the continued propagation of the parasite. On the other hand, he attaches great importance to two forms observed by him in the bug but not found in the artificial cultures, namely, encapsuled forms (Fig. 3, *j*), which he believes to represent zygotes, although no conjugation has been observed, and certain forms which he interprets as schizogony in the intestine of the bug. According to Chagas, the true infective cycle of the parasite in the bug is comprised in four stages:—(1) the encapsuled "zygotes"; (2) the schizogony-forms; (3) the trypaniform individuals in the body-cavity; and (4) the similar forms in the salivary glands. I feel it incumbent upon me to state that in my opinion the encapsuled forms are merely resting stages of rounded or crithidial forms, the interpretation of which as zygotes is a pure assumption, and that the so-called schizogony-forms have nothing at all to do with the life-cycle of Schizotrypanum, but appear to be merely parasitic organisms of the nature of yeasts from the intestine of the insect. In justice to the author, however, it should be mentioned that he does not regard his observations on the life-cycle in the invertebrate as in any way final, and considers that many points remain to be further investigated.

The memoir of Chagas contains a great number of very interesting observations to which space does not permit of further reference. We may direct attention especially to his experiments on the variations in the virulence of the parasite as the result of passage through different vertebrate hosts. The whole work is an exceedingly important contribution to our knowledge of the trypanosomes, and we desire to congratulate both the author and the Instituto Oswaldo Cruz on a great achievement. E. A. MINCHIN.

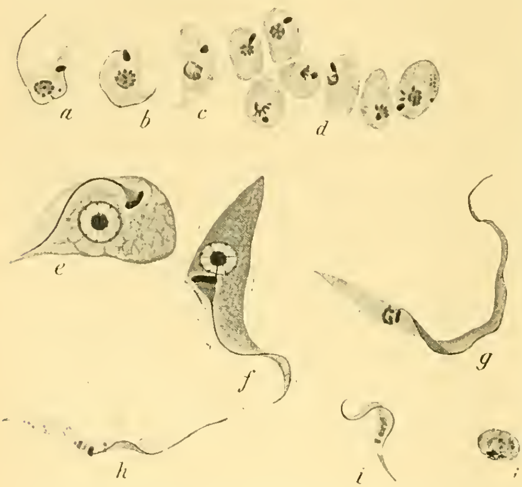


FIG. 3.—*a–j*, Phases of *Schizotrypanum cruzi* in the bug, *Conorhinus megistus*. *a*, *b* and *c*, forms transitional from the ordinary trypanosomes to the rounded forms; *d*, clump of rounded forms; *e* and *f*, change of rounded into crithidial forms; *g* and *h*, crithidial forms; *i*, trypaniform type from the salivary glands; *j*, encapsuled form from intestine.

TIDAL RESEARCHES.[1]

THE collection of data as to high and low water at various ports and the investigation of tidal currents present arduous tasks, and amongst those who have devoted themselves to these subjects Dr. J. P. van der Stok occupies a distinguished position. It is due to him that our knowledge of the tides of the Dutch East Indies rivals that furnished by our own admirable survey of India. He is an ardent adherent of the harmonic notation, and in the paper of which we now give an account he tabulates the principal tidal constants for no fewer than 138 ports in the Dutch Indies. To the best of my belief this immense mass of data has been collected and reduced through his own personal initiative.

This pamphlet gives an account of the theory on which harmonic analysis is based, but it is to be regretted, at least by all but his own fellow-countrymen, that it should have been written in his own language. Of course, the language is immaterial as regards the tables of constants, but it may prove an obstacle to those who desire to understand the other interesting points treated by the author.

Dr. van der Stok summarises his results in the form of co-tidal charts for the tract of ocean extending from the Malay Peninsula to New Guinea. The first of these exhibits the march of the principal lunar semidiurnal tide M_2. It appears that there is a point towards the south-eastern end of Sumatra at which the wave divides, one portion travelling north-west and the other eastward along the south coast of Java. Along the north-eastern coast of Sumatra, past Singapore, the wave travels in the opposite direction, namely, towards the south-east. It is met by a wave which travels westward and south-westward along the southern and northern coasts of Borneo, and westward along the northern coast of Java. Thus, in contrast with the divergence of the tide-wave off the south of Sumatra, there is a convergence from all sides towards a point midway between Sumatra and Borneo. Eastward of Borneo, in the direction of New Guinea, the general trend of the wave is northward.

The second of these co-tidal charts is, I believe, unique in that it exhibits the progress of the diurnal tide K_1.[1] The path of this wave exhibits a considerable resemblance to that pursued by the semi-diurnal wave, but it differs in the fact that it seems to approach the south coast of Java from the south, and thus the line of advance is from the south throughout the whole tract extending from the southern extremity of Sumatra to New Guinea.

I do not think that any previous investigator has attempted to draw a diurnal co-tidal chart. In the north Atlantic the diurnal tide is insignificant in amount and imperfectly known, but I think it might be possible to construct a similar chart for the coasts of India; I am not aware, however, that any such attempt has ever been made.

At the present time there are only three tide-predicting instruments in existence, namely, those in England, France, and the United States; but I have reason to know that a fourth is being constructed for another Government. Without the aid of such an instrument, tidal prediction is notoriously very laborious, and any process which may render predictions easier is very welcome. I have myself shown how numerical predictions may be made, but the preliminary computations are very laborious and tedious, although when the requisite tables are once formed it is easy and short to make a prediction.[2] But this method does little to facilitate the computation of a tide curve for a given place and given day direct from the harmonic constants. Now Dr. van der Stok pro-

[1] "Elementaire Theorie der Getijden—Getij-Constanten in den Indische n Archipel." (K. Nederlandsch Meteorologisch Instituut, No. 102, 1910.)

[1] There is a short discussion of the diurnal tides in Harris's "Manual of Tide," part iv. A, p. 660.

[2] Phil. Trans., clxxxii. A, p. 169, or vol. i. of my "Scientific Papers."

vides just what is wanted to meet this requirement with all needful accuracy. He has computed a set of auxiliary tables from which the required results may be extracted with a fair degree of rapidity. It is in the explanation of the use of these tables that I fear the Dutch language may prove a difficulty to some would-be users of the method.[1]

I shall not try to explain the process in detail, but will only sketch the ideas on which it is founded. It is assumed that sufficient accuracy will be obtained if the phase of each of the constituent tides is specified to the nearest exact hour of mean solar time. It is easy to compute the fall and rise of any constituent tide for successive hours. For example, suppose that we consider the tide M_2, that its amplitude is, say, 174 (expressed in cm. or any other unit), and that we designate the hour of its high water as o h.; then its march would run thus:—

h.		h	
0 ...	174	3 ...	9
1 ...	152	4 ...	−76
2 ...	92	&c.	&c.

Now if at any given place, and on any given day, we find the incidence of the high water of M_2 to the nearest clock hour, it is easy to write down the successive heights from the table in a schedule numbered from o h. to 23 h. If, for example, high water of M_2 is found to occur at 13 h. of clock time on the day in question, we should write 174 opposite 13 h., 152 opposite 14 h., and so on. The same process may be carried out for each of the principal component tides, and the sum may be obtained for each hour of the twenty-four, thus furnishing the resultant height of water. Auxiliary tables are furnished by Dr. van der Stok from which it is easy to determine the incidence of each partial high water in clock time, and tables of fall and rise are given for any required amplitude.

I should guess that it would take from twenty minutes to half an hour to compute and draw a fairly accurate tide-curve for any given day. If this estimate is correct, it would take a computer a month to draw a tide-curve for a whole year. Probably the work would be quicker when the tide is to be found for a succession of days, and in any case the task would not seem to be prohibitive to compute a year's tide-table with accuracy sufficient for practical purposes.

The paper also gives an example of the synthesis from harmonic constants of the tidal currents at a place called Sembilangan. This last statement may well prove almost unintelligible even to a man versed in tidal work. For a full explanation I must refer the reader to Dr. van der Stok's "Études des Phénomènes de Marée sur les Côtes Néerlandaises."[2] Four of this series of papers have been already published by the Nederlandsch Meteorologisch Instituut. I have not seen the first, but the second and third are dated 1905, while the last is of later date than the paper which we are now reviewing. I gather that the first of the series gives a method of obtaining tidal constants from observations taken every six hours, and the subject is resumed in the last paper, which contains an immense mass of information about the constants along the whole length of the Dutch coast. But I must revert to the subject of tidal currents discussed in the second and third of the series, and explain in outline what is meant by the harmonic analysis of tidal currents.

[1] Something of the kind has been done by Harris in his "Manual of Tides," part iii., p. 183. His procedure seems to be more elaborate, and probably more accurate, but also less rapid than that devised by Dr. van der Stok.

[2] These papers ought to have been noticed in the article "Bewegung der Hydrosphäre" of the German Encyclopædia of Mathematics. My article was really written before the publication of Dr. van der Stok's first three papers, but in the subsequent and final revision for the press I carelessly took these papers merely to relate to local hydrography. References are given in them to other papers by MM. Phaff, Petit, van Heerdt, &c., on the hydrography of the Dutch coast.

The author caused a large number of observations to be made from light-ships off the Dutch coast, and then undertook to make an elaborate study of the tidal currents which had been noted. He found it possible to define the velocities and phases of the components of current by means of a notation analogous to that used in defining the rise and fall of the tide. Thus the velocities for the several kinds of tide were specified in centimetres per second, and the phases by angles analogous to the κ's in use in the more ordinary harmonic analysis. A similar investigation had been carried out at Sembilangan, in the Dutch Indies, and it is the result for that place which is given in the paper under review.

It is clear that the harmonic constants which define the horizontal motion of the water cannot claim a high degree of accuracy, but it affords a conspicuous advance that the attempt should have been made and crowned with a certain amount of success.

The vortices off the Dutch coast are very complicated, and the author refers to Airy's theory ("Tides and Waves," §§ 358–63) as affording in some measure an explanation of the facts, although he does not find the explanation by any means complete.

In No. ii. of the papers to which I now refer, Dr. van der Stok integrates, for the light-ship station of Schouwenbank, the expressions for the components of velocity, and thus finds the trajectories of a particle of water under the influences of the tides M_2, S_2, and M_4; he also determines the general drift of the water. The figures illustrative of his conclusions are very interesting, and I commend these papers to the notice of all who are interested in tidal theory.[1]

G. H. DARWIN.

[1] Similar results will be found in Helland-Hansen and Nansen's "Norwegian Sea, Report on Norwegian Fishery," vol. ii., 1909, No. 2, p. 107; and Miss Kirstine Smith's "Gezeitenstroemern," Havenundersögelser, vol. ii., No. 13, 1910.

THE LEANING TOWER OF PISA.

THE first stone of the campanile of Pisa was laid in August, 1174, by Bonanno of Pisa and William of Innsbruck, but accounts given us by various authors are very conflicting and uncertain in regard to the construction of this splendid work of art, which, after being interrupted several times, was completed nearly two centuries later.

The tower, which is entirely of white marble, is of cylindrical shape, hollow in the centre, with a spiral staircase constructed in the thickness of the outer wall which leads up to the belfry floor. The first tier is surrounded by fifteen large columns, with vaulted arches half-encased in the wall, and the six upper tiers are each decorated by an equal number of peristyles with arches, supported by altogether 192 isolated columns. The eighth and last tier, of smaller diameter, on which are placed the bells, was constructed, according to tradition, by one Tommaso, architect and sculptor, a pupil of Andrea Pisano.

As is commonly known, the tower, the height of which is about 56 metres, has a noticeable leaning on its axis, and the cause of this leaning gave rise to bitter controversy among the Pisan writers in past centuries, some of whom attributed the strange piece of architecture to the high ingenuity of the builders, while others more reasonably maintained that the explanation was to be sought in the instability of the Pisa subsoil.

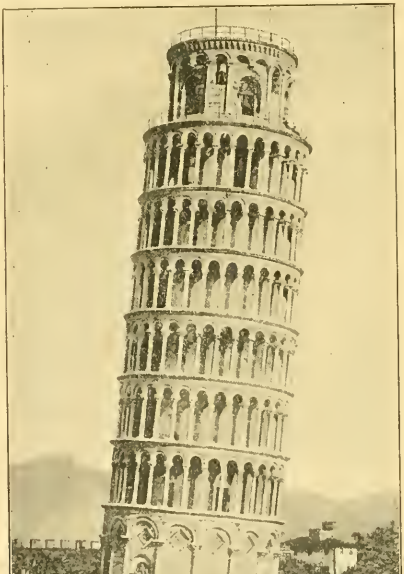
The recent investigations of a competent Government Commission, composed of Profs. Mario Canavari, Paolo Pizzetti, and Agenore Socini, and Drs. Giovanni Cuppari and Francesco Bernieri, have not only confirmed that the leaning of the tower is certainly due to a subsidence of the ground, but that this subsidence has gone on increasing in the last eighty years, and this serious conclusion has attracted the attention of competent authorities.

The investigations of the Commission have clearly brought out the following facts:—

(1) The tower does not rest on a mass of masonry extending over the whole area of the circular base, as was hitherto supposed, but is supported only by a more limited annulus of masonry corresponding to the cylindrical form of the superstructure.

(2) The foundations, hitherto supposed to be about 8 metres deep, are, on the contrary, much more superficial, and hardly sink to 3·60 metres below the level of the ground.

(3) A spring of water rises at the junction of the foundations with the surrounding permeable earth, causing serious damage to the foundations themselves.



The Leaning Tower of Pisa.

A tank excavated near the tower in 1839 for the purpose of maintaining the surrounding basin dry and preserving the base in good condition was made very deep, and much below the level of the actual edge, thus collecting other waters, which were pumped out regardless of the safety of the tower.

(4) The slope of the tower, according to the measurements made in 1829 by Messrs. Cresy and Taylor, which may be regarded as correct, was, from the first to the seventh tier, 86·5 mm. per metre of height. The slope, as now determined by optical appliances by Prof. Pizzetti, and directly by the plumb-line by the engineers, Drs. Cuppari and Bernieri, is—again from the first to the seventh tier—92 mm. per metre. The slope has therefore increased $5\frac{1}{2}$ mm. per metre, and there is thus an external displacement of 2·868 metres, and a total deviation of the axis, from the first to the seventh tier, of 3·265 metres, exceeding that found by the English observers in 1829 by nearly 20 centimetres.

The Commission has not been able to decide whether the increase in the leaning took place gradually or at intervals as the result of different causes. One such cause might be the excavation of the tank and the ill-advised pumping operations already mentioned; another might be sought in the effects of the earthquake of 1846, which was fairly violent at Pisa, and, as asserted by Leopoldo Pilla in his account of the times, caused the tower to oscillate in an alarming way. "Those people who had the opportunity of observing it during the shock," writes the great geologist, "assure me that its swaying was a terrible sight."

In spite of these serious conclusions, the Commission is nevertheless unanimously of opinion that the famous tower of Pisa still possesses good stability, and that the present condition of the same is not such as to give rise to excessive apprehension for the future.

A. BATTELLI.

RECENT BOOKS ON BOTANY.[1]

(1) MR. SCOTT ELLIOT has attempted an ambitious task, *i.e.* to give a popular and at the same time comprehensive account of modern botanical research. On the whole, he has been thoroughly successful, and has produced a readable book, which may well impress the layman or amateur botanist with the extent and scope of the botany of to-day. But (though this is perhaps inseparable from a work of this kind) one is almost bewildered by the rapidity with which the scene changes from the polar regions to the tropics, or the subject under discussion from, *e.g.*, the effect of electricity on plants to the origin of the British flora. In the preface the author states that he is particularly interested in "open-air botany, the story of the conquest of the world by green vegetation," and it is when discussing topics of this kind that he appears at his best. Such descriptions as that of the soil, with its manifold complexities of life and structure, or of a "Chroolepus Forest" are distinctly good, even if a trifle exaggerated. The chapters on bacteria, Arctic and Alpine floras, and the re-conquest of the water are amongst the best in the book. In a few cases, however, Mr. Elliot has attempted the impossible. Thus, in a chapter on the fern alliance, he condenses into three octavo pages an account of the alternation of generations, Bower's theory of the origin of the fern sporophyte, the reduction of the gametophyte in flowering plants, and a description of the pteridosperms. The result can scarcely be other than to cause confusion in the mind of the non-botanist. In describing the growth of the living crust of mosses on the top of a sphagnum bog (p. 74), the author suggests that "these moss plants may, for aught we know to the contrary, be the identical individuals which perhaps began to grow there at the close of the Glacial period." This raises the interesting metaphysical problem of how far the conception of individuality is applicable to plants. Unfortunately, Mr. Elliot does not discuss the question, though he briefly refers to it again on p. 152. It is to be expected that some inaccuracies should creep into a book of this nature. A desire for brevity is probably responsible for the statement on p. 109 that the

[1] (1) "Botany of To-day: a Popular Account of Recent Notable Discoveries." By G. F. Scott Elliot. Pp. 352. (London: Seeley and Co., Ltd., 1910.) Price 5*s.* net.

(2) "The Book of Nature Study." Vol. v. Edited by Prof. J. B. Farmer. Pp. viii+224. (London: Caxton Publishing Co., n.d.)

(3) "A Text-book of Botany for Students, with Directions for Practical Work." By Amy F. M. Johnson. Pp. viii+535. (London: Allman and Sons, Ltd., n.d.) Price 7*s.* 6*d.*

pollen grains of a flower are male sperm cells; while the somewhat astounding information (p. 132) that the leaves of *Victoria Regia* may be 60 feet across is, of course, a mere slip, and not a traveller's tale. There are a number of beautiful photographs (chiefly of plants of economic importance), some of which, however, seem to have little reference to the matters discussed in the text. Similarly, "The First Land Plants," which is the title of chapter iii., scarcely describes its contents, which deal chiefly with soil and the nitrate supply of the vegetable world. One of the photographs is here reproduced.

(2) As other volumes of "The Book of Nature Study" have been reviewed in Nature, it is unnecessary to indicate the general scope of this work. The first contribution to this volume is one by Miss C. L. Laurie, which (considering that it contains a chapter on aquatic vegetation, and another on that of meadows and pastures) bears the somewhat curious general title of "Xerophytic Vegetation." This part of the work contains a good deal of interesting information, and some useful suggestions for practical work; but, on the whole, it is rather disappointing. In many places there is a lack of clearness, both of expression and arrangement. On p. 15, for instance, it is stated that the amount of salt in the sea aster varies from 43-49 per cent. It is only incidentally mentioned in a later paragraph that this refers to ash analysis, and not to the fresh or dry weight of the plant. The editor might well have exercised a stricter supervision over these chapters.

But the remainder of the volume is on a higher level. Chapters v.-xii. are devoted to "The School Garden," the author being Mr. J. E. Hennesey. The subject is treated almost entirely from a practical point of view, gardening operations of various kinds —tillage, manuring, the propagation and treatment of plants, &c.—being clearly described. These chapters should prove invaluable to amateur gardeners, and perhaps more particularly to teachers who have the oversight of a school garden. Mr. Hennesey rightly emphasises the importance of a garden being attached to at least every rural school. It is interesting to note that such gardens are increasing in number in England, though we are still far behind Austria-Hungary, in which more than 18,000 school gardens have been established since 1870.

Distinctly the best part of the present volume has been reserved to the last chapter, which contains a really excellent account of "The Work of the Soil," by Mr. A. D. Hall. The author first deals with the origin of soils, and then with their properties. Under the latter heading clear directions are given for conducting simple soil analysis, also for experiments to show the behaviour of different soils towards water, the work performed by soil organisms, &c. Pp. 209-11 contain a graphic and convincing description of the competition of plants in nature.

Both "The Book of Nature Study" and Mr. Scott Elliot's "Botany of To-day" are worthy of a place on the bookshelves of every school library.

(3) Miss Johnson has produced a carefully and, on the whole, a clearly written text-book, but, like many other books of the kind, it is somewhat deficient in brightness and suggestiveness. In the opinion of the present writer, it is a mistake to adopt the water-tight compartment system in the teaching of elementary students. The author, however, adheres to the time-worn method of devoting entirely separate sections of her book to morphology, histology, and physiology. Thus the external characters, the structure, and the functions of a root are treated in quite different parts of the book. Further, bearing in mind the students for whom the work is intended (*vide* preface), it is somewhat overcrowded with unnecessary detail. The book is fairly free from serious errors, but perhaps it

Photo.] [*Skeen and Co., Ceylon.*

Plucking Cocoa Pods. From "Botany of To-day."

may be worth while to direct attention to the fact that the intercellular passages so frequent in the vascular bundles of monocotyledons are not *air* cavities. Again, the *chief* function of the air spaces in the stems of water plants is scarcely to "give lightness to the plant" (p. 219), though, curiously enough, this statement is also made by Miss Laurie in "The Book of Nature Study" (p. 23), reviewed above. The excellent illustrations, which are nearly all new, form the best feature of the book. These are chiefly by Miss Boys-Smith and Miss Berridge.

NOTES.

SEVERAL weeks ago the announcement was made that an Italian Government Commission, appointed to inquire into the condition of the Leaning Tower of Pisa, had reported that the structure was in danger of collapse (July 14, p. 48). We are glad to be able to print in the present issue the translation of an article by Prof. A. Battelli, professor of physics in the University of Pisa, in which the facts with reference to the tower are clearly stated. The article should serve to moderate anxiety for the safety of this famous structure.

It is stated by the Paris correspondent of the *Times* that the Government of the Republic of Ecuador has proposed to present to France the observatory at Quito, together with its apparatus and dependencies, and that the Academy of Sciences has decided provisionally to accept the gift.

WE regret to see the announcement of the death of the Rev. Robert Harley, F.R.S., on July 26, at eighty-two years of age.

THE Paris correspondent of the *Times* states, on the authority of the *Dépêche Coloniale*, that M. Louis Gentil, professor of geology at the Sorbonne, who accompanied the expedition which recently explored the Atlas region under the auspices of the Comité du Maroc, has been entrusted by the French Minister of Public Instruction with a mission to the Muluya Valley, where he will complete his scientific researches in the Algero-Moroccan frontier district.

THE famous extinct geyser of Waimangu, New Zealand, near which a volcanic eruption was reported last week as having commenced, was for a few years the most powerful geyser on record. The activity of this geyser in 1903 and 1904 created such anxiety in the North Island of New Zealand that an Auckland paper, attributing its activity to the great increase in the size of the adjacent Lake Rotomahana, proposed that the lake should be drained in order to allow the freer outlet from the hot springs of the locality. No action was taken, and the danger was removed by the bursting of the lake dam. The water of Lake Rotomahana was discharged to Lake Rotorua, and Waimangu ceased its eruptions. It will be interesting to learn from the New Zealand geologists whether the renewal of the volcanic activity along the Tarawera rift is connected with the cessation of Waimangu.

THE executive committee formed for the purpose of organising and holding a great International Horticultural Exhibition in London in the spring of 1912 is now doing everything possible to push forward the necessary arrangements. The honorary secretary of the committee is Mr. Edward White, 7 Victoria Street, Westminster, S.W. The exhibition will be held in May, and it will be open to the public on eight weekdays. Although in no way responsible for the exhibition, the Royal Horticultural Society is extending its general approval to the scheme. This society has not only agreed to forgo the holding of the usual Temple Flower Show for that year, but it has also contributed a sum of 1000*l.* towards the International Exhibition, and in addition is prepared to assist generously in the formation of a guarantee fund.

It is seldom that for the period of a whole month there is such a failure of summer weather as was experienced this year throughout July. There were in all only five days at Greenwich with a temperature of 70° or above, and this is the smallest number of warm days in any July since trustworthy records were commenced in 1841, about seventy years ago. The July with the next fewest number of warm days was in 1879, when there were eight days with the temperature above 70°, whilst there have only been four Julys during the last thirty years with fewer than twenty such warm days, and as recently as 1905 the temperature of 70° was exceeded in July on twenty-nine days. In the last nineteen years there have only been two Julys besides last month in which the shade temperature failed to touch 80°. The mean temperature for the month was 60°, which is 4° below the average of the past sixty years, and it is 1·5° below the mean for the corresponding month in 1909, when the early part of the summer was unseasonable like the present, although July last year had eighteen days with a temperature above 70°. The aggregate rainfall in the neighbourhood of London for July this year was 3·5 inches, which is 1·1 inches more than the normal, and rain fell on seventeen days. The aggregate for June and July this year is 5·6 inches, which is 1·2 inches less than for the corresponding two months last year. The duration of bright sunshine in July this year was 115 hours, which is only one-half the average, and is sixty hours less than in July last year.

THE visit of the German Association of Gas and Water Engineers to Great Britain, which was postponed on account of the death of King Edward, has now been arranged to take place during the week commencing October 2 next. The visitors are to be the guests of the Institution of Gas Engineers, the Gas Light and Coke Company, the South Metropolitan Gas Company, the Croydon Gas Company, and the Corporations of Edinburgh and Glasgow respectively, of which latter city the engineer of the gas department, Mr. Alex. Wilson, is now the president of the Institution of Gas Engineers.

AT the last meeting of the British Science Guild, held in the rooms of the Royal Geographical Society, communications were received from the Canadian and New South Wales sections of the Guild. In the case of the Canadian section, Lord Grey is resigning the presidentship on account of his departure, and it is hoped that Lord Strathcona will act as president in his place. No fewer than 120 members have joined the New South Wales section of the Guild, and important literature has been forwarded in connection with technical education and the report on open-air spaces for school children in Sydney. The agricultural memorial to the Prime Minister having received numerous signatures from representative agricultural societies and others was ordered to be submitted to the Prime Minister. The report of the committee on the synchronisation of clocks was finally approved, and it was decided to approach the Local Government Board by deputation and to ask the President to promote legislation on the subject.

ACCORDING to Miss F. Buchanan, writing in the July number of *Science Progress* on the significance of the pulse-rate in vertebrates, the relative size of the heart in different groups of animals depends on the amount of work it is called upon to perform. Thus in fishes, where it has only to pump the blood so far as the gills, the heart is always small, averaging 0·09 per cent. of the body-weight; but in the inert flat-fishes it is still smaller, being only about 0·04 per cent. of the body-weight. On the other hand, in birds, more especially migratory and vocal species, the heart has very heavy work to perform, and is consequently of great relative size, ranging from 1 to 2, or in a few cases 2·6, per cent. of the body-weight. In consequence of these differences in the amount of work the heart has to execute, its size bears no fixed relation to that of the animal to which it belongs. "The heart of a pigeon, *e.g.*, weighs twenty-five times that of a plaice of the same weight, and is about equal to that of a salmon fifteen times as heavy as the pigeon. A thrush, and a guinea-pig of six or seven times its weight, have hearts of about equal size."

In the *Psychological Bulletin* for June Dr. J. C. Hubbard describes a curious visual phenomenon resulting from stimulation of the macular region of the retina. It was first, and can be best, observed when the pupil is dilated by atropin, but it is also said to occur under ordinary conditions when any feeble source of light is viewed against a dark background. If, for example, "a patch of soft red colour, such as a ruby lamp wrapped with tissue paper, be viewed in a dark room, diffuse brushes of bluish tint are seen, apparently spreading laterally from it. With the right eye alone the brushes seem to extend to the right of the source, and with the left eye to the left." These brushes terminate at a point which is found to correspond to the position of the blind spot, for the source of light when not too large disappears if the eye be turned to the point of termination of the brushes. The brushes disappear in two or three seconds if the eye remains carefully fixed, but reappear upon slightly moving the eye. They also occur when the source of light is daylight, are brightest in orange-yellow and yellow spectral light, and are almost imperceptible in blue and violet light. Dr. Hubbard points out that the distribution of these brushes of blue light is strikingly similar to that of the bundles of optic nerve-fibres radiating from the macula to the blind spot. He suggests that certain stimuli, "passing from the macular region along these fibres to the optic nerve, are capable of inducing secondary effects in portions of the retina along which they pass."

THE preliminary announcement made in the *Times* of July 27, by Dr. Max O. Richter, of the discovery by Dr. K. Koritzky and himself of the site of the famous Cyprian temple of Aphrodite-Astarte will, if the facts are verified, rank justly as one of the most important archæological events in recent years, and a well-deserved triumph for German science. We can only express the regret that, in spite of much exploration in Cyprus by British scholars, they have failed to secure the honour of this discovery. The clue to the supposed site of the temple at Rantidi, or Randi, was gained through the examination of some inscribed stones which were smuggled out of the country, the first having been accidentally found by a shepherd. Whether this be the shrine of the Paphian Venus or not, the remains are certainly numerous and interesting. The German archæologists have taken measures to secure the rights of excavation, and Dr. Richter believes that the antiquities to be unearthed will prove to be so numerous that it will be necessary to erect a special museum for their reception, probably at Limassol. The examination of the shrine will probably solve the much debated question of the relation of the worship of the goddess to Oriental cults. In spite of the fact that the law protecting antiquities in Cyprus is severe, we regret to learn from Dr. Richter that many of the precious inscriptions have been removed from the ruins by the Government engineers and broken up for ballast for the new road from Nicosia to Limassol.

THE presidential address on "Nature and Nurture" delivered by Prof. Karl Pearson at the annual meeting of the Social and Political Education League in April last has been published by Messrs. Dulau and Co. in the Eugenics Laboratory Lecture Series. Prof. Pearson lays stress on the necessity for exact methods in the study of sociological problems, and indicates the difficulty of analysing the resultant effects of nature and nurture so as to exhibit the relative importance of each factor. A few pedigrees are given illustrating the appalling extent to which abnormalities may be propagated by a fertile degenerate stock, and conversely the persistence of intellectual eminence in superior stocks; and the strength of nature is contrasted with that of nurture by two tables, the first showing correlations between parent and offspring or between members of the same family, and the second correlations between various factors taken as inoices of environment and physical characters of children. Prof. Pearson concludes that "there is no real comparison between nature and nurture; it is essentially the man who makes his environment, and not the environment which makes the man." Not everyone will agree that the data are adequate to prove the conclusion, and from many of Prof. Pearson's *obiter dicta* the reader is likely to dissent; but the address gives a lucid and stimulating exposition, in popular language, of the lecturer's views.

No. 1746 of the Proceedings of the U.S. Nat. Mus. is devoted to an account, by Mr. G. C. Embody, of a new species of amphipod crustacean, found in abundance in a large, spring-fed pond or lake some three acres in extent near Ashland, Virginia. When first collected, in 1908, they were referred to *Eucrangonyx gracilis*, but they are now found to be distinct, and described as *Eu. serratus*. Although these amphipods formed a portion of the food of at least three species of fishes, the thick fringe of vegetation round the pond, coupled with their rather rapid propagation, prevents any very great destruction of the crustaceans.

In the July number of the *American Naturalist*, Mr. H. B. Wood discusses recent views as to the original source and spread of bubonic plague. Russian naturalists have urged that the bobac marmot (or perhaps some kindred central Asiatic species) is the sole originator of plague, and that it is permanently infected with the disease, thereby periodically re-infecting rats, and thus the human race, by means of fleas. The extermination of the bobac has, therefore, been demanded; but, as the author points out, there are probably other sources of original infection, and, in any case, certain American rodents have now become permanent centres of the disease. It is known, for instance, that a species of suslik, or ground-squirrel (*Spermophilus*, or *Citellus, beecheyi*), is plague-infected in California, and the same is the case with one of the wood-rats of the genus Neotoma, only in a less degree. Susliks may become infected *inter se* by the burrowing owl (Speotito) acting as flea-carrier, the fleas being probably carried from susliks to man by either cattle or rats, although direct transference from the former may take place. Two kinds of Californian rat-fleas will bite man, as will some suslik-fleas; and it has also been ascertained that rat-fleas will carry infection from rats to susliks, while suslik-fleas will carry it from one species of suslik to another, and likewise to rats and guinea-pigs.

AN account was given in the *Times* of July 20 of the deep-sea observations in the North Atlantic made by the *Michael Sars* expedition, which left Plymouth on April 7. It will be remembered that Sir John Murray liberally financed the expedition and took part in the cruise. The work was under the control of Dr. John Hjort, who had the assistance of Prof. Gran, Mr. Helland-Hansen, and Captain Iversen. Physical and biological investigations were made at most of the seventy-four observing stations. Upwards of 600 temperature observations at different depths were recorded. The temperature observations agree very well with those of the *Challenger*, but the determinations of the salinity and density of the water have furnished new results. The measurements of the rate of the current in the Straits of Gibraltar showed that the limit between the upper (east going) and the lower (west going) currents is situated at a depth of between 50 and 100 fathoms, varying in depth with the tide. The greatest velocities measured were about five knots. In the warm waters of the Sargasso Sea, where the tow-nets of the German Plankton Expedition obtained few plants, the centrifuging of the water gave samples showing that the plants there consist of the smallest forms, which escape through the meshes of the finest silk nets; they were found in thousands to a depth of about 50 fathoms. Prof. Gran has recorded a great number of new species, and was able to make quantitative microscopic investigations, and thereby determine the vertical distribution of the different species. The temperature section across the Gulf Stream to the south of the Great Banks showed unexpected results. Both the temperature and the plankton indicate a counter-current at the southern border of the Gulf Stream. In consequence of this the *Michael Sars* followed the course of the Gulf Stream across the Atlantic, taking observations on the way, and the results will be published later.

In No. 1749 of the Proceedings of the U.S. National Museum, Mr. A. H. Clark describes a new species of feather-star (Antedon) from the Adriatic, and discusses the relationships of the other European members of the genus. It appears that considerable differences in the size of the eggs and of their rate of development have been noted by several observers in European Antedons from different localities, although all the specimens were referred to the ordinary *A. rosacea*, the range of which was thus considered to extend from Norway to the Mediterranean. It was, however, suspected by all that the specific determination was unsatisfactory. Mr. Clark is now able to announce the existence of four European species—two from the Atlantic, for which the names of *petasus* and *bifida* (=*rosacea*) are respectively available, and two from the Mediterranean, one of which should bear the name *mediterranea*. The two Mediterranean forms have long, slender arms, and numerously segmented long cirri, while in those from the Atlantic the arms and cirri are shorter and stouter, with fewer segments to the latter; further, it is believed that neither of the Atlantic species has infrabasal plates. These are, however, present in the Mediterranean forms; but the newly named *A. adriatica* has four or five, against three in *mediterranea*. The Mediterranean forms are more primitive than those from the Atlantic, which accords with the author's view that Antedon is primarily an Indian Ocean genus, where it is now represented by the more generalised Mastigometra.

To No. 40 of the Zoological Society Bulletin, New York, July, Mr. W. T. Hornaday contributes an illustrated article on the collections of heads and horns of big game in the temporary "Administration Building" in that city. It appears that attention was recently directed to the poverty of American museums in specimens of this nature from Africa, and that this has resulted in a very gratifying effort on the part of sportsmen and collectors. We notice, however, that the specimens are exhibited on the walls of the apartments of the building without the protection of cases, and apparently exposed to strong light, which will assuredly lead to their rapid deterioration. Mr. Hornaday quotes certain pessimistic views as to the prospects of African big game, in which it is asserted that, in from ten to fifteen years, all except that in protected areas will have been practically wiped out.

The June number of the *Quarterly Journal of Microscopical Science* (vol. lv., part ii.) contains a valuable and beautifully illustrated monograph, by Mr. Cresswell Shearer, on the anatomy of *Histriobdella homari*. This very primitive segmented worm is said to be a normal inhabitant of the branchial chamber of the European lobster. The author concludes that the genus Histriobdella must be placed close to Dinophilus, but that it is more nearly related to the rotifers than the latter. Both genera show distinct relationships with Polygordius and Protodrilus, although they cannot be classed with these as true archiannelids. The same number contains Messrs. Allen and Nelson's interesting paper on the artificial culture of marine plankton organisms, already published in the Journal of the Marine Biological Association and noticed in these pages. Mr. Geoffrey Smith continues his studies in the experimental analysis of sex, and describes a case of parasitic castration in a cockerel, due to tubercle bacilli infecting the alimentary and lymphatic organs. He considers this case to be analogous to the parasitic castration of various invertebrates, such as that of the crab Inachus by the degenerate barnacle Sacculina. There are also three protozoological papers by Miss Annie Porter, Mr. C. M. Wenyon, and Mr. H. Lyndhurst Duke, all of a high standard of merit.

In the *Annals of Tropical Medicine and Parasitology* (vol. iii., No. 5), there is a memoir by A. Breinl and E. Hindle on the life-history of *Trypanosoma lewisi* in the rat-louse, *Haematopinus spinulosus*. In experiments carried on for more than a year, the authors have succeeded three times in transmitting *T. lewisi* by means of the rat-louse. Cytological changes in the trypanosomes in the gut of the louse are described and figured. Amongst other articles in the same number, one by Sir Rubert Boyce and F. C. Lewis, on "The Effect of Mosquito Larvæ upon Drinking Water," may be especially noted. It is found by experiment that "the presence of larvæ in drinking water adds very considerably to the number of bacteria present," and Cyclops appears to produce the same effect.

The eighteenth bulletin of the Sleeping Sickness Bureau contains a great deal of valuable information concerning the results of recent research upon all questions bearing directly or indirectly upon the etiology or treatment of trypanosomiases of man and animals. It begins with an editorial article upon the transmission in nature of *Trypanosoma gambiense*, the main point at issue being whether the trypanosome of sleeping sickness is disseminated, under natural conditions, by *Glossina palpalis* alone or by other species of tsetse-flies also. Recent observations tend to arouse the suspicion that *G. fusca* and *G. morsitans* may, under certain conditions in nature, serve as hosts for the human trypanosome, and if this is true, "the difficulty of prevention would be enormously aggravated. The seriousness of the problem . . . makes it imperative that skilled investigations . . . be conducted without loss of time."

The progress of palæobotany is marked by the appearance of a publication, *Die Palaeobotanische Literatur*, of which the first volume, dealing with the literature that appeared in 1908, has been issued by the firm of Gustav Fischer, Jena. The bibliography not only cites papers devoted primarily to palæobotany, but includes papers on recent botany, in which fossil plants are discussed. The greater part of the volume, which exceeds 200 pages, is taken up by the enumeration of genera and species with references to the various papers where they are mentioned. The compiler, Dr. W. J. Jongmans, of Leyden, makes an appeal for assistance in the shape of literature and papers as published.

THE systematic position of the tropical American genus Phytelephas, well known because the stone-like endosperm furnishes a cheap substitute for ivory, is discussed by Mr. O. F. Cook in vol. xiii., part v., of "Contributions from the United States National Herbarium." The author traces an affinity with Manicaria, a Central American genus, in the number of stamens and the fruit, besides noting an agreement with Attalea in the germination of the seedling. This leads to the formation of a family, Manicariaceæ, connecting the Phytelephantaceæ with the Cocaceæ. At the same time, the author controverts a family relationship between Nipa and Phytelephas.

PROF. H. MOLISCH communicates to the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxviii., part ix.), a note on local coloration of the cell wall in certain water plants induced by manganese compounds. The introduction of manganese salts into cultures of Elodea produces, after a few days' exposure to light, a deposition of brown matter in the outer walls of the epidermis which on continued exposure tends to mask the green pigment in the leaf. The author notes that the deposition takes place only when the plant is exposed to light, and that a similar result was obtained in leaves of Vallisneria, *Ranunculus aquatilis*, and Myriophyllum. The chief point of interest lies in the fact that it furnishes a definite instance of localised action produced by the absorption of a specific element.

DURING the coming December an exhibition is to be held at Allahabad, at which a special feature will be the display of small light machinery for use in agriculture and the allied industries. A pamphlet entitled "Northern India as a Market for Agricultural Machinery" has been issued, not only with the purpose of interesting manufacturers in the exhibition, but to give useful information to those who have in the past found it difficult to ascertain the special requirements of the vast Indian market. It should serve its purpose admirably.

THE fertilising value of seaweed has for some time past been the subject of a long arbitration case in Scotland. From the reports that have appeared in the *North British Agriculturist*, it seems that three farmers were deprived of their rights to gather seaweed when the Admiralty resumed possession of the foreshore at Rosyth for the purposes of naval construction. The facts were not contested, and the only dispute was as to the value of the seaweed. Experts and practical men were called on both sides, and the values assigned varied from 1*s.* per ton to 9*s.* 3½*d.*; in the end the arbitrator fixed 4*s.* 9*d.* and awarded compensation on this basis. As the case has been going on for eight months a considerable amount of money must have been spent, while it cannot be said that any material addition to our knowledge of the subject has been gained in consequence. The problem could only be solved by experiment, and it is reverting to the methods of the mediæval schoolmen to attempt to settle it by collecting "opinions."

THE tobacco produced in India has not hitherto been held in high repute, nor has success been attained by the introduction of American varieties and methods of curing. Mr. and Mrs. Howard have for some time been engaged in a study of the varieties already grown in the country, and have published their results in vol. iii. of the Memoirs of the Department of Agriculture in India. Perhaps no other factor in the production of high-grade tobacco is so important as uniformity in the crop, both as regards growth and also as regards the type of plant grown. Unless the crop ripens evenly the difficulties of harvesting and curing are increased, whilst a crop made up of several types of plant is not readily sorted out into uniform grades. The various types of *Nicotiana rustica* and *N. tabacum* are described in sufficient detail, and typical photographs are given. A great deal of patient work of this kind is necessary before the breeding of new varieties can usefully be begun.

PROF. A. L. ROTCH has contributed to the epitome of the *Aëronautical Annual*, 1910, a useful article on the relation of the wind to aërial navigation. After explaining the methods of investigating the upper air employed at Blue Hill Observatory and elsewhere by means of kites and sounding-balloons, he refers to the results of the upper wind observations in the eastern United States and to the recent discussion of the data by Mr. A. H. Palmer. The surface wind at Blue Hill (200 metres) has a mean annual velocity of 7·1 metres per second (15·8 miles per hour), and increases with height, as follows:—

Height in metres	550	1000	2500	3500	5400	6400
Mean velocity, m.p.s.	9·8	10·7	12·5	15·5	24·9	27·1

and the increase continues to the greatest heights; at 9500 m. it is 35·8 m.p.s. (80·8 miles per hour). The mean range from summer to winter increases very greatly with height:—

Height in metres	200—1000	1000—3000	3000—5000	5000—7000
Velocity in summer	7·5	8·2	10·6	19·1
Velocity in winter	8·8	14·7	21·6	49·3

the velocity of the upper winds in winter being more than double the rate in summer. The velocity increases nearly twice as fast at night as in the daytime up to about 500 m.; above that height there is a decrease, except in winter, up to 1000 m., and then a steady increase. The author points out that at night a suitable level for aërial navigation in summer is 1000 m.; in the daytime it is necessary to ascend above the cumulus clouds. Over the temperate regions the surface winds are obviously constantly changing their direction; above these shifting winds, the balloons sent off from St. Louis showed that the direction is generally westerly. Above the height of a mile the mean direction was from west-north-west.

THE results of a series of investigations by Messrs. de Broglie and L. Brizard, on the ionisation of gases in presence of chemical reactions, are summarised by the authors in the June number of *Le Radium*. Of the three methods adopted by the authors, that in which the ultra-microscope is used has proved the most powerful. The chemical reaction to be investigated is carried out under the microscope and between two charged plates which produce an electrical field across the line of vision. Any charged particles produced by the reaction are moved towards one or the other plate, according to the sign of the charge. A large number of reactions have been observed in this way, and the authors conclude that in none is the ionisation, if produced, due primarily to the chemical reaction, but to secondary effects, such as the bubbling of a gas through a surface of separation of two fluids, or the breaking down of crystalline structure and the projection of particles which become charged by friction with the surrounding medium, or, lastly, to the incandescence produced by the heat of reaction. It will be evident that many observations hitherto unexplained will be capable of explanation on lines suggested by these results.

In a paper entitled "Absorption and Adsorption with Reference to the Radio-active Emanations," published in the Bulletin of the Macdonald Physics Buildings of McGill University, Dr. R. W. Boyle shows that the radio-active emanations behave as all ordinary gases in obeying the laws of solution and of gaseous adsorption. In the case of thorium emanation, the experiments described show that the amount of emanation absorbed by charcoal is proportional to the concentration of the emanation in the gas in contact with it. The absorption also depends on the nature of the charcoal and the amount of surface exposed, and, as with ordinary gases, the absorption decreases with increase of temperature. On comparing the results of several experiments, it appears that thorium emanation is four times as soluble in water as radium emanation, but in petroleum the former is only half as soluble as the latter. Experiments with thorium emanation showed that this gas is less soluble in solutions such as copper sulphate and calcium chloride than in pure water, and the most powerful solvents used were petroleum and alcohol. The order of the solubilities of radium and thorium emanations in different solvents was found to be the same. The paper concludes with a brief notice of current ideas on adsorption, and there is appended a bibliography on the subjects treated.

THE University of Illinois Bulletin No. 41 contains an account of tests made on timber beams by Mr. A. N. Talbot. The tests were made with the view of adding data on the properties of timber in the form of stringers, as used in many railroad structures. The timber stringers were 8 inches by 16 inches by 15 feet to 7 inches by 12 inches by 14 feet in size. One hundred and twelve samples in all were tested, including long-leaf pine, short-leaf pine, loblolly pine, and Douglas fir. The load was applied equally at one-third points of the span length. The dimensions of the specimens were such as to bring out the strengths of timber in horizontal shear. The influence of knots, seasoning checks, and wind shakes can be traced in the results. Much of the data in existence is based on tests made on small specimens, and a valuable feature of the present series consists of the results of tests on minor specimens cut from the stringers. The flexural and shearing strengths of these smaller specimens were determined, and the relation of their properties to those of the full-sized stringers may be studied from the results given. In addition to many tables of results, the bulletin includes photographs showing characteristic fractures under the bending and shearing tests.

OUR ASTRONOMICAL COLUMN.

A CENTRAL BUREAU FOR METEOR OBSERVATIONS.—Under the auspices of the Astronomical Society of Antwerp, a central office has been established for the collection and coordination of observations of meteors. A beginning was made in 1907, and in twenty-two months 5900 observations were recorded by forty observers in thirty-six localities. This essay showed that a much wider organisation was desirable, and the new Bureau Central Meteorique hopes to receive the cooperation of all observers of meteors, amateurs and otherwise, the world over. In the Publication No. 1 is given a complete set of directions and advice, so that anyone, astronomer or not, who can observe regularly, may at once join in the international cooperative scheme. In a circular which accompanies the publication, M. Birkenstock points out that the expenses of the new organisation will be large, and asks all those interested in meteoric astronomy to assist by making an annual subscription of at least 5 francs.

THE ROTATION OF SUN-SPOTS.—To No. 4429 of the *Astronomische Nachrichten* Herr P. Kempf contributes some interesting results derived from sun-spot observations made during 1891–3.

A number of solar observers have been unable to establish any definite rotation of sun-spots, but here the observer shows from careful observations that in thirteen cases there was a distinct rotatory movement of the spot about its own centre. Seven of these occurred, in the northern, and six in the southern, hemisphere, but there appears to be no relation between the direction of the rotation and the latitude—north or south—of the spot; only in two cases in each hemisphere was the motion in the negative (*i.e.* N.W.S.E.) direction. In one case (Greenwich spot-number 2277, August 5–10, 1891) the spot rotated 139° in eleven days, while the average daily motions ranged between 7° and 37°; for the northern hemisphere the mean was 11°, and for the southern 20°.

HALLEY'S COMET.—An interesting popular summary of the phenomena presented by Halley's comet during its recent apparition is published in the July number of *The World To-day* by Prof. Frost. Discussing the "never-to-be-forgotten spectacle" presented by the 100° tail seen about the time of the comet's passage, Prof. Frost affirms that the earth probably passed through a part of the tail on the morning of May 19, and suggests that we were within the forks, or separate streamers, of it for two days following, hence the east and west tails. The strangely iridescent clouds, with a kind of horizontal "rainbow," seen at the horizon, may also have been due, at least in part, to the presence of cometary dust.

Some excellent photographs were secured by Mr. Ellerman, who led a comet expedition to the Hawaiian Islands.

LARGE METEORITES.—A description of the Guffey meteorite, discovered by two cowboys near Guffey, Park County, Colorado, in 1907, is given by Mr. Edmund O. Hovey in a reprint from the *American Museum Journal*, vol. ix., pp. 237–48.

This object is a siderite 36·5 inches long, 15 inches maximum height, and 8 inches wide. The mass is roughly pear-shaped, and weighs 682 lb. Two sides show well-developed "thumb marks" or "piëzoglyphs," but on another, which is nearly straight, these are not so well developed; the author suggests that the straight edge and lack of marks indicate that the mass split into two or more parts when near the end of its flight, and that another part may, therefore, yet be found. The mass is very homogeneous, and chemical analysis shows it to contain 88·7 per cent. Fe, 10·5 per cent. Ni, 0·5 per cent. Co, with traces of Cr, C, S, and P; the specific gravity is 7·939. It is supposed that this may be the remains of a vivid meteor which was observed to pass over the Fresh-water River region during the autumn of 1906; it now lies in the foyer of the American Museum.

Mr. Hovey also describes two other recent additions to the foyer, viz. a slice and cast of the Gibeon meteorite and the largest known portion of the Modoc meteorite. The Gibeon meteorite, weighing 562 lb., was discovered in Great Namaqua Land (lat. 25° 8′ S., long. 17° 50′ E.), and is in the possession of the Hamburg Natural History Museum. A slice of this and a plaster cast were sent to the American Museum, where it is ingeniously mounted with the slice *in situ*, the two halves of the cast being hinged so as to show the complete form with the polished surface of the slice.

The "Modoc" is the largest known portion (20 lb. 3 oz.) of a meteorite seen to fall near Modoc, Scott County, Kansas, on September 2, 1905. Twenty-five fragments have been found, and, where pieces have been broken off by the plough, the meteorite is shown to be composed of whitish stony material containing bright specks of iron.

Photographs of the Guffey and Gibeon meteorites illustrate the paper.

THE UNITED STATES NAVAL OBSERVATORY.—The report by the superintendent for the year ending June 30, 1909, shows that the Astronomical Council, consisting of the various officers and assistants at the U.S. Naval Observatory, is fulfilling a useful function in formulating the programmes of work for the various instruments. During the year, the 6-inch and 9-inch transit circles were thoroughly examined for their fitness for fundamental work, and various adjustments and modifications were made. The latitude-variation observations made with the prime vertical instrument were compared with those made with zenith telescopes at Philadelphia, Cincinnati, and Gaithersburg, and were found to give different values. The cause of this difference between the values given by the two forms of instrument was carefully looked for in the prime-vertical observations, but could not be found. Prof. Skinner was engaged until the end of the year in preparing material for the discussion of the proper motions of the 8824 stars observed by him, and published in the A.G. Zone Catalogue $-13° 50'$ to $-18° 10'$, but the work cannot be carried further until the cataloguing of the Washington zone observations, 1846–52, is completed.

Measures of Double Stars.—Prof. Burnham continues his record of double-star measures in Nos. 4426–7 of the *Astronomische Nachrichten*, where a large number of measures, made with the 40-inch telescope during 1909, are given. Particular attention was paid to doubles generally neglected or little known, also to measurements for the better determination of the proper motions of faint stars and of doubles where the motions are small or uncertain.

THE BRITISH MEDICAL ASSOCIATION IN LONDON.

The seventy-eighth annual meeting of the British Medical Association was held in London, for the first time since 1895, on July 26–30, in the buildings of the University of London. There was a very large attendance, which included a number of foreign guests and over-sea delegates and members. The Earl of Crewe and the Right Hon. Walter Long, M.P., were elected honorary members. Reference was made to Mr. Long's work, which resulted in the abolition of hydrophobia from these islands. Mr. Henry T. Butlin, the famous surgeon, was elected president. At the commencement of the proceedings he announced, amid loud cheers, that the King had signified his willingness to become patron, as his revered father was before him. The president in his address directed attention to the persevering work of the association since 1834 in placing the medical profession upon an increasingly satisfactory footing. He referred to the valuable assistance given by the association to the cause of original research. Since 1874, when scientific grants were founded, large sums have been awarded every year for research work. In 1884 two research scholarships were founded to enable men to devote their whole time to particular researches. Mr. Butlin pointed out that it was desirable to encourage research even though there were no prospect of immediate benefit from the particular line of research taken up, and he instanced cases in which an apparently unproductive investigation had led to results of vast practical importance.

At the present time the association consists of twenty-two thousand members in seventy branches. The business of the recent meeting took place in twenty-one sections dealing with particular branches of medical science, and in each section the line of inquiry which is receiving particular attention at the present time was given full discussion, foreign investigators taking a prominent part in the discussions in many of the sections. In the section of radiology and medical electricity, Sir J. J. Thomson, F.R.S., gave an address in which he pointed out that the softer rays given out from an X-ray tube were inevitably absorbed by the glass wall of the tube, and were therefore not available for application in medical treatment. He then directed attention to the researches of Prof. Barkla, of King's College, who found that substances such as metals when exposed to Röntgen radiation emitted secondary rays, the penetrating power of which was specific for the particular metal, and was independent of the penetrating power of the rays which impinged upon it. The rule was a simple one, for the hardness of the ray given out increases as the atomic weight of the metal. The only necessary condition is that the rays emitted from the X-ray tube must be harder than the specific radiation of the substance. Only substances the atomic weight of which is greater than that of calcium are found to give out these secondary rays. We have thus the power of using rays of uniform penetration for medical treatment. Thus if silver be used, the secondary rays which it gives off are about equal in penetrating power to the β radiation of radium. With iron the radiation is considerably less penetrating, while with tin it is more penetrating; with iodine, extremely penetrating radiation is given off. A large number of other papers were read bearing on Röntgen-ray diagnosis and treatment, and the great advance that has been made in Röntgen-ray diagnosis came prominently to the fore. Thus the papers of Dr. H. Orton and Dr. A. C. Jordan on phthisis showed this method to be a most valuable and trustworthy means of detecting phthisis in its early stages, and of determining the extent and position of the lung trouble. In the section of medicine, Dr. A. C. Jordan also read a paper on the Röntgen-ray appearances of thoracic aneurysm, and the lantern-slides with which it was illustrated showed very clearly the condition of the heart and great arteries in this disease. In many other sections the value of Röntgen-ray diagnosis was also evident. Thus the first session of the surgery section was devoted to a discussion of the operative treatment of simple fractures, in which Mr. Arbuthnot Lane described his method of uniting the severed fragments by means of metallic plates and screws, and in his paper, and all those that followed it, the conclusions were founded, to a very great extent, upon the Röntgen-ray appearances of the fractured part.

The discussion on chronic constipation turned very largely on the Röntgen-ray examination of the large bowel after the patient had taken a meal containing an insoluble salt of bismuth. This discussion was opened by Dr. J. F. Goodhart, who pointed out that constipation in old persons was frequently due to failure of voluntary effort. He said he held a brief for the importance and utility of the large bowel in opposition to those who, following the teaching of Metchnikoff, have come to regard the large bowel as a mere place of storage for the waste material of the food, in which poisons were generated which were very apt to be injurious. The large bowel, he stated, is meant to be full, not empty. Mr. Arbuthnot Lane said that in certain cases poisons were actually generated in the large bowel to such an extent that the patient's life was intolerable. In such cases he had removed a part or the whole of the large bowel with great benefit to his patient.

Drs. Dominici and Wickham came from Paris to discuss the subject of radium treatment. They made it clear that cancer in accessible regions can be greatly reduced in size by radium treatment, and can in certain cases be actually cured. In the case of large, deeply seated growths, a cure is not to be expected, although great diminution in size may be effected and much relief afforded. Various special forms of apparatus have been devised for applying radium to internal growths such as those of the throat, œsophagus, and stomach. Early detection of the cancer and early application of radium are the most important points.

In pathology and bacteriology, a number of important papers were read by those most fitted for the task. Thus Colonel Sir David Bruce, C.B., F.R.S., discussed human trypanosomiasis, while the paper of Prof. Wassermann, of Berlin, opened a discussion on the complement-deviation method in diagnosis—the method which he introduced for the diagnosis of syphilis, and which is now used for this purpose throughout the world. Its application to certain other diseases is now being worked out, so that it is one of the most important matters before the pathologists at the present day. A discussion on the lactic acid organisms took place, at which Prof. Hewlett was among those who took part. There was a most important discussion on the effect of digitalis on the human heart, opened by Prof. Wenckebach, of Gröningen. He was followed by Dr. James Mackenzie, Sir Lauder Brunton, and others.

The subject of dental decay was given very full discussion. It is now taught that both doctors and patients should regard decay of the teeth as a serious danger-signal, and the wholesale decay in young people and in many families so prevalent at the present time requires urgent attention. Foods that are too soft or too finely prepared are frequently causes of dental decay, and many serious illnesses, as well as cases of chronic debility, are due to poisons absorbed from the roots of decayed teeth.

The sour-milk cure, which is now in great vogue, was fully discussed from all points of view, and its benefit in suitable cases was placed beyond doubt. More practical evidence is needed, however, and the discussion will have done much to point out the directions in which this evidence should be sought.

An address on surgery was delivered by Prof. Gilbert Barling, in which he discussed the treatment of cancer. He referred in terms of praise to the work of the Imperial Cancer Research. There was evidence that the tissues resisted the inroad of cancerous growths, though little was as yet known of the nature of the resistance. We had not yet discovered the factors which heighten or lower this power of resistance. In considering the means available for the cure or relief of malignant growths, he discussed the application of X-ray and radium treatment. His conclusions were, on the whole, in agreement with those of Drs. Dominici and Wickham. He emphasised the fact that a genuine cure is not to be expected from these agents in cases of advanced cancer, and he further emphasised the great importance of early detection. Only one real opportunity for cure existed, and this was at the first operation, which should be undertaken at the earliest possible stage of the disease, and advantage of this opportunity should be pressed to its fullest extent.

Dr. J. Mitchell Bruce, in his address in medicine, gave a brief record of the most important additions to medical knowledge during the period since the association last met in London.

First came the discovery of the spirochæte of syphilis; of the part played by the mosquito in malaria and in yellow fever, and by the goat in the diffusion of Malta fever; of the connection of a trypanosome with sleeping sickness; of the Leishman-Donovan body with kala-azar; and of the *Diplococcus intracellularis meningitidis* with cerebro-spinal fever. The existence of typhoid carriers had been fully demonstrated, as well as the dangers of other typhoid products than the stools. The effects of oral sepsis had been worked out, and proved to be so widespread, so multiple, and frequently so grave, as to make us ashamed of our previous blindness to a common source of blood infection staring us in the face all those years. Autointoxication proper had attracted professional—and only too much public—attention, and led to the introduction of a great variety of dietetic and medicinal "cures." Of improved methods of observation and diagnosis, blood examination deserved first mention; and special interest and importance attached to the Widal reaction in typhoid and to the Wassermann reaction in syphilis. Radioscopy, which was coming into clinical use in 1895, had been greatly improved and extended, more particularly in its applications to the investigation of gastric and intestinal disorders and diseases; and the orthodiagraph must be mentioned in this connection. A great impetus had been given to the study of cardiac irregularity, and the sphygmomanometer was now generally employed. A real advance had been made in the introduction of lumbar puncture as a means of diagnosis in cerebro-spinal diseases.

"During these fifteen years several new methods of treatment of the first rank have been either introduced or perfected. Chief of all comes serum-therapy and vaccine-therapy. Of great importance is the employment of spinal analgesia as a substitute for general anæsthesia, the dangers of which have been closely investigated in relation to the status lymphaticus, as well as to post-anæsthetic acid intoxication. Other powerful means of treatment have been discovered in radium, in the Röntgen rays, and in the Finsen light."

A very complete medical museum formed an important part of the meeting. It included a very valuable series of microscopical preparations showing the blood parasites of malaria, sleeping sickness, and other tropical diseases. The Imperial Cancer Research showed a beautiful collection of specimens, lantern-slides, and diagrams giving a very good idea of the valuable methodical work which is being carried out by this institution under the directorship of Dr. E. F. Bashford. In the museum, the value of Röntgen-ray diagnosis was again to the fore, for many of the sections showed negatives, prints, lantern-slides, or diagrams to illustrate the Röntgen-ray appearances in various diseases. There was also a large exhibition in which numerous firms of publishers, instrument makers, chemists and druggists, and manufacturers of special foods and dietetic preparations showed their most recent work. In the electrical apparatus section, the great power of the modern generating apparatus was very obvious, each firm being able to show apparatus capable of giving so powerful a spark that a Röntgen-ray photograph could be taken by a single flash. Different contrivances were shown to accomplish this, including various forms of mercury jet interrupter, of electrolytic interrupter, and the well-known Snook apparatus, in which an alternating current is generated and transformed by means of a step-up transformer placed in a bath of oil, the secondary current being rendered unidirectional by a simple contrivance. A new apparatus was shown by Messrs. Schall for raising the internal temperature of the body by employing the thermal effect from a high-frequency apparatus. In a spark-gap where the electrodes are separated only by the thickness of a sheet of paper, undamped oscillations are generated at the rate of more than a million a second. Similar oscillations are used in wireless telegraphy for the production of continuous oscillations. The voltage of this new type of generator is less than 3000, but currents of 500 to 3000 milliamperes are used, and the patient feels nothing except the rise of temperature. The method is said to be useful in chronic cases of rheumatic and gouty origin.

The social functions included a reception by the Corporation of the City of London at the Guildhall, a garden-party at Ranelagh, receptions at the Natural History Museum and at a large number of hospitals. Special services were held in Westminster Abbey and Westminster Cathedral.

There was a large and distinguished assemblage for the annual dinner, at which Dr. Butlin presided. The Earl of Aberdeen, Lord-Lieutenant of Ireland, emphasised the good work of the British Medical Association, and expressed his opinion that those responsible for measures of social and hygienic reform should come to the association for direction as to the best means by which such reform can be carried out. As an example of a much needed reform, he dwelt on the unnecessary and noxious fumes from motor-cars. In referring to the valuable scientific papers delivered at the various sectional meetings, he selected for special note the paper by Sir J. J. Thomson, the eminent Cambridge physicist, in which he pointed out that certain substances could be made to give out a radiation which had much the same physical properties as some of the radiation given out by radium, and suggested that these radiations might be found to have the same effect upon the tissues as those at present obtained by the application of radium.

The Bishop of Kensington, speaking at a breakfast given by the National Temperance League, said that temperance owed no small debt to the British Medical Association for the new light it was constantly throwing on scientific investigation. It was to the professional men rather than the politicians that we must look for the solutions of the social problems of the day, foremost among which was that of temperance.

Thus medical progress was discussed in all its aspects at this—the greatest annual meeting by far ever held by the British Medical Association—and the discussions added new vigour to the work of observation and investigation.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of the Institution of Mechanical Engineers took the form of a joint meeting with the American Society of Mechanical Engineers. More than one hundred and fifty members of the latter society took part in the meeting, which opened in Birmingham on Tuesday, July 26. The reading and discussion of papers occupied the mornings of Tuesday and Wednesday, and on Thursday the party proceeded to London, where a conversazione was held at the Institution House in Westminster. On Friday morning further papers were read and discussed in the lecture hall of the Institution of Civil Engineers, kindly lent for the occasion. The institution dinner took place on Friday evening. The many excursions and visits to works were attended by large numbers of members of both societies and their lady friends.

At Birmingham, four papers on the handling of locomotives at terminals and running-shed practice were contributed by Messrs. F. H. Clark, F. M. Whyte, H. H. Vaughan, and W. Forsyth, all members of the American Society, and one on the same subject by Mr. Cecil W. Paget, member of the British Institution and general superintendent of the Midland Railway.

In the latter paper, Mr. Paget gives plans and description of two of the most recent sheds built in this country, viz. the Great Western sheds at Old Oak Common, of the centre turntable or round-house type, and the London and South-Western shed at Eastleigh, of the through straight type. Straight sheds are economical in first cost and maintenance, but unless they are of the type known as "through sheds" they are awkward to work; the latter class are necessarily draughty. The centre turntable type, though more expensive to build, possesses considerable advantages of working, because engines can be easily got in and out without moving others, and, in addition, better lighting and convenience in getting about and in bench accommodation are possible. There is, however, the disadvantage that when the turntable requires lifting for repairs it throws the whole of the pits served by it out of use whilst the repairs are going on. So far as possible, engines are allotted to and kept for the same drivers, and this is almost universally the rule in the case of passenger engines on most English railways. By this plan casualties are lessened owing to the greater care taken by the driver in working the engine and in properly reporting defects; as a result, the coal consumption is generally less.

Mr. F. M. Whyte, of New York, describes American methods of handling locomotives at terminals. To insure uninterrupted turntable service, two turntables may be supplied in a circular engine-house, the house being divided into parts, each having a turntable. Mr. Whyte deals very fully with the question of pooling locomotives, *i.e.* the system of increasing the service of the locomotive by placing any crew on any locomotive for service instead of holding it until its assigned crew could obtain the necessary rest. Extensive experiments have been made to determine the relative costs of the assigning and the pooling systems, and in some of these experiments no material difference in cost has been found. There probably is some loss in trustworthiness of service in pooling.

Some very good drawings and photographs of American engine-houses and their appliances are given by Mr. F. H. Clark, of Chicago. A common length of turntable for new installations is 80 feet. For boiler-washing, recent installations are the National, in which the steam and water blown off from the engines are used for washing out and for heating fresh water, and the Raymer system, which is of the enclosed-heater type, and performs similar functions. Mr. W. Forsyth, of Chicago, describes the arrangements of the Pennsylvania Railroad at East Altoona, Pa. The engine-house is in diameter and cross-section the largest structure ever erected for this purpose, having an exterior diameter of 395 feet and a turntable of 100 feet. There are fifty-two stalls, each 90 feet deep. Mr. Forsyth states that the reduction in boiler pressure from 225 lb. to 160 and 180 lb. has also reduced the number of boiler failures, and has permitted the more continuous use of locomotives which results from the pooling system. Mr. H. H. Vaughan, of Montreal, considers that in passenger service pooling is objectionable under any conditions, and should be avoided if possible. In freight service he considers that pooling is advisable if conditions are such that engines cannot be run with assigned crews. His experience is that where assigned crews can be used on engines, the cost of repairs, the amount of fuel consumed, and the class of service obtained will all be more satisfactory.

Other papers read at Birmingham were one on tooth gearing by Mr. J. D. Steven, of Birmingham, and another on interchangeable involute gearing by Mr. Wilfred Lewis, of Philadelphia, Pa. Mr. Steven considers the involute form of tooth only, as being that which is in most general use, and would welcome uniformity of opinion in the matters of cutting and using gearing. If a new form of tooth is desirable, it is his opinion that the stub form with 20 degrees angle of pressure would be a change in the right direction for the following reasons:—it can be used right down to twelve teeth in its true form, and cut on either a single cutter or on a generating machine; it is a stronger form than that most commonly used at present; a very large proportion of its face does useful work; the possible objections on the score of less contact and greater bearing pressure are so slight as to be nearly negligible.

Mr. Wilfred Lewis is chairman of a committee of standards for involute gears appointed about a year ago by the president of the American Society of Mechanical Engineers. Twenty-five years ago, as a result of investigations made on behalf of the firm of Wm. Sellers and Co., he recommended the adoption of a pressure angle of 20 degrees in place of 15 degrees commonly used. This practice has been since followed by the firm, and has given satisfaction in a general way. Mr. Lewis has since advocated an obliquity of 22½ degrees as giving less interference on twelve-toothed pinions. Experiments on behalf of the author's committee are being made at the Massachusetts Institute of Technology, and, although not conclusive, enough has been done to indicate that the friction loss in gear-teeth is influenced to a greater extent by the length of the addendum than by the obliquity of the system.

The papers read and discussed in London dealt entirely with problems connected with the electrification of railways. These were contributed by Messrs. F. W. Carter, of Rugby, H. M. Hobart, of London, W. B. Potter, of Schenectady, L. R. Pomeroy, of New York, and G. Westinghouse, of Pittsburg, the latter being the president of the American Society of Mechanical Engineers.

Mr. Carter directs attention to electrification as a means of recovering traffic drawn away from the railway by tramcars and motor-omnibuses, an expedient which has invariably been found successful in regaining much of the lost traffic. Modern electric railway apparatus leaves little to be desired in the matter of freedom from breakdown. There are about 200 miles of electrified route in this country, for the most part worked by motor coaches, employing a multiple-unit system of control. There appears little prospect of general electrification of the railways of this country, as no advantage is apparent which would in any way justify the expense.

Mr. Hobart draws comparison between systems employing series wound, continuous-electricity train-equipments, and the single-phase system. Continuous equipment provides, per ton of equipment, 11 horse-power at the axles (averaged over the journey), as against 6 horse-power per ton in the case of single-phase equipment. Mr. Hobart gives figures showing that 10 per cent. less of the takings are available for dividend paying in the single-phase system than in the continuous-current system.

Mr. Westinghouse is convinced that the extended distribution of electricity for industrial purposes can be secured only by the generation of alternating currents of high voltage and their conversion by static transformers into currents of various voltages, and has developed his business along these lines. He earnestly recommends to the serious consideration of railway engineers and those in authority the pressing need of determining the system which admits of the largest extension of railway electrification, and of a prompt selection of three standards of electrification which will render possible a complete interchange of traffic in order to save expense in the future and to avoid difficulties and delays certain to arise unless some common understanding is arrived at very shortly.

Mr. Potter considers that the development of apparatus for higher voltage direct-current has so far increased its scope that direct current at 600 volts or higher may be considered the most economical for city and interurban service. Single-phase and three-phase stock equipments are applicable only to exceptional conditions.

Mr. Pomeroy deals with the electrification of trunk lines, and concludes with the following paragraph, which called forth the commendation of Mr. Aspinall, the president of the Institution of Mechanical Engineers. The idea is all too prevalent with the public, and even with some of the bodies that have been given legal power of supervision over railway companies, that any expenditure which can be forced upon the railway companies is just so much gain for the public. Never was there a more absolute fallacy. In the long run, the cost of every bit of railway improvement must be paid for by those who buy tickets and ship freight. Economy in the administration of our railways is just as important in the interest of the general public as if the railways were actually under Government ownership.

THE BRITISH PHARMACEUTICAL CONFERENCE.

THE forty-seventh annual meeting of the British Pharmaceutical Conference was held at Cambridge on July 26, 27, and 28, under the presidency of Mr. F. Ransom. The presidential address dealt mainly with pharmaceutical research, and Mr. Ransom indicated certain directions in which progress may be anticipated. He deplored the fact that a better organisation did not exist to bring together the two classes of investigators—pharmacists and pharmacologists. If a joint committee consisting of medical men and pharmacists were appointed with the object of organising research work, investigations might be directed in the proper channels, and better results would be obtained. The president dealt at some length with the question of the cultivation of medicinal plants, and commented upon the attempts which had been made to obtain plants of more or less standard alkaloidal content. He suggested that a subject inviting investigation was whether the variations in the constituents of drugs were due solely to the seasons, or whether they depended upon other conditions. Referring to the subject of the standardisation of disinfectants, which has recently received much consideration, he said that neither the chemical nor bacteriological processes which had hitherto been devised seemed to be applicable in all cases, although for specific purposes comparisons of efficiency might be deduced.

In addition to the president's address, twenty-one papers were communicated, the larger number of which were of purely pharmaceutical interest. The papers which aroused the most considerable discussion were those dealing with the testing of disinfectants.

In a paper contributed by Prof. Sims Woodhead and Dr. C. Ponder, the authors made clear their position in regard to the question of standardisation of disinfectants. On analysing the Rideal-Walker drop method, they picked out and gave consideration to the following factors:—organisms to be acted upon; number of micro-organisms and amount of organic matter to be added; strength and number of dilutions; time during which the disinfectant is allowed to act; temperature. Prof. R. T. Hewlett in his paper criticised the Woodhead-Ponder method, but expressed the opinion that the use of *B. coli* instead of *B. typhosus* is perhaps a desirable change, although further investigation is necessary.

Mr. C. T. Kingzett and Mr. R. C. Woodcock contributed a paper, in the course of which it was pointed out that while the Rideal-Walker test may very well serve to determine the relative germicidal values of similarly prepared preparations of a coal-tar nature, it is not applicable for ascertaining the real or relative value of other disinfectants of a different chemical nature. Dr. D. Sommerville also read a paper. There was a long discussion on these papers, in which Dr. Rideal, Dr. E. Feilmann, Mr. J. E. Purvis, and others took part, and in the course of reply Prof. Sims Woodhead said he did not wish to doubt the value of the Rideal-Walker method, because he thought it was of extreme value, but they must not be expected to accept it as a final standard.

Another paper to which reference may be made is that by Mr. J. F. Tocher, last year's president of the conference, in which the author describes a modification of Mendeléeff's classification of the elements; the suggested new arrangement, which the author thinks may ultimately prove to have a satisfactory theoretical basis, places elements of like properties in similar positions, while elements with unlike properties are separated by distances proportional to the intensity of their differences.

In a paper on the interpretation of water analysis reports, Mr. J. E. Purvis pointed out the impossibility of fixing any standard by which waters can be judged and condemned; but, he said, there were certain rules which appeared to be necessary before a final judgment could be delivered upon any water. These were briefly as follows:—(1) the history of the water should be supplied to the analyst; (2) the rainfall before and after the analysis should be obtained, because a heavy rainfall before analysis means that the amounts of the constituents are not the same as compared with the analysis before the rainfall; (3) the method of storage and of distributing the water should also be considered; (4) the surface drainage may be a factor; (5) a bacterial analysis should go hand in hand with a chemical analysis; (6) the final judgment with regard to the quality of a water should rest with the chemist and bacteriologist in collaboration.

Mr. P. E. F. Perrédès described an insect pest in belladonna (*Epitrix atropae*, Foudras, a small beetle belonging to the tribe Halticæ of the series Phytophaga), and suggested a method of eradication.

As a result of a chemical examination of the rhizome of *Cimicifuga racemosa*, Mr. H. Finnemore found distinct reactions for alkaloids, but the amount present is very small.

The meeting, as a whole, was one of the most successful which has been held for many years. The attendance was somewhat larger than usual, and the interest taken in the papers was evidenced by the excellent discussions thereon.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

THE ninth annual meeting of the Association of Economic Biologists was held on July 6, 7, and 8 in the Beyer Buildings of Owens College, Manchester. The association was indebted in particular to Profs. Hickson and Weiss for kindly hospitality, and to Mr. J. Mangan for the arrangements he had made as local secretary. Prof. G. H. Carpenter, of the Royal College of Science, succeeded Mr. A. E. Shipley, F.R.S., as president, and in the course of his address dwelt on the close interdependence of research in so-called "pure" and "applied" science. The original discovery of minute protozoal parasites in the blood of various animals was apparently perfectly "useless," yet it prepared the way to modern methods of dealing with terrible diseases of the tropics, such as malaria and sleeping sickness. Similarly, the more recent researches of workers intent primarily on alleviating these diseases have resulted in many discoveries of great theoretical significance.

Turning to another topic, Prof. Carpenter reported that a new crop—tobacco—in Ireland had brought to notice fresh pests, amongst others, a spring-tail new to science. He suggested that this was not a new introduction, but more probably an animal hitherto present in small numbers, which had multiplied under the stimulus of an ample supply of a congenial food plant.

A very interesting discussion arose out of Prof. S. J. Hickson's paper on the place of economic zoology in the modern university. The author pointed out how at present the demand for trained men capable of dealing with agricultural and other pests is in excess of the supply, especially in the colonies. He outlined a scheme for securing to students an efficient grounding in general science combined, by cooperation with experiment stations, with proper practical experience. Stress was laid on the importance of the fourth year's work, and the advisability of securing, if possible, training at a central agricultural college or experiment station, *e.g.* in India or Ceylon, for those destined for a tropical career.

Another well-discussed and important topic was the problem of wild-bird protection, introduced by Mr. W. E. Collinge, who pointed out that under the restrictions imposed by the Wild Birds' Protection Acts some birds had apparently multiplied to an excessive degree. He advocated securing definite knowledge as to which birds were harmful, and taking steps to secure their diminution, *e.g.* by placing in schools specimens of the eggs of such birds, and offering rewards for their collection. The discussion brought out prominently the difficulty of determining exactly whether certain birds, *e.g.* the rook, were beneficial or harmful in all districts and at all seasons; and practical suggestions, some of which are already being utilised, for acquiring this necessary knowledge were made.

Prof. F. E. Weiss contributed the results of observations on the garden Tropæolum, some plants of which bore flowers of different colour at different seasons of the year. These and other cases of differing flower coloration, *e.g.* in *Anagallis arvensis*, are under investigation to ascertain to what degree they are hereditary characters, and to which factors the changes are to be attributed.

Animal pests naturally received considerable attention. Dr. R. Stewart MacDougall emphasised the importance in dealing with coleopterous enemies of trees of taking account of the length of life passed in the various stages, whilst in a second paper he dealt with the sheep-maggot fly (*Lucilia sericata*) and the problems suggested by its life-history, and announced the first record in this connection of *Protocalliphora azurea*. Other pests dealt with were the warble-fly of the reindeer, by the president; a species of Rhabditis injurious to cress, by Mr. G. O. Sherrard; the horse bot-fly, by Mr. Collinge; and the larch saw-fly, by Mr. Mangan. Dr. Malden dealt with the diseases of bees, and Mr. W. G. Freeman with the economic importance of the cambium in plants.

The members of the association attended the formal opening of the Biological Experimental Laboratories at Fallowfield, when Sir Thomas Elliot, of the Board of Agriculture, spoke of the harmonious relations now in existence between practice and science, and the welcome degree to which the agriculturist is prepared to appreciate the aid of the man of science in attempting to solve difficulties. The new Manchester laboratories owe their origin to such calls for aid, and Sir Thomas indicated that the Board of Agriculture would be prepared to assist financially, so far as it could, the local efforts in providing the means for research in economic biology. W. G. F.

THE FIRST INTERNATIONAL AGRO-GEOLOGICAL CONFERENCE.[1]

SOME time ago the Royal Hungarian Geological Institute sent out letters of invitation to those interested in soils in the various countries of Europe and America asking them to attend an International Conference in Budapest, where some attempt would be made at standardising methods and objects. Some degree of uniformity is urgently needed. "Plus que partout ailleurs," says the secretary in his introduction to the present volume, "il y règne une disparité d'idées, de méthodes, de procédés, une divergence de vue sur le chemin à prendre et sur le but à atteindre, un chaos dans l'usage des termes scientifiques, des mesures, des figurés, des noms et des classifications : divergence qui se manifeste non seulement de pays à pays, de langue à langue, mais aussi entre les œuvres d'un même pays et dans la littérature d'une même langue." Some confusion is for a time inevitable in a borderland subject like the present, that joins up with geology, botany, and chemistry, and is closely connected with agriculture; indeed, even its very name has not yet been settled, for we find the subject of the conference referred to as agrogeology, agricultural geology, pedology, or simply "the science of the soil."

The results of the conference are now issued in the volume before us. Several of the papers are descriptive of the soils of the countries in which the respective writers are working, among them being accounts of the soils of European and Asiatic Russia, of Norway, of Rumania, and Bohemia. As an illustration of the method adopted, Prof. Glinka's account of the Russian soils may be noted. There are six main zones recognisable, running in belts from north-west to south-east, and corresponding fairly completely with the climatic and vegetation zones. The most northerly is the Tundra zone, practically destitute of vegetation higher than lichens and mosses. The soils have been but little investigated, but appear to be generally acid and rich in partially decomposed organic matter. South of this lies the Podzol zone, covered with forest, or in lower lying places with marshes and lakes. The typical podzols may be sands, loams, or clays; they are white when dry, acid, generally poor in mineral plant food, but contain a fair amount of organic matter, and they are porous. There is either a pan or else a good deal of concretionary matter in the subsoil, the former being usual in the sands, the latter in the loams and clays. This zone covers an enormous area in Russia and Siberia; it is not much cultivated, the method adopted usually being to clear a part of the forest, crop for a few years, then leave to run wild again, and move on to some freshly cleared ground; to the south, however, the agriculture is much more advanced. Throughout this zone the low-lying soils differ somewhat in type by reason of the accumulation of humus and the presence of reduction products such as pyrites, marcasite, and others; they are more like moorland soils.

The next zone is the famous black earth or Tschernosiom zone, but in between the two is a transition zone occupying the region of the prehistoric steppes now in forest, so that the original steppe soil has become modified. The calcium carbonate originally present may still be found lower down in the soil, and there is also more food material than in the soils further north; still, in the main, these soils are of the podzol type. The black earth proper stretches from the Carpathian to the Ural mountains, and thence across to Siberia; it covers Volhynia in the west and Perm in the east. It is characterised by a dark grey or black layer rich in humus and granular in structure, overlying a subsoil rich in calcium carbonate; this subsoil may originate either from loess, drift clay, or marine deposits. There are no forests, except in the north, as already mentioned, the whole region being steppe country now largely in cultivation producing cereals. Several other types of soil scattered as islands over the zone are described in the paper, but need not concern us here.

Southwards come the chestnut-coloured soils of laminate, and not granular, structure, where the black humus layer is thinner or absent, although calcium carbonate is found in quantity, as in the soil underlying the black earth. We are now approaching the dry steppes, a pastoral region inhabited by a nomad population. Alkali soils are not uncommon in this and the lower zones.

Below this come two others in the semi-desert region, where the rainfall is 8 to 12 inches per annum only, the northern layer being brown and the southern grey or white. They have not been much studied as yet.

We have dwelt at some length on this paper because it illustrates the difficulties in the way of introducing any uniform international system of soil classification. Any attempt to arrange British soils in zones in this way would fail; indeed, in one paper where a very broad system was used, all British soils were classed as of one type. After looking through the descriptions of the soils of the other countries we feel bound to agree with Prof. Hilgard that each region should adopt its own classification. Distinctions of colour, he points out, are not of sufficient general significance to form a basis of uniform soil classification, yet in a particular region they may be of vital importance, and would form the only basis useful in practice. Ramann has drawn up a scheme of classification, so also has Sibirtzeff, both admirable so far as they go, yet neither will fit the soils of California. Indeed, the various authors at the conference were looking at the subject from at least two different points of view: some were considering the zones of continental areas, others confined themselves to the soils of small regions. Climate reacts on soil to a marked extent. The soils of arid and of humid regions differ fundamentally, as Hilgard has shown. To take an illustration from Prof. Glinka's paper, the difference between the black earth and the chocolate-coloured or grey soils further south may arise entirely from climatic causes. Over continental areas, therefore, climatic zones will furnish a useful method of grouping soils in the first instance; but it is not complete, for marked variations occur among the soils in the same zone, necessitating a more detailed classification which would take account of the presence or absence of calcium carbonate, and the "lightness" or "heaviness" of the soil on cultivation. Probably several systems of classification would be found necessary to fit the various climatic regions. If the conference failed to come to any agreement on this subject, it at any rate did much useful work in bringing out the inherent difficulties.

Another matter was dealt with which ought to be capable of arrangement. At present no two countries adopt

[1] "Comptes rendus de la première Conference internationale agrogéologique." Publié par l'Institut géologique du Royaume de Hongrie. (1909.)

the same methods of soil analysis. This would not matter much if the methods were all absolute; unfortunately, they are mainly conventional. Thus an English analyst will say that a soil contains 0·2 per cent. of total potash, meaning by this the amount extracted by hydrochloric acid under particular conditions, although the *real* total is probably three or four times this amount. Continental and American analysts, working on the same soil, but using different methods, would reach wholly different results. The trouble is still worse in the mechanical analysis of soils. "Clay" in Great Britain means material less than 0·002 mm. in diameter, in the United States it stands for particles less than 0·005 mm. in diameter; elsewhere a widely different limit—0·01 mm.—is adopted; so with the other terms. In consequence, one can never compare mechanical analyses made in one country with those made in another; the same terms are used, but they denote different things. The confusion thus introduced into an already difficult subject is most unfortunate. One great advantage of international conferences of this sort would be to prevent such confusion arising in the future.

E. J. RUSSELL.

SCIENCE IN SOUTH AFRICA.[1]

THE Royal Society of South Africa consisted at the time of its annual report (April, 1909) of forty fellows and 160 members; it had held six meetings during the preceding year, ten papers altogether being read. Part i. of the Transactions, in which these papers appear, contains 334 pages; part ii. contains the papers read at subsequent meetings, and has expanded to 477 pages, since there were nineteen papers in place of ten. Most of the papers deal with local matters; only about half a dozen are concerned with general problems, and of these three are mathematical.

The local papers are mainly botanical. Dr. Schönland, of the Albany Museum, Grahamstown, gives a full description of *Haworthia truncata*, Schönl., the only species of Haworthia with strictly distichous arrangement of leaves. The leaves are to a large extent underground, while the exposed parts resemble small pebbles, so that the plant may be classed among the so-called "mimicry plants." Its structure is well adapted to its peculiar mode of life. The truncate apex is without chlorophyll, and thus forms a "window" through which light can pass by way of the central transparent tissue to the assimilating tissue which extends to the underground basal parts of the leaves. Dr. Marloth describes other plants possessing the same structure.

Experiments were also made to find out whether the aërial parts of plants, particularly those growing in arid regions, can absorb moisture from the air. In the Karroo there is commonly a fall of dew at night. Dr. Marloth's experiments indicate that the native plants can take sufficient moisture from this source through their leaves to satisfy their requirements. Dr. Schönland, on the other hand, is not satisfied on this point; the plants examined by him did not appear to absorb from the air anything like a sufficient quantity.

Mr. A. L. du Toit, of the Geological Survey, describes the evolution of the river system of Griqualand West. This system is very complex, but its history can be traced to a remote geological period. In Palæozoic times a continent, at a level lower than the present, extended over this area, the drainage from it being directed southwards mainly along the Kaap valley. At the close of the Carboniferous epoch this continent was intensely glaciated, and finally buried beneath the Permo-Triassic Karroo deposits; upon the surface thus formed the modern drainage system was initiated. In later periods—in late Jurassic, Cretaceous, and Tertiary times—there has been a succession of uplifts, but the rivers have been enabled to cut a peneplain. One of the most important of these surfaces extended from the Stormberg probably into Griqualand West, where it is represented by the Kaap Plateau. This surface has suffered denudation, and the rivers have cut down and laid bare the pre-Karroo floor with its drainage lines.

Dr. Broom discusses the relationship of the South African fossil reptiles to those found in other parts of the world. The Lower Karroo fauna of South Africa shows many points of resemblance to the Permian in America; it seems practically certain that both are modifications of an earlier fauna which probably inhabited a southern continent joining Brazil and South Africa. The American types are considered to be nearer the ancestral, though considerably specialised; the African, probably owing to their living in the swamps of the Karroo, developed greater length of limb and tended to become more active; but in South Africa the conditions must have been such as to promote rapid evolution, for many new types soon appeared, the most remarkable being the Anomodonts, which probably originated there. Towards the end of Permian times a land connection with Europe seems to have formed, by which the pareiasaurian fauna passed into Europe; still later—in the Upper Triassic beds of Burghersdorp—a number of European types passed into Africa without, however, any of the Cynodonts, highly characteristic of this period in Africa, passing back in return. In Lower Jurassic times land connection was well established. There is evidence of continuous land between Africa and Australia in Upper Triassic times.

The mathematical papers by Dr. Muir deal with a theorem regarding a sum of differential coefficients of principal minors of a Jacobian, an upper limit for the value of a determinant, and Borchardt's form of the eliminant of two equations of the nth degree. Other papers deal with the spectrum of the ruby, snake venom, the rainfall of South Africa, evaporation in a current of air, a list of the flora of Natal, and so on.

The *South African Journal of Science* is the organ of the South African Association for the Advancement of Science, its objects being to give a stronger impulse and a more systematic direction to scientific inquiry, to obtain a more general attention to the objects of pure and applied science, and the removal of any hindrances barring the progress of science. Instead of issuing one large annual volume, like our own association, a small journal is sent each month to the members. The numbers of the present volume (vol. vi., beginning November, 1909) contain the presidential addresses and some of the papers read before the sections; notes and articles from other sources are, however, included. The papers, nearly sixty in all, have the general merit of dealing with local phenomena, thus putting on record something that may pass away and be lost, or else attacking problems that can only be investigated on the spot.

It is eminently satisfactory to find that sufficient material exists to keep going these and the other scientific journals and societies of South Africa, including the geological, the chemical, and the engineering societies. South Africa has hitherto loomed so largely in the political and commercial worlds that it will come as a surprise to some to find that research work has been going on quietly and steadily for several years. The foundation has been laid on which a great superstructure may be raised; it has been proved that the fauna and the flora show in relation to their surroundings many features of very general interest and importance; a number of problems have thus been suggested for future workers to attack. Most important of all, however, is the fact that the spirit of research is abroad in South Africa at a time when colleges and universities are being founded and agricultural departments developed. There is, in consequence, the prospect that these new foundations may be started in the right direction at the outset, and so attain a position worthy of the vast possibilities of the country. The men who are now devoting themselves to research work are therefore making more than an examination of local problems, important as this is in a developing country where development often means extermination of species and obliteration of old records. They are creating an atmosphere in which the college and departmental staffs can do research work, in which, indeed, men will feel impelled to investigate. To do this in a busy commercial country like South Africa is no small achievement.

[1] Transactions of the Royal Society of South Africa, vol. i., 1910. The South African Journal of Science, vol. vi., 1909–10.

INDIAN PALÆONTOLOGY.

THE Geological Survey of India continues to publish well-illustrated and exhaustive memoirs on the fossil invertebrate faunas of the region with which it deals. Two more on the Himalayan Trias have lately appeared, and are of much interest for study in connection with recent work on the Triassic fossils of other areas. The first memoir (*Palaeontologia Indica*, ser. 15, vol. vi., No. 1, 1909), on the Lower Triassic Cephalopoda from Spiti, Malla Johar, and Byans, was begun several years ago by the late A. von Krafft, who collected much of the material. It has now been revised, completed, and brought up to date by Prof. C. Diener. It begins with a synopsis of the marine Lower Triassic formations of the Himalayas, which are proved to constitute a remarkably complete series. The detailed descriptions of the fossils which follow show that at least four distinct and successive faunas occur in the rocks of the district under consideration. Of these, the lowest or earliest is perhaps the most interesting, because it seems to represent the dawn of Triassic life in the sea. It is noteworthy for the complete absence of the numerous types of Palæozoic Brachiopoda, which are the predominating element in the Permian rocks of the Salt Range and the Himalayas. Both in the Alps and in the Himalayas the Permian and Trias are connected by an uninterrupted sequence of sedimentary deposits. The second memoir, by Prof. Diener (*loc. cit.*, No. 2), is more special, treating of the fauna, chiefly Cephalopoda, of the Traumatocrinus Limestone of Painkhanda. He returns to a discussion of the age of this limestone, and shows that enough of its ammonites are identical with (or closely allied to) species found in Europe to justify its correlation with the Julic horizon, or zone of *Trachyceras aonoides*.

Another memoir just received from the Geological Survey of India, though dated 1908, contains a valuable description of the Devonian faunas of the northern Shan States by Mr. F. R. Cowper Reed (*Palaeontologia Indica*, n.s., vol. ii., No. 5). The fossils are chiefly corals, bryozoa, and brachiopoda, with only few representatives of other groups, but they constitute the richest collection of Devonian age hitherto described from south-eastern Asia. Most of them were obtained from Padaukpin, and many appear to be identical with European species which characterise the lower part of the Middle Devonian. The marine faunas of Middle and Upper Devonian times prove to have been remarkably cosmopolitan, but in all cases, as at Padaukpin and other places in eastern Asia, there is also a local element giving them a special character.

DUTCH METEOROLOGICAL WORK IN THE EAST.[1]

(1) WE have to chronicle the issue of a new set of meteorological charts for the part of the Indian Ocean around Cape Guardafui. It is issued by the Meteorological Institute of the Netherlands to replace a set of similar charts published in 1888 which is now out of print. The observations are now sufficiently numerous to justify the subdivision of the restricted area under discussion into squares measuring 12′ by 12′, so as to bring out variations over short distances.

Special attention has been given to currents. Nearly 4000 observations, extending over the period 1888–1908, have been used, and these are all based on astronomical observations made at intervals of six or eight hours. The results are represented by "current roses," giving for each subsquare the mean velocity observed from each of sixteen directions. This method of representation gives an excellent idea of the varying nature of the currents; thus some of the roses quite near to Cape Guardafui are very nearly symmetrical stars, showing that currents from all directions may be encountered. We rather miss an indication of the number of observations used in computing each vector. Some must be based on very few observations, while others represent the mean of a considerable number of records, and we cannot help thinking that it would be useful both to the mariner and to the student to be in a position to weight the results.

The charts which follow give for each month and for each subsquare the averages for wind, pressure, temperature of the air, and temperature of the water. In the last the extraordinary low temperature of the surface water off the coast south of Cape Guardafui during the south-west monsoon is well shown. In July we find a reading of 18·8° C. (65·8° F.) slightly south of Ras Hafun, while in the Gulf of Aden, slightly west of Guardafui, a subsquare has a mean temperature of 30° C. (86° F.). Nevertheless, there is a caution in the introduction against relying on low surface temperatures to give warning of the proximity of land during hazy weather, for warm water is occasionally encountered south of Guardafui.

It has been found necessary to represent the monthly results for each element on a separate chart. Our first impulse when dealing with charts of this nature is to compare the results for different elements, and for this it is very laborious to have to refer to five different charts bound in different parts of the volume. We admit that there is danger of overcrowding, even if different colours are used for different elements, but it is a great advantage to be able to survey the complete data for a month with a minimum of cross-references.

(2) The rainfall volumes for the Dutch possessions in the East Indies form the thirtieth issue of the series. The first of the two volumes for 1908 gives daily observations of rainfall for 272 places. In the second volume we have statistics of the number of rain-days, greatest rainfall in a day, and comparisons with averages, and also a discussion of the records of eight autographic gauges. The publication, especially the first volume, which gives the names of all the observers for each month separately, seems at first sight unnecessarily detailed, but in a country where the rainfall is of such great economic importance such details are necessary, and do much to ensure accuracy.

[1] (1) Koninklijk Nederlandsch Meteorologisch Instituut, No. 105. Oceanographische en Meteorologische Waarnemingen bij Kaap Guardafui. Pp. 38. (Amsterdam: H. G. Bom, n.d.) Price 6.00 florins.
(2) Regenwaarnemingen in Nederlandsch-Indie. Dertigste Jaargang 1908. Deel i., Dagelijksche Regenval. Pp. vi+392. Deel ii., Uitkomsten. Pp. xii+190. (Batavia: Landsdrukkerij, 1909.)

PRACTICAL SPECTROSCOPY.

A NOVEL and very compact form of mounting for concave gratings is described by Mr. Albert Eagle in No. 2, vol. xxxi., of the *Astrophysical Journal*. Such a mounting has been erected, and found very satisfactory, in the spectroscopic laboratory of the Royal College of Science, and it is the experience obtained from this that has led to the publication of the details for general use.

In the Rowland form of mounting in general use there are serious disadvantages, the chief of which is that a large and darkened room must be devoted solely to the spectrograph when in use; the difficulty of efficient temperature control is also a serious one. In the new form most of the disadvantages are eliminated, and no serious new ones are introduced. The whole spectrograph for a 10-foot grating is, in the new form, contained in a box 11 feet 1 inch in length, 25 inches broad, and 22 inches deep, and the plates reproduced in the paper prove conclusively the efficiency of the apparatus under the ordinary conditions of laboratory work. On a photograph of the cyanogen band at λ 3883, taken in the fifth order with an exposure of forty minutes, lines only 0·05 Ångström are distinctly resolved. The temperature is maintained constant by lagging the double walls of the camera tube with slag wool, and the reproduction of part of a first-order iron spectrum, given four separate exposures of ten seconds at intervals of an hour, shows how efficient it is; this spectrum was taken without any special precautions whilst other work was proceeding in the well-lighted laboratory as usual, and yet the close pair of lines, separated by only 0·118 Ångström unit, at λ 4240 is resolved. Other advantages claimed for the new mounting are its comparatively low cost, its rigidity, a slightly increased dispersion, the use of higher orders than in the Rowland mounting, and the fact that the orders on either side of the normal may be employed. Against these are to be set two or three apparent disadvantages, of which, at first sight, a slight departure from normality appears to be the most serious; but, as pointed out by the author, an observer always has to construct a curve of errors when reducing observations, and such a curve would include this slight deviation from the normal, which, taken over a 3-inch range in the first-order spectrum, only amounts to 0·2 Ångström unit.

The important part played in solar and stellar spectroscopy by the H and K lines of calcium renders it essential that the absolute wave-lengths of these lines should be known with the greatest possible accuracy. For this reason Mr. C. St. John, working at the Mount Wilson Solar Observatory, has recently made a series of wave-length determinations for these lines in the arc, spark, and electric furnace, and in No. 2, vol. xxxi., of the *Astrophysical Journal* he gives his results in terms of the secondary standards of Fabry and Buisson adopted at the Meudon meeting of the International Solar Union. The mean results are 3968·476 and 3933·667 for H and K respectively, and are estimated to be certain within 0·001 Ångström. Mr. St. John also discusses the behaviour of these lines under the various conditions employed, and, from his results, concludes that the wave-lengths are identical for the absorption and the fine emission lines, and are the same in arc, spark, and furnace. The mean ratio of the width of K to H is 1·28, and the mean ratio of the respective intensities is 1·47. The experiments described were preliminary to an exhaustive comparative study of the corresponding solar lines.

PLANT DISTRIBUTION.

TWO recent papers furnish a supplement to the magnificent phytogeographical memoir on South Africa by Dr. R. Marloth. The one is an article, by Dr. L. Diels, on formations and flora-elements in the north-west of Cape Colony, published in Engler's *Botanische Jahrbucher* (vol. xliv., part i.). This is a detailed and localised account of botanical observations made in the country lying between the mouth of the Olifant River, Clanwilliam, and Calvinia. Near Clanwilliam lie sandy stretches where Compositæ and Scrophulariaceæ provide the bulk of the conspicuous vegetation. As the land rises, succulents, notably species of Euphorbia and Crassulaceæ, become predominant. At a height of 500 metres the vegetation begins to show elements natural to the true Cape flora, culminating in a "proteaceous-macchi" association on the Bokkeveld ridge. A special object of the trip was the exploration of the Hantam-berg flora, which is classed by the author with the botanical formations associated with Namaqualand.

The second paper is a contribution by Dr. H. H. W. Pearson to the Royal Geographical Society, published in the *Geographical Journal* (May), giving a general sketch of a botanical expedition through the dry western districts of Cape Colony and the adjoining German territory to Luderitzbuch, and thence from Mossamedes in Angola to Ft. Rosadas on the Kunene River. The regions of vegetation through which Dr. Pearson travelled are very clearly set out in the accompanying map. The succulent Karroo vegetation was first traversed until this gave place to a composite flora near Calvinia. Further north, floras known as the Namaqualand montane and Bushmanland were met with. The former is characterised by the presence of *Aloe dichotoma*, *Vogelia africana*, and other plants, while species of Aristida and *Parkinsonia africana* are typical of the latter type. The district lying immediately south of Mossamedes is the historic locality in which Welwitschia was discovered, and here the author found it more at home than in Damaraland, which suggests that it is a tropical species, and therefore more closely related to the genus Gnetum than to Ephedra.

Attention is frequently directed to weeds produced in new countries by exotic plants. There is, however, more interest attaching to the spread of indigenous plants caused by a disturbance of natural conditions, of which a striking instance in the case of *Celmisia spectabilis* is described by Dr. L. Cockayne in the Canterbury Agriculturists and Planters Association's Journal (April). This plant is a composite and endemic, growing naturally with other species of the genus at elevations above 3000 feet. It has a woody, creeping stem furnished with numerous cord-like roots. The end of the stem bears a rosette of thick tomentose leaves with long sheathing bases; the rosettes are crowded together, forming a circular mat or cushion. Within the shelter of the leaves lies the bud, which throws out daisy-like flowers above the leaves, and subsequently develops downy fruits. As a result of burning and overgrazing, the tussock formations at a lower level, which consist of useful grasses, are being replaced by the Celmisia. The remedy suggested is to reinstate natural conditions, when the grasses should win back the lost ground.

Captain A. A. Dorrien-Smith contributes to a recent number of the *Kew Bulletin* (No. 4) an account of his botanical excursions in Chatham Island with the primary object of collecting specimens of *Olearia semidentata*, *Aciphylla Dieffenbachii*, and other local plants for introduction into the Scilly Isles. In the south and boggiest part of the island *Olearia semidentata* covers acres of ground, and here the author discovered a pure white form of this normally purple daisy-like flower, and his companion found a pink variety. The article provides an interesting sketch of the vegetation, and is illustrated with several photographs, two of which represent bushes of the normal type and white variety of the Olearia respectively.

THE MAINTENANCE AND ADMINISTRATION OF ROADS.

AUTHORITIES having control of highways have now to consider the problem of road construction and maintenance from a new point of view in consequence of the conditions of modern traffic. The problem is an acute one everywhere, and various solutions of it have been put forward by highway engineers. Evidence of experts as to the causes of the increased wear and tear of roads and their opinions as to remedies will be found in the report of the important conference on roads, held last year at the Institution of Civil Engineers, and also in various publications of the Roads Improvement Association and the Royal Automobile Club. The subjoined extracts from these publications, and summaries of papers, provide the essence of a large amount of evidence given by road engineers before several conferences and associations upon important questions relating to roads.

A very large number of our roads, except those of recent construction, may be said to have grown, or developed, rather than to have been made. Many of them were originally mere tracks, and have arrived at their present state through the accretion of coats of ground-up stone, often of poor character, possibly faced with a thin crust of granite or some inferior material. The fact that many roads have been built up by the use of metalling, without foundations, other than the subsoil upon which the metalling is placed, accounts for the difficulties, troubles, and expensive maintenance now experienced in connection with most existing rural main roads, for where the foundation of a road is weak, the surface is always difficult and costly to maintain.

The greatest practicable improvement in the construction of macadamised roads is to be found in the use of the very hardest and toughest coating materials well consolidated by rolling, with the addition of just sufficient fine chippings during the consolidating process to fill completely the spaces between the stones. The common method (condemned by every road engineer) of binding together the aggregate of an ordinary macadam road by the use of road scrapings is productive of the greater part of the mud and dust found so objectionable. One of the resolutions referring to macadamised roads adopted by the International Road Congress held at Paris in 1908 was:—"To use as far as possible only hard and homogeneous road materials, regularly broken; to make choice of a binder suitable to the structure of the road material used, reducing, moreover, the binder to a minimum."

As to the wearing characters of various rocks used as road metals, some definite information is available. The Town Council of Hornsey possesses a machine by which the effect of wear and tear on road stones can be tested. The stones to be tested are all broken to a 2-inch gauge and placed in cast-iron cylinders, which are made to revolve 8000 times at a speed of twenty revolutions a minute. They are tested both wet and dry, and as the result of the shaking they receive a certain amount of chips and dust is produced. The percentage loss of weight experienced by the stones is then determined. As the treatment is the same in every case, the machine enables an estimate to be obtained of the relative power of road stones to withstand the wear and tear of traffic, and the rubbing action which takes place at the surface of a macadamised road. A series of tests with this machine was made a few years ago in connection with an examination of the constitution of the stones by H.M. Geological Survey, and the results were published in a work entitled "Attrition Tests of Road-making Stones." The table given below shows the average loss per cent. of a few typical rocks used for road-making:—

Stone	Quarry or Locality	Average Percentage of loss in dust
Quartzite	Wick, Glos.	4·0
Ferruginous Quartzite ...	Winford, Somerset... ...	4·4
Quartz Porphyrite	Quenast, Belgium... ...	3·7
Quartzite	Cherbourg	5·7
Biotite-hornblende Granite	Mount Sorrel, Leicestershire	6·6
Chalk Pit Flints	Grays, Essex	10·4
Gabbros	St. Sampson's Guernsey	10·7
Calcareous Sandstone ..	Liphook, Hants	17·3
Foraminiferal or Mendip Limestone	Winford, Somerset ...	19

It will be seen from this table that quartzites stood the test best, that flints came out fairly well, and that sandstones and limestones are at the bottom of the list. Though the final test of a road metal can only be known by wear and tear upon the actual road, yet the results obtained by the systematic testing of stones under precisely the same conditions serve as a guide in the selection of suitable materials. They give no indication, however, of resistance to crushing. Flints only lose a small percentage of their weight by rubbing together, but they are crushed into dust by heavy traction-engines.

There can be little doubt that poor materials, with road sidings used for binding, are largely responsible for the unsatisfactory condition of many roads. A limestone road-metal is undesirable for most districts, and flints make bad roads when they are used where heavy traction-engine traffic occurs. In the long run it is less expensive to use a good road-metal than a cheap one. It does not seem to be recognised that good material can be carted as cheaply as bad, and that, properly applied, the former lasts years longer than the latter.

Assuming that a macadamised road has been properly constructed, it is worth while to consider the chief causes of damage to it. It is often said that motor-cars are responsible for the chief part of the damage; but that is not really the case. If a newly made road be noticed, it will often be seen that the ordinary motor-car traffic scarcely wears the road at all in the tracks where the wheels go, whereas the part where the horse traffic goes is worn hollow in the middle, being dug out by the hoofs. Motor-cars probably do less damage to a good road than horses. Moreover, the damage done by a 2-ton pneumatic-tyred pleasure car is superficial compared with that done by a motor-waggon with a total weight of 12 tons. The wear and tear is caused by (1) the heavy weight per axle carried; (2) the speed at which the heavy motor-car runs. Under the Heavy Motor-car Order, a car weighing 3 tons unladen, and having a load of more than 5 tons (making a total of above 8 tons), must not exceed a speed of five miles an hour, with or without trailer; but this weight and speed are constantly exceeded. It is the combination of illegal speed with illegal weights carried that is largely responsible for much serious wear and tear of roads.

It is generally believed that ordinary motor-cars cause much damage to roads by what is described as the "sucking action" of pneumatic tyres; but this action has never been proved to exist. The action which undoubtedly does remove the small particles of the road is due to a scouring or brushing of the surface by the tyres, thus leaving the large particles to be crushed into dust by the rigid wheels of other vehicles. In the case of steel-studded pneumatic tyres the brushing action is, of course, greatly increased, and is accompanied by crushing forces. To sum up, the causes of damage due to altered conditions of traffic are:—(1) Traction engines: great weight of engine; excessive vibration, rigid and ribbed construction of tyres. (2) Heavy motors with trailers: vibration, weight, rigid tyres running over road at high speed. (3) Pleasure cars: scouring action of the pneumatic tyres of cars travelling at high speed.

The chief cause of dust, as apart from its method of production, is to be found in the use of unsuitable road material. As already stated, the horse is a serious factor in the creation of dust; and the 5-cwt. battering-ram, as each leg of the horse has been called, gives a road a succession of heavy blows, apart from the screwing or puddling action, and disintegrates the surface far more than is generally realised. The motor-car, on account of its tyres and the rapidity of its movement, though it raises and scatters dust to a greater extent than any other vehicle when going very fast, does far less to create it than is generally imagined.

The dust nuisance may be lessened greatly by using nothing but high-class road metal, reducing the quantity of binding material, and reducing the cross-fall or camber of the road, so as to ensure that the traffic spreads itself over the whole width instead of always being driven to the crown of the road; but Mr. Walker Smith, in an exhaustive book recently published on "Dustless Roads and Tar Macadam," points out that even when these conditions are satisfied no very substantial improvement can be looked for. "Even when the best material and the best methods of binding are introduced, the road will always remain a pervious road. The moisture in wet weather, which tends to hold the particles of the road together, will, on being evaporated in the dry weather, leave the surface loose and friable and a ready prey to the disintegrating forces, the shock of the horses' feet, the abrasion of the steel-studded vehicle, and the scouring action of the soft-tyred ones." Mr. Walker Smith says very strongly that the binding is undoubtedly the crux of the whole question of efficient road-making and maintenance. The binding makes or mars the macadamised road, and it is, and ever has been, the weak spot in the ordinary macadam road. The Dust and Dustless Roads Committee of the Royal Automobile Club reports that, in the opinion of the whole of the road engineers with which it has been in touch, if macadam roads are to be constructed to meet the needs of the present-day traffic, with the searching demands that the traffic makes on the road surface, a bituminous binding or matrix must be employed.

The committee states that, setting aside the temporary palliatives of watering roads with chemical preparations which keep the road damp by the absorption of moisture from the air, the treatment which has been most successful in rendering roads dustless has been the surface application of tar applied either by hand or by machine. By this method great lengths of road have been rendered dustless for a whole summer season, the mud in the winter following has been reduced in quantity, and in some cases the application has lasted for more than one season. Moreover, there is almost unanimous testimony that the whole cost of the treatment is more than saved by the increased durability of the road, and already many surveyors are able to make a strong case for the extension of the treatment solely on the ground of economy alone.

The most permanent mode of treatment is that of re-making the whole of the surface of the road with tar macadam, and when a road has to be re-surfaced this treatment is also the most economical in the end.

The use of calcium chloride to keep down dust is not recommended, one reason being that the keeping of the roads moist and soft tends to the more rapid wear of the surface.

The Roads Improvement Association has issued a report showing the extent and result of the treatment of roads by tarring. From this it appears that the road must be thoroughly cleansed before treatment; about six square yards of surface can be treated per gallon of tar; sand or granite chippings must be applied after treatment; the average cost is about 1*d.* or $1\frac{1}{4}$*d.* per square yard when a machine is used, and $1\frac{1}{4}$*d.* to $1\frac{1}{2}$*d.* when the tar is applied by hand; at least one treatment per annum is required; the road should be dry when treated. Excellent results have been obtained at the cost of about 40*l.* per mile, and with a small consumption of tar—about one-sixth to one-fifth of a gallon per square yard.

No suggestion of tarring is, however, of any use unless the road itself is constructed of good materials, so that, with the exception of some main roads, few roads in rural districts are at present in a condition for such treatment, though the changed conditions of traffic demand a change in the character of the roads. The new conditions demand increased expenditure upon maintenance both on main and secondary roads. The annual outlay in maintenance and repair of the main roads in England and Wales has steadily increased from an average of 76*l.* a mile in 1901 to more than 100*l.* a mile in 1909. Here is an average increase of 25 per cent. in eight years, and there is no prospect that the rate of increase will diminish. It would seem that a road system which requires an outlay of about 100*l.* a mile upon the 150,000 miles of road in England must be inefficient and costly. The explanation is probably to be found in the fact that the maintenance of our highways devolves upon local authorities. It is instructive to compare our system with that followed in other countries; and this comparison is made by Mr. L. W. Page, director of the U.S. Office of Public Roads, in a paper on road administration and maintenance published in the May number of the Journal of the Franklin Institute. Subjoined is a summary of a part of this paper.

Systems of Road Administration.

The basis of the French system is the School of Roads and Bridges, one of the finest technical schools in the world, and maintained at the expense of the national Government. From the graduates of this school are chosen the highway engineers who are entrusted with the building and maintenance of the roads in France. At the head of the administrative organisation is an inspector-general of bridges and highways, under whom are chief engineers in charge of the road work of single departments and communes. Single subdivisions of departments are under the direction of district engineers and assistant engineers, the latter being equal in rank to non-commissioned officers in the army. The subdivisions are under the direction of principal conductors and ordinary conductors. Next in line come the foremen of construction gangs, the clerks employed at headquarters, and finally the cantoniers or patrolmen, each having from 4 to 7 kilometres of highway under his immediate supervision. This great administrative machine, working in complete harmony with definite lines of responsibility clearly established, accomplishes results with military precision and regularity.

In England, jurisdiction over the road is vested in, first, the county boroughs; second, the county councils; third, the urban district councils; fourth, the rural district councils. In most counties the maintenance of the highways devolves upon urban councils in the urban districts and rural councils in the rural districts. The only exception to the control of the urban and rural district councils is in the case of main roads which are highways between large towns, and the maintenance of these roads devolves upon the county councils. As to skilled supervision, it may be said that no qualifications are required by law to be possessed by the men in charge of road building and maintenance, but it is the general practice, at least in important districts, to appoint experienced highway engineers for this work. It will thus be seen that the English system lacks strong central control in the counties, there being four different classes of Government units, each acting largely independently of the others.

Germany is a confederation of States, and it follows that road administration is conducted separately by each State of the Empire. The Imperial Government exercises very little control over the highways, and does not in any way contribute toward their construction or maintenance. The Kingdom of Saxony may be taken as a representative State of the German Empire. In Saxony the highways are divided into State roads, county roads, and private ways. The State roads comprise those which are built and maintained by the State. The county roads are generally termed communicating roads, and are built and maintained at the expense of the parishes through which they lead. A striking feature of the Saxony road system is the practice of planting fruit trees along the road. The fruit yields a revenue of about 8000*l.* a year from the State roads, while the amount obtained from the fruit grown on the county roads represents a much larger sum.

The State roads are cared for by a commission of engineers. The kingdom is divided into seventeen road districts, in each of which there is a road inspector. Under these inspectors are road masters, who are employed constantly throughout the year. Each road master has about thirty-seven miles of road under his direction, and a road force of about fifteen men. In the case of the minor roads, the direct responsibility is borne by the county authorities. They levy and collect the revenues necessary for maintenance and new construction. The communities engage the road employees for the continued care of the highways. The technical supervision, however, is exercised by the road masters of the State force.

The road system of Switzerland is local in character, the various cantons having jurisdiction over the roads within their respective borders. Each canton has at the head of its road system an engineer with capable assistants. In the canton of St. Gaul, which is fairly representative, there are under the control of the engineers five inspectors or road masters who are assigned to certain districts in the canton. The engineers and their assistants must have an academic education and possess a diploma from the Polytechnic Institute, while the road masters are required to have a good technical education.

It is apparent from the foregoing that while the units of administration in European countries range all the way from the localism of England to the highly centralised system of France, through varying degrees, skilled supervision is provided for by all the systems, as well as an ample cash revenue sufficient to enable the engineers to carry out the plans for improvement and maintenance. England is the most striking example of extreme localisation, and, it is a significant fact, also the most striking example of lack of uniformity in road work and of excessive expenditure in proportion to mileage. It is also significant that the most perfect road system is that of France, which is admittedly the most highly centralised of all the road systems. France, with a total mileage of about two and one-third times that of England, expends about the same amount annually for maintenance. Certainly the inference must be plain, that centralisation makes for economy and efficiency in the administration of the public roads.

When we turn to the subject of road administration in the United States, we find that about half the States are operating under practically the same road laws as prevailed in England when America was a colony. This system of road administration provides for the payment of road taxes partly in labour, and localises the work to an extreme degree. Organisation is almost entirely lacking, and no requirements are made to secure skill or knowledge on the part of the road officials. With few exceptions, no system of accounting is in force, and no definite lines of authority are established, such as would guarantee the wise and equitable conduct of the work.

The erroneous impression often prevails that when a so-called permanent road is constructed the expense has practically all been met in the first cost. An investigation of the cost of maintaining roads in the leading countries of Europe shows how incorrect is this view. In 1901 England and Wales maintained 26,598 miles of main road at a cost of 74*l.* per mile. In 1907 England and Wales maintained 27,556 miles of main road at a cost of 89*l.* per mile, or in six years the cost of maintenance had increased 15*l.* per mile, an increase of about 20 per cent. In France the increase in cost of maintaining the national roads was about 5 per cent. in the same period. The cost of maintaining main and urban roads in England and Wales in 1905 and 1906 was 88*l.* per mile. In France the cost of maintaining all roads during 1904 was 48*l.* per mile. While these last figures are not strictly comparable, one being for 1904 and one for 1905, yet the mere fact of one year's difference in time fails to explain the difference of 40*l.* per mile in cost of maintenance—the natural inference being in favour of the superiority of the French system.

These figures express most forcibly two facts: first, that even the best of improved highways are not self-maintaining, and second, that the cost of maintenance varies tremendously with the degree of centralisation of the administrative organisation which has the roads in charge.

France, with its most highly centralised organisation, is maintaining her roads at about 54 per cent. of what it costs England and Wales with her very local and loosely centralised organisation. Furthermore, the alarming increase in the cost of maintenance has been far more rapid in the countries with local and poorly organised systems of highway administration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—The council has appointed Mr. A. E. Findley to the newly instituted post of lecturer of applied chemistry in the University. Mr. Findley is at present assistant lecturer in chemistry at the Bradford Technical College.

THE Mercers' Company has made a donation of thirty guineas to the South-eastern Agricultural College library for the purchase of books of reference. The Fruiterers' Company has also presented a very fine copy of that scarce work, "The Herefordshire Pomona," and the Carpenters' Company a work on forestry, to the college library.

THE July issue of the *Battersea Polytechnic Magazine* shows how successfully the authorities of the polytechnic encourage an all-round development of their students. The magazine contains two general articles; one, on the house-fly, is based on the published papers of Dr. C. G. Hewitt, and the other deals with the discharge of electricity through high vacua.

AN open competitive examination for not fewer than seven situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in September next. The examination will commence on September 26, and forms of application for admission to it are now ready for issue, and may be obtained on request addressed by letter to the Secretary, Civil Service Commission, Burlington Gardens, London, W.

ACCORDING to the *Revue scientifique*, a national office of French universities and schools has been inaugurated under the presidency of M. Paul Deschanel, of the French Academy. Prof. Paul Appell, of the University of Paris, and Prof. Georges Lyon, of the University of Lille, have been elected vice-presidents. Dr. Raoul Blondel has been appointed director. The new department is to be installed at the Sorbonne, and its object will be to make known to foreigners the educational resources of France.

AT the close of the term of the Royal Agricultural College, Cirencester, on July 27, the principal, Prof. J. R. Ainsworth-Davis, announced that the council of the University of Bristol has enacted a temporary ordinance, which will probably be made permanent in the autumn, making the college part of the University for higher teaching in agriculture and forestry. He also announced that Mr. H. J. Elwes, F.R.S., has placed a portion of his afforested land at Colesborne at the disposal of the college for research purposes.

WE are glad to receive a copy of the July number of the *Science Journal* of King's College School, Wimbledon. It is a special photographic number of twenty-four pages with several inset plates and sheets of illustrations, and is evidence that photography at Wimbledon takes a very noteworthy place among the out-of-school subjects that engage the boys' attention. Of the thirteen papers or essays, all except two seem to be by the boys themselves, and they deal with camera construction, exposure, development, printing, optics, enlarging, sports photography, and colour photography. It is gratifying to see that the greater number of the articles refer to the writers' own experiences, and are evidence of intelligent work. There may be room for different opinions as to the usefulness of a table of poisons, with the symptoms when taken and the ordinary antidotes, because it may be thought preferable for a lad to get assistance rather than to attempt to diagnose and treat a case of poisoning himself, but with reasonable care such cases of need will never arise.

THE report (Cd. 5257) has been issued of the departmental committee appointed to consider the statement of claims to additional State assistance, and estimates of the amounts needed for the respective services, which have been supplied by the Scottish universities at the request of the Government, and to report for what objects and to what extent assistance, if any, should be granted from public funds in the interests of the proper development of the work of the universities. The committee reports that a good claim has been made out for an additional grant to Scottish universities, and recommends 40,000*l.* as a fair contribution to their more pressing needs. This sum it proposes should be allocated as follows:—Edinburgh, 12,500*l.*; Glasgow, 12,500*l.*; Aberdeen, 9000*l.*; St. Andrews, 6000*l.* The grants, it is recommended, should be on condition that their administration should be in the hands of the respective University Courts, which should submit annual reports to the Treasury. Not less than 1500*l.* of the grant to St. Andrews University is to be devoted to the conjoint Medical School at Dundee. It is further recommended that, in addition to the 40,000*l.*, 3000*l.* should be paid annually to University College, Dundee, and that the grant at present received from the University Colleges (Great Britain) Grant should be discontinued.

THE antagonism which exists in England between the mathematician and the "practical man" is so deeply rooted that any attempt to break down existing prejudices will be studied with the keenest interest. In his presidential address to the Mathematical Association last January, Prof. H. H. Turner gave a remarkable account of the efficient development of the Egyptian Survey under the direction of Captain H. G. Lyons, F.R.S., in which he states:—"Now it will be readily imagined that for work of such extent and variety it is not easy to get a suitable staff of assistants. Scientific knowledge is necessary, but so also is a knowledge of Arabic and a physique which will stand the hot climate; so also is a business capacity and a faculty of detecting the truth in its Oriental disguises. It might well be that any one of these qualities was essential, while the rest, though desirable, might have to be dispensed with; or it might be that some rare combination of them must be sought with toil. It will probably be admitted that the final opinion of a man who has gone through the trying experience of getting together a staff suitable for such work, and finds himself ultimately satisfied as to the right course, is worth hearing; and hence I feel that the association will learn with peculiar pleasure that Captain Lyons's final method is to take able mathematicians from Cambridge or Oxford and trust to luck for the other qualities. The one thing he finds needful is that when some strange situation occurs, they should have a firm grasp of the fundamental principles, and not merely a knowledge of the rules deduced, which may fail to meet some unforeseen contingency. And this essential condition Captain Lyons has found to be fulfilled by mathematicians when others have failed to meet it. His faith in them has been justified in cases where a breakdown might have possibly been admitted. Even the most complete knowledge of mathematical or physical principles could scarcely be expected to inspire a man in dealing with an Arab camel-driver who was shamming sick; or with the organisation of the commissariat for a journey in the desert; or with an unexpected attack by wandering tribes which necessitated addressing them with dignity from the hump of a camel with three rifles pointed at one's chest. But it has been proved in the best possible way, viz. by actual experience, that such situations are dealt with capably by young men selected for their mathematical ability, with no special training for the contingencies of life beyond what undergraduates all pick up from life in one of our great universities. This is a lesson which we may well lay to heart."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 25.—M. Émile Picard in the chair.—H. **Deslandres** and J. **Bosler**: The phenomena presented by the tail of Halley's comet during the passage of May 19 last. From a discussion of various observations, especially those made by R. T. A. Innes at Johannesburg, it is concluded that the tail of Halley's comet was repulsed by the earth, and the evidence is in favour of this repulsion being due to electrical causes.—P. **Villard** and

H. **Abraham**: Explosive potentials. A study of the phenomena of the spark discharge. In a previous paper a description was given of the results obtained when the changes of potential were slow; the present note deals with the effects of high-voltage alternating currents.—D. **Gernez**: The colours arising in colourless solutions of coloured bodies at the moment of the solidification of the colourless solvent. Colourless solutions of mercuric iodide in various solvents (naphthalene, stearic acid, chloral hydrate, phenol, &c.) become yellow on solidification, owing to the separation of the dissolved iodide in the unstable yellow modification.—A. **Lacroix**: Some minerals formed by the action of sea-water upon Roman metallic objects found off the coast of Mahdia, Tunis. A sheet of lead gave crystals of cotunnite ($PbCl_2$); transparent brilliant crystals of phosgenite ($PbCO_3.PbCl_2$) were also found. Two copper minerals are also described, covellite (CuS) and chalcosite (Cu_2S).—L. **Mangin**: New observations on callose. This name is applied to a new substance obtained from the membrane in fungi; it is differentiated from cellulose by several reactions, especially by its insolubility in Schweitzer's reagent, and by its rapid solution and destruction by glycerol at 300°.—A. **Ladenburg**: Racemic and liquid combinations. The results of experiments on the melting points of mixtures of inactive pipecoline containing variable quantities of *d*- or of *l*-pipecoline are shown in the form of a curve. The existence of the racemic pipecoline in solution is clearly demonstrated.—A. **Calmette** and L. **Massol**: The precipitation reactions of serums from tuberculous subjects, and of the serums from animals hyperimmunised against tuberculosis in presence of the tuberculins.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1910. The results are collected in three tables, giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Jean **Mascart**: Photographs of Halley's comet. Reproduction of photographs taken from Mt. Guajura, Teneriffe, at an altitude of 2715 metres.—D. **Eginitis**: The physical phenomena presented by Halley's comet.—R. **Bricard**: Concerning a claim for priority by E. Study.—Paul **Dienes**: A problem of Abel.—Étienne **Mazurkiewicz**: The theory of *ensembles*.—A. **Korn**: The biharmonic problem and the fundamental problem in the theory of elasticity.—E. **Pringsheim**: The emission of gases. A reply to some remarks by M. Bauer on some experiments by the author.—Gabriel **Sizes** and G. **Massol**: The harmonics of wind instruments.—L. **Hackspill**: The electrical resistance of the alkali metals. The metals cæsium, rubidium, potassium, and sodium were distilled directly in a vacuum into the tubes used for the measurements, and the electrical resistance determined at temperatures ranging from 55° C. to the boiling point of liquid air. The figures are somewhat lower than those given by previous observers; a trace of oxide appreciably raises the resistance.—A. **de Gramont**: The place of ultimate lines in spectral series.—G. **Reboul**: Chemical reactions and ionisation. The experimental results are in general accord with those given by MM. de Broglie and Brizard.—Abel **Buguet**: The cryoscopy of the naphthylamines and addition compounds.—E. **Briner** and A. **Wroczynski**: The action of pressure and temperature upon cyanogen. Prolonged heating at 220° C. under a pressure of 3/4 atmosphere was without effect upon cyanogen; at the same temperature, under a pressure of 300 atmospheres, 10 per cent. of the gas was converted into paracyanogen in six hours. At the ordinary pressure a temperature of 310° C. is required to effect an appreciable change; under high pressures the change commences at lower temperatures, and in the latter case, in addition to *para*-cyanogen, some carbon and nitrogen are produced by the decomposition of the gas.—Henri **Bierry**, Victor **Henri**, and Albert **Ranc**: The action of the ultra-violet rays upon certain carbohydrates. Under the influence of the ultra-violet rays the molecule of *d*-fructose undergoes a profound degradation, formaldehyde and carbon monoxide being produced. Duffy **Wolk**: Aluminium nitride, its preparation and fusion. The temperature of formation of aluminium nitride from aluminium and ammonia is 820° C. to 850° C.—Miroslaw **Kernbaum**: The decomposition of steam by the brush discharge. Working at the ordinary temperature, the brush discharge converts water vapour into hydrogen and hydrogen peroxide. At higher temperatures the latter substance is decomposed, and a mixture of hydrogen and oxygen is observed.—V. **Grignard**: The decomposition of phenol ether-oxides by mixed organo-magnesium derivatives.—Gabriel **Bertrand** and G. **Weisweiller**: Researches on the constitution of vicianose. The products of the diastatic hydrolysis of vicianose have been found to be *d*-glucose and *l*-arabinose.—G. **Friedel** and F. **Grandjean**: The anisotropic liquids of Lehmann.—Leclerc **du Sablon**: The theory of periodic mutations.—M. **Hue**: The variation of the gonidia in the genus Solorina.—J. **Virieux**: The sheaths and mucilages of the fresh-water algæ.—Audebeau **Bey**: Experiments carried out in Egypt with the view of determining the influence of the level of the underground water of the Delta on the growth of cotton.—MM. de Drouin **de Bouville** and L. **Mercier**: The appearance of the *furonculose* in France. This formidable disease of the trout has appeared at Bellefontaine, near Nancy.—O. **Duboscq** and B. **Collin**: The sexual reproduction of a parasite of *Cyttarocyclis Ehrenbergii*.—J. E. **Abelous** and F. **Bardier**: An attempt at the immunisation of animals against urohypotensine: the antitoxic action of the serum of immunised animals.—E. **Tassilly** and R. **Cambier**: The abiotic action of ultra-violet rays of chemical origin. The light from a carbon bisulphide flame burning in nitric oxide possesses a distinct, though feeble, sterilising action.—E. **Gley**: The modes of extraction of secretine. A new stimulant for the pancreatic secretion.—A. **Briquet**: The genesis of relief forms in the Gallo-Belgian region.

CONTENTS.

	PAGE
Christian Topography	133
Trophoblast and the Early Development of Mammals. By B.	134
Plant-life in the Balkans. By A. B. R.	135
Mathematical Text-books. By T. J. I'a. B.	136
Schlich's Manual of Forestry. By J. F. A.	137
General Biology. By A. D.	137
Our Book Shelf	138
Letters to the Editor:—	
X-Ray Spectra.—Prof. C. G. Barkla and J. Nicol	139
Pwdre Ser.—Geo. H. Pethybridge	139
The Pressure of Light. (*Illustrated.*)	139
A New Trypanosome Parasitic in Human Beings. (*Illustrated.*) By Prof. E. A. Minchin	142
Tidal Researches. By Sir G. H. Darwin, K.C.B., F.R.S.	144
The Leaning Tower of Pisa. (*Illustrated.*) By Prof. A. Battelli	145
Recent Books on Botany. (*Illustrated.*)	146
Notes	148
Our Astronomical Column:—	
A Central Bureau for Meteor Observations	152
The Rotation of Sun-spots	152
Halley's Comet	152
Large Meteorites	152
The United States Naval Observatory	152
Measures of Double Stars	153
The British Medical Association in London	153
The Institution of Mechanical Engineers	154
The British Pharmaceutical Conference	156
Association of Economic Biologists. By W. G. F.	156
The First International Agro-geological Conference. By Dr. E. J. Russell	157
Science in South Africa	158
Indian Palæontology	159
Dutch Meteorological Work in the East	159
Practical Spectroscopy	159
Plant Distribution	160
The Maintenance and Administration of Roads	160
University and Educational Intelligence	163
Societies and Academies	163

THURSDAY, AUGUST 11, 1910.

RECENT EARTHQUAKE INVESTIGATIONS.

The California Earthquake of April 18, 1906. Report of the State Earthquake Investigation Committee (in two vols. and atlas). Vol. ii., The Mechanics of the Earthquake. By Harry F. Reid. Pp. viii + 192. (Washington: Carnegie Institution, 1910.)

ON the average a little earthquake occurs in the world every fifteen minutes. Great earthquakes occur on the average about every four days, but it is only on rare occasions that they hit populated districts. The majority of the latter originate beneath deep oceans or in uninhabited mountain regions, and as neither little fish nor wandering tribes write letters to the *Times*, all we know about their occurrence comes from the observations of enthusiastic seismologists. Nineteen hundred and six, however, was a bad year for humanity, and exhibitions of seismic relief took place in many districts. On January 31 a great disaster occurred in Colombia. On April 4 many soldiers and natives lost their lives in the Kangra Valley. On April 14 nearly 6000 houses fell in Formosa, whilst four days later San Francisco and other towns in Central California were reduced to ruins. On June 14, Kingston, in Jamaica, was badly shattered, and in the autumn, on August 17, Valparaiso and Santiago fell. In connection with the disaster at San Francisco, British shareholders in insurance companies were called upon for twelve million pounds, whilst towards the reconstruction in Kingston their contribution was two millions. What they paid for the happenings in other parts of the world I do not know, but it is quite certain that attention was directed to the fact that even the inhabitants of the British islands were not entirely beyond the pale of the vagaries of Mater Terra.

In 1906 the proprietors of newspapers, lawyers, expert witnesses, the vendors of building materials, constructors, and others may have regarded earthquakes as blessings in disguise. The charitably disposed had frequently opportunities to derive comfort from their donations, while scientific bodies saw opportunity for investigations. The International Seismological Association spent a very large sum in collecting and reproducing seismograms relating to the earth movements which had devastated Central Chile. The Carnegie Institution of Washington not only carried on similar work for the earthquake of California, but by publishing three volumes based on the material collected it has considerably extended our knowledge connected with seismological observations.

To the first two of these volumes, issued as part i. and part ii., reference has been made already (NATURE, March 4, 1909, vol. lxxx., p. 10). The second volume, by Prof. H. F. Reid, of the Johns Hopkins University, which is now before us, treats of "The Mechanics of the Earthquake." In the discussion on the origin of the shock, this is shown to have taken place from point to point along a line of fracture many miles in length and with a variable depth. There are therefore many times of origin, each of which depends upon the particular point considered. This may be a seismometrical refinement, but Prof. Reid, by his insistence on this, has done much towards the exact understanding of certain observations. In the discussion on permanent displacements of the ground we are shown that as the results of three surveys, the first of which commenced in 1851, there have been permanent displacements parallel to the length of a well-known fault. The ground on the east side of this fault has moved southwards, whilst that on the opposite side of it has gone to the north. A part of this displacement, no doubt, took place at the time of the earthquake, but there are convincing reasons for the belief that much of it took place gradually before the earthquake. The ground, in fact, was bent before it broke. By experiments with a stiff slab of jelly across which a slight cut made by a knife represented a line of fault, the nature of the strain which takes place before and after an earthquake is illustrated. The actual forces required to produce in solid rock the observed distortions, which resulted in rupture, are given in mechanical units. If the depth of the fault was 12·5 miles, its length 270 miles, and the average movement 13 feet, then the work done at the time of rupture is estimated at 13×10^{16} foot-pounds. After this energy was set free, seismographs throughout the world were set in motion.

A cause for the deforming forces which resulted in these strains is sought for in the theory of isostacy, which implies that the shifting of materials accompanying surface denudation is compensated for by a sub-surface flow. By this flow a dragging force is exerted upon the superincumbent crust, which from time to time yields suddenly. To predict tectonic earthquakes we should build a line of piers at right angles to a fault line and determine from time to time the difference in direction between these piers and their relative levels. Such observations, whether they did or did not prove of value as an assistance towards earthquake prediction, it is extremely likely that they would throw light upon certain branches of earth physics. Rotary movements are considered at some length, and the idea that they may be the result of vibrations at right angles is considered to be the one offering the simplest explanation.

A chapter of great interest, not only to the builder, but to the mathematician, relates to the influence of a foundation upon apparent intensity, this being most pronounced upon alluvium.

Part ii. of this volume is devoted to a critical description of seismograms obtained from stations in various parts of the world. This is followed by old and new explanations for the apparent increase in the duration of an earthquake as it travels. This is another good chapter, but it might easily have been extended. The discussion of the velocities with which different wave types were propagated and the paths they may have followed has been worked out with great care, and is distinctly instructive. The determination of the distance of the origin of an earthquake, as is now well known, depends upon the interval of time between the arrival of the first motion and the arrival of

 G

some other phase of motion like the large waves. This is closely examined, and observations previously made upon this point are brought more closely in accord.

Disturbances of magnetic needles at the time of the earthquake have not been overlooked. Much is said in favour of damping pendulums, and reference is made to the recently devised "dead-beat" instruments of Prince Galitzin. We have not, however, come across any reference to his method of determining the direction of an earthquake from the first of the preliminary tremors. The monograph closes with the theory of the seismograph. In this we notice the statement that the instruments designed by myself in 1892 and Dr. Schlütter about 1903, to show tilting of the ground at the time of an earthquake failed to show such a phenomenon. This is only true for the latter instrument (see British Association Report, 1893, p. 222).

Prof. Reid's memoir is a valuable contribution to the mechanics of earthquakes. He has ploughed both new ground and old, and seismologists will thank him for the material he has furnished for their consideration. JOHN MILNE.

TAR, ACID, AND ALKALI.

(1) *Coal Tar and Ammonia.* By Prof. George Lunge. Fourth and enlarged edition. Part i., pp. xix + 563; part ii., pp. xiii + 564–1178. (London: Gurney and Jackson, 1909.) Price 42*s.* net, two vols.

(2) *The Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches: a Theoretical and Practical Treatise.* Third edition, enlarged. By Prof. George Lunge. Vol. ii., part i., Sulphate of Soda, Hydrochloric Acid, Leblanc Soda, pp. xx + 490; vol. ii., part ii., ditto, pp. xii + 491–1010. (London: Gurney and Jackson, 1909.) Price 42*s.* net, two parts.

THESE three terms—tar, acid, and alkali—stand for the most important of the determining factors of chemical technology. Round them may be ranged practically everything that relates to the business of applied chemistry. In its most comprehensive sense, each in turn may be regarded as the parent or genital substance from which flows a countless number of bodies, forming by their mutual actions and reactions the vast array of products which modern manufacturing chemistry has placed at the service of mankind. In the works before us, Dr. Lunge's treatment of these themes is worthy of their importance. The works themselves have already taken an assured position in the literature of chemical technology. In each successive edition their veteran author strives to make them a faithful and adequate reflection of the state of contemporary knowledge and achievement, thereby tending, so long as his ministering care is available, to make that position secure. They have long been recognised as indispensable to the technologist, and each new issue is certain of an immediate welcome.

The volume on coal-tar and ammonia is now in its fourth edition. What enormous changes have come over the industry of tar production, and of the extraction and utilisation of the innumerable substances which enter into its composition, will be evident from even the most superficial examination of the several issues. The rate of progress, indeed, transcends anything to be observed in any other branch of manufacture. Only nine years have elapsed since the third edition made its appearance, but such has been the accumulation of new material in that interval that practically the whole of the chapters—eleven in number—dealing with coal-tar and its products have had to be revised and in great part rewritten. In this section of the work Dr. Lunge has had the assistance of Dr. Kraemer, of Berlin, an acknowledged authority in this branch of chemical technology.

England is still the great tar-producing country of the world, but her supremacy in this respect is threatened by the United States. Tar is mainly obtained from gas-works, from blast furnaces, and from coke-ovens. In the United Kingdom the annual production at the present time approaches a million tons—obtained by the destructive distillation of about seventeen or eighteen million tons of coal—an amount exceeding that of the whole of Europe put together, and probably more than twice the aggregate yield of Germany and France. This country, where benzene was discovered by Faraday, where its industrial extraction was worked out by Mansfield, and where the first aniline colour was made by Perkin, has become simply as the hewer of wood and the drawer of water in this matter. We make the tar, but apparently we can do little with it except sell it to the Germans in order that they shall turn it into that astonishing array of manufactured products which their admirable system of scientific training has taught them how to produce. When in the hour of her humiliation Germany set herself to reconstruct the educational system which has culminated in her present scheme, she forged the most powerful instrument of national development which human forethought could have devised. With it has come her extraordinary commercial development and her ambition to be supreme in the world's markets, and with it, too, she thinks, has come the necessity of being able to protect that commerce, if necessary, by force of arms. What becomes of coal-tar may seem a small matter in determining the course and destiny of nations. But is is absolutely certain that if our university system had been developed, even *pari passu* with that of Germany, and that if those who were responsible for the government of this country, and those who seek to form public opinion, had paid more heed to the signs of the times, we should to-day have less talk about Tariff Reform and of the imperative necessity of more "Dreadnoughts." If Peace has her victories, no less renowned than those of War, we may well ask ourselves if we have always gone the right way to work to secure the victories of peace.

Dr. Lunge's second work—that on sulphuric acid and alkali, now in its third edition—further serves to illustrate the same text. If there was one chemical industry more than another in which Great Britain was pre-eminent, it was that to which this work relates. Upon it hangs a great number of collateral industries, and their prosperity is bound up together and is mutually dependent. We had abundant stores of most things we needed to extend and develop this industry, and whatever else we required our oversea trade enabled us to procure. That supremacy is challenged. Newer methods have undermined the position which the industry enjoyed with us for so many years, and in which such large amounts of British capital are still locked up. So long as we were concerned with the application of the simplest chemical principles we could hold our own by virtue of our natural advantages. Immediately we were confronted by new processes involving more recondite principles, questions of chemical dynamics, and abstract considerations of mass-actions, reversible reactions and the like, our manufacturers were powerless; nor were they able to find in this country the help they needed. Some of them eventually found it in imported polytechnically trained German and Swiss chemical engineers—for the most part university men with post-graduate technical training—men that the German and Swiss systems produce in abundance.

This system of fighting our industrial battles, in fact, resembles that on which decadent Rome depended for her national existence, and which eventually proved her ruin. It is true, we are beginning to wake up, and sporadic efforts are being made in various directions to rouse the country from its lethargy. Large sums of money are being spent, but whether always wisely is very doubtful. Anything like control, or action directed from outside, is resented, for there is no controlling authority armed with the necessary powers, or, even if it were armed, commands general confidence. We can only hope that "we shall worry through somehow," but if we do, it will only be, as hitherto, by the expenditure of a vast amount of fussy energy, much delay, and waste of money and means.

SOUNDING ROUND THE ANTARCTIC CONTINENT.

Deutsche Südpolar-Expedition, 1901–3. Band ii., Geographie und Geologie. Heft vi., Die Grundproben der Deutschen Südpolar-Expedition, 1901–3. By E. Philippi. Pp. 415–616+xxxi–xxxiii plates. (Berlin: Georg Reimer, 1910.)

THIS memoir forms the sixth division of the second volume—that devoted to geography and geology—of the reports on the German South Polar Expedition, under Prof. von Drygalski, in the *Gauss*. Since the issue of this important memoir, the news has arrived of the great loss which science has sustained by the death of its talented author.

During the whole of the voyage out to the Antarctic Ocean, frequent soundings were taken, directly the equator was crossed. Thirty soundings are recorded between the equator and the Cape of Good Hope, and eighteen more between the Cape and the ice-limit. In the same way, on the return voyage, eighteen soundings were obtained during the somewhat circuitous course by way of the Heard, Kerguelen, St. Paul, and New Amsterdam islands, and by the south of Madagascar back to the Cape; thence to the equator, by a different course to the outward one, thirty-nine further soundings were taken. The methods of obtaining samples of the sea-bottom, in the case of these soundings, and the subsequent treatment of the materials in the laboratory, are fully discussed in the memoir, and the careful descriptions of the specimens of the globigerina and diatomaceous oozes, and of the blue and red muds, are supplemented by mineralogical notes by Dr. R. Reinisch, and chemical analyses by Dr. J. Gebbing. On the chart, a graphic illustration is given of the nature of the sea-bottom at each of the stations, and this part of the work is of considerable value as adding fresh materials for a description of the exact character of the floors of the South Atlantic and Indian Oceans. The descriptions of the soundings and the tabular statements concerning them are very complete, and will prove of great value for purposes of comparison.

The portion of the memoir which will perhaps excite the greatest interest, however, is that which deals with the materials obtained in soundings along the margin of the Antarctic pack-ice. The thirty-three soundings in which specimens of the ocean floor were obtained are valuable as giving indications of the geological structure of that portion of the Antarctic continent lying between the meridians of 80° and 96° E. The mineral fragments, which have been very carefully examined and described, must have been brought down by glaciers from the interior of the continent. Among the larger fragments occur granitic rocks, gneisses, amphibolites, and other crystalline schists, with a red quartzitic sandstone, coarse or fine grained, and, more rarely, gabbro. Of recent volcanic rocks, fragments of basalt and of volcanic glass are recorded from a few stations only, and it is suggested that possibly these may have come, not from the continental lands, but from some island or islands lying within the limits of the ice-pack, or possibly they may be the products of submarine eruptions.

The long list of minerals given from the different soundings confirms the conclusions drawn from the study of the rock-fragments, for they nearly all belong to species characteristic of granitic rocks and the older crystalline schists. The study of the sandy or muddy materials in which these rock and mineral fragments are embedded shows that, as a rule, they are free from calcareous matter. Of the thirty-three deposits examined, only one was found to contain any considerable proportion of calcium carbonate, nearly 20 per cent.; four others contained from 1 to 5 per cent., and four others mere traces; the remaining twenty-four were perfectly free from all calcareous matter. Although the glacial muds graduate, in passing northwards towards warmer seas, into the diatomaceous ooze, the remains of the microscopic algæ are not abundant in the muds from the borders of the pack-ice. Some foraminifera occur, and glauconite was detected in five of the soundings.

The study of this very complete and suggestive memoir cannot fail to increase the regret which must be universally felt in the scientific world at the death, so early in his career, of its distinguished author.

J. W. J.

READABLE BOOKS IN NATURAL KNOWLEDGE.

Wonders of Physical Science. By E. E. Fournier. Pp. viii+201.

Tillers of the Ground. By Dr. Marion I. Newbigin. Pp. viii+224.

Threads in the Web of Life. By Margaret R. Thomson and Prof. J. Arthur Thomson. Pp. vii+198. (London: Macmillan and Co., Ltd., 1910.) Price 1s. 6d. each.

SOME years ago a new series of "Readable Books in Natural Knowledge" would have been a gift of doubtful value to the teacher. Written by the capable hands that have made the present volumes, they could not have failed to awaken here and there the genuine passion for scientific inquiry, and so would have seemed to justify their existence. But, speaking generally, the more completely such books had succeeded in "popularising" the labours of the *savant* the further they would have been held to direct the attention of the teacher from the proper aim of instruction in science. We now recognise that that aim is not so much to make the pupil acquainted with certain ranges of facts as to train him in the exercise of one of the most important forms of human activity. Thanks largely to the tireless propaganda of Prof. Armstrong, this aim is at present pursued with more or less intelligence wherever it is claimed that science is being taught. The boy learns that the essence of science consists in putting a clear question to nature and wresting from her a clear answer to it. In favourable circumstances he acquires some of the mental habits essential to success in this pursuit, or at any rate is made to see that such success comes only of faithfulness and labour.

It was natural that the training value of heuristic methods should be emphasised by their advocates since this element was almost entirely absent from the older didactic methods. But modern pedagogy, instructed by the results of psychological inquiry, has become critical of the claims of a subject to train or cultivate "faculties," and prefers to find in the nature of the subject itself the justification for teaching it. Thus the prime reason for teaching science is that, intrinsically and in its results, the scientific activity is one of the greatest and worthiest types of human effort. An education that does not give a sympathetic acquaintance with it is, therefore, necessarily incomplete. Whatever other arguments may be urged in their favour, heuristic methods in science teaching are rendered necessary by the fact that by them alone the pupil is made actually to exercise the scientific activity, and so to gain direct knowledge of one of the cardinal forms of human achievement. But when by first-hand experience he has genuine knowledge of the scientific activity, he should also have opportunities of appreciating its significance in human history. It is precisely to serve this function that the present series of "Readable Books" has been designed. To quote the publishers' note, they "aim at exalting the scientific spirit which leads men to devote their lives to the advancement of natural knowledge, and at showing how the human race eventually reaps the benefit of such research."

It may be said at once that in the first three books of the series this aim has been already admirably fulfilled. The authors have approached their task in the right temper, and have, on the whole, been remarkably happy, both in the choice and in the treatment of their topics. Mr. Fournier takes ground, a great part of which has been worked over by predecessors, but he has evidently gone himself to the works of the great physicists, and his chapters have the freshness and force derived from this direct contact. Dr. Marion Newbigin tells of the evolution and spread of food-plants with an epical directness and unity of plan. An episode in the development of Transatlantic commercialism—such as the transportation of Smyrna figs to California—becomes in her hands a wonderfully impressive illustration of the working of the scientific spirit. Mrs. and Prof. J. A. Thomson have taken a subject which hardly lends itself to the same unity of treatment. In part, their object is to exhibit the dependence of man upon deliberate or unconscious partnership with animals—such as the domesticated animals on the one hand, and earthworms on the other. They come nearer to the special aim of the series in the chapters where they show what tremendous results depend upon the scientific investigation of the life-histories of microscopic parasites. It is unnecessary to say that both parts of their programme are admirably executed.

A notable characteristic of each of the books is that they bring the tale of scientific conquests down to our own days. Thus Mr. Fournier describes Röntgen's discovery of the X-rays, and tells the story of aviation down to Blériot's flight across the Channel last year. Dr. Newbigin gives capital chapters on the work of Mendel, de Vries, and their followers. Prof. and Mrs. Thomson have a chapter on the relation between mosquitoes and malaria, as well as one on Pasteur. In short, these most interesting and stimulating little books initiate a series which will at once prove of great value as an adjunct to the systematic instruction of the class-room and laboratory, and, if continued in the same spirit and with the same ability, will become an almost indispensable part of a school equipment for science teaching.

T. P. N.

SALMON AND TROUT.

Life-history and Habits of the Salmon, Sea-trout, Trout, and other Fresh-water Fish. By P. D. Malloch. Pp. xvi+263. (London: Adam and Charles Black, 1910.) Price 10s. 6d. net.

THIS book is almost entirely devoted to the salmon of the Tay, sea-trout, and brown trout. "The other fresh-water fish" are but slightly dealt with, and the chapters allocated to them call for no particular notice, save to direct attention to the startlingly inaccurate assertion that "Prof. Grassi, of Rome, discovered the breeding grounds (of the eel) to be out in the Atlantic Ocean from Norway, Denmark, France, and Spain in some parts 1000 miles from shore."

With salmon and trout the case is different; any work upon this subject by a fisherman and fishery manager of Mr. Malloch's experience cannot fail to be of interest. Some readers will doubtless not be prepared to accept in their entirety all the views advanced, but all will be grateful to the author for recording the conclusions which he has drawn from a very wide personal experience.

The most interesting feature of the book is the really excellent series of illustrations, reproduced from photographs of Tay salmon of all ages and conditions, and of sea-trout and brown trout from various rivers and lochs. Illustrations such as these give a far better impression of the changes due to growth and condition and the variations caused by environment than any letterpress. The investigations of the Scottish Fishery Board and the Department of Agriculture in Ireland have familiarised us with the great individual difference in the period spent by salmon in the sea, and Mr. Malloch figures salmon which were marked as smolts and subsequently re-captured on their return to the river after a longer or shorter sojourn in the sea, and discusses the probable length of such sojourn. He expresses himself as "fully convinced that many (Tay) fish from 40 lb. and upwards are on their first return from the sea when they are captured in fresh water"; we could wish that some definite evidence were forthcoming in support of this conviction, for a 40-lb. salmon is presumably eight, or at least seven, years old, and Calderwood has stated that "it appears to be somewhat unusual for a fish to remain till its fourth sea year" (*i.e.* its sixth year) "without spawning."

In the Tay, salmon run at all seasons of the year, and Mr. Malloch is of opinion that the clean winter fish which run in October remain thirteen months in fresh water before spawning. We must confess to feeling sceptical on this point, more particularly as there seems to be nothing to show that such fish may not drop back again to the sea after a short sojourn in fresh water without spawning. In the case of the Blackwater (mentioned in this context as a spring river) there is some positive evidence that clean early-spring fish do drop back into the sea.

The opinion now generally held that the "bull-trout" of the Tay is a salmon is confirmed by an illustration of such a fish side by side with a salmon of the same size and weight; we understand Mr. Malloch to regard "bull-trout" as salmon which have spawned and again ascended the river as mended fish, a view which seems hardly consonant with that held by Calderwood, though not inconsistent with the results of some of the marking experiments conducted by the Scottish Fishery Board. It cannot, of course, be seriously suggested that all salmon, after once spawning, become "bull-trout."

Some space is, very properly, given to a consideration of the deductions to be drawn from an examination of the scales of salmon. While the figures given by Mr. Malloch are excellent, we find his explanations in the text rather difficult to follow; the generalisation that a salmon adds sixteen rings to its scale in each year of its life, so long as it feeds and grows, is not borne out by the scales figured or by the observations of other persons; the two years spent as a parr and smolt would, in fact, seem to account for a number of rings, varying from about twenty to twenty-seven, while from twenty to thirty rings may be added in any subsequent year spent wholly in the sea.

Such matters as the spawning and feeding of salmon in fresh water and their movements in tidal rivers are briefly discussed, and interesting figures are given of land-locked salmon up to three-quarters of a pound in weight.

Did space permit we would willingly quote freely from the chapters dealing with sea-trout and brown trout, and in particular from a most interesting discussion of the effect of environment on the latter fish, and the lessons to be drawn therefrom in the stocking and management of fisheries.

In conclusion we must deplore the entire absence of either index or detailed table of contents.

L. W. B.

NON-EUCLIDEAN GEOMETRY.

Theories of Parallelism: an Historical Critique. By W. B. Frankland. Pp. xviii + 70. (Cambridge: University Press, 1910.) Price 3*s.* net.

THE appearance of this tract is a welcome sign of the growing interest in the foundations of geometry. Those who, greatly daring, first disputed or denied Euclid's fifth postulate were treated, if not as charlatans, at least as idle speculators, whose theories, even if sound in the abstract, had no relation to actual space. It may be added that the earlier works on the non-Euclidean geometries were not very attractive to the average mathematician, because they were either so analytical that the reader was inclined to regard their geometrical interpretation as a mere *façon de parler*, or so vague and intuitive as to raise a suspicion of want of rigour.

Things have altered so much, not in substance, but in mode of presentation, that it may fairly be said that anyone with a knowledge of spherical trigonometry and elementary calculus may satisfy himself of the validity and coordinate rank of the elliptic, hyperbolic, and parabolic (or Euclidean) geometries; and he could hardly wish for a better introduction to the subject than that which Mr. Frankland has provided.

The tract falls naturally into three parts. The first, with remarkable brevity and clearness, gives the principal formulæ derived from the assumptions that the area of a polygon of n sides is proportional to the difference between the sum of its interior angles and $(n-2)\pi$, and that Euclidean geometry holds for infinitesimal figures. The second part gives, in separate paragraphs, short accounts of forty contributors to the theory, ranging from Euclid to Dodgson. This list seems fairly complete, with one noteworthy exception—Sophus Lie. In the third volume of his "Theorie der Transformationsgruppen" (section v.) Lie gives a masterly and exhaustive critique of the subject from an analytical point of view, and his discussion of Helmholtz's axioms is particularly instructive.

The third part of the tract consists of two notes—one developing the metrical formulæ of elliptic geometry, and the other dealing with planetary motion in elliptic space, with a law of attraction expressed by the formula $P=\frac{\mu}{k^2}\operatorname{cosec}^2\frac{r}{k}$, where k is the absolute constant of the space considered. The results are, in some respects, curiously analogous to the Newtonian ones; but there are also striking differences—for instance, the uniform description of areas about the centre of force does not hold good.

Mr. Frankland's critique deserves a wide circulation, and will doubtless do much to make the general public more familiar with what is, after all, a matter of great philosophical interest, that can be explained, apart from demonstration, to any intelligent person. There is no reason at all why a schoolboy, who has made some progress in geometry, should not be made acquainted with the main characteristics of the three possible systems, and realise, to some extent, the transformation so recently undergone by the oldest of the sciences.

G. B. M.

FOREST FLORA OF THE BOMBAY PRESIDENCY.

Forest Flora of the Bombay Presidency and Sind. Vol. i., Ranunculaceæ to Rosaceæ. By W. A. Talbot. Pp. vi+508+xxvi. (Poona: Printed by Government at the Photozincographic Department, 1909.)

IN 1894 Mr. W. A. Talbot issued a useful "List of the Trees, Shrubs, and Woody Climbers of the Bombay Presidency." A new and improved edition of this "List" appeared in 1902. In the present work Mr. Talbot has supplied what is essentially a more complete and considerably enlarged edition of the "List," with full accounts of all the species included, and illustrations of the more important ones. Those using the "List" will find full accounts of the species it includes in Dr. T. Cooke's "Flora of the Bombay Presidency"; the main purpose of this "Forest Flora" we may, therefore, assume to be the provision of an illustrated work of reference for Bombay comparable with the "Flora Sylvatica" which Col. Beddome prepared for Madras forty years ago. If this assumption be correct, the provision of yet another series of plant descriptions, marked as they are by all the care and accuracy which characterise Mr. Talbot's work, cannot be said to be supererogatory.

The quarto size seems to have been adopted in order to render the "Flora" uniform with the corresponding work for southern India rather than because of the nature of the illustrations, only two of which occupy the whole of a page. It seems, therefore, doubtful whether Mr. Talbot is right in thinking that the size of the work has been kept as small as possible, or justified in hoping that it may not prove too unwieldy for transport in the baggage of a forest or district officer.

The text is clearly and carefully printed, but the glazed paper used is heavy, unpleasant to handle and to look at, and does not promise to be durable in damp localities. No doubt this type of paper has been chosen on account of the process employed in the reproduction of the illustrations, which, unfortunately, as matters stand, are the least pleasing portion of the work. The drawings made use of have not lent themselves at all well to reproduction by the process adopted, a statement of fact which involves no reflection either upon the process or upon the drawings. These, indeed, one can readily imagine to have been pleasing in their original form, though they have the disadvantage of falling short of what is desirable in a work of this kind, since for the most part they do no more than display the habit of the species illustrated, and rarely include analyses of the flower.

APPLIED CHEMISTRY.

Chimica Generale e Applicata all' Industria. Vol. ii.: Chimica Organica. By Prof. Ettore Molinari. Parte i.: pp. xvi+416; parte ii.: pp. xii+417 to 979. (Milan: Ulrico Hoepli, 1908–9.) Price 21 lire the 2 vols.

THE volumes with the above title form a supplement to the treatise on inorganic chemistry by the same author, already reviewed in NATURE (vol. lxxi., p. 339). The same general plan has been followed in these later volumes as was adopted in the case of inorganic substances, the treatise differing from nearly all other smaller treatises on organic chemistry in giving very full details of industrial operations. The book is not, however, a treatise on technology in the narrower sense of the word, the theoretical side being by no means neglected. A very great deal of thoroughly up-to-date information of processes and plant is imparted, but at the same time there is due regard to the theory of the operations. The work is excellently illustrated with cuts of the latest kinds of machinery. An idea of the character of the work may be conveyed by stating that sixty-five pages of small print are devoted to the manufacture of sugar, and that the processes involved are described clearly but concisely, the illustrations being very well chosen. Such a work must necessarily prove of good service to students who intend to devote themselves to industrial chemistry and are desirous of becoming acquainted with general manufacturing operations. There are many signs that the author has spared no pains to make himself acquainted with the latest facts and processes, references in some cases being given to results brought before the recent International Congress of Applied Chemistry in 1909.

It is nowadays obviously impossible for any one individual to give an authoritative account of all the different branches into which industrial chemistry is subdivided, and in such a work as that under review it would, no doubt, be easy for specialists to detect several errors. Thus, for example, the 1898 Goldenberg process of analysis of tartaric acid material described on p. 451 was superseded by the 1907 process, and this was again modified in 1909. Certain statistical information given is, too, of doubtful correctness. Names are frequently misspelt. But putting aside minor blemishes of this kind the work is of a decidedly useful nature, and, like the inorganic portion, to be commended. It may be noted that a German translation of the whole work is in progress, so that it may shortly become more accessible to the English student.

W. A. D.

OUR BOOK SHELF.

Guide to the Crustacea, Arachnida, Onychophora, and Myriopoda exhibited in the Department of Zoology, British Museum (Natural History). Pp. 133; 90 illustrations. (London: Printed by order of the Trustees of the British Museum, 1910.) Price 1s.

THIS "Guide" admirably fulfils its functions; it is written in a clear style, and indicates tersely the main points of interest associated with the chief families and genera. The principal characters of each subdivision—class, order, tribe, family—are concisely stated, and those of its members are selected for mention which most aptly illustrate points in morphology or distribution, or show some striking habit. The section on the Crustacea opens with a short account of the lobster, its external features and appendages, internal organs, development, moulting, and the asymmetry of its chelæ. Short notes are added on the modifications caused by parasites and on adaptations to environment.

The systematic account of the Crustacea, in addition to stating the characters of each subdivision, contains a large number of interesting references to morphological and distributional points which make it valuable apart from the special purpose for which it was prepared. To give two instances—(1) the formation of a respiratory siphon which takes place in the Albuneidæ by apposition of the antennules, but in Corystes by association of the antennæ; and (2) the appearance of Apus in Scotland in 1907, which is ascribed to the introduction of the eggs, perhaps on the feet of birds, from the Continent. The Arachnida, including Limulus and the Eurypterines, and the Myriopoda are dealt with in a similarly interesting manner, and short notes are added on the Trilobita, Pycnogonida, Pentastomida, and Oncychophora. A little more space might well have been devoted to the Ixodidæ, in view of their great importance in connection with the spread of disease in man and animals. The illustrations, many of which are new and are prepared from photographs of the specimens exhibited, are excellent, and well support the text.

Popular Astronomy. By the late Prof. Simon Newcomb. Pp. xx+580+5 star maps. (London: Macmillan and Co., Ltd., 1910.) Price 8s. 6d. net.

ASTRONOMY has no doubt made progress in several directions since the late Prof. Newcomb revised his renowned work; nevertheless, if the lamented author were alive to re-write his book at the present time, by far the greater part could not be improved upon. The extensions of knowledge take place at the frontiers of a science, while the main body of fact and principle remains unaltered. While, therefore, this cheap edition of Prof. Newcomb's "Popular Astronomy" is issued without additions referring to recent developments, the volume can fairly be described as one of the most lucid and authoritative statements of the foundations of astronomical science available even now. To let such a work pass out of print would have been a misfortune, and we trust that the issue of an edition at less than half the original price will be the means of making many new readers familiar with its merits.

Naturwissenchaftliches Unterrichtswerk für höhere Mädchenschulen. Teil iv., Lehrstoff der iv. Klasse. By Dr. K. Smalian and K. Bermau. Pp. 152. (Leipzig: G. Freytag, 1910.) Price 2.50 marks.

THIS volume, one of a series graded for successive school classes, has been prepared to comply with official regulations, wherein presumably lies the reason for combining a triad admixture of botany, zoology, and mineralogy. The aim of the authors has been directed less towards a training manual and more towards providing a compendium of information on objects which are met with in daily life. The book contains an accurate but condensed collation of facts concerning cryptogamic and economic botany, the zoological groups of mollusca, vermes, and cœlenterata, and common or useful minerals. It is plentifully illustrated with good text-figures and a dozen coloured plates.

LETTERS TO THE EDITOR.

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

Pwdre Ser.

IN my former communication on this subject I gave all the information I had been able to collect respecting the popular belief as to the masses of white jelly found in my experience on mountain pastures, but, according to the observations of others, on different kinds of ground and at various seasons.

I recently procured a specimen of the jelly, and quoted a letter from Mr. Arber, to whom I had sent it, giving the opinion of Mr. Brookes, to whom Mr. Arber had referred it. After that was written I received the following note from Mr. Brookes, under the date April 4:—"The 'jelly' had been gathered several days before it reached me, and hence its condition was not suitable for examination, several putrefactive organisms having begun to flourish upon the jelly in the meantime. The remains of the substance which I saw seemed to be most like the zooglœa stage of some bacterial organism or the plasmodium of a myxomycete. The 'jelly' itself had no cellular structure. There was no nostoc present or any allied organism."

More recently I received a specimen which Mr. Burnett, headmaster of the Grammar School at Kirkby Lonsdale, found in the Rawthay Valley, some miles above Sedbergh. This also I sent to Mr. Brookes, who writes (July 26) that "the jelly-like mass sent from Kirkby Lonsdale is undoubtedly the plasmodium of a myxocete," and adds that he is "keeping it to see whether it will give rise to spores."

Mr. Worthington Smith, in a letter dated June 24, says:—"Perhaps you will find the substance so accurately described by you in this week's NATURE under the generic name of Zooglœa; the name as a genus may be obsolete now, but I think that in past times it was placed amongst the algæ, perhaps near Nostoc, and afterwards included in the Schizomycetes. However this may be, I know the substance very well, and I have often had it sent on to me in the past (when I used to answer correspondents for some of the horticultural papers) as a fungus—a Tremella—difficult to trace. I have heard it, as well as Nostoc, associated with fallen stars amongst rustics."

These authorities, as well as Miss Fry (NATURE, June 30), agree as to the nature of the Pwdre Ser, and I must say that whenever I have observed its manner of occurrence it has seemed to me to grow out of the sod—but I would not like to say that what I have seen has always been the same kind of matter.

The very circumstantial account given by Morton, that something of the kind is disgorged by birds, is confirmed by other later observers.

Although we must not too hastily accept what is undoubtedly a *vera causa* as the only explanation, we may feel that we are moving in the right direction to find the answer to the question, What is it?

The question why it is associated with falling stars has received a plausible explanation from Messrs. Grove and Griffiths (NATURE, July 21); but falling stars do not appear to hit the ground so that an observer can walk up to the spot where they seem to have fallen, as in the case of lightning or thunderbolts, and if we bring in possibilities of other luminous bodies we raise the difficult question of lambent fires, &c. The star-like radiating form of the jelly-fish, like that of the star-fish, is sufficient to explain the name given by Admiral Smyth (July 21, p. 73).

While our botanical friends are finding out for us what it is, may I hope that some of our literary friends will trace the belief back further than the sixteenth century, when we find it accepted as if founded upon well-known facts? T. MCKENNY HUGHES.

July 29.

The Blood-sucking Conorhinus.

IT may interest readers of NATURE to be informed that the great South American bug figured on p. 142 of the issue of August 4 punished Charles Darwin when travelling in the Pampas, happily without infecting him with its trypanosome (see "Journal of a Naturalist," ed. 1845, p. 330). J. D. H.

The Camp, near Sunningdale, August 5.

[SUBJOINED is the description to which our correspondent refers.—ED. NATURE.]

"WE slept in the village of Luxan, which is a small place surrounded by gardens, and forms the most southern cultivated district in the Province of Mendoza; it is five leagues south of the capital. At night I experienced an attack (for it deserves no less a name) of the *Benchuca*, a species of Reduvius, the great black bug of the Pampas. It is most disgusting to feel soft, wingless insects about an inch long crawling over one's body. Before sucking they are quite thin, but afterwards they become round and bloated with blood, and in this state are easily crushed. One which I caught at Iquique (for they are found in Chile and Peru) was very empty. When placed on a table, and though surrounded by people, if a finger was presented the bold insect would immediately protrude its sucker, make a charge, and, if allowed, draw blood. No pain was caused by the wound. It was curious to watch its body during the act of sucking, as in less than ten minutes it changed from being as flat as a wafer to a globular form. This one feast, for which the benchuca was indebted to one of the officers, kept it fat during four whole months; but, after the first fortnight, it was quite ready to have another suck."

The Early History of Non-Euclidean Geometry.

IN a recent number of NATURE (June 30) there appeared a review of a book by G. Mannoury on the philosophy of mathematics, and the reviewer emphasised a statement of the author to the effect that the claim for Gauss that he was the first to assert the possibility of a non-Euclidean geometry is threatened by F. K. Schweikart, who in December, 1818, sent a note to Gauss asserting the existence of a geometry in which the sum of the angles of a triangle is less than two right angles. The facts about Schweikart were made known fifteen years ago by Stäckel and Engel ("Theorie der Parallellinien," p. 243), and the actual documents were published in Gauss's "Werke," Bd. viii. (1900). It must be admitted that Schweikart arrived independently at this result, though it is not so obvious that he had forestalled the "giant mathematician." Schweikart states his hypothesis very clearly, and explains that Euclidean geometry is a special case of a more general geometry. On the other hand, Gauss was interested in the theory of parallels from at least 1799; and some time between 1808 and 1816 he arrived at the belief that non-Euclidean geometry was possibly true, for in 1808 he asserted that the idea of an *a priori* linear constant (the "space-constant") was absurd, while in 1816 he declared that, while seemingly paradoxical, this idea was in no way self-contradictory, and that Euclid's geometry might not be the true one. In his comments on Schweikart's note, he exhibits quite an extensive knowledge of non-Euclidean trigonometry.

Of course, the development of non-Euclidean geometry and trigonometry is due independently to Lobachevskij (1829), and Bolyai (1832), and even that was worked out to a large extent previously by Lambert (1786), and still earlier by the Italian Jesuit Saccheri (1733), though neither of these two conceived for a moment the possibility of non-Euclidean geometry being true.

It is interesting in this connection to recall the hesitancy of Cayley to accept non-Euclidean geometry, although he himself practically inaugurated a new epoch. He never seemed quite to appreciate the subject, and on one occasion, at least, fell into a mistake in writing about it. In his article "On the Non-Euclidean Plane Geometry," Math. Papers, vol. xiii., p. 237, he inadvertently takes the equatorial circle of the pseudosphere (the surface of revolution of the tractrix) as representing the points at infinity, whereas the absolute is only represented by a single point, viz. the point at infinity on the pseudosphere.

D. M. Y. SOMMERVILLE.

The University, St. Andrews, July 26.

The Total Solar Eclipse of April 28, 1911.

WHILST astronomers who intend to observe this eclipse are choosing from amongst the Vavau, Tau, Nassau, and Danger Islands, the best one on which to land, it may be useful to state the totalities of the eclipse in these islands.

From the calculation of the phases obtained by the Besselian method, and with the data of the "American Ephemeris," I have found the following values:—

				m.	s.
Vavau (arch. of Tonga)	...	...	Totality	=3	36·6
Tau (arch. of Samoa)	...	...	,,	=2	13·0
Danger (arch. of Union)	...	...	,,	=3	19·4
Nassau (,,)	...	...	,,	=4	9·9

The geographical coordinates of these islands, adopted in the calculations, are respectively:—

Islands			λ		φ
			° ′		° ′
Vavau	...	...	−173 59·0	...	−18 39·0
Tau	...	...	−169 32·0	...	−14 13·5
Danger	...	...	−165 45·0	...	−10 53·0
Nassau	...	...	−165 25·0	...	−11 33·0

Rome, July 29. PIO EMANUELLI.

Mars in 1909 as seen at the Lowell Observatory.

THE accompanying prints are photographs of the globe of Mars, representing the details seen on the planet at the Lowell Observatory at the last opposition in 1909.

These maps demonstrate strikingly the development of the canals from the melting cap, shown by the number of canals visible in the southern hemisphere at the time, especially about the south pole, and by the absence of canals in the northern one, notably in the neighbourhood of the north polar cap.

The canals numbered 659 or 660 are the two great new canals, of which the account has already been published, and of which the size enabled the advent to be established with certainty. Several other examples of fresh origination are to be seen on the charts, about which the evidence is hardly less conclusive.

The white patches at some distance from the south pole mark the first frost of the autumn in the planet's southern hemisphere. These patches were photographed, as were also many of the canals.

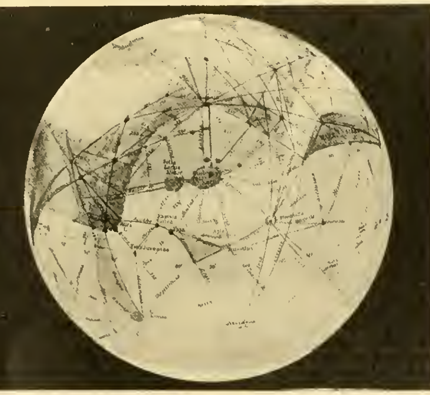
The number of the latter photographed at Flagstaff since 1905 is between fifty and one hundred.

Boston, U.S.A., July 22. PERCIVAL LOWELL.

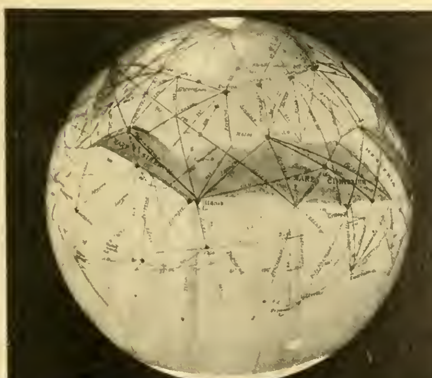
North Pole.

South Pole

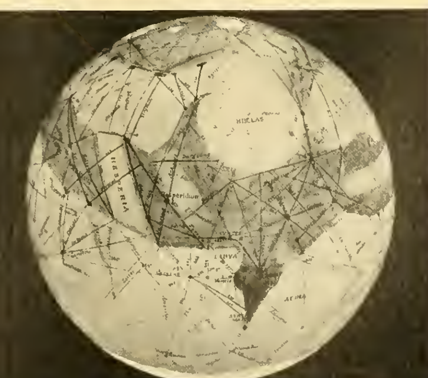
$\lambda =$.



$\lambda = 90$.



$\lambda = 180°$.



$\lambda = 270°$.

Lowell Observatory Photographs of Mars in 1909.

Treatment of Storage Cells.

IN the "Notes" of NATURE for July 28 (p. 118) reference is made to an article on the renewal of sulphated storage cells by Mr. J. O. Hamilton. Readers of NATURE may be interested in a method of treatment I have employed for a number of years, which has given most satisfactory results.

A strong (30–40 per cent.) solution of crude, commercial sodium hydroxide solution is prepared in a large iron pot and is heated to boiling. The accumulator plates, previously washed thoroughly for several days in running water, are dipped into the boiling soda solution and allowed to remain for a period of from five to fifteen minutes, depending on the extent to which "sulphating" has taken place. They are then removed and washed for several days in fresh water, after which they are placed in the jars with fresh sulphuric acid solution and thoroughly charged.

This treatment can be applied to any cells which have not undergone structural disintegration, and when properly carried out restores the cell to its full normal capacity. I have used it with complete success for treating a set of six large portable accumulators which had stood uncharged for nearly five years, during which period almost all the water had evaporated from the electrolyte, and the greater part of the sulphuric acid had combined with the plates. It is also a very effective remedy when applied to cells which show local action and continuously evolve gas from the plates after charging, with a corresponding more or less rapid loss of charge on standing. In treating such cells a more dilute solution (20 per cent.) of sodium hydroxide can be used.

I have never found a cell too completely "sulphated" to be restored by this treatment.

BERTRAM B. BOLTWOOD.

Munich, Germany, August 7.

The Sheffield Meeting of the British Association.

MAY I ask the favour of your columns to bring to the notice of intending visitors to the meeting of the British Association in Sheffield the fact that, at the reception to be given to the association by the Duke of Norfolk, the Chancellor of Sheffield University, on Tuesday evening, September 6, exhibits are being arranged of new experiments, apparatus, specimens, &c., of scientific interest? The committee of the University formed to make arrangements for the exhibition will be glad to hear from any members of the association or others who have any exhibits which they can show on this occasion. The committee will welcome cooperation, and will give every facility for demonstrations.

S. R. MILNER.

(*Secretary to the Committee.*)

The University, Sheffield, August 8.

YELLOW JACK AND THE WEST INDIES.[1]

THIS is a popularly written book, giving an account of the health of the West Indies of to-day, as compared with one hundred years ago. The motto on the title-page is "Wear a smile on your face, and a flower in your buttonhole," and, in accordance with this, the note of the book throughout is cheerful and optimistic.

The book is the outcome of a visit paid by the author, at the request of the Colonial Office, to Barbados in March, 1909, to report on an outbreak of yellow fever which threatened the colony at that time. After spending a month in Barbados, a flying visit was paid to Grenada, St. Vincent, St. Lucia, Trinidad, and British Guiana, in order to study and compare the health conditions of these colonies with those of Barbados. Further, in a series of appendices, the health progress of Martinique, Guadeloupe, Cuba, Porto Rico, Jamaica, the Bahamas, and British Honduras is summarised.

FIG. 1.—Belleville, Barbados. From "Health Progress and Administration in the West Indies."

The diseases mostly dealt with are yellow fever, malaria, filaria, plague, and ankylostoma. The medical organisation of the different islands to improve sanitary conditions, to destroy mosquitoes, to prevent the introduction of disease, and to stamp out existing diseases, is discussed at length. A large part of the book is given up to the various health ordinances and sanitary by-laws issued by the various Governments. From this it will be seen that the scope of the book is wide. It is illustrated by many fine reproductions of photographs of places and scenery in the West Indies; also by plans of the towns visited, giving the distribution of mosquitoes and the diseases due to them. There is an excellent coloured map of the region in question.

[1] "Health Progress and Administration in the West Indies." By Sir Rubert W. Boyce, F.R.S. Pp. xv+328. (London: John Murray, 1910.) Price 10s. 6d. net.

The first chapters are devoted to an historical account of the health conditions of the West Indies at the beginning of the nineteenth century. These are rather hastily and loosely written, but suffice to show that at that time these islands were veritable death-traps. It was the newcomer who was attacked, and no one felt safe until he had at least passed through an attack of yellow fever, and so become, as the saying was, acclimatised. Now, by the introduction of drainage, pipe-borne water supply, the destruction of mosquito breeding-places, and general sanitation, these diseases have almost disappeared, and the islands are becoming the sanatoria nature surely intended them to be.

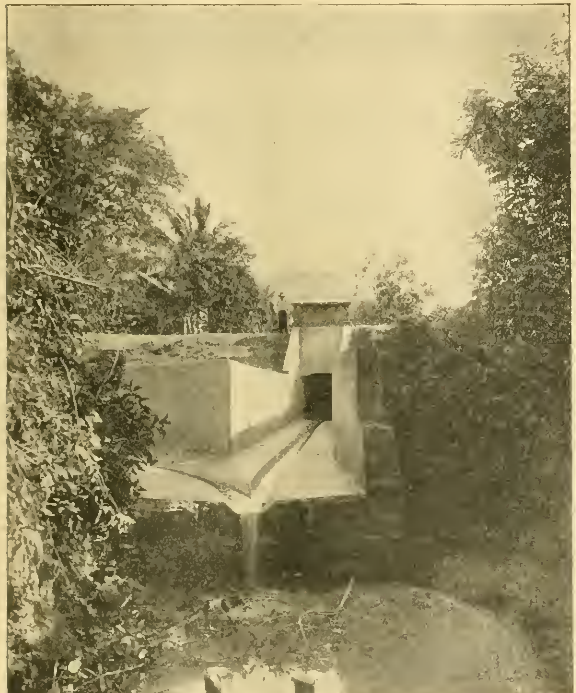


Fig. 2.—Large Concrete Drain, Port of Spain. Trinidad. From "Health Progress and Administration in the West Indies."

Truly, according to Sir Rubert, the victories of modern medicine over tropical diseases in the West Indies during the last few years have been marvellous. Owing to the discovery of the cause, and the fact of it being water-borne, cholera is now unknown. Malaria has given up its secrets, and it is now merely a matter of putting the knowledge gained into practice to stamp out that scourge of the Antilles. Yellow fever, which a hundred years ago blotted out whole regiments, is now relegated to the place of a pathological curiosity. Ankylostoma disease, one of the most potent destroyers of health and energy in the tropics, is now understood, and can be coped with. Prof. Boyce's book is full of instances of man's enlarging dominion over that unlovely domain of nature—disease.

There are some signs, as mentioned above, of haste in the production of the book, especially in the second chapter. For example, a table is given on p. 8 which is meant to show that the newly-arrived seaman was frequently attacked, but no figures are given of the total number of seamen dealt with. Again, on p. 16, the following sentence occurs:—"From 1817 to 1836, in the garrisons in Jamaica, amounting at that time to 2578 men, the deaths from intermittent and remittent fevers rose to 258 men." This probably means a yearly rate, but it is not so stated. Other awkward sentences are:—"Swooped down on every ship, war vessel, and merchantman." "These were the days which tried the nerve and endurance of our fathers and grandparents, or at least those of them who survived the deadly disease of not so long ago." "In fact, the entomological equipment of Trinidad is exceedingly good and is bearing excellent fruit." "So as to reap at once the advantages which must accrue." "In ten out of the fifteen yards larvæ were found in the barrels, and the barrels nearly always contained larvæ."

To conclude, this book, by bringing together and presenting in an easy form the efforts now being made by the various Governments in the West Indies towards the improvement of the health of their respective islands, and the brilliant results which have already rewarded their labours, will be of great use to all officials whose duty it is to look after the health and well-being of tropical populations.

THE VERTEBRATE FAUNA OF CHESHIRE.[1]

THERE are few counties in England which present a variety of natural features so favourable to a varied fauna as does Cheshire. It possesses undulating plains; heather-clad or wooded hills of considerable altitude; numerous rivers, meres, lakes, and "flashes"; tree-clad vales; forest, woods, plantations, and shrubberies; marshes and remnants of mosses, besides considerable estuarine frontages and half the broad "Sands o' Dee." The county is freer from manufactories, with their destructive smoke and fumes, and has less of its area under the plough than most of its neighbours. It is chiefly given up to sheep and dairy farming, necessitating extensive grasslands, and to large market gardens and nurseries, which are, on the whole, friendly to the increase of certain classes of animal life. Still, with all these advantages, the vertebrate fauna of Cheshire is not so rich as one might expect, nor so rich, indeed, as it once was.

1 "The Vertebrate Fauna of Cheshire and Liverpool Bay." Edited by T. A. Coward. In two volumes. Vol. i., The Mammals and Birds of Cheshire. By T. A. Coward and C. Oldham. Pp. xxxii+472; with illustrations from photographs by Thomas Baddeley. Vol. ii., The Dee as a Wildfowl Resort. By John A. Dockray. The Reptiles and Amphibians of Cheshire. By T. A. Coward and C. Oldham. The Fishes of Cheshire and Liverpool Bay. By James Johnstone. Pp. xl+210; with illustrations from photographs by Thomas Baddeley. (London: Witherby and Co., 1910.) Price 26*s.* net the 2 vols.

"During the last half-century farming has greatly improved . . . old hedgerows have been grubbed up and replaced, and waste lands and mosses have been reclaimed and cultivated; changes no doubt advantageous to the common weal, but deplorable when viewed from the standpoint of the naturalist."

That is, the increase of population and the movement and disturbance of nature due thereto, and the incessant hustling by civilisation, are in Cheshire, as everywhere else, tending to "move on" every form of life.

Although the cover bears the title of "Fauna of Cheshire," these volumes deal only with the vertebrates of the county. The editor, Mr. Coward, and his co-contributor-in-chief, Mr. Oldham, are responsible for the greater part of the fauna. Both are well known for the attention they have long devoted to the natural history of Cheshire, and theirs are, consequently, the right and proper names to appear on the title-page.

Somerford Cattle. From "The Vertebrate Fauna of Cheshire and Liverpool Bay." Edited by T. A. Coward.

The work seems to us, however, to go considerably beyond the legitimate limits of the county in including in it the marine fishes within a line "from the Great Orme's Head in Carnarvonshire to Formby Point in Lancashire." We believe that the editor would have been well advised if he had restricted his observations to the land, fresh-water, and estuarine life, and thus rendered a second volume unnecessary, which would have been a great advantage in many ways. By omitting such quite unnecessary matter as the Wild Birds' Protection Act, set out verbatim at the expense of more than six pages; by judiciously squeezing the migration section; circumspectly condensing the interesting yet somewhat disproportionately long account of Dee as a wildfowl resort, and excising the repetitions in the bibliography, room could have been made for the contents of the second volume within the first. The map, which, under the present arrangement of the book, is relegated to the second volume, where it is very inconvenient, would have then been found in the volume the contents of which necessitate its more frequent consultation. The portrait of J. Fell, Esq., the estimable former chairman of the Lancashire Sea Fisheries, seems dragged into a work dealing exclusively with Cheshire, especially as he ceased to occupy that position in 1894, and his name does not, apparently, occur in the book.

Following a short introduction, in which the extinct and fossil species of the county are enumerated, full descriptive notices are given of each of the forty-six mammals which "occur or have occurred within recent years in Cheshire and its territorial waters." We read that the Scotch white hare which was introduced into Yorkshire has spread largely into Cheshire, and it will be interesting to watch how the rodent will be affected by this change to a locality where the warmer climate disperses the snow before the time for changing its protective winter-coat arrives. An interesting *résumé*, chiefly from the British Association report on the subject in 1887, is given of the herd of white cattle at Somerford Park, where it has existed for two centuries, and still consists of twenty-five head, and that now extinct at Lyme Park. As to the birds, the authors admit the title to a place on the list "during the present and last centuries" of 231 species, of which 112 breed, or "bred till recently," in the county, and among which the nightingale is included, "as there is no doubt that the bird has bred on some, at any rate, of the occasions when it has been observed"; but, as neither eggs nor nestlings have been seen, we may be permitted to continue to doubt the accuracy of the statement until better evidence be forthcoming. With regard to the pose of the kingfisher when hovering over a stream in quest of food, the authors assert that the long axis of its body is placed almost at right angles to the plane of the water. The bird no doubt adopts any attitude which it considers most appropriate to the occasion, but it is not by any means, in the writer's experience, the usual one, which is to hover hawk-like a score or so of feet above the stream, and like it remain perfectly stationary, just as it is represented in the figure by Harting in his "Recreations of a Naturalist," reproduced in NATURE of May 24, 1906. It is pleasant to read that the great crested grebe, one of our handsomest birds, is more numerous in Cheshire than in any other county, from which we may infer that, temptation notwithstanding, plumassiers' agents leave it unmolested. It is well known that this bird covers its eggs on leaving the nest during incubation with a mass of rotting and fermenting nesting material, and our authors seem to assent to the suggestion (of Seebohm) that the material is so placed that through the heat thereby generated incubation during the bird's absence may not be retarded. This idea is rather discounted by the fact that the material used is often neither rotting nor fermenting, and therefore without heat, but consists of fibres of reeds cut off from those within reach of the breeding bird's beak, and freshly teased out by it. The most remarkable bird in the list is Schlegel's petrel (*Œstrelata neglecta*), a wanderer from the antipodes, found dead in a field near Chester. Whence it arrived and how its dead body came where it was found are unexplained mysteries. Cheshire reckons in its reptilian and amphibian fauna the usual small number of forms common to nearly every other county in the country.

Mr. Johnstone's introduction to the section of the fishes, extending to thirty-nine pages, enters into many subjects valuable in another relation which seem to us foreign to the subject of this book, and which few would look for in an inland fauna. The majority of the fishes enumerated can hardly be claimed as belonging to Cheshire, which has only a snout of seaboard less than ten miles in extent, faced, besides, with a sandbank stretching seaward almost as far as the limits of its territorial waters. Of the 107 species enumerated, fifty-five are "very rare," and many are included on the scantiest authority. The list, for instance, opens with the sunfish, "once recorded from local waters," thereby meaning Southport! Other notes are:—"No occurrence of the mature fish in strictly Cheshire waters"; "on Welsh side of Dee"; "does not occur in territorial waters of Liverpool Bay." Then why insert these species? Those taken "once in Queen's Channel" and in "Crosby Channel" are surely game poached from Lancashire. By what right can species from "off the Mersey banks," "off the estuaries," or "mouth of Dee" be ascribed to Cheshire's "territorial waters"? And if "drifted eggs" of pelagic species detected in water of the bay be sufficient evidence for adding them to the Cheshire fauna, why not include the whole marine fauna of the Irish Sea? This shortcoming, except as we have indicated, detracts little from the unquestionable value of the major part of Mr. Coward's book.

Messrs. Witherby and Co. are to be highly congratulated upon the excellence of the work as a commercial product. A special word of praise is also due to the illustrations, the majority of them separate plates on fine-surfaced paper, every one excellent, several of quite charming bits of scenery, all admirably photographed and reproduced. By the courtesy of the publishers we are enabled to present "Somerford Cattle" as an example.

ACROSS YUNNAN.[1]

IN the present work the author gives an account of his last journey from the Yangtse to Yunnan-fu, and onward to Haipong and Hong Kong. It is edited by Mrs. Archibald Little, who accompanied him in his travels, and whose personal experiences among the Chinese have been recorded in her published works. The main interest of the volume lies in its bearing upon the great railway just completed, which links up the capital of Yunnan with the French colonial possessions in Cochin-China. The author, in following the route, points out the engineering difficulties that had to be overcome in building the line. It traverses a rough, mountainous region, alternating with rivers, low-lying, malarious swamps, and stony, sterile wastes, places where work had to be suspended owing to outbreaks of fever that thinned the ranks of the labourers.

The line from Tonking, in a distance of 263 miles, rises 8000 feet to the level of Yunnan-fu, by gradients of 2·51 feet in 100. It was to be opened officially on April 1, 1910, and the issue of the book was designed to be coeval with this event "as a tribute to

Lofty Stone Column, such as are common in Yunnan, and recall Cornish Crosses. Near Chao-tung-fu. From "Across Yunnan."

the French enterprise" on which the author touches so often with warm admiration in his pages. While the project of building a British line of communication to Yunnan-fu from Kunlung ferry remained in abeyance, M. Dormer, the energetic Governor of Cochin-China, pushed forward his scheme, which was at once passed by the French Chamber in 1905, and carried through with a promptitude deserving of all praise.

The completion of this trade-route involves a new factor in the problems of international commercial intercourse with western China, the advantages which may accrue falling at present to France. There are other existing lines of communication with Yunnan, but no railways, as the west river route, by which, after tedious marches, produce reaches Canton and Hong Kong. There is also that by the Yangtse. Some

[1] "Across Yunnan." A Journey of Surprises, including an Account of the Remarkable French Railway Line now completed to Yunnan-fu. By Archibald Little. Pp. 164. (London: Sampson Low, Marston and Co., Ltd., 1910.) Price 3s. net.

idea of the difficulties encountered by this route may be gathered from the author's experiences. Were it possible to construct a railway from Ichang, at the lower entrance of the Yangtse gorges, through to Yunnan-fu, produce would readily find markets at the treaty ports on the lower river. In 1872 the present writer ascended the gorges, and concluded from his survey that it would be impossible to utilise this section of the river for steam navigation. The late Mr. Archibald Little appeared to have confirmed this view when he made his memorable ascent in 1887.

The story of this journey is admirably told, and rendered all the more attractive by a series of well-chosen photographs. J. T.

DOES THE INDIAN CLIMATE CHANGE?[1]

ANYONE who has examined carefully the meteorological elements of any country, whether they deal with pressure or rainfall, will have noticed that the curves formed by plotting the values for consecutive winter or summer seasons, or even for whole years, present a very wavy appearance. A closer inspection of such curves brings out the fact that they are really of a composite nature, and are made up by the superposition of waves of long and short lengths.

Such curves indicate that the meteorological elements not only oscillate, about a mean value, rapidly and to a considerable extent in magnitude, in a short period of time of about three or four years, but that, in addition to these variations, there is another oscillation, or perhaps several others, occurring over very much longer periods.

It is the presence of the long oscillations which has given rise to the idea that climates are permanently changing. This is due to the fact that in many cases meteorological observations made in a homogeneous manner do not extend over a sufficiently long period of time to exhibit a complete wave or oscillation, and the conclusion of climate change is drawn incorrectly from the portion of the wave which is indicated.

The main difficulty met with in dealing with a long series of observations is that those made in the early days are not so accurate as those made more recently with modern instruments and methods. Thus while the data may show a change in the meteorological elements, such a variation may be purely fictitious, and due to either the instruments, the methods, the observers, or a combination of all three.

In the volume under notice attention is directed to the fact that since the year 1894 the monsoon in north-west India has indicated a very marked weakness, and the suggestion has been made that a permanent change in the climate of that region has taken place, due, as some believe, to increased irrigation or diminution in forests.

The question of the strength of the monsoons in India is of such great importance to the inhabitants of that country—for it means drought or plenty, according as the monsoon is weak or strong—that Dr. Walker, the director-general of Indian observatories, discusses the subject in considerable detail in this memoir. In the first portion of this work he describes the care he has taken to use only data, extending over a great number of years, which can be thoroughly trusted, the records being obtained from the same stations throughout the whole period of time considered. Each province is separately dealt with, and the rainfall tabulations and curves begin at the earliest year possible and end at 1908.

Without entering into the results from each area, the broad conclusions need here alone be summarised. Thus Dr. Walker states that

> "although there is no proof of any permanent climatic change, there has been a tendency over a large part of north-west and central India for rainfall during the past thirty years (*a*) to increase to a maximum between 1892 and 1894; (*b*) to sink to a minimum in 1889; and (*c*) to improve slowly since that time. Over the remainder of India there do not appear to have been any progressive changes of importance."

Dr. Walker, in seeking the causes of this variation, remarks, in the first instance, that (*a*) and (*b*) negative any explanation which has irrigation as a basis, and that as the destruction of the forests on a large scale ceased about twenty years ago, the expected improvement in the rainfall during the last fifteen or twenty years does not agree with the actual facts.

Failing local causes for variation, he shows that the true explanation is to be found in the extra-Indian area. Thus he finds that in the Nile there was a rise to a maximum in 1892 to 1894, followed by a rapid fall to 1899, from which time until 1906 a deficiency has prevailed, while in 1908 a very great improvement occurred.

This comparison shows the close association between the monsoon rainfall and the height of the Nile, and suggests that they are both dependent on the Arabian Sea current.

He, however, goes still further afield, and utilises, in a practical manner, some of the results of the investigations which have been made in recent years at the Solar Physics Observatory, South Kensington. In the researches just mentioned, it was demonstrated that when in any year the pressure over South America was in excess, that over India was deficient, and *vice versa*. As low pressure over India means a good monsoon, and high pressure a weak monsoon, the close meteorological relationship between these two very distant countries becomes of great importance.

Dr. Walker states:—

> "Further, it is an established fact that the monsoon rainfall in India tends to be abundant when pressure is high in the Argentine Republic and Chili, and low in the Indian Ocean: it shows a fairly close correspondence, therefore, with the excess of pressure in South America above the pressure at Mauritius."

Using the data for these countries, he shows that the favourable character of the extra-Indian conditions rose to a maximum in 1892, fell to a minimum in 1899, and has on the whole recovered since that time. Thus he writes:—

> "There are valid reasons, therefore, for regarding these extra-Indian conditions as having largely determined the general character of the Indian rains."

The discussion of the question as to whether the climate of India changes leads him finally to the following inferences:—

> (*a*) "The recent deficiency of monsoon rainfall in a large part of central and north-western India must be attributed to something abnormal in the larger movements of the atmosphere and not to human agency in India; (*b*) the deficiency has not lasted long enough to justify the conclusion that there has been a permanent change of climate; and (*c*) there are marked indications of a return to good seasons."

WILLIAM J. S. LOCKYER.

[1] Memoirs of the Indian Meteorological Department, vol. xxi., part i. "On the Meteorological Evidence for supposed Changes of Climate in India" By Dr. Gilbert T. Walker, F.R.S. (Simla, 1910.)

NOTES.

THE Physical Society of London announces that the Montefiore Electrotechnic Institute at Liége has instituted a "George Montefiore Levi" prize, which will be awarded every three years, the first award being in 1911. The value of the prize in 1911 will be 20,000 francs (800*l*.). It will be awarded for the best original work presented upon the scientific advance and on the progress of technical applications of electricity in every field. Popular works and simple compilations will be excluded. Works must be in English or French. The jury will consist of ten electrical engineers, five being Belgian and five from other countries. The latest date for receipt is March 31, 1911. Further particulars are obtainable from the secretary, Association des Ingénieurs Electriciens sortis de l'Institut Electrotechnique Montefiore, rue Saint Giles 31, Liége.

THE *Morning Post* of August 9 gives prominence to an account of experiments made by Mr. Armbrecht, of Duke Street, on the change of colour of sapphires and other precious stones by the action of radium. The observations are interesting, but the results obtained are by no means new. Nearly three years ago Prof. F. Bordas read before the Paris Academy of Sciences a series of papers in which he described investigations of the effect of radium and other rays upon various forms of crystallised alumina from clear sapphire to brown and opaque corundum and other precious stones. Colourless corundum was transformed into topaz by the action of radium bromide; the depth of colour of natural topazes was increased, and a similar effect was produced with faintly coloured rubies. Short abstracts of Prof. Borda's papers will be found in the seventy-seventh volume of NATURE, November, 1908, to April, 1908.

THE tenth International Geographical Congress is to be held in Rome during the week beginning October 15, 1911. The congress will be under the patronage of the King of Italy. An organising committee of a representative character is already at work under the presidency of the Marquis Raffaele Cappelli, president of the Italian Geographical Society. Commander Giovanni Roncagli, secretary of the Italian Geographical Society, is acting as general secretary of the committee. The work of the congress will be carried on in eight sections, namely:—(1) mathematical geography; (2) physical geography; (3) biogeography; (4) anthropogeography and ethnography; (5) economic geography; (6) chorography; (7) historical geography and history of geography; (8) methodology and didactics.

WE are glad to notice that the useful work of the extension section of the Manchester Microscopical Society is to be continued during the coming winter session. The purpose of this section is to bring scientific knowledge, in a popular form, before societies unable to pay large fees for lectures. In some cases a small fee is charged, but all money thus obtained is devoted to the expenses of the section. The work of lecturing and demonstrating is entirely voluntary and gratuitous on the part of the members of the society. The list of lectures from which secretaries of societies may choose includes some sixty-one subjects and the names of seventeen lecturers. Application for lectures should be made to the honorary secretary of the section, Mr. R. Howarth, 90 George Street, Cheetham Hill, Manchester, who will send a list of the lectures on application.

MR. OSCAR GUTTMANN, whose death occurred in Brussels last week from injuries received in a taxi-cab collision, was known both as a consulting engineer and a technical chemist. He took frequent part in discussions upon chemical and manufacturing topics at the meetings of the Society of Chemical Industry, and contributed occasional papers. The titles of some of these—*e.g.* "Novelties in the Explosives Industry," "The Manufacture of Smokeless Powder," and "The Chemical Stability of Nitrocompound Explosives"—illustrate the fact that Mr. Guttmann was an authority upon explosives. Other contributions dealt with the manufacture of sulphuric and nitric acids, and the author was the patentee of several devices for use in this and other industrial operations. In an interesting note upon the oldest document in the history of gunpowder, Mr. Guttmann directs attention to the use of this explosive as described in an illuminated MS., "De Officiis Regum," contained in the library of Christ Church, Oxford; and papers upon the early phases and progress of the sulphuric-acid industry also indicate that he was interested in the historical aspects as well as the practice of his professions. As an engineer, Mr. Guttmann had been charged with the design and construction of many large chemical and explosives works at home and abroad. His experience in the two branches of his calling was probably unique, and well qualified him to speak, as he did in an address delivered some three years ago, upon "The Works Chemist as Engineer." Mr. Guttmann was born in 1855, and became naturalised here in 1894. He was a member of the Institution of Civil Engineers, a Fellow of the Chemical Society, a Fellow and sometime vice-president of the Institute of Chemistry, and a member of the council of the Society of Chemical Industry. At the time of his death he was acting as one of the British jurors at the Brussels Exhibition.

THE arrangements for Section H (Anthropology) at the forthcoming meeting of the British Association have just been communicated to us. The preliminary programmes of other sections were stated in NATURE of July 28. In general ethnography, Mr. E. Torday will describe in Section H some of the tribes encountered in his recent exploration of the Congo area; Mr. Beech will deal with the Sok, of whose language he has made a special study during his residence in Africa; Mr. A. K. Newman, of Wellington, New Zealand, will discuss the origin and racial affinities of the Maori; and Miss Fletcher, of Washington, in an important communication, will deal with certain points connected with exogamy. Miss Fletcher will also contribute an account of recent developments in the study of anthropology in American universities. The archæology of the Mediterranean area will be dealt with by members of the British School at Athens. Dr. T. Ashby, director of the British School at Rome, will describe his excavations at Hagiar Kim and Mnaidra in Malta, and Messrs. Woodward and Ormerod a primitive site in Asia Minor. Prof. W. M. Flinders Petrie will give an account of his excavations at Memphis, and Dr. Seligmann will describe a Neolithic site in the Sudan. An important communication by Prof. Elliot Smith, which summarises the results of ten years' work, will discuss the racial affinities of the Egyptians from the earliest times. Among other archæological papers may be mentioned an account of the work of the Liverpool Committee for Excavation and Research in Wales, by Prof. R. C. Bosanquet, and a report on recent excavations at Caerwent, by Dr. Ashby; a communication from Mr. H. D. Acland will describe prehistoric monuments in the Scilly Isles, and Mr. Alexander Sutherland will give an account of the exploration of a Broch at Watten, Caithness. Friday, September 3, will be devoted to a joint meeting with Section L (Education), in which intelligence tests in school children will be discussed. Among those who have promised papers written from the special point of view of the anthropological section are Dr. Lippmann, of Berlin, Dr. C. S. Myers, of Cambridge, Mr. W. Brown, of King's College, London, Mr. Burt, of the Liverpool Psychological Laboratory, and Mr. J. Gray. Dr. Kerr, medical officer (education) of the London County Council, Dr. W. H. R. Rivers, and others will take part in the discussion.

IN the Long Vacation number of the *Oxford and Cambridge Review* Dr. A. Smythe-Palmer begins an elaborate study of the luck of the horse-shoe, "a veritable fetish, maintaining its reputation for magical potency with unabated influence into the twentieth century." He agrees that the belief in its power is largely based upon the mystical respect for iron, dating from its introduction as an innovation at the close of the Neolithic period; but he also supposes that in shape it is "only a rough-and-ready substitute for the old and long venerated symbol of the crescent," the use of which as a protection against the evil eye and other demoniacal influence is illustrated by numerous examples. He postpones to another article the further question of the mode in which the crescent acquired its magical significance.

IN *Travel and Exploration* for August Mr. W. J. Clutterbuck publishes an interesting and well-illustrated account of the little known Great Lu-Chu Island, or, as the Japanese, who now occupy it, call it, Okinawa, the most important of the Lu-Chu group. He considers the islanders to be a finer race than their conquerors; the shape of the eye is different, being wide open and seldom oblique at the corners, while the women reminded him of southern Europeans. The distinguishing feature of the landscape is the tombs; and at a funeral he noticed the professional female mourners wailing as they marched along enveloped in sackcloth bags, the intention obviously being to conceal them, and thus avoid the unwelcome attentions of the ghost. The corpse is deposited in a tomb for three years, after which the bones are removed, washed, and placed in a highly ornamented earthenware urn, which has a curious resemblance to the house-shaped funeral urns found in other parts of the world, the intention in all cases being to provide a home for the spirit resembling that which the deceased occupied in this life.

Naturen for July and August (Nos. 7 and 8 of vol. xxxiv.) contains a well-illustrated account of the recent eruption of Etna, by Mr. A. Hoel.

WE have to acknowledge the receipt of vol. xxxiii., No. 1, of Notes from the Leyden Museum, which, in addition to other articles, contains a continuation, illustrated by two coloured plates, of Mr. C. J. H. Biermann's account of the Homoptera of the Dutch East Indies.

THE amphipod crustaceans of Bermuda and the West Indies, according to a memoir of 115 pages by Dr. W. B. Kunkel, published in vol. xvi. of the Transactions of the Connecticut Academy of Arts and Sciences, have apparently received but scant attention at the hands of naturalists. Recent collecting in Bermuda—by Prof. Verrill and others—has enabled the author to put matters on a very different footing. The most striking peculiarity of the amphipod fauna of Bermuda is its close affinity to that of the Mediterranean. Of forty-five Bermuda species, nineteen, or possibly twenty, are common to the Mediterranean. Eighteen out of the forty-five are peculiar to Bermuda, and only seven which are not endemic are unknown in the Mediterranean. In contrast to this abundance of European types, the presence of only nine species common to South and Central America is remarkable, especially in view of the fact that 93 per cent. of Bermuda decapods have been recorded from the West Indies and Florida Keys. "This paucity of forms from Central and South America probably has little significance, however, and is due simply to the small amount of collecting of Crustacea from these waters."

THE difficult, if not indeed unanswerable, question as to the limitations of species and races is again raised by Mr. G. Dalgliesh in the case of the yellow-necked field-mouse. In this instance the writer maintains that this mouse ought to be regarded as specifically distinct from the ordinary long-tailed field-mouse (*Mus sylvaticus*) under the name of *M. flavicollis*, basing his arguments, not only on the physical differences between the two forms, but likewise on their distribution and their divergence in habits and disposition. It may be remarked in this connection that naturalists are by no means in accord as to the proper name for the yellow-necked form. Mr. Dalgliesh uses Melchior's *flavicollis*; but in his recently published "Faune des Mammifères d'Europe" Dr. Trouessart regards this term as a synonym of the true *sylvaticus*, and employs *wintoni* for the British form. On the other hand, Mr. Millais, as quoted by Mr. Dalgliesh, regards the British yellow-neck as a distinct local form of the Continental *flavicollis*, under the name of *M. f. wintoni*. Mr. Pycraft, again, in his "Guide to the British Vertebrates in the British Museum (Natural History)," alludes to the one form as *Apodemus sylvaticus* and to the other as *A. flavicollis*. The question of species or race is of infinitesimal importance, but the eccentricities in nomenclature are perplexing.

MUCH interest attaches to an article by Dr. Felix Oswald in the July number of *Science Progress* on the area termed by Dr. Sven Hedin the Trans-Himalaya, an area bounded on the north by the chain of lakes first discovered by the explorer Nain Sing, and on the south by the Indus-Tsan-po valleys. Throughout the area the trend of the mountains, as shown by a map, is quite distinct from the north-west and south-east direction of the Himalaya proper, this alone being held sufficient to justify Dr. Hedin's proposal of the term Trans-Himalaya. There is, however, much more than this, for, in the author's opinion, the Trans-Himalaya represents a block of ancient rocks thrown into folds at a very remote epoch, but at the date of the folding of the Tibetan plateau so intractable that they yielded to mountain-making force by first becoming fractured and then uptilted. If this be granted, "it follows that the natural continuation of the parallel ranges of the block now lies sunk beneath the Brahmaputra Valley, at the base of the great fault-scarp, to which the river flows in parallel alignment. Accordingly, this valley must be of the nature of a rift-valley or sunken trench, especially since the opposite (southern) wall of the valley lies parallel to the northern wall, and in like manner possesses an average height of 23,000 feet." In conclusion, Dr. Oswald traces a curious parallelism—which he believes to be more than accidental—between the structure of the Arabian-Armenian-Caucasian area on the one hand, and the Indian, Tian Shan, and Siberian region on the other, each having an anterior and posterior table-land separated by three systems of "waves."

THE ninety-fifth volume of the *Zeitschrift für wissenschaftliche Zoologie* is completed by the number published on June 21. The papers which this volume contains deal, as usual, with a great variety of subjects, from pure descriptive anatomy, as in the case of the elaborate memoir by Albert Bauer on the musculature of the water-beetle, *Dytiscus marginalis*, to the most minute investigations in cytology and protozoology. Heinrich Stauffacher's "Beiträge zur Kenntniss der Kernstrukturen" affords a beautiful example of the results to be obtained by modern cytological methods. Its chief interest, perhaps, lies in the demonstration of "nuclear bridges" (Kernbrücken) in the form of threads which connect the protoplasm of the nucleus with that of the cell body. W. Knoll, in the next memoir, deals critically with the question of the existence of such connections between karyoplasm and cytoplasm, and demonstrates their existence in the leucocytes of the human body. Amongst the other papers we have only space to mention the first part of C. Janicki's studies on parasitic flagellates, dealing with two species of Lophomonas found in the cockroach. The application of modern technique to the investigation of the Protozoa, as we hardly need point out, marks the commencement of a new era in the study of these organisms, revealing complexities of structure previously unsuspected, as the plates illustrating the remarkable genus dealt with by Janicki abundantly testify.

In the *Bio-chemical Journal* for June (vol. v., No. 4) Prof. Benjamin Moore and Dr. Stenhouse Williams detail experiments on the effect of an increased percentage of oxygen on the vitality and growth of bacteria. Of twenty-six organisms tested, two may be termed oxyphobic. These are the tubercle bacillus, which is not only arrested in growth, but is actually killed by a high percentage of oxygen, and the plague bacillus, which, though not killed, uniformly refused to grow in percentages of oxygen from 60 to 91. The staphylococcic group was also adversely affected, but the remainder, including the typhoid, dysentery, glanders, diphtheria, anthrax, and cholera organisms, was unaffected.

In the Bulletin of the Johns Hopkins Hospital for July (xxi., No. 232) Dr. John L. Todd contributes an excellent review of the recent advances in our knowledge of tropical diseases. He summarises the most striking additions to our knowledge of tropical medicine during 1909 as being (1) the discovery of infantile kala-azar in northern Africa; (2) the discovery of a new human trypanosome in South America; (3) the researches which have made it almost certain that the parasite of sleeping sickness undergoes a developmental cycle in the tsetse-fly which conveys it; and (4) the transmission of typhus fever to monkeys by the bites of body lice.

Important information with regard to the thyroid body and related structures is supplied in a paper by Mr. F. D. Thompson, just published in the Phil. Trans. A thyroid, thymus, and post-branchial body are developed in the gill-slits of elasmobranch fishes; but parathyroid and carotid glandules have not been observed. In teleostomous fishes, on the other hand, the only organs of this nature are the thyroid and thymus; but parathyroids make their appearance in amphibians and reptiles, in the former of which the post-branchial body is retained. In these groups the structure of the various glands of the thyroid type differs considerably; but in mammals such structural differences tend to disappear, and in certain circumstances the parathyroids may develop colloid vesicles, and thus become practically identical with the thyroid. The thyroid and parathyroids may accordingly be regarded as structures of diverse embryological origin, which remain distinct in lower vertebrates, but in mammals become intimately related and constitute a single apparatus.

So closely are fungi and bacteria often associated in their destructive action on plant tissues, that it is extremely difficult to determine which organism is taking the lead. Some botanists, including De Bary, Hartig, and A. Fischer, have expressed themselves very sceptical as to the possibility of bacteria penetrating living plant tissues; others, notably E. F. Smith in the United States and Prof. M. C. Potter, have offered results of experiments as proof that bacteria do pass into the living plant and penetrate through cell walls. The subject is fairly discussed by Prof. Potter in his presidential address delivered before the British Mycological Society, and published in their Transactions. In addition to other arguments, the author refers to his experiments upon the white rot of turnips, when the bacterium *Pseudomonas destructans* was not only isolated and re-inoculated on the host, but it was demonstrated that oxalic acid was produced by the bacterium, which acts as a toxin in plasmolysing and killing the protoplasm; he also states that subsequently penetration of the cell wall by bacteria was observed.

We have received from Mr. E. Reinders a copy of his paper on the "Sap-raising Forces in Living Wood," read before the Royal Academy of Sciences of Amsterdam, January 29. After a short discussion of the available evidence on the problem of the ascent of water in trees, he gives an account of his own experiments. His results are of interest, as supporting the view that water is raised by a pumping action of the living elements of the wood (a theory generally connected with the name of Godlewski), and the detailed description of Mr. Reinders's work will be expected with interest. Mr. Reinders proceeds from the fact "that manometers placed at different heights up the trunk behave quite independently of one another. Sometimes one shows a lower pressure, sometimes the other." This irregularity is assumed by Reinders to be due to the pumping action of the living elements in the wood, and he proceeds to test his view by killing the stem either by steam or by an induction shock. He found that "as soon as the trunk was dead the difference of pressure followed the same rule as would be expected to apply to a glass tube." In one striking case the stem was not killed, but so seriously injured that five days elapsed before the behaviour of the manometers became once more "as irregular as in living trees." It should be added that Mr. Reinders assumes that in dead trunks which can no longer act as pumps, water ascends "through other causes, *e.g.* with the help of cohesion."

In the June number of the *Agricultural Journal of the Cape of Good Hope* is an article on the dried fruit and raisin industry recently established in Cape Colony. Although no great amount of produce has yet been raised it appears that the local conditions are suitable for success, and when certain improvements are effected there is the prospect of supplying the needs of the colony and even perhaps of establishing an export trade.

We have received from the University of Wisconsin Agricultural Experiment Station several "Research Bulletins" devoted to subjects of scientific interest. A study was made of the physiological effect on the cow of the milking machine which is now threatening to supplant the cowman and the milkmaid. No bad effects on the general health of the animal or the state of the udder could be found, and for an ordinary dairy herd the machine worked very well. Whether it would give equal results in a high-class herd is not certain; but here the economic problem is rather different. There still remain, however, a number of details in which improvements must be effected before the machine can be widely used. In another bulletin a description is given of an organism producing acidity in milk which appears to be closely related to *B. bulgaricus*, the characteristic organism of Yogurt, and to be widely distributed. Messrs. Hart, McCullum, and Humphrey continue their work on the functions of the mineral constituents of foods on metabolism in the animal, and show that the skeletal tissues can, if necessary, make good any deficiency of calcium and phosphorus in the ration. A low phosphorus intake was accompanied by a high calcium output in the urine.

THE use of more exact statistical methods in the investigation of agricultural problems has already led to interesting results, and is likely to prove of great benefit. Mr. Vigor recently discussed the relation between the reduction in area of wheat in England and the increased yield; his paper is published in the Journal of the Royal Statistical Society (part iv.). The reduction of the wheat area has been accompanied by a rise of the yield per acre in England as a whole, and improvements of the yield often appear to be greatest in those countries where the proportionate reductions of area have been greatest. Counties of low yields do not, however, appear to have been specially selected for a reduction of area. The yields of the various counties have shown a slight tendency to level up. By applying somewhat similar methods, H. Arctowski has, in Bulletin No. 7 of the American Geographical Society, mapped out the variations in the harvest in the United States during the decade 1891–1900. In general, very bad years in one region of the globe are years of excellent yield in another region, but the centres of compensation are not always found in the same regions nor is the compensation always exact; otherwise the supply would be constant.

THE Scotch Education Department has issued in connection with the Royal Scottish Museum, Edinburgh, two useful guide-books, "An Introduction to Petrography and Guide to the Collections of Rocks," published in 1909, and "A Guide to the Scottish Mineral Collection," published in 1910. Both are from the pen of Dr. S. J. Shand, who is in charge of the geological department of the museum, and both are sold for the modest sum of one penny. The guides have been specially compiled from the point of view of Scottish minerals and rocks, and are written in simple and, so far as possible, untechnical language, so as to appeal to the ordinary visitor unversed in these subjects. A few pages of the rock guide are devoted to a description of the collection of rocks of the Christiania district, which has, owing to Prof. Brögger's exhaustive studies, become classical in the science of petrology. Copious indices add to the usefulness of the books.

THE Tanami goldfield in Central Australia was discovered in the year 1900, but its development has been delayed by the scarcity of water and its situation in a remote part of the continent on the eastern frontier of Westralia. The general geographical and geological conditions of the goldfield are described in a short report by Mr. H. Y. L. Brown, the Government geologist of South Australia. (Government Geologist's Report on the Tanami Gold Country, Northern Territory of South Australia. Pp. 12; three maps. Adelaide: 1909.) Mr. Brown shows that the oldest rocks of the district belong to a series of slates, quartzites, and schists which, though pre-Cambrian, are stratified sediments. They have been invaded by plutonic rocks, including diorite and felsite, and covered by a series of limestones and dolomites, which he identifies as Lower Cambrian, and by quartzites, sandstones, and boulder beds, which he regards as probably Permo-carboniferous. There are widespread volcanic rocks, mainly basalts and volcanic ashes, which Mr. Brown assigns to eruptions ranging from Mesozoic to Cainozoic. His description of extinct craters suggests that some of the eruptions are of recent age. The gold occurs in lodes numerous in the pre-Cambrian sediments near the junction with the intrusive diorites, and also in "lode formations" in the igneous rocks. The mines are at present little more than prospecting shafts. The gold in the quartz is coarse, and where it occurs in the altered igneous rocks it is finely diffused. The widespread limestones and basalts produce a rich soil, and if adequate water can be obtained, the district will be valuable for pastoral purposes, while Mr. Brown regards the gold discoveries as promising and important.

IN a short article in the *Physikalische Zeitschrift* for August 1, Messrs. R. A. Houstoun and J. Logie direct attention to the fact that aqueous solutions of ferrous ammonium sulphate form a good filter for stopping heat rays. Alum solutions are, it is now known, no better than water in this respect. A glass cell, of inside thickness 3 cm., filled with a solution of ferrous ammonium sulphate, transmitted 75 per cent. of the light and 5·1 per cent. of the total radiation from a carbon glow-lamp; when filled with water it transmitted 90 per cent. of the light and 11·1 per cent. of the total radiation. The light, it should be stated, forms about 3 per cent. of the total radiation.

THE *Physikalische Zeitschrift* reproduces in its number for July 15 a communication made recently by Dr. F. Ehrenhaft to the Academy of Sciences of Vienna on an ultra-microscopic method of measuring the electric charges carried by small particles. The particles investigated were of the noble metals, and were produced by means of an electric arc between electrodes of the metal concerned. The air containing the particles in suspension was drawn into an ebonite enclosure in front of the objective of a Zeiss ultra-microscope placed with its axis horizontal, and illuminated from the side in the usual way. The enclosure contained the plates of a small condenser the axis of which was adjusted to be vertical. With the condenser uncharged, the time of fall of a particle through a measured distance in the field of view was observed; the condenser was then charged in such a direction that the particle ascended, and its speed again observed. Finally, the condenser was short-circuited, and the speed of fall again determined. Assuming that Stokes's formula for the resistance to the motion of a sphere in a viscous fluid holds for the particles investigated, the magnitudes of the electric charges carried by the particles come out smaller than 1×10^{-10} electrostatic units, a conclusion which does not accord with the view so generally held at present that the "atom" of electricity is $4{\cdot}6 \times 10^{-10}$ electrostatic units.

THE "Metzograph Grained Screen" takes the place of the ordinary cross-lined screen in photo-block making, and differs from it in giving an irregular grain and in requiring a shorter exposure. It does not produce its effect by stopping a large proportion of the light, as the cross-lined screen does, but by the lens-like action of the irregularities of its surface. It is produced by obtaining by sublimation a reticulated film on the surface of a glass plate, and then etching with hydrofluoric acid, the film acting as a resist. The screen was invented by Mr. James Wheeler about thirteen years ago, and as the little differences in its manipulation, as compared with the lined screen, appear to have hindered its adoption in those cases where it offers especial advantages, Messrs. Penrose and Co., of 109 Farringdon Road, have just issued a booklet of instructions for its use. The pamphlet includes specimens of each of the ten degrees of fineness, suitable for work from large posters to the finest photogravure. The impressions show what fine results the screen yields, the chief peculiarity being the entire absence of the regular grain that some persons find so objectionable in the usual type of photo-block.

THE report of the senior analyst, Cape of Good Hope Government Laboratories, for the year 1909, contains some interesting reading. About three-fourths of the samples examined (3154 out of 3820) consisted of foodstuffs, beverages, and drugs; these call for no special comment except, perhaps, to question the utility of giving much analytical detail in a publication of this kind. The remainder of the samples reflect the character of the country: they are mainly mineral, agricultural, and toxicological articles. Gold assays are the most numerous amongst the mineral analyses, which include also the testing of coals, supposed platiniferous rocks, copper, iron, manganese, and tin ores, and supposed diamonds. Amongst the toxicological cases, one is especially noteworthy. A native woman had been poisoned with an indigenous bulb administered by a Kaffir "doctor," and it took four months to obtain proof that such bulbs (Hæmanthus) could produce the fatal effects in question. This delay was due to lack of knowledge concerning the local poisons, and the senior analyst urges that a research into the properties of the vegetable drugs and poisons of South Africa should be carried out systematically. At present, any such investigations are merely casual and incidental upon legal proceedings. The production of barley suitable for brewing purposes, and an investigation into the agricultural soils of the colony, are some of the other topics mentioned in a report which everywhere bears evidence of useful activity.

WE learn from the *Engineer* for August 5 that the first of the large caissons for the new foundations of the Quebec Bridge was launched at the works yard, near the bridge site, on July 8. This particular caisson is for the new north pier, and will be situated clear of the old pier, its centre being 57 feet further out from the shore. The new centre line of the bridge has been decided upon 15 feet west, or upstream, from the old centre, this alteration enabling the new superstructure to be 30 feet wider than the old. The new south pier will be 15 feet nearer the river centre, consequently the span will be 1758 feet instead of 1800 feet, as before. The rebuilding of the south pier presents many more difficulties than the north. The new south pier will occupy very nearly the site of the old, necessitating the placing of a caisson at the side of the existing one, and another across the end of the pair. Upon the three a new caisson, 79 feet by 180 feet, will be sunk. It is thought that the latter will be the largest ever constructed for this class of work.

A DESCRIPTION of the hydroplane *Miranda IV.*, built by Sir John Thornycroft, appears in *Engineering* for August 5. This boat is 26 feet long by 6 feet beam, and 2 feet 6 inches deep. In general outline she approaches very much to the shape of an ordinary boat, but the bottom is specially adapted to make her skim at high speeds. This arrangement gets over the difficulties of the original type of hydroplane, for at moderate speeds she goes through the water in a similar manner to an ordinary boat, and the variation of form necessary to make her skim is so small as not materially to affect her performance. When skimming, a small portion of the length amidships carries the weight, the rest of the boat being entirely clear of the water with the exception of a small length aft, which may have enough weight on it to make the boat stable longitudinally. The greater part of the bottom being thus clear of the water, frictional and other resistances are very greatly reduced. It is remarkable how small the disturbance of the water is considering the speed of the boat, which has exceeded 31 knots under somewhat unfavourable conditions. If the speed development of hydroplanes is found to follow the same law as that of torpedo boats, a hydroplane 52 feet long, 10 tons displacement, with a brake-horse-power of 950, should do 45 knots, and a speed of 60 knots might be obtained from a boat 110 feet long. Such development depends on the progress made with petrol motors of large power, and in a matter of this kind it is not wise to be in too great a hurry.

MR. WERNER LAURIE will publish shortly "The Black Bear," by Mr. W. H. Wright, author of "The Grizzly Bear."

MESSRS. D. APPLETON AND COMPANY are publishing immediately a new work entitled "Up the Orinoco and down the Magdalena," in which Mr. H. J. Mozans relates his travels to South American countries and across the Andes.

OUR ASTRONOMICAL COLUMN.

PHOTOGRAPHS OF NEBULÆ.—Among the recent additions to the Royal Astronomical Society's collection of celestial objects are three of surpassing excellence taken by Dr. Ritchey with the new 60-inch reflector at Mount Wilson. The objects are the spiral nebulæ M. 51, M. 81, and M. 101, and these photographs bring out remarkable details as to their structure; the spirals of M. 101 are shown as broken up into soft, star-like condensations, like nebulous stars.

Dr. Ritchey has made a number of important improvements to his camera, and now uses two guiding eye-pieces, one on each side of the centre, in order to allow for any possible slight rotation of the field; a power of 800 is employed in the eye-piece. By using a smaller plate, only $3\frac{1}{4}$ inches square, the guiding star comes much nearer the centre of the field, that is, nearer the object under observation. He also has the plate carrier easily detachable, so that it may be taken off, and accurately replaced, *every half-hour* or so, to allow of re-focussing; this is done by using a knife-edge in the focal plane, and by such frequent re-focussing he keeps in the true focal plane within 1 or $1\frac{1}{2}$ thousandths of an inch. With an exposure of 7·5 hours, the photograph of M. 101 shows practically perfect star images, of which the smallest are only 1·6 seconds of arc in diameter, and Dr. Ritchey states that an exposure of $3\frac{1}{2}$ hours on the globular cluster M. 3 shows tens of thousands of star images which are only 1·15 seconds in diameter.

Photographs of parts of the Great Andromeda nebula, the Ring nebula in Lyra, and the Crab nebula were also sent, and are strikingly beautiful; much new light is likely to be thrown on the structure of these objects from the careful study of the negatives. A preliminary study shows that while in some (*e.g.* M. 101) the spirals are broken up into "nebulous stars," in others (*e.g.* M. 64, Comæ Berenices) they are apparently smooth; in M. 101 more than 1000 of these condensations have been counted. In the Andromeda nebula the central parts are apparently regular, with complicated dark rifts, and the spiral extends practically to the nucleus, but the outer branches contain great numbers of the "nebulous stars" (Monthly Notices R.A.S., vol. lxx., No. 8).

HALLEY'S COMET.—The Journal of the Royal Astronomical Society of Canada (vol. iv., No. 3) contains reproductions of fifteen photographs of Halley's comet, taken at the Dominion Observatory, Ottawa, by Mr. Motherwell, during the period May 3 to June 9, also reproductions from two photographs taken by Prof. Barnard, at Yerkes, on May 5, the former of which shows a tail 20 million miles long.

Some extraordinary phenomena were observed at Victoria (B.C.) at about 7 p.m. (local M.T.) on May 18. The sun appeared to be in a state of rotation, emitting bright flashes of light at frequent intervals. These were probably unusual refraction phenomena, possibly produced by the interposition of cometary matter, and are recorded by an octogenarian, Mr. Helmcken, who has never seen similar phenomena before.

In No. 8, vol. lxx., of the Monthly Notices there are more than a dozen papers dealing with observations of the comet's position, its physical characteristics, and its spectrum.

The *Rivista di Astronomia*, No. 6, contains some ancient records of the comet, reproduced by Father Stein, one of which shows that Halley's comet was observed in Italy for about fifty days in 1066; it became lost in the solar rays on April 19, and reappeared, as an evening star, on April 24.

The Accurate Measurement of Photographs.—In all photographic astronomical researches the results are more or less vitiated by errors introduced by the optical apparatus, including the eye and brain of the observer, employed in their reduction. To eliminate these errors, Prof. E. C. Pickering proposes, in Harvard College Observatory Circular No. 155, the employment of an automatic registering apparatus. Briefly, he suggests that the negative to be measured be passed between a constant illumination and the two balanced arms of a bolometer. As the star image, or spectral line, comes in between the heat source and the bolometer, some heat would be cut off, and the galvanometer in the circuit would show a deviation, which could be registered automatically. The galvanometer curve would thus become a record of the positions and intensities of the star images or the lines in the spectrum, and the method, especially for spectrum work, should certainly be tried by someone having the necessary bolometric apparatus or selenium cells at their disposal.

Observations of Perseids in 1909.—In No. 31, vol. iii., of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo*, Herr S. Beljawsky describes the observations of Perseids made at Simëis on August 10, 11, and 12, 1909. The horary rates of the meteors observed on these three dates were 21, 60, and 17 respectively, and the positions of the radiants were $49°$, $+60°$ (5 obs.); $45°$, $+56°$ (15 obs.); and $43°$, $+55°$ (8 obs.), respectively. On August 11 there appeared to be another radiant at $62°$, $+16°$, from which four meteors appeared to emanate, but the determination is uncertain.

Results from the Micrometric Observations of Eros, 1900.—During the opposition of Eros in 1900, a number of observers made micrometric comparisons between the planet and neighbouring stars. The results from a number of observatories have been reduced at Cambridge, and Mr. Hinks now discusses them in No. 8 of the Monthly Notices. The individual results agree generally, and give as the most probable value for the solar parallax $8{\cdot}806'' \pm 0{\cdot}004$.

WILD PLANTS ON WASTE LAND IN LONDON.

THE waste ground between Aldwych and the Strand has been colonised by a variety of plants, most of which show luxuriant growth. Many of the colonists have fruits or seeds adapted to wind distribution, as in the case of the winged fruit of the sorrel (*Rumex acetosa*), and of the plumed seeds of the hairy willow herb (*Epilobium hirsutum*) and French willow, or rose bay (*E. angustifolium*), by far the most conspicuous plant on the ground. It is of interest that *E. angustifolium*, which is absent in many of the waste places of London, occurs in the garden of Fountain Court, near the Strand. Among wind-distributed forms are also numerous Compositæ, the fruits of which are furnished with a pappus; these include the spear thistle (*Cirsum lanceolatum*), the groundsel (*Senecio vulgaris*) and its ally *S. viscosus*, the dandelion (*Taraxacem vulgare*), the butter bur (*Tussilago petastes*), and the Canadian fleabane (*Erigeron canadense*). Fruits and seeds of these various types might be blown with some readiness from neighbouring districts, or from one part of London to another.

To a varying extent, wind may be also efficient in carrying the seeds of hedge mustard (*Sisymbrium officinale*), London rocket (*S. irio*), which appeared in quantity after the Great Fire of 1666, and shepherd's purse (*Capsella bursa pastoris*); and the same is the case with chickweed (*Stelloria media*), white campion (*Lychius alba*), opium poppy (*Papaver somniferum*), a garden escape, frequently established in waste places, great plantain (*Plantago major*), pale persicaria (*Polygonum lapathifolium*), and scentless mayweed (*Matricaria inodorata*). In several of the above the seed is small or flattened, but it is not elaborately adapted to wind dispersal, and it may be questioned whether wind alone will account for the presence of these plants. A probable auxiliary exists in the sparrow, through the alimentary canal of which various seeds and fruits no doubt pass, and it is not unlikely that others become attached to its feet by means of the sticky London mud. It will be remembered that Darwin in the "Origin of Species" describes eighty-two plants as springing from the earth obtained from the feet of a single partridge. This method of distribution no doubt accounts for the presence of Dutch or white clover (*Trifolium repens*) and of two balsams, the pink-flowered *Impatiens glandulifera* and a white variety. The explosive fruit characteristic of this genus could certainly not shoot its seeds across the traffic of a London street. Possibly cats may be effective as agents of distribution in this case, and they may also account for the presence of cleavers (*Galium Aparine*), the hooked fruits of which would readily cling to their fur.

Among garden escapes, the marigold, nasturtium (=Tropæolum), wallflower, and a species of Prunus can be observed, as well as the opium poppy mentioned above; in connection with these, and with many of the wild species also, the neighbourhood of Covent Garden must be recalled.

The above list is by no means exhaustive, none of the grasses, for instance, having been mentioned; in one or two cases the identification had to be made from a distance and through the fence surrounding the waste ground.

AGRICULTURAL INVESTIGATIONS IN EGYPT.[1]

SEVERAL important events are chronicled in the current "Year-book of the Khedivial Agricultural Society." The scope of the society has recently been extended by the formation of a section dealing with farm animals, the object of which is to effect as much improvement as possible in the livestock of the country. Twenty stallions have already been distributed over the country, a number of selected cows have been acquired from which good stud bulls can in time be sent out, and a herd of buffaloes has been purchased with a view to the establishment of a heavy milking strain. In addition, an experimental farm of about 160 acres has been acquired near Cairo, and an arrangement has been effected with the State Domains Administration whereby a considerable tract of land is to be set aside for the raising of cotton or wheat seed of good quality. Finally, the society has directed attention to the diminished yield of cotton in proportion to the area sown. A committee was appointed to investigate the matter, and has already issued a report.

A considerable proportion of the year-book is taken up by Mr. Lawrence Balls's studies of Egyptian cotton. A detailed account is given of the results of a single cross made in 1905 between Afifi and Truitt Big Boll. The fourth generation is now growing, and, although the cross has no special economic value, and the results are in some ways incomplete, the record is a very valuable one, and throws much light on production of cotton varieties on Mendelian lines. The synthesis of a commercially useful cotton is a tedious business. Desirable characters are mostly dominant over undesirables, except where the

[1] The Year-Book of the Khedivial Agricultural Society, Cairo, 1909. Pp. xv+239. (Glasgow: The University Press, 1910.)
The Cairo Scientific Journal. Vol. iv., No. 43.

heterozygote is intermediate. Experimental difficulties are considerable. The plants are large, the flowers are not entirely self-fertilised, and some of the characters fluctuate considerably. Numerous pests attack the plants, including aphides, boll worm, and the cotton stainer bug, while two fungi, the "sooty mould" and "sore-shin," do great damage. An advantage, however, is that the cotton plant can be grown as perennial by simply cutting it back; in this way a further supply of seed from a particular plant can always be obtained if necessary.

Bees appear to be the chief agents in effecting cross-pollination, and they have to be excluded by mosquito nets covering the whole plant; there appears to be no wind-fertilisation. Before these nets were used, the preparation of self-fertilised seed was laborious and uncertain. Tissue-paper bags were employed for separate flowers, but a large proportion of the bagged flowers were shed. Now the operation is simplified. The flowers are castrated at 4 a.m. and cross-pollinated at 9 a.m. No bags are necessary if the other open flowers under the net are removed, except, of course, to cover the flower from the plant which is to be employed as the male parent.

The results are worked out in detail for a number of unit characters, and are plotted on curves. The data thus obtained are not only interesting in themselves as a study of a Mendelian problem, but are of distinct practical value for the cotton breeder.

Mr. Balls also writes on the general position of the cotton crop in Egypt, and gives a number of interesting historical details. It is not certain how or when cotton was first cultivated in Egypt. The old mummy cloths are of flax. Apparently no distinct allusion to cotton occurs until the time of Pliny, and there is nothing to show that cotton was cultivated before 200 B.C. No definite historical account can be given until the time of Jumel, a French engineer who, in the early years of the last century, recognised the possibilities of Egyptian cotton and made plans for extending and improving its cultivation. Importation of Sea Island cotton began in 1822 and went on for many years; Mr. Balls's view is that the present Egyptian cottons are hybrids between the brown-linted tree types associated with Jumel and Sea Island cotton. He further thinks that, for the future, it is necessary to evolve strains which mature early and are therefore not likely to suffer from the boll-worm, and which yield heavily, so as to compensate for the decreased production per acre which is now setting in.

This falling off in productivity makes a very pretty problem unlike any we know of elsewhere. Fifteen years ago the yields ran about 5·5 cantars per feddan; of late years they are only 4·5. There are, of course, many conceivable explanations duly set out in the report of the commission in the present volume and meriting further examination, but it is suggested that part of the trouble arises from a rise in the subsoil water following on the rise brought about in the Nile by the barrage schemes. On this question Mr. Lucas has something to say in the *Cairo Scientific Journal*. He tabulates the minimum water-level in certain wells, and shows that in these cases there has been a rise of more than 1 metre since 1894. Other factors have to be taken into consideration, and many further measurements will be required, but the scientific interest and practical importance of the problem can hardly be overrated.

Mr. Hughes gives an account of manurial trials on cotton, and we are pleased to see that he gives full mechanical and chemical analyses of the soils on lines accepted in Great Britain. A considerable amount of trouble is involved, but the results are of much wider value in consequence. Mr. Willcocks describes the insects injurious to stored grains, seeds, &c. In the *Cairo Scientific Journal* Mr. Fletcher describes an experiment in which maize was grown for ten days in soils heated, respectively, to 95° C. and 170° C., and which he considers inconsistent with the work of Russell and Hutchinson. Mr. Fletcher accepts Whitney's hypothesis that soils contain a toxin injurious to plants, but put out of action by heat, an hypothesis much too controversial to be discussed here. No account appears to have been taken of the marked chemical decomposition of soil substances at the high temperature of the experiment.

SCIENCE IN BENGAL.

THE Journal and Proceedings (new series) of the Asiatic Society of Bengal has become a veritable miscellany—a very doubtful improvement upon the old arrangement followed by the Society, of publishing papers on philology and archæology, natural science, and ethnology, in three distinct and independent "parts," and of relegating matters of domestic and colloquial interest to the Proceedings.

The latest issues (Nos. 5–11 of vol. iv.) include thirty papers, in which Hindu mythology, numismatics, natural history both of the formal and of the discursive kind, archæology, geography, higher mathematics, lists of Oriental MSS., botany, epigraphy, and Indian history keep the strangest and most bewildering company with fragments of chemistry, philology, and geology, and with obituary notices and other domestic records.

Many of the papers deal with speculations rather than with matters of verifiable fact, and of these one of the most reasonable and most generally interesting is that by Mr. G. R. Kaye, on the use of the abacus in ancient India. The author examines, and expresses himself far from satisfied with, the evidence offered in support of the belief that the abacus was used in India in ancient times; and he is not at all disposed to accept without question the view that the Arabs borrowed their notation, which forms the basis of the science of arithmetic, from the Hindus.

The noteworthy papers on natural science are three in number. In one, Dr. N. Annandale describes a recent Himalayan species of a Psychodid fly of the genus Diplonema, a genus that "appears to have been known hitherto from three Tertiary species which occur in Baltic amber and from one Quaternary form in fossil copal." Another paper, by Mr. P. Bruhl, on recent plant immigrants into Bengal and Bihar, is a laborious compilation of considerable value, although, as the author includes cultivated plants as well as weeds, the title is a little disappointing; 234 phanerogams are enumerated and classified according to their systematic position and their land of origin, the result showing that 54·7 per cent. of them have been derived from America. Of these 234 species, however, only thirty-seven are entirely wild, and so are true, unassisted (or, at any rate, not deliberately introduced) immigrants; all the others are either cultivated or can be traced to cultivation. A third paper, by Colonel Prain and Mr. Burkill, describes seventeen new species of yams from China and neighbouring countries to the south, the descriptions, which are in Latin, being models of clearness and conciseness.

The twenty-first instalment of the late Sir George King's "Materials for a Flora of the Malayan Peninsula" is happily distinguished by appearing as an independent "extra number" of the old series of the Society's journal. It treats of the Gesneraceæ and Verbenaceæ. Of the former order, 131 species, distributed in twenty genera, are described by Mr. H. N. Ridley; of the latter order, seventy-two species, belonging to fifteen genera, are dealt with by Mr. J. S. Gamble.

We have also received Nos. 5–9 of the second volume of the new Memoirs of this society.

No. 5 of these is a most learned and interesting treatise (which is to be continued) on Mundari poetry, by Father J. Hoffmann. The Mundas are one of the aboriginal tribes of Central India, and a large remnant of them is isolated in the hills of Chota Nagpur. "Their world is a narrow circle of villages hidden away in forest-clad mountains . . . and they are quite content to leave . . . its wonders to such races as may care for them. Their only desire . . . is to be left alone." They are entirely illiterate, and know nothing about any alphabet. If they did, one would suggest that the sixteenth ode of the second book of Horace might be translated into their language as a good reflection of their views of life; but their own poetry, which is meant to be sung, does not touch the skirts of divine philosophy: it deals with the simplest of perennial themes, such as first love, friendship, maiden vanity, the pleasures of the chase, and the goodness of the good old customs, or, on the other hand, blighted affection, the pangs of hunger, and the terrors of the jungle. According to Father Hoffmann, their simple lyrics are unrhymed, and have no pronounced rhythm, except such as is imparted by the singer; and they consist for the most part of repetitions of some simple idea, but are saved from monotony by a tricky use of synonym and metaphor. As the vocabulary is limited, the Munda poet uses the utmost freedom in detaching a required word from its associations; for instance, in order to harp upon the idea of the perfume of flowers, the word that in ordinary conversation implies an ancient and fish-like smell may be used as a synonym with perfect propriety. But this poetic licence never breaks the bounds of decorum: "Of the hundreds of songs which, after the day's work, resound over the whole country, evening after evening, not one is defiled by a lewd expression, or even by an indecent allusion."

No. 8 of these Memoirs is entitled "A Monograph of Sea-snakes," and its author would have done better had he considered that in this very fallible world nothing is ever gained by labouring to expose the mistakes—or supposed mistakes—of fellow-workers. To read this pretentious "monograph," one might suppose that the British Museum Catalogue of Snakes, the author of which is persistently gleeked and galled at throughout, was hardly worth the paper it is printed on. No doubt there may be errors in the catalogue, as there are in all the works of mortal men; but even were the errors great and manifold—and no one who uses the catalogue considers this to be the case—the work would still stand out as a comprehensive and critical account of our knowledge of the Ophidia, and a well-arranged storehouse of fact, to which all after-workers must be indebted, whether they choose to acknowledge their debt or not. So that when the author of this monograph states that his "views are substantially different from those held by 'Professor' Boulenger" (the distinguished begetter of the British Museum Catalogue), and further solemnly announces that "there are discrepancies between Mr. Boulenger's work and mine affecting questions of actual fact," the most easy-going critic is roused to attention.

The shattering "discrepancy of fact" turns in the main upon the question whether the posterior maxillary teeth of certain sea-snakes are grooved or not. The British Museum Catalogue recognises the genus Hydrophis as distinct from the genus Distira, because in the former genus the posterior maxillary teeth are not grooved as they are in the latter genus; but to the author of this monograph, using "a new lens of the very highest power and quality specially recommended for this work," it "became clearly revealed" that the posterior maxillary teeth in Hydrophis are "all grooved." In any case, the matter is of no very great importance, as every naturalist understands that the limits between species and genera are often not very sharply defined; but to test the case we removed the poison-fang and one of the posterior maxillary teeth of a well-preserved and authentic spirit-specimen of *Hydrophis latifasciatus*, and examined them side by side, not indeed with any "patent double million magnifyin' gas microscopes of hextra power" such as Mr. Sam Weller demanded in order to see through a flight of stairs and a deal door, but with an ordinary microscope. In the poison-fang the poison-canal is as plain as a diagram; in the small posterior tooth there is no trace whatever of any groove.

If, instead of holding up the British Museum Catalogue to reprobation, and adding grievous burdens to terminology, the author had given us some facts about the anatomy of sea-snakes, and had summarised what is known about the habits, food, and enemies of these animals, and the nature and mode of action of their venom, his work might have approached the standard of a monograph. As it stands, it is merely what is known as a revision of the subfamily—and an incomplete revision, because, among other things, the several genera are not fully defined, and are not properly referred to their respective authors.

We cannot leave these Memoirs without a short reference to No. 9, which contains a "Polyglot List of Birds in Turki, Manchu, and Chinese," by Dr. E. D. Ross. The author disclaims any acquaintance with ornithology, and apologises for undertaking such work "with nothing but linguistic equipment." The paper, which, with indices, occupies more than 100 pages, is divided into "Part i., Large Birds," for which the "generic" name is Qus, and "Section ii., Small Birds," for which the general name is Qucqac; 360 birds are included; some of them are specifically identified, others are identified in a general way, while others are merely treated after the manner of the commentator. An illustration of each of the three methods will show how far this dish of literary minutalia is likely to be of service to an ornithologist.

"30. *Qu:* ? The Cormorant: Manchu, *Kotan*; Chinese, *Tao Ho.* The 'Mirror' says: 'It somewhat resembles the wild swan and is grey in colour. Its beak is wide and its crop large. It fills its crop with water which it pours into rat-holes, and having thus driven out the rats eats them.' I am in doubt whether the swan or cormorant is intended here. *Qu* is the common Turki name for a swan."

"179. *Aqis Cikdaci:* The Chough: *Pyrrhocorax graculus*: Manchu, *Cinjiri*; Chinese, *Liao ko* [Giles's Dict., the blue grackle]. The 'Mirror' says: 'Colouration violet; red beak parting on the top of the head. A skilful singer with a very clear voice.'"

"336. *Ding-ding Qucqac:* A species of wagtail: Manchu, *Tukiyeri cecike*; Chinese, *Yao t'un ch'iao.* The 'Mirror' says: 'Over the eyelids are long ash-coloured feathers looking like eyebrows; short tail; always struts when walking.'"

Many other fearful wildfowl are exhibited, and all are fitted with tags of comment and reference, some of which call to mind the notes to Thackeray's delightful parody "Timbuctoo."

AUSTRALIAN AND ARGENTINE BIOLOGY.

THE third number of the Memoirs of the National Museum of Melbourne is devoted to descriptions by Messrs. Baldwin Spencer and J. A. Kershaw of remains of subfossil emeus and marsupials from King Island, Bass Strait, and, in a second paper, to a review of the existing species of wombat. As regards emeus, the authors find that Kangaroo Island, King Island, and Tasmania were severally inhabited by species distinct from *Dromaeus novae-hollandiae* of the mainland. Both the Kangaroo Island *D. peroni* (*ater*) and the King Island *D. minor* were darker than the mainland bird, the first being distinguished from the second by its less robust build. The Tasmanian emeu, which survived in numbers until at least as late as 1840, is still insufficiently described, but appears to have differed in colour from each of the other three species, and also laid eggs of a distinctive character.

With the exception of a Dasyurus, the marsupials from King Island are identified with existing species.

Turning to wombats, the authors state that the first specimen known to Europeans was secured on Clarke Island, Bass Strait, in 1797 (not by Bass), and taken alive to Sydney, this forming the type of Shaw's *Didelphys ursina.* All the early examples of wombats came, in fact, from the islands in Bass Strait, and the identification of the Tasmanian animal with the Bass Strait *Phascolomys ursinus* is shown to be erroneous. In addition to skulls and bones, it appears to be now represented in collections only by a couple of skins recently secured on Flinders Island, where it still survives. The Tasmanian species, for which the authors propose the name *P. tasmaniensis*, is intermediate in size between the large *mitchelli* and the smaller *ursinus*, but agrees in shape with the former; its general colour is grizzled grey, with light hairs inside the ears.

In the course of a long paper on the birds of the East Murchison district, published in the April number (vol. ix., part iv.) of the *Emu*, Mr. F. L. Whitlock gives an account of his discovery of the playing-grounds and nests of the yellow-spotted bower-bird (*Chlamydodera guttata*), illustrated by photographs. A peculiar feature of the species is that at the commencement of the breeding season several individuals sometimes resort to the same play-ground, where the adult males make a nuptial display. The dimensions of one play-ground were 7 by 5 feet. The foundation was a mass of twigs, which raised the floor of the inverted arch about 6 or 8 inches above the general level of the ground, the walls of the arch being some

18 inches in height and 6 inches in thickness, while the total length of the intervening run was approximately 25 inches. In this run were placed thirteen flakes of limestone, together with about the same number of small green pods and a few beans, but no feathers or shells. The nests, which were built of twigs and placed in casuarina trees near the run, each contained a pair of heavily scribbled eggs.

For several years past Messrs. Baldwin Spencer and J. J. Fletcher have been studying and describing a large collection of Australian earth-worms, but in many instances it has been found impossible to decide on the proper generic position of the species. Before the classification can be considered final, a large amount of anatomical investigation is essential, and this work is being undertaken by the scientific staff of Melbourne University. Four papers, two by Miss G. Buchanan, the third by Miss F. Bage, and the fourth by Miss J. W. Ruff, embodying some of the results of this work are published in vol. xxii., part ii., of the Proceedings of the Royal Society of Victoria. Miss Bage, who treats of the structure and arrangement of the nephridea, states that these organs are subject to great variation in the different groups, and will probably be found of great value for systematic purposes.

Among other articles on local natural history in the March issue (vol. i., No. 5) of the *Queensland Naturalist*, special interest attaches to one describing a visit paid by Mr. G. H. Barker in September, 1909, to the reserve at Gold Creek, where numerous kinds of birds were observed.

The writer of these notes has been favoured with a cutting from the Argentine journal *La Nacion* of April 15 containing an account of a newly discovered skull of the gigantic glyptodont Dædicurus, with the previously unknown dermal head-shield in position. The skull appears to have been found in association with the skeleton, thus making the fourth more or less nearly complete example of the bony framework of this gigantic species.

RAINFALL OF RHODESIA AND AUSTRALIA.

TO the Proceedings of the Rhodesia Scientific Association (vol. viii., part iii., 1909) the Rev. E. Goetz, S.J., contributes a very valuable discussion of the rainfall of Rhodesia, based upon observations at sixty-three stations. Fifty of these are in southern Rhodesia; the conclusions therefore apply more particularly to the country between the Zambezi and the Limpopo (long. 27°–33° E.). The tables contain monthly and yearly amounts from the actual observations. The longest series is for Hopefountain (nineteen years), and the averages at most of the other stations have also been reduced to this normal by the usual method. An annual rainfall map shows clearly that the amounts near the Portuguese territory vary from 45 to 30 inches, and decrease westwards to 20 inches; but to the north-west (north of the Zambezi) the unreduced averages increase to 30 inches and above. There are some closed areas of high rainfall in southern Rhodesia which, the author assumes, will probably disappear with the returns of a larger number of stations. The rainfall for seasons, and for short periods at some selected stations, is dealt with in considerable detail. There is also an interesting discussion of rain and drought cycles; the nineteen-year cycle, based on the periodic movement of the high-pressure belt, recently proposed by Colonel H. E. Rawson, seems (the author thinks) to promise good results.

Bulletin No. 4, issued by the Australian Commonwealth Bureau of Meteorology, includes, *inter alia*, tables of percentages and mean monthly and annual average rainfall for each colony and for Tasmania. These values are transferred to a map consisting of miniature "graphs," showing very clearly the mean monthly percentages and other details. One of the several useful appendices shows the hourly distribution of rainfall and frequency of showers in most of the capital towns for a year ending June 30, 1909. The text of the bulletin gives an interesting account of the broad features shown by the maps, viz. that nearly the whole of tropical Australia receives the bulk of its rains during the period of the year when the convectional action in the interior of the continent is at its maximum. In the central latitudes, although the monsoonal influence still predominates, the colder months are under the influence of V-shaped depressions which skirt the southern shores during the winter and spring seasons. In Western Australia the maxima occur in the early and mid-winter months over the whole of the western and southern districts. In the agricultural areas of South Australia the winter and spring maxima are very marked, but in the far north the monthly values are very erratic. The pronounced feature of winter rains over South Australia and the western part of Western Australia is maintained in the western slope districts of New South Wales, but is obscured over the Victorian areas south and east of the mountain ranges by the disturbing character of the country. The same peculiarities affect the central, western, and northern interior of New South Wales.

THE CHEMICAL SIGNIFICANCE OF CRYSTAL STRUCTURE.[1]

LARGE numbers of chemical substances occur on the earth's surface as definite geometrical forms bounded by plane faces; these polyhedral shapes are called crystals. Inspection of the crystal forms assumed by mineral substances shows that, roughly speaking, each crystalline substance affects some specific geometrical shape which is characteristic for the material; further that, whilst crystals of any particular mineral attain vastly different dimensions and are bounded by planes which vary greatly in relative area, one geometrical feature remains constant. The angles between corresponding pairs of faces on any two crystals of the same substance are the same, notwithstanding the existence of difference in size or in relative face magnitude between the two crystals. The constancy of interfacial angle amongst crystals of the same substance is a law of nature, and has been amply demonstrated by the very careful crystallographic measurements made by Tutton during the last twenty years.

It is, however, not essential to study mineral substances alone in order to obtain a knowledge of the laws governing crystal growth. Great numbers of laboratory products can be caused to crystallise by condensation from some fluid condition; thus the crystals of various alums exhibited were obtained by slow evaporation of aqueous solutions of these salts.

The examination of a crystal shows that many of its physical properties differ according to the direction in the crystal in which the property is determined; the hardness of crystals, the speed at which light travels through them, and many other properties, are commonly dependent on the direction in which the material is examined.

The dependence of crystal properties on direction indicates the most essential feature of the crystal to be a definite and orderly arrangement of its ultimate particles; this arrangement is referred to as the crystal structure. Further evidence that crystals possess an arranged structure is furnished by the observation that crystallisation is not necessarily a spontaneous process. Thus, on melting benzophenone and rapidly cooling the clear molten mass, the liquid state is retained for many hours at a temperature far below the normal melting point of the compound. But on inoculating the liquid with a trace of crystalline benzophenone, crystallisation immediately commences and rapidly becomes complete. The introduction of a small particle of crystalline or arranged material into the liquid mass provides a nucleus upon which the molecules are able to deposit themselves in a similar crystalline arrangement; the process thus started quickly becomes propagated throughout the entire mass. The lack of spontaneity in the process of crystallisation leads occasionally to quite unexpected results. Thus tetrahydroquinaldine has been known for many years, and has been prepared by numbers of chemists. It has always been obtained as a liquid, and has never been supposed capable of existing in the crystalline state at ordinary temperatures; even when cooled in liquid air it merely becomes a thick resin, and does not crystallise. But on dissolving a few drops of it in a little light petroleum, and cooling the solution thus obtained in liquid air, the tetrahydroquinaldine crystallises out; on transferring a trace of the crystalline material obtained to

[1] Discourse delivered at the Royal Institution on Friday, April 15, by Prof. William J. Pope, F.R.S.

the liquid substance at the ordinary temperature, the liquid mass is seen to immediately crystallise. This well-known substance, hitherto known only in the liquid state at ordinary temperatures, really exists in a more stable condition as a crystalline solid.

Many substances are capable of crystallising in two or more distinct crystalline forms, of which one is, in general, the more stable at any particular temperature. The physical properties of the several crystalline modifications of any one substance are quite distinct and characteristic for the particular crystalline form, and in many instances even the colours of the several modifications are different. An example of this is afforded by pouring boiling water into a beaker coated with cuprous mercuric iodide; the brilliant scarlet crystalline form, stable at ordinary temperatures when heated in this way, becomes converted into another crystalline modification which is nearly black. The change is a reversible one, and the differences between the properties of the two crystalline modifications are to be attributed to differences in the mode of arrangement of the molecules in the two cases; the two modifications, in fact, possess different crystalline structures.

Although vast numbers of observations, such as the preceding, lead to the conclusion that crystals are arranged structures, it is not essential that the crystal should be a solid substance; during recent years large numbers of crystalline liquids have been discovered. On allowing melted cholesteryl chloride to cool rapidly, a brilliant display of interference colours is seen, owing to the particles of the substance assuming crystalline or orderly arrangement, whilst still retaining the liquid condition.

Having very briefly reviewed some of the many reasons for concluding that crystals are structured edifices, the nature of the architecture which they exhibit may now be considered. All the properties of crystalline solids harmonise with one simple assumption as to the manner in which the parts of the structure are arranged; this assumption is that the structure is a geometrically "homogeneous" one, that is, a structure the parts of which are uniformly repeated throughout, corresponding points having a similar environment everywhere within the edifice. The assumption of geometrical homogeneity as the characteristic of crystalline solids leads at once to the great problem solved by the crystallographers of the nineteenth century. This consisted in the inquiry as to how many types of homogeneous arrangement of points in space are possible, to the study of those types and to their identification, in symmetry and other respects, with the known systems into which crystalline solids fall. This work was commenced by the German crystallographer Frankenheim in 1830, and completed by the English geometrician Barlow in 1894. Briefly stated, the final conclusion has been attained that 230 geometrically homogeneous modes exist of distributing material, or points representing material throughout space, and that these 230 homogeneous types of structure, the so-called homogeneous "point-systems," fall into the thirty-two types of symmetry exhibited by crystalline solids. Models of a number of homogeneous point-systems illustrating some of these types are exhibited.

It is, however, obvious that the limitation of the possibilities of solid crystalline arrangement to 230 types marks but one stage in the determination of the nature of crystal structure, and throws no direct light on the relation between crystal structure and chemical constitution. Although by the end of the nineteenth century we had learnt that corresponding points of the units of crystalline structures form homogeneous point-systems, the great problem still remained of determining what are the entities which become homogeneously arranged, for what reason they become so arranged, and in what way the conclusions drawn by modern chemistry are reflected in crystal structure. This problem was a legacy to the twentieth century, and it now remains to indicate briefly the extent to which it has been solved and the results of chemical importance which have accrued during its investigation.

The problem may be most easily visualised in connection with some comparatively simple case, that, for instance, presented by the crystalline forms assumed by the elements themselves. It is generally admitted that an elementary substance consists of identical atoms, each of which acts as a centre of operation of attractive and repulsive forces. In a solid crystalline structure the atoms are obiously not free to travel through the mass, each, if not indeed fixed to a particular spot, being retained within a certain minute domain; each of these domains must be regarded as possessing a centre which marks the mean position of the atom.

The crystalline condition of an element may consequently be defined as one of equilibrium between forces of attraction and repulsion emanating from or referable to a flock of points homogeneously arranged in space, that is to say, conditions, the space occupied by a crystalline element, a homogeneous assemblage of identically similar atoms, may be partitioned into identically similar cells in such a manner that the boundaries of a single cell shall enclose the entire domain throughout which a particular atom exercises predominant influence. Since it is postulated that every point in the space is subject to the dominating influence of some next neighbouring atomic centre, it follows that the cells fit together so as to occupy the whole available space without interstices. Nothing is here said about the shape of the cells; but since, in the case of an elementary substance, the atomic centres are all alike, so too will be the cells. Before proceeding to discuss the actual shapes of the cells referred to, it will be convenient to illustrate

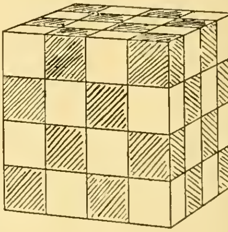


FIG. 1.

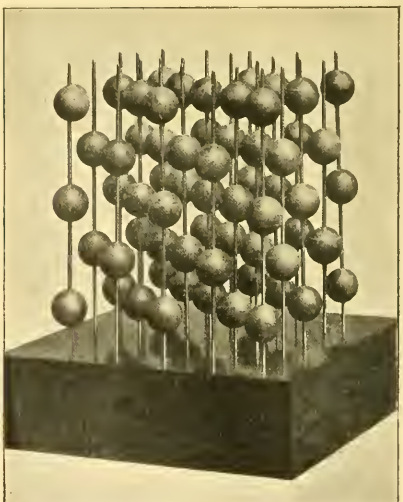


FIG. 2.

more graphically the mode of treating the problem which is here introduced with the aid of a particular point-system connected with the crystalline structure of elementary substances.

The point-system in question may be derived in the following manner. Space is first partitioned into cubes by three sets of parallel planes at right angles to one another (Fig. 1); a point is then placed at each cube corner and at the centre of each cube face. The cubes of the partitioning, having served their purpose, may now be removed, leaving one of the 230 types of homogeneous point-systems (Fig. 2). Imagine, next, that each point of the system expands uniformly in all directions until it touches its neighbours; a system of spheres packed together in contact is thus obtained (Fig. 3), and, on examination, it is found that no way exists of packing these equal spheres more closely together than the one thus derived. The system is therefore termed the cubic closest-packed assemblage of equal spheres, and, being derived in the manner described, still retains the high symmetry of the cube; the fragment shown, in fact, outlines a cube. Three directions at right angles in it, those which are parallel to the three cube edges, are seen to be identical in kind; this identity in kind in the three rectangular directions a, b, and c is conveniently expressed by the ratio $a:b:c=1:1:1$.

On removing spheres from one corner of the cubic closest-packed assemblage of equal spheres a close triangularly arranged layer is disclosed, and, by similarly treating each corner of the fragment of assemblage, the cube outline gives place to one of octahedral form. The assemblage is now seen to be built up by the superposition of the disclosed triangularly arranged layers, the hollows in one layer serving to accommodate the projecting parts of the spheres in adjacent layers. When this operation is performed it is perceived, however, that two ways of stacking the layers homogeneously are possible. The first of these, in which the fourth layer lies immediately over the first, the fifth over the second, and so on, yields the cubic closest-packed assemblage. The alternative mode of stacking, in which the third layer lies immediately over the first, the fourth over the second, and so on, exhibits the same closeness of packing as the first, but possesses the symmetry of the hexagonal crystal system; it is accordingly termed the hexagonal closest-packed assemblage of equal spheres (Fig. 4). Examination of the hexagonal assemblage shows that the horizontal directions, in the planes of the layers, are not identical in kind with vertical directions perpendicular to the planes of the layers. Corresponding dimensions in these two directions, a and c, are in the ratio of

$$a:c=1:\sqrt{(\tfrac{2}{3})}=1:0{\cdot}8165.$$

The final step in the treatment of the closest-packed assemblages of equal spheres consists in converting them into the corresponding assemblages of cells fitting together without interstices which have been already mentioned; it may be carried out in these, and in all other cases, by causing the component spheres to expand uniformly in all directions until expansion is checked by contact with the expanding parts of neighbouring spheres. The cubic closest-packed assemblage then becomes a stack of twelve-sided polyhedra, rhombic dodecahedra, which are so fitted together as to fill space without interstices. It is now seen that the even rate of expansion from each point of the original point-system which gives rise to the closely packed stack of rhombic dodecahedra symbolises an even radiation in all directions of the forces of which the atom is the centre of emanation. On applying the same operation of expansion to the spheres present in hexagonal closest-packing, each becomes converted into a dodecahedron, although of symmetry different from that of the rhombic dodecahedron. In each of the two cases the system exhibits the important property that, with a given density of distribution of the centres, a maximum distance prevails between nearest centres; these two systems thus represent the equilibrium arrangements of the postulated forces of repulsion exerted between near centres, the repulsions between more distant ones being neglected.

It will be sufficiently evident from what has been said that the function of the spherical surfaces in the closest-packed assemblages of spheres, as representing crystal structures, is merely a geometrical one; these surfaces are employed only as so much scaffolding by the aid of which may be derived arrangements exhibiting a maximum number of equal distances between neighbouring centres, and no physical distinction is to be made between portions of space lying within the spheres and portions forming part of the interstices between them. Insistence on this point is necessary, because many investigators have made use, quite illegitimately, of spheres for the representation of atomic domains, piling the spheres together in what they have termed open packing; this term seems to imply that some physical difference can subsist between the portions of space lying within the spheres and those lying without. The one kind of space is apparently regarded as susceptible to atomic influence in some sense not exhibited by the other. To state this view in any definite manner probably suffices to demonstrate its superficiality; the question of ascertaining what proportion of the total space is available for atomic occupation by the use of assemblages of spheres does not arise, because the spheres used are solely the geometrical instruments for producing equality amongst the atomic distances, and so determining the prevailing equilibrium conditions.

So far as the inquiry has been carried, it would seem that the elements should crystallise either in the cubic or the hexagonal system, and that in the latter case corresponding dimensions in the horizontal and vertical directions should be in the ratio of $a:c=1:0{\cdot}8165$. The facts are summarised in Table I.

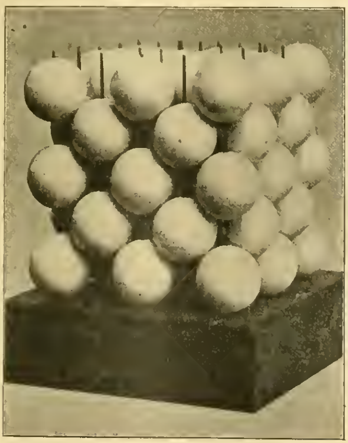


FIG. 3.

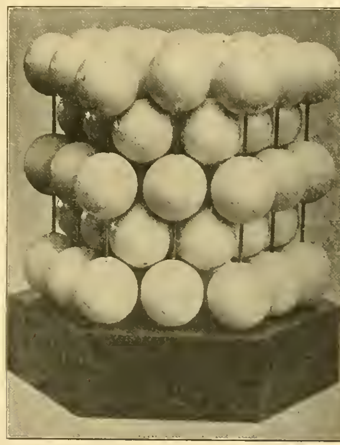


FIG. 4.

TABLE I.—*Relation between Crystal Form and Molecular Complexity.*

Crystal system	Elements	Number of atoms in molecules of compound inorganic substances					Organic compounds
		2	3	4	5	More than 5	
Cubic	50	68·5	42	5	12	5·8	2·5
Hexagonal	35	19·5	11	35	38	14·6	4·0
Tetragonal	5	4·5	19	5	6	7	5·0
Orthorhombic	5	3·0	23·5	50	36	27·3	34·0
Monosymmetric ...	5	4·5	3	5	6	37·3	47·5
Anorthic	0	0	1·5	0	2	8	7·0
Number of cases summarised in each vertical column ...	40	67	63	20	50	673	585

The proportion of substances crystallising in each system is stated above as a percentage.

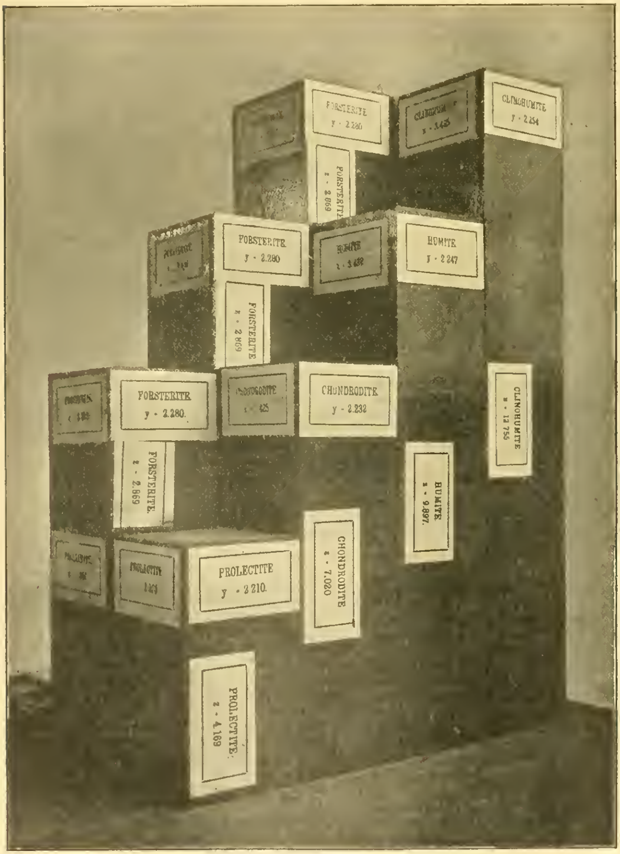


FIG. 5.

Of the elements which have been crystallographically examined, 50 per cent. are cubic; their crystal structure is simulated by the cubic closest-packed assemblage of equal spheres. Another 35 per cent. belong to the hexagonal system, and that these are correctly represented by the hexagonal closest-packed assemblage of equal spheres is indicated by the fact that for the hexagonal elements the ratio of corresponding dimensions in the horizontal and vertical directions approximates to the value $a:c=1:0{\cdot}8165$, deduced for the model assemblage.

The task of accounting for the 15 per cent. of the crystalline elements which have been examined and found to crystallise in systems other than the cubic or hexagonal still remains. A little inspection shows that the crystal forms of these elements in every case approach very closely to one or other of the two of highest symmetry, namely, the cubic or the hexagonal; one example of this will now suffice. The values of corresponding dimensions in three directions in space for the monosymmetric form of the element sulphur are given by the axial ratios $a:b:c=0{\cdot}9958:1:0{\cdot}9998$, $\beta=95^\circ\ 46'$. The slight departure of these dimensions from the corresponding values for the cubic closest-packed assemblage, in which $a:b:c=1:1:1$, $\beta=90^\circ$, at once suggests that the monosymmetric modification of sulphur is derived from the latter assemblage by some minute distortion. Such a distortion indicates a very trifling departure from uniformity in the influence exerted in different directions from each atomic centre, and may either arise from some want of symmetry in the individual atoms or in a reduction of the symmetry caused by some grouping of the atoms; two or more atoms might thus be more closely connected in some way with one another than with other next neighbouring atoms.

Having shown that the crystalline forms of the elements are in complete harmony with the conception that crystal structures can be homogeneously divided into similar cells of polyhedral shapes approximating closely to the spherical, reference may now be made to some simple compounds, those, namely, in which the molecule consists of two dissimilar atoms.

The conception of the equilibrium of centred forces which has been shown fertile in the case of the crystalline elements can be immediately applied to the binary compounds; as before, each atom will be represented by forces emanating from a centre, and equilibrium will demand closest packing of the spheres used, just as in the previous case. The atomic centres will now, however, be of two kinds, and the question arises as to whether the domains of atomic influence to be described about them will be all of the same magnitude or whether two magnitudes of spheres must be employed, one for each element present. This question is difficult to answer by reference to the facts already reviewed above; probably the only indication which the latter afford in this connection is that closest packing of a considerable variety of different magnitudes would certainly be most unlikely to lead to the close similarity of crystal form observed as between the elements and the binary compounds. A direct answer is, however, provided as the result of investigating the crystalline forms of organic substances, to which reference will presently be made; this investigation has led to the discovery of a definite law which governs the magnitudes of the several kinds of atomic domain concerned in any crystalline compound substance. It is found that the magnitudes of the atomic domains in any crystalline compound are very approximately in the ratio indicated by the fundamental valencies of the corresponding elements. Since the molecules of nearly all the binary compounds which have been crystallographically examined contain in the molecule one atom each of two elements of the same valency, the polyhedral cells from which a crystalline binary compound must be supposed built up are all, in general, of approximately the same magnitude. The fact that most binary compounds, like most elements, crystallise in either the cubic or the hexagonal system, represents one of the simple results of this law of valency volumes.

The binary compounds thus, in general, affect crystalline structures which are derived from the cubic or the hexagonal closest-packed assemblage of equal spheres; one-half of the spheres, selected homogeneously, represent atoms of the one element and the remainder atoms of the second element. The mode in which the necessary homogeneous selection may be made in the cubic assemblage, without altering the values of corresponding dimensions in three rectangular directions, is shown in a model.

The crystalline forms of the binary compounds are in accordance with what has been above foreshadowed. Table I. indicates that in geometrical respects the crystalline binary compounds closely resemble the elements; 68·5 per cent. of those examined are cubic and 19·5 per cent. hexagonal, the remaining 12 per cent. crystallising in systems of lower symmetry than these. The axial ratios, $a:c$, of all the hexagonal binary compounds known are stated in Table II.; all approximate closely to the value, $a:c=1:0{\cdot}8165$, for the model hexagonal closest-packed assemblage of equal spheres.

TABLE II.—*Hexagonal Binary Compounds.*

		$a:c$			$a:c$
Beryllium oxide	BeO	1 : 0·8153	Cadmium sulphide	CdS	1 : 0·8109
Zinc oxide ...	ZnO	1 : 0·8039	Silver iodide.	AgI	1 : 0·8166
Zinc sulphide..	ZnS	1 : 0·8175	The ratio, $1:\sqrt{(\frac{2}{3})}$		1 : 0·8165

In connection with the elements and binary compounds, it is noteworthy that the mode of treatment described appears practically to eliminate molecular aggregation of the atoms as a factor in determining the crystalline structure; that is to say, the distance separating two neighbouring atom centres is the same whether those atoms belong to the same or to different molecules. Another interesting fact is that, whilst the elements and binary compounds for the most part crystallise in the cubic or hexagonal systems, substances of greater molecular complexity rarely crystallise in these highly symmetrical systems; thus, of a great number of organic compounds examined, 2·5 and 4·0 per cent. only belong to the cubic and hexagonal crystalline systems respectively (Table I.). This observation is important as one of many indications that the cells into which the crystal structure of a complex compound are partitionable are not, in general, all of the same volume. Further investigation shows that the volumes of the polyhedral cells representing the atomic domains of the several elements present in a complex crystalline compound are governed by the law of valency volumes, to which reference has already been made. The correctness of this conclusion concerning the proportionality between the numbers expressing the fundamental valencies of the elements and the volumes of the corresponding spheres of atomic influence has been abundantly verified, not only by the laborious process of working out a large number of cases, but in several other ways which may be more rapidly indicated. The following are illustrations of the latter kind of verification.

Table III. states the composition and axial ratios, $a:b:c$, of a series of four crystalline minerals which differ in composition by the increment, Mg_2SiO_4; the sums of the valencies of the atoms composing the different molecular aggregates are stated under the heading W. The increment, Mg_2SiO_4, also occurs as the crystalline mineral forsterite, of which the axial ratios have been determined. It is evident that the ratio a/b has approximately the same value of 1·08 for all four members of the series, and that practically all differences in relative dimensions are expressed by the ratio c/b. On dividing the valency volume, W, by the corresponding value for c/b in each case, the quotients 11·7, 12·1, 12·3, 12·4, and 12·7 are obtained respectively for the substances prolectite, chondrodite, humite, clinohumite, and forsterite. The relative dimension, c/b, is thus roughly proportional to the sum of the valencies in this set of minerals. The comparison may, however, be made more accurately by including the changes in both relative dimensions, a/b and c/b, in the calculation, in the following manner. The "equivalence parameters" are the rectangular dimensions, x, y, and z, of a rectangular block having the volume W, and are in the ratio of the axial ratios $a:b:c$. The parameters x and y preserve almost constant values throughout the series, and addition of the increment, Mg_2SiO_4, leads to a practically constant increase of about 2·86 in the dimension z on passing from one mineral to the next in the series. The mineral forsterite also gives nearly the same x and y values as before, and its z value, 2·87, is equal to the differences between consecutive pairs of z values in the main series; these differences vary between 2·85 and 2·88. The axial ratios and equivalence parameters of forsterite can, indeed, be calculated with considerable accuracy from the data available for the series of four minerals.

TABLE III.—*The Humite Minerals.*

Prolectite ...	$MgSiO_4$	$2Mg(F,OH)$ ...	W = 22
Chondrodite ...	$Mg_3(SiO_4)_2$.	$2Mg(F,OH)$ ...	W = 38
Humite	$Mg_5(SiO_4)_3$.	$2Mg(F,OH)$ ...	W = 54
Clinohumite ...	$Mg_7(SiO_4)_4$.	$2Mg(F,OH)$ ..	W = 70

The increment is Mg_2SiO_4, namely, forsterite, with W = 16.

	Axial Ratios $a:b:c$	Equivalence Parameters $x:y:z$
Prolectite	1·0803 : 1 : 1·8862	2·389 : 2·210 : 4·169
		Diff. = 2·851
Chondrodite ...	1·0863 : 1 : 3·1447	2·425 : 2·232 : 7·020
		Diff. = 2·877
Humite	1·0802 : 1 : 4·4033	2·428 : 2·247 : 9·897
		Diff. = 2·858
Clinohumite ...	1·0803 : 1 : 5·6588	2·435 : 2·254 : 12·755
Values for the increment, forsterite.		
Oberved	1·0757 : 1 : 1·2601	2·449 : 2·277 : 2·869
Calculated	1·0823 : 1 : 1·2775	2·429 : 2·245 : 2·869

The relations here displayed may be rendered more obvious by a series of models (Fig. 5). Rectangular blocks having as the horizontal dimensions the x and y values, and as vertical dimension the z value, for forsterite, when superposed upon a similar set of blocks having the corresponding dimensions for prolectite, form a stack exhibiting the equivalence parameters of chondrodite; superposing on this a second set of forsterite blocks leads to a stack showing the equivalence parameters of humite, and on again repeating the operation, a stack with the dimensions of clinohumite results. From the numerical data and the models exhibited, it must be regarded as definitely proved that, in this series, the volumes appropriated by the constituent atoms are, in any one member, directly proportional to the valency numbers of the corresponding elements.

Another set of observations of a very convincing character, although of a totally different kind, is laid out in Table IV. Experimental determinations of the mole-

TABLE IV.—*Molecular Volumes of the Normal Paraffins at their Melting Points.*

—	W	Melting point $t°$	Molecular volumes: Observed at $t°$	Molecular volumes: Calculated as W×S
$C_{11}H_{24}$	68	−26·5	201·4	201·96
$C_{12}H_{26}$	74	−12·0	219·9	219·78
$C_{13}H_{28}$	80	− 6·2	237·3	237·60
$C_{14}H_{30}$	86	+ 4·5	255·4	255·42
$C_{15}H_{32}$	92	+10·0	273·2	273·24
$C_{16}H_{34}$	98	+18·0	291·2	291·06
$C_{17}H_{36}$	104	+22·5	309·0	308·88
$C_{18}H_{38}$	110	+28·0	326·9	326·70
$C_{19}H_{40}$	116	+32·0	344·7	344·52
$C_{20}H_{42}$	122	+36·7	362·5	362·34
$C_{21}H_{44}$	128	+40·4	380·3	380·16
$C_{22}H_{46}$	134	+44·4	398·3	398·00
$C_{23}H_{48}$	140	+47·7	416·2	415·80
$C_{24}H_{50}$	146	+51·1	434·1	433·62
$C_{27}H_{56}$	164	+59·5	487·4	487·08
$C_{31}H_{64}$	188	+68·1	558·4	558·36
$C_{32}H_{66}$	194	+70·0	576·2	576·18
$C_{35}H_{72}$	212	+74·7	629·5	629·64

Mean value of S = 2·970.

cular volumes of a long series of normal paraffins, made on the liquid substances at temperatures at which the materials are in physically similar conditions, are stated in column 4. Since the valency of carbon is four times that of hydrogen, it would be anticipated from the crystallographic conclusions previously drawn that each carbon atom should appropriate four times as large a space for occupation as one hydrogen atom; the quotient of the molecular volume by the valency sum or valency volume, W, should consequently lead to the same value, S, in the case of all the hydrocarbons. The mean value of S, namely, the atomic volume of hydrogen, is thus calculated as 2·970, and that it is constant within very narrow limits is seen on comparing columns 4 and 5, the latter of which states the product of the valency volume, W, by the value 2·970. The simple relation between the atomic volumes of carbon and hydrogen in the liquid normal paraffins indicated in the above table was recently pointed out by Lebas, and is abundantly confirmed by numerous series of determinations in addition to that now quoted. It is thus definitely proved that the law of valency volumes, first enunciated on the ground of the crystallographic evidence, holds rigidly in the case of these liquid substances.

Sufficient has been said to demonstrate that a method has now been devised by means of which the vast stores of accurate goniometric measurements collected by crystallographers during the past century can be interpreted, and that the requisite interpretation has in many cases already been given. Prof. Liveing, in a discourse delivered in this room nineteen years ago, suggested that crystalline forms are the outcome of the accepted principles of mechanics; the aid of these, and of these alone, has been invoked to show that crystalline structures result from the equilibrium of the attractive and repulsive forces radiating from the atomic centres.

RESULTS OF SOME RECENT INVESTIGATIONS ON MAGNETIC DISTURBANCES.[1]

AN examination of the times of beginning of the magnetic disturbance which occurred on May 8, 1902, as coincidently with the Mont Pelée eruption as can be determined, revealed the interesting fact that they were not the same all over the globe, being, in general, earliest at European stations. The times next progressed going around the earth eastwardly, the complete circuit being made by the disturbance in about $3\frac{1}{2}$ minutes. This fact led to an examination of other similar disturbances, such as the one of January 26, 1903, and it was again seen that this one also progressed around the earth eastwardly, the time for the complete circuit being about 4 minutes.

Mathematical analyses were next made, and it was found that for both disturbances (May 8, 1902, and January 26, 1903) the systems of disturbance forces which it would be necessary to superpose upon the earth's own magnetic field were precisely of the same character as the earth's. In other words, were we to assume electric currents as constituting the disturbance systems, then, as is the case for the earth's field, the currents would have to circulate around the earth from east to west if they are positive ones, and in the contrary direction—from west to east—if they are negative or such as would be produced by moving negative charges. Furthermore, for both disturbances the electric currents would have to circulate chiefly in the regions above the earth.[2]

For the disturbance of May 8, 1902, there were a sufficient number of trustworthy determinations of the effect on the vertical intensity, and accordingly it was possible, by means of the analysis, to separate the external system of currents from the internal (below the surface) one; and then the surprising result revealed itself that the internal currents went in the same direction as the external ones, the latter being about three times the strength of the former. Hence, were we to suppose that the disturbance is caused by the motion of negative charges around the earth eastwardly, then the internal negative currents also go in the same direction, and accordingly they are not currents induced in the earth by the outer system.

If the earth's own magnetic field is likewise separated into an internal system and an external one, it is also found that for both systems the negative electric currents go in the same direction around the earth, viz. from west to east. The disturbance systems found above are therefore precisely similar in character to the earth's field. It should also be noted that the negative currents of the disturbance progress around the earth in the same way as did the times of beginning referred to above.

We have now become acquainted with the fundamental facts of observation pertaining to the simplest class of magnetic disturbances experienced by the earth—the sudden beginnings of magnetic perturbations, which, in accordance with van Bemmelen's suggestion, we will term for brevity "S" storms. Let us see what hypotheses are necessary for a *physical* explanation of the observed facts.

Prof. Kr. Birkeland, of Christiania, was the first to have attempted a definite physical theory to account for this class of disturbances, which he termed "equatorial perturbations," since they are most strongly developed in the equatorial regions, as judged alone from the size of the disturbance effect on the horizontal intensity. If the latter element suffered an increase, the disturbance was called a "positive equatorial perturbation," and if, on the other hand, the horizontal intensity was decreased, the disturbance was termed a "negative equatorial perturbation." The theory for these particular disturbances is only a part of the general "kathode-ray theory" developed by Birkeland and Störmer to account for all classes of magnetic disturbances and of polar lights, as set forth in their various papers, and especially in Birkeland's recent publication, "The Norwegian Aurora Polaris Expedition, 1902–3," vol. i., "On the Cause of Magnetic Storms and the Origin of Terrestrial Magnetism." It will be noted that it is even hoped to build up a general theory of terrestrial magnetism, and there is an intimation that the earth's magnetic periodic variations may likewise be among the consequences of kathode rays coming from the sun and entering the earth's field.

Without question, these important contributions of Birkeland and Störmer mark a distinct advance, and the student of magnetic science will find not only incentive, but also a wealth of material and many suggestive facts by looking over these very valuable researches. At present, however, their theoretical results and deductions must be regarded chiefly as *qualitative*. While it is made very plausible that the cause of our magnetic storms is to be referred principally to kathode rays originating in the sun and coming within reach of the earth's magnetic field, there are a great many questions left open which will require answering before full acceptance can be given to the theory in all its details. How the earth's own magnetic system is affected by a magnetic disturbance—whether the intensity of magnetisation is increased or decreased, if there are any after-effects, whether the currents within the earth are induced ones or are the same in direction as those outside, &c.—are but a few of the interesting and important questions to be solved.

It seemed very desirable, therefore, that someone should take up the investigation from an *analytical* point of view, viz. to take a typical magnetic storm and analyse the observed effects into spherical harmonic terms, so as to determine just how much is due to outside currents and how much to currents within the earth itself.

Birkeland concluded, from a general consideration of the effects of a magnetic disturbance on the vertical intensity, that all storms originate from without, and it is quite possible that, in the main, he may be right, but the conclusion cannot be accepted as invariably true without a detailed mathematical analysis of each particular case. In his first volume he accordingly proceeds on the assumption

[1] A summary of two papers presented respectively at the meeting of the Washington Academy of Sciences, February 17, 1910, and at the meeting of the Philosophical Society of Washington, April 9, 1910.

[2] See *Terrestrial Magnetism and Atmospheric Electricity*, vol. xv., pp. 9–30. In this connection it is also well to record that Dr. W. van Bemmelen, in his recent investigations on "The Starting Impulse of Magnetic Disturbances" (Proceedings of the Amsterdam Academy of Sciences, April 24, 1908), found the following important fact as applying to the Batavia magnetic observatory records, 1882–99:—"Taking no consideration of the slight introductory movement, 124 cases furnished for the duration of the impulse: in horizontal intensity, 4·5 min.; declination, 3·2 min; vertical intensity, 12·0 min. The duration of the vertical intensity movement is in general difficult to determine, as the decrease in this element keeps on mostly much longer. It is important to notice that the initial movement of D stops or is inverted, whilst of H the increasing movement keeps on."

that by far the greater part of a disturbance is due to upper electric currents, though quite likely, in a subsequent volume, he will consider the subterranean currents also. Since the observed quantities actually to be operated with appear to be resultant effects of both external and internal forces, it is very desirable that we should know just what proportion must be referred to one cause or the other. For this separation we require, however, a knowledge of the disturbances in the vertical intensity, and these are either difficult to determine with sufficient accuracy or are not to be had always at a sufficient number of stations, so that Birkeland was perforce compelled in his first treatment to assume chiefly external currents.

It was for these reasons deemed desirable to make known promptly the deductions derived from the mathematical analysis of certain typical cases of the class of "S" storms. We have now the means of applying the first decisive tests as to how far the Birkeland-Störmer theory will account for the facts.

There is a distinct advantage in treating, for the present, simply these sudden beginnings of magnetic disturbances for the reason that not only the time of beginning can be sharply determined, but, what is equally important, the actual magnitude and direction of the disturbance effect on any particular element can be most accurately determined. As the effects we are here especially considering do not extend, in general, over five minutes, we may readily scale off on the magnetogram the disturbance effect, being, without essential error, simply the difference between the ordinate to the curve at the point of beginning of the disturbance and the ordinate to the particular point of the disturbance considered. When, however, a magnetic storm extends over many hours, and even days, and one wishes to know the magnitude and direction of the disturbance at stated times, for example, every hour or half-hour, then what is called a "normal curve" must be drawn from which the disturbance ordinate is to be measured. This "normal curve" is supposed to represent the curve of magnetic variations which would have resulted had there been no disturbance; but to determine such a curve is far more difficult than is generally realised, and usually an arbitrary assumption of some kind must be made to derive it. Of such assumptions we are practically free in the disturbances considered.

Application of Tests.

The first fact of importance found from the analysis of the disturbance of May 8, 1902, was that the direction of flow of the negative electric currents, which could account for the external and internal magnetic disturbance systems, was the same for both systems. While the strength of the external system was about three times that of the internal, nevertheless, the internal currents were not the direct consequence of the outside moving negative charges, *i.e. they were not induced currents.* Instead, for both systems—outside and inside the earth—the flow of electricity was eastwardly around the earth for negative charges and westwardly for positive charges.

Having fixed the direction of flow of negative electricity, let us inquire now whether kathode rays coming from the sun will give the required direction. Birkeland, in his experiments on a magnetised terrella when placed in a Crookes's tube and subjected to a bombardment of kathode rays, observed, among other interesting phenomena, the formation, under certain conditions, of a ring of kathode particles which encircled the terrella in the magnetic equatorial regions. For an unmagnetised terrella there was no such ring. Störmer, from his mathematical investigations, found under what conditions a similar ring would be formed when kathode rays from the sun came within the deflecting influence of the earth's magnetic field. The ring results when electric charges enter a magnetic field perpendicularly to the lines of magnetic force, *e.g.* in the magnetic equatorial regions. It was on account of the possible formation of such an equatorial ring that Birkeland was apparently led to the adoption of his term "equatorial magnetic perturbation," and to refer its cause to such a ring.

If we apply, however, the well-known law according to which a negative charge would be deflected if entering the earth's magnetic field from without at right angles to the lines of magnetic force, it is unfortunately found that the deflection is to the west, and the moving negative electric charges would accordingly encircle the earth from east to west, hence opposite to what our mathematical analysis of the disturbance of May 8, 1902, and January 26, 1903, have shown must be the case to account for the observed disturbances.

Were we to assume, on the other hand, that the corpuscles are shot up into the earth's field instead of downwards, then those which struck the lines of magnetic force perpendicularly would, after successive deflections, circulate around the earth from west to east or eastwardly, and hence harmonise with the observed facts. Thus far, then, we should have to conclude that if the disturbances considered are to be referred to kathode rays deflected by the earth's field into more or less circular paths, the source of the kathode rays would have to be within the earth itself, and not without.

But if the radius of the ring of moving corpuscles is computed to conform with the time of propagation of the disturbance around the earth (about $3\frac{3}{4}$ minutes), it is found that the orbit would have to be distant from the earth's centre 580 times the earth's radius, or 3,700,000 kilometres, or 2,300,000 miles, and thus the possibility of a terrestrial origin of the kathode rays is likewise eliminated. Furthermore, if we calculate the intensity of the current which at that distance could produce the observed effects of the disturbances of May 8, 1902, and January 26, 1903, it is found to be 5,900,000 amperes. Now Birkeland says on p. 311 of his book:—"In the case of the greater storms, we found current-strengths that varied between 500,000 and 1,000,000 amperes, or even considerably more." Hence, to produce the comparatively insignificant magnetic disturbance effects here considered, by supposing a band of kathode particles circulating around the earth, would require a current at least six times stronger than that which Birkeland finds sufficient to account for the much larger storm effects!

The hypothesis was next briefly examined on which the disturbance effects considered might be referred to alterations in the electrical conductivity of the atmosphere and of the earth, either brought about by the secondary effects from bombarding kathode particles, viz. the formation of Röntgen rays, or, say, by the entrance into the earth's field of the penetrating radiation (γ rays of radium). The ionising effect and resultant alteration of electrical conductivity of the regions involved might either be due to the penetrating radiation from the sun or from the earth, if only *qualitative* results are considered. It is therefore at present not possible to state definitely whether the initial cause of the disturbance of May 8, 1902, was due to a terrestrial eruption or a solar one. First, further examinations will have to be made of the disturbances of May 20 and July 9, 1902, which were again closely coincident with the Mont Pelée eruptions. The electric-conduction hypothesis appears to satisfy, in general, the observed phenomena, and accordingly it is to be subjected to a further rigid examination. It seems also to explain why some of the disturbances take a westward path, although the majority of them go eastward.

Were we to suppose that the generated currents lie on a sphere of radius approximately equal to that of the earth, a velocity of the moving negative charges of 180 kilometres, or 110 miles per second, results, hence a quantity of the order of that for metallic conduction, or as found for the kathode rays from glowing electrolytes.

In conclusion, it should be stated that while it has been shown that the class of simple disturbances discussed in this paper cannot be referred to kathode rays in the way Birkeland and Störmer have supposed, it should be distinctly understood that this in no wise vitiates other portions of their theory, especially with reference to the larger and more complicated magnetic disturbances and to the origin and formation of polar lights. Before anything definite can be said as to the validity of these portions of their theory, it will be necessary to await the completion of a similar analytical treatment to that made for the "S" disturbances.

Such an analytical examination the writer has had under way for more than a year, and a preliminary statement of results was made at the meetings of the American Philosophical Society and of the American Pnysical Society in April, 1909. Instead of drawing curves showing the variations in the diurnal ranges of the magnetic elements with solar activity, as is most frequently done, curves were constructed showing the effects of the magnetic disturbances experienced by the earth during the period April, 1906, to December, 1909, at the Coast and Geodetic Survey magnetic observatories, on the absolute values of the magnetic elements, and especially upon the intensity of magnetisation. This latter curve had been drawn for the first time; when it was compared with the curves showing the variation in solar activity, during the same period, as manifested by sun-spot frequency, sun-spot area, and calcium flocculi area, then the interesting result was obtained that "the intensity of magnetisation of the earth in general decreases with increase in solar activity."

In other words, the average or residual effect of magnetic disturbances, in general, is equivalent to that which would result by the superposition of a magnetic system opposite to the earth's own field, *i.e.* a demagnetising or induction system of magnetic forces. The north magnetic pole of this superposed system is, in general, in high south latitude instead of high north latitude, as is the case generally for the small "S" disturbances already discussed.

Hence for the larger *disturbance systems*, the electric currents which we may suppose to cause the effects would circulate around the earth, for negative ions, from east to west, *i.e.* contrary to the negative currents for the "S" disturbances, but this time in strict accordance with the direction in which a kathode ray coming from the sun would be deflected by the earth's magnetic field.

For these big disturbances, accordingly, the times of beginning, if they can be accurately obtained, will show an increase going round the earth westwardly. A good example is the most remarkable disturbance of which there is any record, viz. that of September 25 last. Here are the times for two sudden deflections at the beginning of the storm, as scaled by Mr. R. L. Faris, of the U.S. Coast and Geodetic Survey, from the horizontal intensity magnetograms of the five Coast and Geodetic Survey magnetic observatories:—

No.	Station	Greenwich mean civil time Sept. 25, 1909 Impulse		
		First h. m.	Second h. m.	I.–II.
(1)	Porto Rico	8 37·7 ...	11 39·8 ...	−2·1
(2)	Cheltenham	8 40·9 ...	11 43·3 ...	−2·4
(3)	Baldwin	8 38·7 ...	11 41·1 ...	−2·4
(4)	Sitka	8 39·5 ...	11 39·8 ...	−0·3
(5)	Honolulu	8 42·7	11 45·4 ...	−2·7
(6)	Mean of all	8 39·9 ...	11 41·9 ...	−2·0
(7)	Mean of Nos. 1, 2, 3.	8 39·10 ..	11 41·37 ...	−2·27
(8)	,, ,, 2, 4 ..	8 41·10 ...	11 42·60 ..	1·50
	Difference No. 7–No. 8	−2·00	−1·23	
	Mean Difference ...		−1·62	

The average latitude for the two groups Nos. 7 and 8 is, respectively, 32° N. and 39° N., and the average longitude 79° W. and 147° W. It is accordingly found that this particular disturbance was propagated from stations in the eastern part of the United States to stations in the eastern Pacific Ocean about two and a half times slower than was found for the simple "S" disturbances, hence roughly at the rate of 2600 miles per minute, against 6700 miles for the latter cases. It is not to be assumed at present, however, that the big disturbances progress over the whole earth at a uniform rate. Their motions appear much more complicated than for the "S" cases.

Accordingly, so far as the big disturbances in general are concerned, the kathode-ray theory of Birkeland and Störmer fulfils the test regarding direction of progression of the disturbance over portions of the earth, and as far as the direction in which the negative electric currents must, in general, go, as found from the preliminary analyses above mentioned. Whether the theory will bear the application of quantitative tests cannot be discussed now. The main thing is to have working hypotheses to which rigid tests can be applied.

Should the electric-conduction theory above proposed to account for the disturbances there considered find further confirmation, the way is opened to a possible corpuscular theory of terrestrial magnetism. On the basis of such a theory, a number of the puzzling features of the distribution of the earth's magnetism and of its variations can readily be explained.

L. A. BAUER.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE have received a copy of the "Livingstone College Year Book" for 1910. It contains college news, letters from old students detailing their experiences, a review of a year's progress in tropical medicine, &c. The training given at Livingstone College (a nine months' course) is designed to educate missionaries going to tropical countries in the elements of medicine, so far as they are required for the prevention of disease and the recognition and treatment of common accidents and diseases.

INDIANA UNIVERSITY, says *Science*, owns an experimental cave farm near Mitchell, Indiana, and has established a small laboratory there primarily for cave work. Cement pools have been placed inside and outside the caves, and give opportunities for breeding cave animals in the light and outside forms in the dark. The University offers a 100*l*. fellowship, in addition to a furnished cottage, to anyone who has had sufficient training to take up such work. Applications should be sent to Mr. F. Payne, Winona Lake, Indiana.

WE have received a copy of the handbook of the faculty of engineering at University College, London, for next session. The faculty includes the departments of mechanical, electrical, civil, and municipal engineering, and is intended to provide a systematic training for students who wish to devote themselves to engineering. It has been recognised by the Board of Trade as providing suitable technical training for marine engineers, and its courses also meet the needs of students who intend to enter for engineering appointments in the various public services. Prof. J. A. Fleming, F.R.S., is the dean, and Prof. J. D. Cormack the vice-dean, of the faculty.

THE governing body of the Imperial College of Science and Technology at South Kensington last year awarded two scholarships for research in connection with aëronautics. The students have held their scholarships at the National Physical Laboratory at Teddington. We learn from the *Times* of August 5 that an additional scholarship is now being offered for award at an early date by the governors of the college. The scholarship will be tenable for one year, and will consist of exemption from fees, together with a maintenance allowance at rates fixed with regard to the circumstances of the case, the value of the scholarship being not less than 50*l*. and not more than 150*l*. a year. It is open to any properly qualified individual, irrespective of residence or place of education. At Regent Street Polytechnic, too, the courses in aëro-engineering are to be developed. A second-year course of aërodynamics is being arranged for students who have qualified in the first year's work in aëro-engineering inaugurated during last session. The course will be open to other persons who can provide evidence that they possess the requisite knowledge of applied mathematics. Special instruction in workshop practice relating to aëroplanes and airships will be given, and students will receive help in making gliders and working models of different types of aërial craft they may be interested in.

THE calendar of the Edinburgh and East of Scotland College of Agriculture for 1910–11 provides full information as to the courses of instruction offered to pupils for the coming session. The college was founded in 1901 with the object of providing for agricultural education and research in the central and south-eastern counties of Scotland. Its classes are arranged in conjunction with certain classes in the science faculty of Edinburgh University. Courses for the diploma of the college and for the science degree of the University are concurrent. A short course, specially arranged to suit those who are actively engaged in farm work, is held at the college annually. The college also maintains a comprehensive scheme of extension work in the neighbouring counties, and the services of its staff are placed at the disposal of farmers investigating new conditions or special points arising out of their farming operations. Under the regulations of the Scotch Education Department, the college is recognised as a central institution to which students may be sent by burgh and county education committees. Instruction in poultry-keeping has been considerably developed. The interest in school gardening grows, and seventy-three gardens have been laid out with the assistance of the college staff. The experiments and demonstrations carried on throughout the neighbouring district are described in the calendar, and give proof of the practical nature of the work undertaken.

SOCIETIES AND ACADEMIES.

London.

Physical Society, July 8.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. H. L. **Callendar**: The radio-balance: a thermoelectric balance for the absolute measurement of radiation; with applications to radium and its emanation. In this apparatus, which was first constructed in 1905, and was briefly described in an article on radiation contributed to the "Encyclopædia Britannica," heat supplied by radiation is directly compensated by the Peltier absorption of heat in a thermo-junction through which a measured electric current is passed. In the simplest form of the instrument, radiation admitted through a measured aperture, 2 mm. diam., falls on a small copper disc 3 mm. diam. by 0·5 mm. thick, to which two thermo-junctions are attached, forming a Peltier cross. One couple is connected to a sensitive galvanometer for indicating changes of temperature. The other is connected to a battery and rheostat in series with a millammeter or potentiometer for measuring the current required to reduce the deflection of the galvanometer to zero. In practice, two similar discs with similar connections are mounted side by side in a thick copper box, and are balanced against each other in order to avoid changes of zero due to exposure to sunshine, or rapid variations of temperature. The advantages of the disc radio-balance are that it is very simple to construct and easy to reproduce without material variation in the reduction constants. It is very suitable for measurements of solar radiation, or strong sources, but is insufficiently sensitive for weak sources; and the absorption coefficient a must be determined by comparison with a standard. In the cup radio-balance, the radiation is received in a copper cup 3 mm. diam. by 10 mm. deep, so that the absorption coefficient is practically equal to unity. Greater sensitiveness is secured by employing a pile of several couples, insulated from the cup, in place of the single balancing couple. External disturbances are eliminated by employing a pair of cups, similarly mounted but oppositely connected, enclosed in a thick copper cylinder. The Joule effect, represented by the C^2R term in the equation, is automatically eliminated by passing the same current in series through the opposing Peltier junctions soldered to the bottom of the cups. The cup exposed to radiation is cooled, and the cup screened from radiation is heated, by the Peltier effect, while both are equally heated by the Joule effect. A complete observation involves reversing the current and switching over the radiation screen, in order to eliminate any difference of sensitiveness of the two piles. By observing the neutral current, each cup can be used separately, as with the disc balance, but the disc balance cannot be used with the Peltier couples connected in opposition unless the balancing couples are insulated from the discs. The cup radio-balance is sensitive to less than a tenth of a micro-watt, and is very suitable for measuring the heat evolved by small quantities of radio-active substances. It was applied to radium at Prof. Strutt's suggestion, and Prof. Rutherford has kindly supplied samples of emanation, and has determined the value of the radium sample employed by comparison with his own standards. The second sample of emanation had only just come to hand, and the absolute values had not been finally reduced at the time the paper was read; but it appeared from the preliminary reductions that the heat evolution of radium in terms of Prof. Rutherford's standards was much greater than that given by previous observers.—Dr. A. **Russell**: The convection of heat from a body cooled by a stream of fluid. Attention is directed to certain deductions made by Boussinesq from the mathematical theory of the conduction of heat in liquids. Complete proofs are given of Boussinesq's formulæ, stress being laid on their limitations, and some of their practical applications are pointed out. It is proved that when a hot body is immersed in a stream of liquid flowing with constant velocity, the cooling is proportional to the difference of temperature between the body and the liquid. Newton proved experimentally in 1701 that this law was true for the case of a hot body being cooled by a draught of air. He enunciated his law with reference to the forced convection of heat from a body, and not, as is often stated, to the natural free convection from it. Lorenz has shown that in special cases the natural convection of heat will vary as the 1·25th power of the difference of temperature. Provided that the velocity of the cooling draught is kept constant between certain limits, Compan has shown that Newton's law is very approximately true even when the difference of temperature is as high as 300° C. Another deduction from the formulæ proved in the paper is that the cooling is very approximately proportional to the square root of the velocity of the convection current. The author gives the solution of the problem of the heating of a liquid flowing steadily, with a velocity less than the critical velocity, through a cylindrical tube which is maintained at constant temperature. It is shown that, in many practical cases, the heating power of the tube varies as $R\theta\sqrt{s\sigma k V l}$, where R is the radius of the tube, θ the difference of temperature between the tube and the liquid, s the specific heat, σ the density, k the conductivity, V the velocity of flow, and l the length of the tube. It is proved that if a wire be immersed in a stream of liquid with its length at right angles to the direction of flow, the electric current which will fuse the wire varies as the 1·25th power of the diameter of the wire. Finally, the effect on the cooling of an electrically heated cylinder by a stream of liquid, of putting an insulating wrapping round it, is considered. It is shown that in certain cases the effect of this procedure is to lower the temperature of the cylinder, an effect which can be easily demonstrated experimentally. In order to simplify the mathematical work, only the case of incompressible fluids is considered. Experimental results, however, obtained by various physicists are quoted to show that some of the formulæ are approximately true for the cooling of heated bodies by convection with currents of air.—Prof. S. P. **Thompson**: Hysteresis loops and Lissajous's figures, and on the energy wasted in a hysteresis loop. Attempts have been made to find an explanation of the forms of the looped curves which express the hysteresis exhibited by iron and steel when subjected to cycles of magnetisation. Physical explanations to account for their general shape have been given by Ewing and Hopkinson, and M. Pierre Weiss has put forward an electronic theory to account for the principal features. The author shows that any hysteresis loop can be analysed into a harmonic series of closed curves corresponding to the various terms in the analysis of the current wave, and their constituents are examined in the paper. A number of examples of hysteresis loops were chosen and subjected to analysis. The loops chosen related to various kinds of iron and steel, hard and soft, solid and laminated, and taken by various methods. In carrying out the analysis, the simple approximate method described by the author (Proc. Phys. Soc., vol. xiv.) was used. Details are given of the analysis of various loops, the effect of eddy currents on the size and form of the loops is discussed, and an account is given of the effect of the higher sine and cosine constituents of the current wave.—Dr. W. H. **Eccles**: The energy relations of certain detectors used in wireless telegraphy. The paper is a record of the results of an experimental examination into the physical properties of the electrolytic detector, the zincite rectifier, the carborundum rectifier, and a thermoelectric detector consisting of a light contact between graphite and galena. The conditions of the experiments have been generally identical with those arising in the ordinary employment of the detectors, and, in particular, the quantities of energy given to the instruments, in the form of electrical oscillations, have been of the same order in these experiments as in actual practice. The chief fact brought to light is that the power curves of all the detectors are straight lines, which suggests that all the detectors are fundamentally thermal in their action.

PARIS.

Academy of Sciences, August 1.—M. Émile Picard in the chair.—M. **Bassot**: The geodesic expedition to the equator. A description of the first two volumes dealing with the results of the expedition under Col. Bourgeois for measuring the arc of the meridian at Quito.—A. **Gautier** and P. **Clausmann**: The action of mixtures of carbon monoxide and hydrogen, or of carbon dioxide and hydrogen, upon the oxides of iron. Carbon monoxide and hydrogen with Fe_3O_4 at 500° C. gave a mixture of ferrous oxide and a carbide of iron, the latter corresponding to the composition $Fe_{12}C$. The bearing of the results on the composition of the gases issuing from fumerolles is discussed.—Paul **Sabatier** and A. **Mailhe**: The catalytic preparation of alkyl-aryl ethers. A mixture of methyl alcohol and phenol vapours passed over thoria at 390°–420° gives a good yield of anisol, $C_6H_5.O.CH_3$. If the phenol is replaced by its higher homologues, the corresponding homologues of anisol are obtained, and the substitution of ethyl alcohol for the methyl alcohol gives $C_6H_5.O.C_2H_5$ and its homologues, some unsaturated hydrocarbon being produced by a secondary reaction between the ethyl alcohol and the thoria.—M. **Schwœrer**: The thermal phenomena of the atmosphere.—G. **Gaiffe**: A method of stereoscopic and kinematographic radiography.—E. M. **Antoniadi**, F. **Baldet**, and F. **Quénisset**: The occultation of η Gemini by the planet Venus. Observations made at the Juvisy Observatory on July 26. The duration of the occultation was 3m. 30s. ± 2·5s. The variations in the luminosity of the star when approaching contact lead to 80 to 110 kilometres as the height of the atmosphere of Venus.—José Comas **Solà**: The discovery of a small planet, presumably new. This was found on a photograph of Halley's comet, taken on June 6 last.—José Comas **Solà**: Study of Halley's comet.—M. **Coggia**: The occultation of η Gemini by Venus, observed at Marseilles.—Th. **de Donder**: Poisson's theorem and the differential invariants of Lie.—Paul **Lévy**: Some equations defining line functions.—Harald **Bohr**: The convergence of Dirichlet's series.—A. **Sainte-Laguë**: Proportional representation and the method of least squares.—William **Duane**: The evolution of heat in a mixture of radium and a phosphorescent salt. The rate of evolution of heat by a radium salt is not affected by admixture with a phosphorescent substance.—Pierre **Jolibois**: The relations between white phosphorus, red phosphorus, and pyromorphic phosphorus. By a study of the vapour pressures, the author concludes that these three varieties of phosphorus are distinct, and criticises the theory recently proposed by Cohen and Olie.—Henri **Leroux**: The heats of combustion of some hydronaphthalene derivatives.—Ed. **Chauvenet**: The combinations of thorium chloride with ammonia.—Georges **Charpy**: Behaviour of steel analogous to the "tin disease." A study of the conditions leading to an increase of the velocity of crystallisation in steel on annealing.—J. B. **Senderens**: Catalytic reactions in the wet way based on the use of aluminium sulphate. In the preparation of ethylene by the interaction of alcohol and sulphuric acid, the presence of aluminium sulphate lowers the temperature of the reaction and increases the velocity of evolution of the gas. The same salt also possesses a favourable catalytic effect in the preparation of ether.—Daniel **Berthelot** and Henry **Gaudechon**: The mechanism of photochemical reactions and the formation of plant principles: the decomposition of sugar solutions. The mechanism of the reactions caused by exposure to ultra-violet rays is analogous to that in living plants. Exposed to these rays, solutions of glucose give carbon monoxide, dioxide, methane, and hydrogen. Levulose, maltose, and saccharose behave similarly, but the proportions of the gases are different in each case.—André **Piedallu**: A new mould in oil tanning.—Henri **Labbé**: Contribution to the study of nitrogenous exchanges.—Gabriel **Bertrand** and A. **Compton**: The individuality of cellase and emulsin. Comparative experiments on the hydrolysis of cellose by cellase and of amygdalin by emulsin show that these two diastases are quite distinct.—N. A. **Barbieri**: The non-existence of free or combined lecithins in yolk of egg.—Etienne **Sergent** and Edmond **Sergent**: Immunity against malaria in birds. Conservation *in vitro* of the sporozoïtes of *Plasmodium relictum*. Relative immunity obtained by inoculation with these sporozoïtes.—B. **Brunhes**: Telluric currents.

NEW SOUTH WALES.

Linnean Society, June 29.—Mr. C. Hedley, president, in the chair.—R. J. **Tillyard**: Monograph of the genus Synthemis (Neuroptera: Odonata). The most important points discussed are:—(1) The position of the genus in the subfamily Corduliinæ. The view is put forward that it should be separated from the Macromina, so as to constitute a subgroup Synthemina. (2) Subdivision of the genus itself.—T. G. **Sloane**: Studies in Australian entomology. No. 16. New species of Carabidæ. A new genus, Stichonotus, referable to the subfamily Carabinæ, and eighteen species belonging to the subfamily Harpalinæ, are described as new, including a species of the Asiatic genus Holcoderus, now first recorded from Australia.—W. W. **Froggatt**: The entomological fauna of Narru Island, of the Ocean Island group.—A. H. **Hamilton**: Description of a new species of Lepidosperma (Cyperaceæ) from the Port Jackson district, with some miscellaneous botanical notes.

CONTENTS.

	PAGE
Recent Earthquake Investigations. By Prof. John Milne, F.R.S.	165
Tar, Acid, and Alkali	166
Sounding Round the Antarctic Continent. By J. W. J.	167
Readable Books in Natural Knowledge. By T. P. N.	168
Salmon and Trout. By L. W. B.	168
Non-Euclidean Geometry. By G. B. M.	169
Forest Flora of the Bombay Presidency	170
Applied Chemistry. By W. A. D.	170
Our Book Shelf	171
Letters to the Editor:—	
Pwdre Ser.—Prof. T. McKenny Hughes, F.R.S.	171
The Blood-sucking Conorhinus.—J. D. H.	172
The Early History of Non-Euclidean Geometry.—D. M. Y. Sommerville	172
The Total Solar Eclipse of April 28, 1911.—Dr. Pio Emanuelli	172
Mars in 1909 as seen at the Lowell Observatory. (*Illustrated.*)—Prof. Percival Lowell	172
Treatment of Storage Cells. — Dr. Bertram B. Boltwood	174
The Sheffield Meeting of the British Association.—S. R. Milner	174
Yellow Jack and the West Indies. (*Illustrated.*)	174
The Vertebrate Fauna of Cheshire. (*Illustrated.*)	175
Across Yunnan. (*Illustrated.*) **By J. T.**	177
Does the Indian Climate Change? By Dr. William J. S. Lockyer	178
Notes	179
Our Astronomical Column:—	
Photographs of Nebulæ	183
Halley's Comet	183
The Accurate Measurement of Photographs	184
Observations of Perseids in 1909	184
Results from the Micrometric Observations of Eros, 1900	184
Wild Plants on Waste Land in London	184
Agricultural Investigations in Egypt	184
Science in Bengal	185
Australian and Argentine Biology	186
Rainfall of Rhodesia and Australia	187
The Chemical Significance of Crystal Structure. (*Illustrated.*) **By Prof. William J. Pope, F.R.S.**	187
Results of some Recent Investigations on Magnetic Disturbances. By Dr. L. A. Bauer	192
University and Educational Intelligence	194
Societies and Academies	195

THURSDAY, AUGUST 18, 1910.

INTERNAL-COMBUSTION ENGINES.

The Design and Construction of Internal Combustion Engines. A Handbook for Designers and Builders of Gas and Oil Engines. By Hugo Güldner. Translated from the second revised edition, with additions on American engines, by Prof. H. Diederichs. Pp. xix+672. (London: Constable and Co., Ltd., 1910.) Price 42*s.* net.

THIS work is the most complete and elaborate treatise on the gas-engine which has ever been published, as will be realised when it is stated that there are 664 pages of comparatively small-type letterpress, 728 figures, and 36 folding plates. There is a certain amount of the usual padding, namely, photographic reproductions of large and small gas-engines of various makes, as well as records of tests, but there is also a large amount of original work and practical information which, owing to the position of the author, viz., chief engineer and director of the Güldner Motoren Gesellschaft, must be regarded as of great value. In the preface to the first edition, the author states:—

"Germany's gas-engine industry justly enjoys an international reputation . . . everything that has served to lay the foundation of the industry and that has helped to make it vital and important is either the product of German thought, or was first practically realised on German soil."

It is not surprising, therefore, that the work reflects German practice.

The book is translated into English by Prof. H. Diederichs, of Cornell University, and he has entirely omitted the first part of the German edition, which treats of the history of the gas-engine, and has substituted therefor descriptions of, and information relating to, American gas-engines. The author says that his principal object in writing this book was to make it "serve as an every-day working guide to the designer and constructor," and to follow out this object he has adopted the somewhat unusual feature of giving dimensioned drawings, not only of complete engines or producers, but of various parts. These drawings will undoubtedly be found to be of the greatest use to many designers and also to purchasers of engines who may wish to verify whether a proposed engine is correctly designed or not.

The work is divided into four parts and an appendix. The first part deals with the various methods of operating gas-engines and the gas-engine cycles; the second part with the design and construction of internal-combustion engines; the third with the erection and tests of modern internal-combustion engines; the fourth with gas-engine fuels and combustion in gas-engines; and the appendix with various theoretical matters relating to thermodynamics and thermochemistry, as well as with certain details derived from practice.

In dealing with the constant-volume cycle, the author investigates the question of the maximum compression that should be practically adopted, taking into consideration the theoretical thermal efficiency based on comparatively recent data of the variation of specific heat with temperature, as well as the efficiency ratio and mechanical efficiency, and finds that the economic limit of maximum compression lies between 210lb. and 280lb. per square inch, a conclusion which, although these pressures are somewhat higher, is substantially in agreement with the experimental work of Prof. Burstall.

A critical comparison of the four-cycle and two-cycle engines is made, and the author comes to the conclusion that the four-cycle engine can only be considered "as a makeshift until an efficient and trustworthy two-cycle machine appears on the market"; he also discusses the question of compounding, and states that "it will remain without promise in gas-engine construction." The design of the various parts of gas-engines is gone into in the very fullest manner, and numerical examples are worked out in great detail; some interesting photographs are given showing the effect of weak frame construction and of imperfectly designed crank-shafts. A great deal of information respecting the type of material to use for the various parts of gas-engines is given, and in the matter of connecting-rods, while stating that soft steel is usually employed, the author says that the use of cast-steel is on the increase. The design of inlet and exhaust valves is given in great detail, and the various methods of water-cooling are described. Amongst the latter is an interesting arrangement designed by Pawlikowsky, in which the water-pipe is stationary and the water is led through the valve spindle, which is large enough to be bored out to admit the inlet pipe with a space around it through which the hot water can find its way back. The design of fly-wheels is discussed at considerable length, and numerous tangential effort diagrams for various types and designs of gas-engines are given, and the results of various calculations are embodied in a series of curves by which the required weight of rim of a fly-wheel can be ascertained under various conditions occurring in practice.

In respect of gas-producers, the author appears to favour the suction-producer in preference to pressure-producers, and says that the former have almost entirely displaced the older form. This statement is made without any reference to the size of the engine to be supplied with gas, and cannot, therefore, be regarded as conforming with present practice, in which the large gas-engines are supplied with gas from pressure-producers. Numerous designs of suction-producers are described, none of them larger than 600 b.h.p., and there is only a passing reference to pressure-producers.

At the beginning of part iii., much detailed information is given in respect of the capital cost and cost of erection and running of gas-engine installations, and all this information is collected together in a tabular form, giving all the various heads of expenditure for engines varying from 5 b.h.p. to 200 b.h.p., both when using illuminating gas and suction gas. It is interesting to note that the total operating costs for 5 b.h.p. are the same for both kinds of gas, but after that the suction gas is much the cheaper. At 200 b.h.p. the suction gas is nearly one-third the cheaper.

There are some very interesting folding plates showing the pipe-work necessary for various designs of gas-engines; the various kinds of pipes—gas, water, and exhaust—are shown in different colours, and thus the matter is made very clear.

Nearly ninety pages of the book are devoted to descriptions of American gas-engines, made by Westinghouse, Allis Chalmers, the Snow Engine, and many others. Many of the drawings are dimensioned, and the results of numerous tests are given.

In part iv. various fuels available for producing gas are described, and there is an extensive table on American coals, giving for each full analysis and the calorific value per pound; there is also information with reference to blast-furnace gases and coke-oven gas, also with regard to various oils, alcohol, &c. There is an important table giving the explosive range of various gases. The remainder of the book consists of the theory of the gas-engine and producers, and in the appendix the fullest particulars are given of the methods of testing gas-engines prescribed by the American Society of Mechanical Engineers and by the German Society of Engineers. This information is of great importance, especially as at the present moment there is nothing of the kind issued by any society of British engineers in connection with gas- or internal-combustion engines.

STRUCTURE AND DISTRIBUTION OF ORE DEPOSITS.

Lehre von den Erzlagerstätten. By Dr. R. Beck. Dritte Auflage. Band i., pp. xii+540+1 map; Band ii., pp. x+542. (Berlin: Gebrüder Borntraeger, 1909.) Price, two vols., 32 marks.

PROF. BECK'S "Lehre von den Erzlagerstätten" is one of those works which disarm criticism. The predominant feeling in the mind of the geologist when using it must be of gratitude to its author for this comprehensive and up-to-date account of the structure and distribution of ore deposits. The previous edition was published in 1903, and an American version, translated and edited by Weed, was issued in 1905. The new edition has been so much enlarged that it now appears as two volumes, each almost equal in size to the original.

The book follows the same general lines as the previous editions, but there are many important changes which indicate the trend of current opinion as to ore classification. Prof. Beck divides ores into two primary divisions, the epigenetic and syngenetic, those formed respectively later and simultaneous with the rocks in which they occur. These divisions are, however, practically abandoned in the work. The author divides ores into eight groups, in which the first, seventh, and eighth in order of treatment are mostly syngenetic; the intermediate groups are epigenetic, but include some ores which are admittedly syngenetic. The term syngenetic, though it appears in the introduction, is not much used, but epigenetic recurs frequently. That term is not altogether satisfactory, as most of the epigenetic ores are subterranean, and some of them are very deep seated in origin. Hence epigenetic ores are not epigene, but hypogene, to use two old and well-established geological terms.

The ores first treated are those attributed to direct segregation in molten rocks. They are the truly igneous ores. Prof. Beck recognises fourteen types, of which all but four were included in the previous edition. The only new type of oxide ores amongst these is that of magnetite in granite, described by Vogt, from the Lofoten Islands. Prof. Beck, however, in a note added to the proofs, remarks that Sjögren's recent paper confirms his own opinion that these granitic ores are due to contact metamorphism, and not segregation. The whole chapter on magmatic segregation shows that less importance is attached now than formerly to this process of ore formation. The author includes the nickel ores of Sudbury in this chapter, but recognises that they are mainly due to secondary processes. He also quotes Loewinsen Lessing's interesting work on the famous iron ores of the Urals, which are thus shown to be contact deposits and not segregations, as has been usually maintained; and as Prof. Beck points out, the great Lapland ores, which have also been claimed as igneous segregations, must be regarded as of the same origin as those of the Urals.

The group of ores which came second in the previous edition, included those deposited by direct sedimentation and precipitation. These aqueous ores were placed next after the igneous, because both groups are syngenetic. Description of the sedimentary ores is now postponed till near the end of the book, and the ores due to contact metamorphism take their place. This significant change is a great improvement, as many of the ores now assigned to igneous segregation will probably be found to be contact deposits. The bulk of the work is occupied with a description of the epigenetic ores, which include ordinary mineral veins and certain ores in stratified rocks, due to the same process as ore veins. The author includes here the banket of the Transvaal. He gives an excellent judicial summary of the arguments in favour of the rival theories as to the origin of that ore without here expressing any very definite preference. He obviously still favours the infiltration theory which he has elsewhere supported. In reply to the suggestion that much of the pyrites in the banket is altered "black sand," he asks what has become of the ilmenite that is usually associated with magnetite in such deposits. There is, however, plenty of titanic oxide in the banket which has probably been derived from decomposed ilmenite. Little stress is laid on the old arguments in support of the infiltration theory, and according to Prof. Beck the weightiest argument in its favour is the dependence of the gold contents of the banket on its dip. This may be questioned as a matter of fact, and it is at any rate an indefinite and unconvincing argument. The author includes the West African banket as also epigenetic, though he accepts its gold as alluvial in origin. It is not surprising to find this ore described immediately after that of the Rand, for those who know both deposits regard them as of the same origin, though the iron ores of the West African banket still mainly occur as magnetite. It seems difficult to regard the West African banket as a modified placer, and the South African as an ore due to infiltration.

The feature in Prof. Beck's arrangement of ores which seems most improbable is his reference of so many metalliferous sandstones and conglomerates to the epigenetic group. He includes there, for example, the Katanga quartzite, which contains small nuggets of gold and platinum. In fact, the only pre-Cainozoic alluvial gold deposits which are included in the chapter on detrital ores are those of the Cambrian of the Black Hills of Dakota, a few occurrences of no economic value in the Carboniferous rocks of Australia, Nova Scotia, and France, and in the Mesozoic of California, New Zealand, and Saxony. Alluvial gold must have been deposited in pre-Cainozoic times, but whenever ancient gravels are of much economic value their gold is attributed to infiltration. While in some cases Prof. Beck may be disposed to underrate the extent of ancient alluvial ores, he includes the tin deposits of Mt. Bischoff in Tasmania as alluvial, having apparently overlooked a short note upon that mine, explaining its tin-bearing sands as decomposed gossan in which a pseudo-stratification has been produced by the settling of the decaying rock.

Prof. Beck's work shows remarkably thorough acquaintance with recent literature on economic geology, and his statement of rival hypotheses is always given with scrupulous fairness. This greatly enlarged edition will become even more indispensable as a work of reference than its predecessors, and is worthy of the high traditions of the Freiburg Mining School.

J. W. G.

THE SUGAR-CANE AND ITS PRODUCTS.

The Manufacture of Cane Sugar. By Llewellyn Jones and F. I. Scard. Pp. xix + 454. (London: Edward Stanford, 1909.) Price 12s. 6d. net.

A NOTEWORTHY feature in tropical agriculture is the new lease of life taken recently by the cane-sugar industry. A few years ago it appeared not improbable, to say the least, that the sugar-cane was doomed to be forced into a position permanently inferior to that of the beet as a source of the world's supply of sugar. Originally possessed of a practical monopoly, the cane had lost so much ground that in the opening years of this century the beet supplied about two-thirds of the sugar which came into the world's markets. It is true that a great deal of cane-sugar is consumed in countries where it is produced and escapes record; so far as the world's commerce was concerned beet was the chief contributor. Within, however, the last five years, the output of cane-sugar has markedly increased, whilst that of beet has slightly diminished, and a little more than one-half of the sugar of commerce is now derived from the sugar-cane.

This period of activity in the industry has been marked by the issue of various books. One of the most useful is that now under review. The authors have wide practical experience of sugar-making, as engineer and chemist respectively; with the aid of numerous illustrations they present the results of their experience in an exceedingly simple manner.

A marked feature of the book is the explanation of practical matters in clear, non-technical language, and a reader with no special engineering knowledge and no experience of sugar-making should easily understand and be able to follow the whole chain of processes by which the ripe sugar-cane is converted into sugar and the various by-products.

No pretence is made to deal with cultivation. There is in chapter i. an illustrated account of the structure of the cane (the references on pp. 3 and 4 to the figures are not accurate), and notes on the chief varieties, diseases, chemical composition, &c.; but the subject-matter proper of the book opens with crushing, in the next chapter. Whilst the novice will read this easily, the mature planter will find much worthy of consideration, as, for example, in the excellent presentment of the *pros* and *cons* of improved methods of extraction. In dealing with the boiling or concentration, the evolution of the modern vacuum pan, capable of yielding 40 tons of sugar at a single operation, is traced from the simple open pan still in use in many parts of the world. Equally here, whether dealing with the simplest or the most complicated processes, the authors have contrived to preserve a conspicuously clear and direct style.

The volume is one which should be of great value to non-technical readers who wish to obtain information regarding one of the best-organised and most scientific of the great industries of the tropics. The practical sugar-maker will appreciate the exposition of the theory underlying various processes, the clear description of methods, and also doubtless derive assistance from the useful practical hints with which the book abounds.

W. G. F.

THE PSYCHOLOGY OF THE WILL.

Ueber den Willensakt und das Temperament: eine experimentelle Untersuchung. By Prof. Narziss Ach. Pp. xii + 324. (Leipzig: Quelle and Meyer, 1910.) Price 6.50 marks.

TO the layman an act of volition is one of those obvious things, such as gravity or growth, which present no difficulty and suggest no problem. Their mechanism is so smooth in its working that the mind never dreams of the presence of a mystery. Add to which the fact that it is impossible to go through the process of willing and at the same time to contemplate and observe the process. Yet at least one difficulty has been noted by the crudest philosophy for ages past—the power of choice, the so-called freedom of the will. This, however, as Prof. Ach observes, is a function not of the will but of reason. He also well insists that the judgment "I can do that which I will," has two distinct meanings, which have often been confused. The one meaning is positive, "I have the capacity to carry out what I will"; "can" being equivalent to *posse, pouvoir, vermögen.* The other is negative, "It is my wish to do what I will." Psychologists are only too well aware that "In no department of the science of mind does there prevail greater confusion and uncertainty than in that of Volition."

In the present volume Prof. Ach continues the records and results of his prolonged investigation into will-psychology; the former instalment being his 1905 treatise, "Über die Willenstätigkeit und das Denken." An account is given of the experimental method employed, which is largely a combination of those of Ebbinghaus and G. E. Müller. He employed eighteen subjects who were practised on reproduction of syllables, rhymes, and the like components of methods well known in laboratories.

As his main result, the author claims to have shown that the act of will is a specific psychic experience. The positive phenomenal characteristics of a primary volition are (1) the perceptive moment—sensations of tension; (2) the objective moment—ideas of reference and end, purpose, and means; (3) the actual moment—the acoustic—kinesthetic, "I will actually"; (4) conditional moment—consciousness of effort. Of these the chief is (3), and he explains why it has hitherto been so often ignored. None of these moments, of course, is independent; they are sides of one fact. Great spectacular results are not expected from the minute laboriousness of experiments like these; but they are latent, and, as Weber's Law, for instance, has done, will emerge in due time. Yet light is thrown on a score of "little problems." Not the least interesting, and the most detailed, discussion is that on weakness of will. A close study of this chapter in connection with the tabulated results of the investigation which occupy the first half of the volume would be a fruitful piece of book-work for the learner. Prof. Ach rightly censures the use of such examples, as the famous "How we get up in the morning" of Prof. James, for illustrating the mechanism of volition. Trained or habituated will is precisely that form of the process which is least original. Here, by the way, in the relation between habit and will—a relation of practical, no less than theoretical, importance—is a fruitful field for investigation. Another fruitful area is the connection between will and temperament. Prof. Ach ends his volume with a few suggestive pages on this subject.

The material supplied by the author's investigation is probably rich enough to yield further results if re-studied. So far, the author has been led towards a reaction against the prevailing view of will-processes. Without doubt this and similar work is clearing the ground for a new psychology, both of feeling and of will.

A BOOK OF CHARACTERISTIC FOSSILS.

Leitfossilien: ein Hilfsbuch zum Bestimmen von Versteinerungen bei geologischen Arbeiten in der Sammlung und im Felde. Lief. I.: Kambrium und Silur. By Prof. Georg Gürich. Pp. 95. (Berlin: Gebrüder Borntraeger, 1908.)

PROF. GEORG GÜRICH has prepared a well-illustrated handbook of characteristic fossils which is now in course of publication in eight parts. It is intended for elementary students and amateurs who are occupied with geological work and desire an exact knowledge of those fossils which are of special value in determining the relative ages of rock-formations. It is not a treatise on common fossils, and those who seek in it an account of so familiar a brachiopod as *Atrypa reticularis*, for example, will be disappointed; but it deals with those species and genera which, whether common or not, happen to be restricted in their geological range, and are thus of service as unerring time-markers. The fossils of each successive period are taken in order, beginning with the earliest; and the twenty-eight plates included in the first part of the book are devoted to those of the Cambrian and Silurian formations. The figures are not original, but judiciously selected from standard works, and all are beautifully reproduced by a half-tone process. The accompanying text consists chiefly of brief definitions of the various groups, families, genera, and species, in systematic order under each geological formation. There are also useful synoptical tables, both of the formations themselves in different parts of the world and of the fossil species which are characteristic of each special stage. Occasional text-figures are added to explain structural features and the more important anatomical terms employed. In the first part, the figures illustrating the structure of trilobites and graptolites are especially good.

Dr. Gürich does not recognise an Ordovician system, but classifies the formations from the Tremadoc to the Caradoc inclusive as Lower Silurian. His work is also unusual among stratigraphical handbooks in paying special attention to fossil plants and vertebrates when they can reasonably be claimed as of value. His first reference to vertebrates, however, in the Upper Silurian is unfortunate, for it takes no account of Dr. Traquair's important discoveries, and repeats an old error in supposing that the shagreen named Thelodus belongs to the same fish as the fin-spines named Onchus. In view of present rapid progress and specialisation this oversight is not surprising, and Dr. Gürich is to be congratulated on having made an excellent beginning of a useful and trustworthy student's manual.

METALLOGRAPHY.

Metallographie: Ein ausführliches Lehr- und Handbuch der Konstitution, und der physikalischen, chemischen und technischen Eigenschaften der Metalle und metallischen Legierungen. Erster Band, Die Konstitution, Hefts. i. and ii. By Dr. W. Guertler. (Berlin: Gebrüder Borntraeger, 1909.)

THE number of investigations in metallography published up to 1902 amounted to about one thousand, but to-day reaches three times that number. This fact alone makes the appearance of a complete text-book on the subject most welcome.

The work is appearing in parts, the first two of which consist each of eighty imperial octavo pages, and it is expected that seven or eight more similar instalments will complete the first volume, which is devoted to the constitution of metallic alloys. A second volume, dealing with the physical and chemical properties of the alloys and with their technical applications is to follow.

The subject is to be treated from the technical as well as from the theoretical standpoint, and is to be made intelligible to a beginner without forfeiting its character of a complete text-book and work of reference.

Part i., after a short history of the development of metallography, deals with the "nature" of metallic alloys, the application of the phase-rule to the consideration of the various types of freezing of binary alloys, and also with solid solutions and chemical compounds of two metals. The remaining fourteen pages of the first part and half of part ii. deal with the "Zustandsdiagramme" of all the possible binary alloys of the metals manganese, iron, cobalt, nickel, copper, silver, gold, palladium, and the metals of the platinum-group. The second half of part ii. is devoted to internal kinetics, embracing such subjects as crystal growth and transformation, diffusion in metals, &c.

Whether all the objects aimed at will be achieved by the author cannot be predicted from a perusal of the first two instalments, but it may be safely asserted that a very promising beginning has been made on what can truly be described as a colossal task. The subjects already discussed are treated clearly and in a masterly style, and the arrangement (which is a matter of great importance in metallography) is excellent. The work will constitute the only complete text-book on the subject, and will undoubtedly rank as a classic.

EXERCISES IN PHYSICAL GEOGRAPHY.

(1) *Manual of Physical Geography.* By Dr. F. V. Emerson. Pp. xvii+291. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 6s. net.

(2) *A Laboratory Manual of Physical Geography.* By Prof. R. S. Tarr and O. D. von Engeln. Pp. xvii+362. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 6s.

(1) THE purpose of the first of these books would have been made clearer if it had been entitled "Manual of Exercises in Physical Geography," for the 273 pages of which the body of the book is composed are almost entirely made up of questions and directions to students. The manual is divided into eighteen chapters, the first on the earth as a planet, the next four on climate and others on common minerals and rocks, on the contour map, on weathering streams and stream valleys (a long chapter, in which prominence is given to the cycle of erosion and all that that involves), on land forms (three chapters), on glaciation, lakes, the ocean, shore lines and forms, harbours, and soils, the final chapter being devoted to studies of typical areas.

Now there can be no doubt that teachers of the subject could hardly fail to get many a useful hint from an examination of this volume, but, on the other hand, it is scarcely conceivable that any teacher, at least in this country, would ever try to make use of it as it stands. For this there are several reasons. In the first place, the manual is not self-explanatory. Among the questions of which the bulk of the book is made up, some are childishly simple (though, it may be admitted, not without justification in the author's way of presenting his subject), others assume that the teacher is well versed in his subject, and has either already given the necessary explanations to his students or is prepared to do so when the student is required to answer them. Some of the questions are, unfortunately, confusing and misleading. Moreover, the teacher who is sufficiently well versed in his subject to be able to use the book will be too independent to submit his mind slavishly to the lead of another in presenting the subject to his class. The author says that the exercises have for the most part grown out of his class-room experiences, and it may fit in very well with the rest of the author's teaching of the subject, but it is not likely to fit in with the method of anyone else. Finally, the exercises set in this volume must involve the consumption of a great deal of time, and the doubt cannot but suggest itself whether the result in trained intelligence will be at all proportionate to the amount of time and labour expended.

(2) The work by Prof. Tarr and Mr. von Engeln is similar in design to that of Dr. Emerson, and its distinguishing features may be best given by the following extracts from the preface:—

"The feature which will first attract attention is the leaving of space after each question for the student to write the answer. This serves a double purpose. It ensures the student's following the argument of the outline and the appreciation of every point by personal observation and deduction . . .

"Another feature which we feel sure will meet with general approval is the insertion of all maps, figures, diagrams, and tables at the exact place where they are needed." (These maps, &c., it should be stated, are all likely to be very useful.)

The authors claim, moreover, as the most marked pedagogical departure in their manual, their orderly method of presenting the physiography of the lands. We may note further a feature which is likely to attract attention even before that just mentioned. The loose-leaf construction of the manual makes it a very simple matter for the teacher to change the order or introduce other work. The pages are all perforated to allow of their being detached, and pierced with two large holes to allow of their being refixed in another arrangement, this being done because

"the authors feel that teachers who are progressive, capable, and enthusiastic over the subject should be given the greatest latitude in carrying out their own ideas."

Finally, with reference to the present reviewer's remark at the end of his notice of Dr. Emerson's work, it is only fair to say that the methods of this manual,

"are not to be regarded as experiments. The senior author has had over fifteen years' experience and the junior author four in the laboratory teaching of physical geography."

They tell us, too, that the results in their own classes have been very gratifying, and that the students pursue the work with keen interest. The reviewer, therefore, would have his "doubt" taken as no more than a doubt, and he is sure that such systematic efforts towards the improvement of teaching are entitled to sympathetic consideration. G. G. C.

OUR BOOK SHELF.

The House-fly, Musca domestica, Linnaeus: a Study of its Structure, Development, Bionomics, and Economy. By Dr. C. Gordon Hewitt. Pp. xiv+196+10 plates. (Manchester: University Press, 1910.) Price 20s. net.

IN this volume the student will find, in a convenient form, the three valuable papers on the common house-fly which Dr. Hewitt contributed to the Quarterly *Journal of Microscopical Science* in 1907, 1908, and 1909. In the first the author deals with the anatomy of the fly, in the second with the habits, development, and anatomy of the larva, and in the third with the bionomics, allies, and parasites of the insect, and its relations with human disease. The volume opens with a brief introduction, and concludes with three short appendices, comprising some facts ascertained since the issue of the original papers.

The first part is noteworthy for a full and original description of the tracheal system of the fly. In his account of the proboscis, Dr. Hewitt agrees with most recent students of the jaws of Diptera in regarding the palps as maxillary and the sucking organ as labial; in this, as in some other interpretations, he differs from the opinions expressed in Lowne's well-known work on the blow-fly. In the second part, especial attention has been paid to the muscular system of the larva, which is described and figured in detail. The rate of development is very rapid, and there are only three larval instars. While horse-dung is the most usual food of the house-fly maggot, the female fly may lay her eggs in a wide variety of unclean and decaying animal and vegetable substances, in any of which the larvæ can be successfully reared. Hence it follows that house-flies must frequently carry disease germs which they have abundant opportunity of introducing into human food, and the name "typhoid fly," which some American entomologists are trying to affix to *Musca domestica*, might be justified from certain unpleasant but instructive records which Dr. Hewitt quotes of the proximity of typhoid-infected privies to dairies.

The hygienic bearing of the insect's relations with mankind is seriously and temperately discussed by the author, who pleads for such protection or destruction of substances in which the eggs are laid as may effectually reduce the numbers of the species, and for the covering of food substances, like milk and sugar, on which the flies habitually alight. The book affords an excellent illustration of the amount of original and useful work that may be done on the commonest and best known of animals. G. H. C.

The Science of Happiness. By Dr. H. S. Williams. Pp. vi+350. (London and New York: Harper and Brothers, n.d.) Price 7s. 6d. net.

THIS might well be given the still wider title of "The Art of Living," for it concerns itself with human activity of all kinds. It is a pleasantly written series of papers on such topics as how to eat, how to sleep, how to think, and even how to die, and, though a trifle diffuse and flat revealing the fluent writer with not much that is original to say—it contains much wisdom of an everyday kind, and many apt quotations to spice up the text.

Dr. Williams is not a food faddist, and almost his only criticism on this head is that most of us eat too much. But he would not cut down the number of meals to anything below three per day, for he believes that, on the whole, experience endorses that number. He condemns alcohol, tobacco, and—less vehemently—tea and coffee. Exercise ought to be gentle and regular, and we may sleep eight hours per night if we want to, but must not doze off for another forty winks after a good night's rest. An interesting point is that Dr. Williams believes the stunted growth of the Latin races to be the result of the habit of wine-drinking.

As to the mind, the author counsels the strenuous life, as befits a good American, and stimulative examples are quoted. Mezzofanti learned fifty-seven languages. Pliny (the elder) never left off studying except when asleep or in his bath, and after the latter he had a book read to him while he was being rubbed dry. As to opinions, religious or political, think them out for yourself. Ask yourself why you believe this or that. Do not be content to inherit opinion as you inherit the colour of hair or eyes. Work your way to rational conviction.

It is all very chatty, pleasant and sensible; and we do not mean any cheap satire when we say that the book is beautifully bound and produced.

Rinaldo's Polygeneric Theory: a Treatise on the Beginning and End of Life. By Joel Rinaldo. Pp. 123. (New York: 206 West 41st Street.)

To Mr. Rinaldo, "evolution" is like the red rag to the proverbial bull; and, like most violently biased people, he has not given sufficient study to the object of his attack. For example, in arguing for the special creation of man, he says it is "ridiculous" to explain by migration the similarities found in widely separated countries. But evidently he does not realise the length of duration in past time of a being justifiably called man, for, even if we assume that duration to go back no further than the Miocene period, there is ample scope for almost unlimited migration (*e.g.* there was land at this period probably across the North Atlantic); and, indeed, human migration is not essential to the theory; migration of lower animal forms, in still more remote periods, would do nearly as well. Mr. Rinaldo seems to think that evolution implies an Adam and Eve from whom all mankind are descended. As a matter of fact, the theory of biological evolution would not be invalidated if it were proved that man appeared on various parts of the earth's surface at the same time, for these primitive human beings would be descended from other and less complex forms of life—animals of anthropoid but not yet human structure.

Mr. Rinaldo, though an amateur, is well read in some directions, but he has not studied Darwin and Huxley thoroughly, not to mention more recent biologists, and his judgment is warped, like Carlyle's, by mistaken notions of the "monkey damnification of man." The wish being father to the thought, he asserts that "Darwinism is already dead." If he will read a book reviewed in NATURE, July 14, he will see that one of our greatest authorities—Sir E. Ray Lankester—thinks it is still very much alive. But we hardly expect that he will be converted.

Letters from High Latitudes, being Some Account of a Voyage in 1856 in the Schooner-Yacht "Foam" to Iceland, Jan Mayen, and Spitzbergen. By Lord Dufferin. With an introduction by Dr. R. W. Macan. Pp. xxxvi+261. (London: Henry Frowde, Oxford University Press, 1910.) Price 1s. net.

THESE entertaining letters were first published in 1856, and are so well known that any words of praise are unnecessary. The master of University College, Oxford, in his introduction, says:—"The letters are, or ought to be, a *World's Classic*; Mr. Frowde's happy enterprise has made that concept a reality." It may be noted that the volume is the hundred and fifty-eighth to be added to the series of "The World's Classics."

LETTERS TO THE EDITOR.

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

Wiltshireite: a New Mineral.

THE dolomite quarry near Binn (Valais) affords such a large variety of grey sulpharsenites, mainly of lead and copper, that a new one is received with much hesitation; but a crystal recently obtained at Binn gives results which leave little doubt as to its independent character. The specimen consists of a number of very small crystals aggregated together in parallel orientations, and a single well-defined image is obtained from several minute end-facets.

The crystal belongs to the oblique system. The zone of pinakoids consists of smooth faces, 201, 302, 101, 001, and $\bar{1}01$, which give good images. Two other important zones are placed symmetrically on opposite sides of the symmetry-plane; they show the forms 522, 211, 111, 122, 011, $\bar{1}11$, and others. The faces, placed vertically, are striated parallel to their zone-axis, and give very imperfect images, save when they are obtained across the zone; the forms are 100, 310, 320, 010, and some others. The elements adopted are:—$100:001=79° 16'$; $100:101=48° 47\frac{1}{3}'$; and $011:001=46° 25\frac{3}{4}'$.

I propose for it the name wiltshireite, after the late Prof. Wiltshire, who was a most generous benefactor to the Cambridge museums of mineralogy and of geology.

Cambridge, August 13. W. J. LEWIS.

The Nomenclature of Radioactivity.

A FEW years ago I wrote to NATURE (vol. lxxvi., p. 638) protesting against the proposal of Prof. Boltwood to call the member of the uranium-radium series, which he had just discovered, by the fanciful name of "ionium" instead of by a name based upon the system of nomenclature started by Sir William Crookes and extended by Prof. Rutherford. Prof. Rutherford replied (p. 661) that the time had not yet come for the establishment of a definite system of nomenclature, but that he hoped that some day "physicists and chemists would meet together to revise the whole system." After such a decision from the first authority on the subject I could do nothing but collapse; but there are three reasons why the present moment seems to me suitable for a renewal of vitality.

First, Prof. Rutherford said that he thought it undesirable (I did not agree with him) to fix a method of naming until nearly all the products to be named appeared to have been discovered. I believe it is about two years since the last new member was added to any of the series previously known. Second, there is at hand an admirable opportunity for the meeting together of physicists and chemists which he suggests—the congress at Brussels next month. Third, it appears to me that reform has been made urgent by a particularly disastrous attempt at unsystematic nomenclature. In a recent number of the *Comptes rendus* Sir William Ramsay, after determining more certainly the molecular weight of radium emanation by a beautiful experiment, and finding the result to confirm his suspicion that this substance belongs to the group of inactive gases, proposes that it should henceforward be called "niton." (By a curious oversight, he suggests that the symbol should be "Ni," which is, of course, already appropriated.)

The purpose of a systematic nomenclature is to express relations between the objects named. So long as elements were regarded as wholly independent objects, the practice of naming them, as if they were dogs, on purely sentimental grounds was more or less justifiable, for there were no relations between them to express. As soon as the first general relation between the elements, the periodic "law," was discovered, a systematic nomenclature was desirable, and some feeble steps towards it were taken. With the discovery of the radio-active elements, the whole importance of which lies in their relations to each other, a complete system becomes a necessity.

Let me take an analogy. If Sir William Ramsay takes a house in the country, where buildings are scattered at random, nobody will care what he calls it. But if he takes a house in the street of a city and proposes to replace the number on the door by "Bellevue," or "Glencoe," or "Chatsworth," or any other of the names dear to lodging-house proprietors, he will meet with scant sympathy from the postal and municipal authorities. His case will not be much better if, like Prof. Boltwood, he builds a house where there was none before, instead of merely improving one that existed already.

The only defence Sir William Ramsay can offer for his proposal is that it is in accordance with chemical, if not with radio-active, nomenclature. If this were true, the question would arise whether the chemical or the radio-active properties of the element were more important; I cannot conceive that anyone would doubt the superior interest of the latter. But it is not true. The name which he proposes, interpreted according to chemical usage, suggests (1) that the substance is non-metallic, and (2) that it is not an inactive gas. It suggests (1) because it ends in -on; it suggests (2) because the root is Latin. The only names of elements ending in -on which are not those of inactive gases—carbon, boron, silicon—all have Latin roots; all the names of inactive gases have Greek roots. By the choice of a Latin name, radium emanation is placed in the former and not in the latter group. Surely, also, when in the names of the argon group we have a rare instance of terms, invented recently, which are linguistically correct, it is a crime to spoil the group by the intrusion of one of those philological barbarities the toleration of which does so little credit to the general intelligence of men of science. I do not know whether Sir William Ramsay has been troubled by the fact that the most familiar Greek word for "bright," ἀργός, is clearly inadmissible, but I am sure that any classical scholar could provide a suitable synonym.

I am not going to propose a system of radio-active nomenclature, for, if I succeeded in attracting any attention, people would then confine themselves to abusing my system, and not to considering whether any system is desirable. But I should like to point out the faults of the present method, and direct attention to two possibilities for a new method.

The faults of the old system are (1) that it does not permit of interpolation; (2) that it separates systems which are now known to be connected, such as uranium and radium; (3) that it lays far too much stress on the accidental fact that some of the elements are gases at ordinary temperatures; and (4) that it is anomalous in making X precede A.

The first possibility for a new system is to order the elements by numbers, and not by letters. Such a system admits of indefinite interpolation; between 1 and 2 there can be interpolated, first, the 9 terms 1·1–1·9, then the 90 terms 1·01–1·99, and so on. The second possibility lies in the fact that the rays emitted by the elements are distinguished by single letters, so that the radiation from an element might be expressed by the terminations -o (for no rays), -a (for α rays), -ob (for β and γ rays only), -ab for all kinds of rays. Of course, the form "radiob" would have to be avoided on account of prior rights (NATURE, vol. lxxii., p. 79), and modification would be needed if the additional termination -g were rendered necessary by a discovery that β and γ rays could occur separately.

A scientific system of names need not displace completely such well-known terms as "radium" any more than the appropriate name, according to the excellent system of organic chemistry, has displaced that of (say) "indigo." But I maintain strongly that every radio-active element ought to have a name discoverable from its properties, and a name from which, conversely, its properties may be discovered. Such a plan would not help greatly those who are so accustomed to radio-active work that the association of a fanciful name with definite properties is intuitive, but it would be an inestimable boon to those who now, when they hear of "mesothorium," have to trust an imperfect memory or else search laboriously through original memoirs.

Leeds, August 2. NORMAN R. CAMPBELL.

Perseid Meteoric Shower, 1910.

THE only night really good for witnessing the Perseid shower near its maximum this year was August 10, when the clear state of the sky afforded every facility for securing observations.

I began watching at 9h. p.m., and up to 11h. 45m. p.m. there were fifty-two meteors, so that the horary rate was nearly twenty, of which about three-fourths were Perseids. The finest specimen appeared at 10h. 6m.; it had a long and slowish flight from $328^\circ + 37^\circ$ to $301^\circ + 8^\circ$, and left a bright streak just above the small stars of Delphinus for fifteen seconds. The meteor itself was much more luminous than Venus, and was also observed by Mr. T. K. Jenkins at Nantyglo. From a comparison of the recorded paths, I find the height 75 to 48 miles over Wiltshire, and the end point near Blandford, Dorset.

The velocity was decidedly slower than that of the ordinary Perseid, its observed speed being 27 miles per second.

I saw brilliant Perseids also at 11.34 and 11.46, the former shortening towards α Andromedæ and the latter just under Polaris, and at $11.34\frac{1}{2}$ there was a beautiful slow-moving Draconid falling from $303\frac{1}{2}^\circ + 33^\circ$ to $311^\circ + 19\frac{1}{2}^\circ$. Its pear-shaped nucleus threw off a tail of yellow sparks as it sailed down the sky.

I think the display of August 10 was better than it was last year, and gave promise of a pretty abundant shower on August 11 and 12, but I cannot speak as to its actual character, the firmament being cloudy on those dates at Bristol.

There were a few breaks in the clouds on August 12, and I happened to notice a fine meteor at 11h. 49m. shooting upwards from $355^\circ + 40^\circ$ to $338\frac{1}{2}^\circ + 50^\circ$. It was as bright as Jupiter at least, and left a train, but it quickly disappeared. The meteor was not a Perseid, but apparently belonged to a shower with radiant lying eastwards of α Andromedæ, or at $9^\circ + 27^\circ$. The meteor was also seen by Mr. G. Powell at Aberdare, and I find its height 89 to 53 miles. It was nearly over Bath at end point. Velocity 40 miles per second, and certainly more rapid than the Perseid alluded to above, though it should have been the swifter of the pair.

Several observers have written me describing the Perseid shower as fairly rich on August 10, though the maximum was not due until the morning of, or night following, August 12. Some large meteors were also recorded on August 5, which was a very clear night, and the Perseid display was in pretty strong evidence even at that early date.

W. F. DENNING.

Brilliant Meteor of July 31.

AN exceedingly beautiful meteor, one of the finest I have seen, was observed from this vessel, while at sea, on the night of July 31. The time of observation was 10h. 0m. ship's apparent time, or 13h. 0m. G.M.T., the position of the ship at the time of observation being latitude 43·34° N., longitude 43·37 W. The duration of the flight was between fifteen and twenty seconds, and the meteor was much more brilliant than Venus. It pursued an almost horizontal course, about 8° above the horizon, passing below the constellations Ursa Major, Perseus, and Aries, in all traversing an arc of about 135°.

At first the meteor appeared as a brilliant steel-blue ball, with a short tail of the same colour. It disappeared at a point about 90° from its first position, reappearing almost immediately, and exploding and dividing into three or four parts, with a luminous tail some 3° in length, and of a vivid red and blue colour. Its motion was slow, and it conveyed to all who witnessed it, officers and passengers alike, the impression of being at no great distance from the ship when it exploded.

The night was very fine; and the chief officer, who was on the bridge at the time, reports that when it disappeared it left a small black cloud in the sky. At the time of seeing this meteor we were in wireless communication with the U.S.N. *Texas*, and it is hoped that other observations may be forthcoming from other vessels at sea. A. L. CORTIE.

On Board S.S. *Cymric*, August 3.

ON COLOUR VISION AT THE ENDS OF THE SPECTRUM.

IT is half a century since Maxwell [1] investigated the chromatic relations of the spectral colours and exhibited the results on Newton's diagram. The curve "forms two sides of a triangle with doubtful fragments of the third side. Now, if three colours in Newton's diagram lie in a straight line, the middle one is a compound of the two others. Hence all the colours of the spectrum may be compounded of those which lie at the angles of this triangle. These correspond to the following—scarlet, wave-length (in Fraunhofer's measure), 2328; green, wave-length, 1914; blue, wave-length, 1717. All the other colours of the spectrum may be produced by combinations of these; and since all natural colours are compounded of the colours of the spectrum, they may be compounded of these three primary colours. I [Maxwell] have strong reason to believe that these are the three primary colours corresponding to three modes of sensation in the organ of vision, on which the whole system of colour, as seen by the normal eye, depends."

Later observations, such as those of König and Dieterici,[2] have in the main confirmed Maxwell's conclusions. The green corner is indeed more rounded off than he supposed. It is with regard to the "doubtful fragments of the third side" that I have something to say. According to Maxwell's results with both of his observers the extreme red deviates from the less extreme by a tendency towards blue. Neither my friends [3] nor I can perceive anything of this. When the extreme and the less extreme red are seen in juxtaposition in the colour-box, no difference whatever can be perceived after the brightnesses are adjusted to equality. I have not any precise measurements of wave-length, but the extreme red passed a cobalt glass while the less extreme was stopped. Observations at the ends of the spectrum are more difficult than elsewhere. Owing to deficiency of illumination at these parts there is more danger of false light finding access. To get satisfactory results I found it desirable to supplement the action of the prisms by placing red glass over the slits. It is probable that Maxwell was misled by some defect of this sort, since the differences he found would appear to lie outside the errors of observation. The German observers, it should be added, also found the colour constant at the red end.

At the other extreme the tendency of the violet towards red is, to my vision, not in the least doubtful. Some remarks made a few years ago by Dr. Burch, who speaks of violet in terms which I could not possibly use, were the occasion of a more particular examination. Although, so far as I remembered, I had never made the trial, I was confident that I should be able to match violet approximately with blue *plus* red, and full blue with violet *plus* green. And it seemed further that this must be the general estimation, as there is no widely spread protest against describing the upper extreme of the spectrum as "violet"—a name which would be quite inappropriate in the absence of an approach towards red.

1 Phil. Trans., 1860.
2 Helmholtz, "Phys. Optik," 2nd edition, p. 340.
3 Mr. Gerald Balfour included.

The light which the flower of that name sends to the eye undoubtedly includes red rays.

The apparatus employed is on the model of the first described in an early paper,[1] the only difference worth mentioning being that the side upon which the movable slits are disposed is made oblique, to meet the variation in focal length along the spectrum. By this means any desired mixture of spectrum colours can be exhibited in juxtaposition with any other. For example, the violet can be shown alongside the blue, and any addition can be made to either. A few trials in 1907 confirmed my anticipations, an approximate match being easily attained by addition of *red* to the blue or of *green* to the violet. The slits by which the light entered were protected with suitable coloured glasses, cobalt glass being used for the blue and violet slits. In this way, as already mentioned, the danger of false light is obviated. I do not affirm that the mixture of blue and red looked *exactly* the same as the violet. I thought that I could recognise the violet as being more saturated, but the difference, if real, was very small and certainly a mere fraction of the original difference between blue and violet. Needless to say, the blue chosen was a full blue, showing no approximation to green.

The point of greatest interest lies in the contrast between my observations and those of Mr. Gerald Balfour, who was with me at the time. Mr. G. Balfour is one of the three brothers whom I found in 1881 (*loc. cit.*) to make anomalous matches of mixtures of red and green with spectrum yellow. To effect the match they use much smaller amounts of red than is required by normal eyes. But their colour vision is as acute as usual, and the abnormality is quite distinct from what is called colour-blindness. To Mr. Balfour's vision the violet of the spectrum is *not* redder than the blue, and such addition of red to blue as I required to make the match gave, in his estimation, a "reddish purple." Curiously enough, Mr. Enock, who was my assistant at that time, bore similar testimony, no addition of red on either side improving the match, which was indeed nearly complete as it stood. It is probably not a coincidence that Mr. Enock is also abnormal in his red *plus* green = yellow match, coming perhaps about half-way between myself and the Balfours.

When a few months ago I commenced to write out an account of these observations, it occurred to me that it would sound strange if I described my own judgments as normal and those of two other male observers as abnormal, and I sought to confirm my own judgment by that of others, especially of women. As to this, there was no difficulty. I usually showed first the simple blue and violet with about equal illumination[2] and asked the observer to describe them. In nearly every case the names blue and violet were correctly given. Can you describe one as redder than the other? was the next question. In most cases the answer came, "the violet is the redder"; but in some others all I could get at this stage was a negative. When, however, the same addition of red light that I require was made to the blue, every female observer that I have tried agreed that now the difference had practically disappeared. I can say with confidence that in this matter my own vision is normal.

Lately I have had another opportunity of repeating the observation with Mr. G. Balfour. It is certain that he sees no colour difference at all between the blue and violet. When to the blue an addition of red (less than I require for a match) is made, he describes the mixture as a reddish-purple, strongly distinguished from the violet. Mr. A. J. Balfour also could see no difference between the blue and violet, but he seemed rather less sensitive to additions of red. A determination of wave-lengths gave for the (mean) violet 415 (above G), and for the blue 440. The red was rather extreme.

That ordinary normal vision is very approximately trichromic cannot be doubted; but a question may be raised as to the possible existence of a very subordinate fourth element of colour. Thus Dr. Burch's descriptions might suggest that in his vision the sensation of violet depended upon such a fourth element. I am speaking here of fundamental sensations, not of such judgments as make yellow appear a distinct sensation to normal eyes, although certainly resolvable into red and green. The only way to get a final answer to such questions is by making matches with superposed colours; but to this method some workers seem singularly averse. In my own case I am certain that there is no fourth element of colour practically operative.

The character of the three primary sensations in normal vision is another and a much more difficult question. Perhaps in recent years we have rather lost sight of the argument which weighed with Maxwell in the passage above quoted. The better to see its significance, let us suppose that the spectrum is *accurately* represented on Newton's diagram by two sides of a triangle, and inquire into the significance of this disposition. The only explanation which does not involve highly improbable coincidences seems to be that in each spectrum colour only two of the three elements are involved. If the third is involved at all, how comes it to be involved in such a way as to make the spectrum straight? And the fact that near the red end variation of wave-length entails no variation of colour, makes in the same direction. That the green corner is rounded off and that (if it be so) the sides are not quite straight, may diminish, but cannot destroy, the cogency of the argument, while the less precise character of the conclusion is not without advantages.

RAYLEIGH.

[1] NATURE, vol. xxv., p. 64, 1881; Sci. Papers, i., p. 541.

[2] This adjustment can be made by partially cutting off the light on the side required by means of strips of glass interposed. By varying the number (up to 5 or 6) or inclination, the proportion of light transmitted can be regulated. This procedure was found more convenient than altering the widths of the slits.

MORE ANTARCTIC NATURAL HISTORY.[1]

(1) THE fifth, probably the penultimate, volume of the natural history results of the voyage of the s.s. *Discovery* has followed its predecessors without loss of time, and it resembles them in quality and interest, reflecting great credit on all concerned. The first memoir, by Dr. H. W. Marett Tims, deals with the embryos of Weddell's seal. The author finds in the musculature some additional support for Mivart's suggestion of a lutrine origin for the Phocidæ, and he has discovered in a very early embryo what seems to be the vanishing point of a vestigial external ear. Prof. Herdman deals like an old hand with the small but interesting collection of tunicates, comprising twenty-two species, of which ten are new to science. None of them are very remarkable forms in any way, but they confirm the impression which other collections

[1] (1) National Antarctic Expedition, 1901–4. Natural History, vol. v. Zoology and Botany. (London: British Museum [N.H.], 1910.) Price 30s.

(2) British Antarctic Expedition, 1907–9, under the command of Sir E. H. Shackleton, C.V.O. Reports on the Scientific Investigations. Vol. i., Biology, parts i.–iv. Pp. 1–79, 13 pls., 3 figs. (London: Published for the Expedition by W. Heinemann, 1910.) Price 12s. 6*d*. net.

(3) Expédition Antarctique Belge. Résultats du Voyage du *S.Y. Belgica* en 1897–8–9. Sous le Commandement de A. de Gerlache de Gomery. Rapports scientifiques. Botanique—Diatomées. By H. Van Heurck. Pp. 128+13 plates (1909). Geologie—Petrographische Untersuchung der Gesteinsproben, 1 Theil. By A. Pelikan. Quelques Plantes Fossiles des Terres Magellaniques. By Professor A. Gilkinet. Pp. 50+2 pls. +6 (1900). Oceanographie—Les Glaces—Glace de Mer et Banquises. By H. Arctowski. Pp. 55+7 pls. (1908). Zoologie—Schizopoda and Cumacea. By H. J. Hansen. Pp. 20+3 pls. (1908). (Anvers: J. E. Buschmann.)

have suggested, that "the ascidian fauna of the far south is characterised by the abundance and the large size of the individuals of a comparatively few species." In the present collection we have a number of gigantic forms, such as *Styela spectabilis*, of 18 cm.

Mr. T. V. Hodgson, who did so much hard work in collecting from under the ice-sheet, reports on the isopods, and has some very interesting discoveries to relate. Thus seven species, out of the total of twenty-five, have their eyes on enormous peduncles, which rather takes the edge off the "sessile-eyed" character of isopods! Striking also is the sexual dimorphism of one of the Arcturidæ, *Antarcturus franklini*, the male and female of which appear on one of the plates (remarkably fine pieces of work) as two species, and not very like one another either. "It was only when all the specimens of both sexes, or as it was then thought to be, both species, came to be overhauled that the error was noticed." Prof. L. Joubin has made

is covered with minute endodermal papillæ, but whether these have the same function as the gastric filaments of the Scyphomedusæ remains to be found out. Very curious, too, is the new species of Sibogita, with its stomach completely converted into a reproductive organ when the gonads are ripe. "The stomach then ceases to function as stomach, and its cavity is filled with endoderm. The gonads are apparently in ectodermal pouches, which are embedded in the endoderm, and the pouches have openings to the exterior for the discharge of their contents." But we must pass from these exciting things to notice that the volume ends with a report by Mr. O. V. Darbishire on a collection of twenty-five species of lichens, of which five are new. As he says, they are "the outposts of plant life," occurring where no other plants at all are met with; *e.g.*, at a height of 5000 feet on the ridge of the Western Mountains. It is interesting also to notice that of four species collected on Mount Erebus at a height of 1500 feet, three are also Arctic.

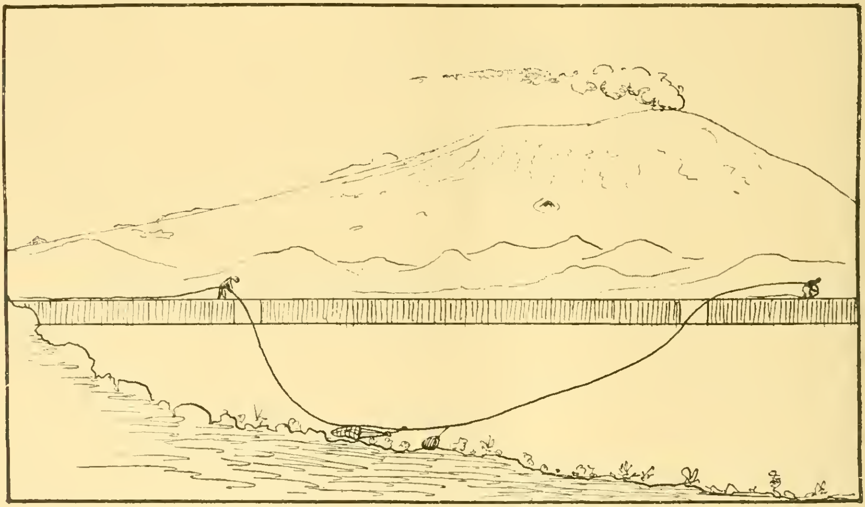


Diagram illustrating method of dredging. The ice (which is supposed to be five or six feet in thickness) and the bed of the sea are shown in section. One man is shown hauling the dredge and another is paying out the spare line to lessen the strain which tends to lift the dredge off the ground. A few feet in front of the dredge a weight is seen, which serves to keep the dredge down, and at the same time, by the length of its attaching cord, maintains it in the right position. From Vol. i., Biology, of the Reports of the British Antarctic Expedition, 1907–9.

the best of a bad business in his report on the nemerteans, for by misadventure he had only the remains of a collection to work with, which indeed only a courageous enthusiast would have touched.

Mr. Edward T. Browne has a finely executed and beautifully illustrated memoir on the Hydromedusæ and Scyphomedusæ of the *Discovery* and *Southern Cross* expeditions, seventeen species in almost as many genera. All are either new species or have been recently described as new species from the Antarctic. Some of the general results are noteworthy: there is no proof that a single species is common to Arctic and Antarctic; there is definite evidence of relatively primitive features in some Antarctic Medusæ, corroborating the view that evolution lags in the cold; it is doubtful if there are any "deep sea" Medusæ in the usual sense of that term. Among the anatomical results of interest is the discovery that the interior of the stomach in the hydromedusan genus Koellikeria

(2) We turn from what is almost the last of one series to the first of another—the reports on the scientific investigations of the British Antarctic Expedition, 1907–9, under Sir E. H. Shackleton. The editor, Mr. James Murray, has lost no time in bringing out a part of the "Biology," and what he has to tell is of much interest. The collecting at Cape Royds (about lat. 77° 32′ S., long. 166° 12′ E.) was done under great difficulties. There was no vestige of life on the beach itself, where an ice-foot persists most of the year. The black lava inshore yielded only a few tufts of moss and some lichens. The small lakes had a sheet of vegetation at the bottom, but it was hard work reaching this through over fifteen feet of ice. Some laborious collecting was done in the sea by hauling a dredge between two holes cut in the ice. Traps were also baited, which brought up amphipods, molluscs, and the like.

The mean temperature of a summer day at Cape

Royds rarely rises above freezing-point, and there is no vegetation higher than mosses. It is therefore surprising to hear of an abundant microscopic fauna and flora. Mr. Murray's experience stood him in good stead, for he made much of a very unpromising centre of operations. "The kinds of animals which are usually to be found among mosses have at Cape Royds a shelter of another sort, which, judging from their numbers, appears to suit them better. This is furnished by the foliaceous vegetation which grows so abundantly in the lakes and ponds." Thus Mr. Murray reports:—"I have never anywhere seen bdelloid rotifers so plentiful as are the two dominant species at Cape Royds (*Philodina gregaria* and *Adineta grandis*). . . . The water-bears are of only a few kinds, but one of them (*Macrobiotus arcticus*) is extremely abundant. There are nematode worms of two or more kinds, mites of several kinds, and two crustacea belonging to the Entomostraca. The ciliate infusoria are very numerous, there are a good many flagellata, but only two rhizopods were observed." Numerous microphotographs were taken under disadvantageous conditions, and some of these are printed—showing not only rotifers, water-bears, and the like, but some other creatures which the editor has wisely refrained from naming.

Some sixteen species of rotifers were distinguished, representing all the orders, though mostly bdelloids. This is the first definite record of rotifers within the Antarctic Circle, and five of the bdelloids are new species. The most interesting facts are those regarding the toughness of the rotifer constitution. Thus *Philodina gregaria* n. sp. is normally frozen in the ice of the lakes for the greater part of the year, and revives at any time that the ice is thawed. It may be alternately thawed and re-frozen at weekly intervals for several months. In England it was subjected to a temperature of -78° C. for many hours, by Mr. J. H. Priestley, of Bristol, and survived. Of *Adineta grandis* n. sp., which survived the lowest temperatures experienced at Cape Royds (-40° F.), and repeated freezing and thawing, and immersion for a month in sea-water, it is further recorded that "a proportion of them lived after the bottle containing them (in the dry condition) was immersed in boiling water for a short time. It was one of the rotifers which was to be seen alive and active in London in September, 1909, after being dry for about a year, and spending some months in tropical and sub-tropical climates." This toughness of constitution is interesting in several ways; *e.g.*, in showing that these Antarctic rotifers can stand very adverse circumstances in the course of dispersal. Another point of interest concerning the rotifers is that the two dominant species, named above, are viviparous, which seems therefore the mode of reproduction best adapted to secure success in the struggle of existence under the severe conditions at Cape Royds. M. Jules Cardot reports on four mosses; the rest of the report is due to Mr. Murray, to whom we offer congratulations.

(3) From a third Antarctic expedition, the *Belgica* (1897–9), some additional reports have been recently received. Thus Dr. H. J. Hansen, who has done such good work among the crustacea, describes some new schizopods and cumacea. He indicates, as other authorities on crustaceans have done, that the familiar title schizopods will have to go, and that the orders of Euphausiacea and Mysidacea, which it includes, are far from closely related to each other. In regard to *Euphausia superba* he notes that it is the staple food supply of seals, such as *Lobodon carcinophaga*, and that it seems to live everywhere in the Antarctic Ocean. A. Pelikan gives a petrographical account of diorites, gabbros, porphyrites, and other types of rock collected by the expedition. Prof. A. Gilkinet reports on a few fossil plants from Magellan; Fagus, Nothofagus, Myrtiphyllum, Saxegothopsis, which seem to be of relatively recent age, and bear a close resemblance to members of the present-day flora of that region. H. van Heurck reports on the diatoms and adds to the value of his work by a survey of polar diatoms in general. Henryk Arctowski gives a beautifully illustrated account of his personal observations on the different kinds of ice and their transformations. These observations are all the more interesting since very little was known of southern ice before the voyage of the *Belgica*. As the author indicates, a good deal has been done since.

ATOMIC WEIGHTS.[1]

DR. CLARKE continues to put all chemists under an obligation to him by reason of the zeal and care with which he collects and disseminates information concerning the most important of all chemical constants—the atomic weights of the elements. In the volume before us—the third edition of a work with which his name is inseparably associated—he has brought to a focus all contemporary knowledge on the subject, discussing, digesting, and weighing the experimental evidence with the same lucidity, completeness, and impartiality which have characterised his previous publications.

It is interesting and instructive to compare the present issue with the original one of 1882. The number of the chemical elements has not greatly increased during the last thirty years. Even including the inert gases of the atmosphere and such of the radio-active elements of which the individuality may be said to be established, the increase is not more than about a dozen, and such values of their atomic weights as we possess are only of the order of first approximations. The most significant feature of the difference between the two issues is seen rather in the far higher standard of accuracy which is now required in such estimations. It is absolutely useless nowadays for anybody to engage in such determinations who is not prepared to impose upon himself the most rigorous checks, the most scrupulous attention to detail, and an inflexible determination to put forward no result that will not stand the severest scrutiny.

Atomic weights to-day are required for other purposes than chemical arithmetic, and comparatively rough approximations serve for the greater number of the operations of quantitative analysis. The errors due to manipulation, and to the use of methods faulty in principle, are, as a rule, far larger than those due to the employment of incorrect values for the atomic weights. Instances, indeed, might be quoted where it is apparently necessary to adopt a confessedly inaccurate value for an atomic weight in order to compensate for the error due to an imperfect method of quantitative estimation. Certain large trade operations could not be equitably arranged on any other basis. This, of course, does not concern the chemist as a man of science, and is certainly no argument for the retention of an inaccurate constant in our tables

[1] (1) The Constants of Nature. Part v., A Recalculation of the Atomic Weights. Third Edition. Revised and Enlarged. By Frank Wigglesworth Clarke. Pp. iv+548. (Washington: Smithsonian Institution, 1910.)

(2) Determinations of Atomic Weights. Further Investigation concerning the Atomic Weights of Silver, Lithium and Chlorine. By Theodore W. Richards and Hobart Hurd Willard.

The Harvard Determinations of Atomic Weights between 1870 and 1910. By Theodore W. Richards.

Methods used in Precise Chemical Investigation. By Theodore W. Richards. Pp. iv+113. (Washington: Carnegie Institution, 1910.)

of atomic weights. These require to be known with all the precision of which quantitative chemistry is capable.

It is only by such knowledge that we may hope to find solutions to some of the most interesting and important problems with which contemporary chemistry is confronted. There is, to begin with, the fundamental question of the validity of the law of the conservation of mass. Is there a dissipation of matter, as of energy, in a cycle of chemical changes? Is an atomic weight a fixed and unalterable quantity? Or is it, as first suggested by Marignac, a statistical quantity varying within limits, doubtless very small, but still possibly appreciable?

There is further the perennial question of Prout's law, which, like the poor, seems to be always with us. Modern views of the genetic relations of the elements and of the dependence of their properties upon their relative masses are intimately connected with the exact values and numerical relations of atomic weights. It is these and similar questions lying at the very basis of chemical philosophy that render it imperatively necessary that these constants should be known with the greatest possible precision. The greatest possible precision is, of course, relative; it depends upon the degree of perfection of contemporary quantitative chemistry, and as this is progressive, each decade seeing improvements, both in the application of old methods and in the discovery of new, it necessarily follows that there is no such thing as finality in measurements of this kind. A large number of atomic weights are now known with accuracy to the first decimal place; even in the case of those of high values a considerable proportion indeed are known even to the second decimal, and a few, especially those elements which are habitually employed as a basis of comparison in atomic-weight work, as, for examples, silver and the halogens, are being ascertained with a still greater exactitude. It is only when atomic weights in general are known to a like degree of precision that we can hope for definite answers to such questions as have been indicated above.

It is largely due to the attention which this subject has received in America that our present position has been reached, and it is especially to the Harvard School of Chemistry that we are indebted for the high standard of accuracy which is now incumbent on every worker in this field of determinative chemistry. No laboratory in the world can point to such a remarkable sequence of memoirs as those which are embodied in the short synoptical statement in which Prof. Richards has dealt with the Harvard determinations of atomic weights between 1870 and the present year. Initiated by the late Prof. Josiah Parsons Cooke, whose determination of the atomic weight of antimony is still regarded as the best ascertained value for that element, the work has been continued by his assistant and successor, Prof. Theodore Richards, partly alone, but mainly in collaboration with pupils whom he has trained and imbued with his own high sense of exactitude. What the outcome of this work, extending over many years, has been is abundantly illustrated by the significant table on p. 90 of Prof. Richards's memoir. Of the eighty-three elements at present known, and of which the atomic weights are given in the annual tables prepared by the International Committee on Atomic Weights, no fewer than twenty-eight of those estimations which are regarded by the committee as among the best ascertained values are to be credited to the Harvard laboratory.

It is remarkable that this work should have been done in America. It is commonly held that no nation is more keenly appreciative of the utilitarian value of science than America; but there is no money to be made out of the results of an atomic-weight determination. It is quite impossible to evolve a new colouring matter out of it, or to turn it into a synthetic drug. Not even the "smartest" and most enterprising of German chemists could bring it within the protective influence of the mystic letters D.R.P. On the contrary, atomic-weight work requires money, and that frequently in no small amount; platinum vessels, and apparatus of transparent quartz, electric ovens, high-class balances, and pure materials, render such work extremely costly. No doubt Harvard is well endowed, and Prof. Richards presumably has been liberally supported by his university. But the beneficence of the university has been largely supplemented by the action of the Carnegie Institution of Washington; without the pecuniary help afforded by the Trust, the work could not, says Prof. Richards, have been carried out on so large a scale, nor could it have reached the degree of precision which it has attained.

T. E. T.

TESTS FOR COLOUR VISION.

THE agitation concerning the official colour-vision tests for seamen has entered upon a new stage. The Board of Trade has announced its decision to hold an inquiry into the matter, and the *personnel* of the committee has been published (NATURE, June 30, p. 529).

After the reiteration of the confidence of the Board in the certitude of the official tests, this change of front comes somewhat as a surprise, but that can be forgiven in the welcome possibilities of a revision of tests that have forfeited the confidence of those most concerned.

It is not to be expected that the constitution of an official committee will please everyone, and already protest has been made by letter to the Board of Trade from the secretary of the Imperial Merchant Service Guild. The Guild protests that it was given to understand that the projected new committee would be of small size and of strictly impartial character, but that it proves to be large, and in the view of the Guild heavily weighted. The Guild states that of the members of the committee, at least two were prominent supporters of the official tests in recently disputed cases where the official position was admittedly wrong.

The choice of tests for colour vision is not so simple as it may seem at first sight. The difficulties presented in appreciating the mental picture of a colour-blind person are very great; and complexity is introduced by the several conflicting theories of colour vision which, consciously or unconsciously, bias the opinion of those who essay to determine these tests.

It is perhaps unfortunate that theories of colour vision should enter into the question of colour tests, at any rate, in the present state of our knowledge. It is, of course, conceivable, nay, even probable, that the true theory of colour vision when that is formulated and proven, supposing it for the moment to be none of those extant, will show an infallible means of testing the sense of colour in any and every person. Until then it would appear better that the test should be frankly empirical, and, so far as possible, unbiased by any theory. And for the reason that, unless rival theories be eliminated from the field, we can scarcely expect a reasonable uniformity in our tests.

There are two main lines of cleavage between rival schools of testing. One insists upon the matching of colours, the other on the necessity for naming colours. The first is official and based upon Holmgren's tests. A candidate is given a skein of coloured wool, and required to pick out from a heap of skeins other wools that, in his opinion, match the wool given him. The second method of testing is performed by exhibiting a colour in wool, card, or preferably by means of light from a distant lantern, and the candidate is required to name the colour shown in whatever language he knows. The colour is exhibited detached from any other colour that could give external help, the man must judge of the exposed colour alone and unaided, and name it in common terms. Now each of these modes of colour perception are common habits with us in our daily life. We constantly match colour, consciously or unconsciously, and we as often, perhaps more often, name colours we see, matching them mentally and naming them according to a standard we have learned by experience. On the respective merits of these methods, the rival schools clash, and, so far as can be judged, the disagreement rests upon theoretic conclusions rather than practical experience.

If we consider these two tests in relation to actual life, or, at any rate, the life of a seaman, it can scarcely be denied that the second non-official test, naming the colour, is the one that most nearly tallies with his experience. The seaman is required to pick up a light, most likely a solitary light, and judge of its colour without possible comparison; he must rely on his judgment of that light in relation to the mental impressions that are part and parcel of his cerebration, and the impression he receives is instantly and unconsciously correlated with a name, the name of a colour in the language in which his mind works. To name is second nature. What the name may be matters not, so long as it be current coin; the "B" line in the spectrum may be "red" to us or "blood-colour" to the savage, and "F" "blue" to us and "sea-colour" to the savage: the intention is the same.

But it is argued by the adherents of the Holmgren test that the matching of colour is more likely to be true, for it eliminates possible errors due to ignorance in precise nomenclature, *e.g.*, three people may see the same colour and variously describe it as purple or mauve or heliotrope, with a result that a fourth might not be sure what colour was meant, yet each of the three would find no difficulty in matching the colour correctly, particularly if they were women who took an interest in their dress.

The good and bad of these tests can only be put to proof when they are tried on known colour-blind persons. Then it has been found that persons can successfully match colours who grossly misname them when the colours are shown singly. On the other hand, there are some who can name colours who fail to match well. The evidence of the cases, particularly those of the first and more important group, has been sifted and is established. Which, then, of these two persons is the colour blind, he who can match but not name or he who can name but not match? The solution of this perplexity is as follows: Matching depends rather on a keen sense of light and shade than on colour sense; colour-blind persons can be educated up to the matching test, but never to acquire a colour sense they do not possess. Those who name colour accurately yet fail to match are bunglers, folk just ignorant of what matching means; the maid-of-all-work will know, but a youth or a seaman may not.

On the mode of applications of tests, if a little pleasantry be permitted, it can scarcely be denied that in some aspects the official methods are as fine a joke as could well be devised. What would a stranger visitant think of these heaps of coloured wools? Surely he would commend a State whose paternal care extended to the examination of young ladies desiring employment in haberdashery shops, to the end that they may be good at matching their customers' patterns! That these wools were to test the seaman's ability to pick up lights in rain and shine, storm and fog, our visitant would surely find unthinkable. And yet it is so. So far has theory divorced from experiment carried us. If it be well to let the punishment fit the crime, how much more should the test of a quality fit the usage of that quality. It seems obvious that the ability to see lights and signal flags should be tested with lights and flags. That this is now recognised is shown by the number of testing lanterns that have been fathered since Edridge Green directed attention to the matter; but some of the lanterns are bad by reason of the poor range of their tints.

The next line of cleavage between rival schools is due to differences in opinion as to what are to be the crucial colours of the tests. Here theories of colour vision come in most emphatically, and until this problem is solved, we cannot expect agreement unless there be a truce to theory and a trial by ordeal.

There is one satisfactory mode of surmounting the difficulty in the choice of crucial colours, that is, by the use of the spectrum itself. Much of the experimental work on colour vision has been done with the spectroscope, and the appreciation of the value of it as an everyday appliance is shown in that, within the last two years, there has been devised three pieces of apparatus for colour testing by direct appeal to the spectrum. A very clever projection spectroscope has been devised by Dr. J. H. Tomlinson, and valuable instruments for direct view of the spectrum by Dr. Maitland Ramsey and by Dr. Edridge Green. Of these instruments, the first has the advantage that both examiner and candidate can view the spectrum together. But Edridge Green's instrument has the germ of the right principle in colour testing, for it is provided with scales which give the measurement of the aperture of the shutters in wave-lengths, so that by this means the range of distinction of colour throughout the spectrum can be measured and registered.

In conclusion, what we want is not only a trustworthy mode of qualitative test, but also a quantitative test—some mode whereby we can express a man's colour-sense in terms as stable as we can express his form-sense by Snellen's test types. At present, opinion and fact are hopelessly muddled by our inability to convey what our tests show. Say a man fails to distinguish a certain red: he must be written down "red blind," notwithstanding he can see another red. To say he is red blind is both true and false, but it is the only statement that can be made in the absence of finer modes of expression. We want to take the measure of his perception of the colours of the spectrum and register them in simple terms. Given such an absolute register of his colour sense, there will remain only the expression of opinion as to his capability for doing certain work. Requirements will vary with the work to be done. For seamen and railway men we should require the highest standard, even as is required of them for form vision.

We wish the new committee a happy issue out of all its troubles! N. B. H.

GREENWICH WATCH AND CHRONOMETER TRIALS.

"WHAT is the chief end of an astronomer?" is not so stereotyped a question as the corresponding conundrum respecting the chief end of man. This question is, however, suggested by the following statements in the last annual report of the Astronomer Royal to the Board of Visitors:—"In the year ending 1910, May 10, the average daily number of chronometers and watches being rated (at Greenwich) was 596." "The number of Government marine chronometers and watches now at the Observatory is 455." "For the annual trial of chronometers . . . 66 . . . were sent in . . . 8 were purchased for the Navy and 4 for the Indian Government." "For the annual trial of chronometer watches . . . 173 . . . were entered . . . and . . . 35 were purchased for the Navy." In addition there was a trial of pocket chronometers, seventeen being sent in and two purchased for the Navy. The average number of chronometers rated daily has, we learn, more than trebled since 1880, so that the burden of this work borne by the Observatory has enormously increased. The work is doubtless most valuable for the Navy, but is our great national Observatory exactly the place where it should be done?

The question is many-sided. Science for its own sake is regarded by the multitude as a most excellent occupation for wealthy amateurs, but a State-supported institution is expected to devote itself to immediately-practical ends. From this point of view it is only work such as supplying the national time and rating the national chronometers that justifies the existence of Greenwich. There is thus some reason to fear that if this and other obviously useful work ceased, the continuation of the financial support from Government that enables the Observatory to carry out work that is more directly astronomical might be jeopardised. On the other hand, whatever adds to the burden of routine and administrative labour borne by the Astronomer Royal, must reduce the time and energy which he can devote to what is purely scientific.

There are several points of interest in the details of the trials. The box chronometer trial lasted twenty-nine weeks, from June 19, 1909, to January 8, 1910, the temperatures to which the chronometers were exposed varying from 45·8° to 105·6° F. The chronometers are arranged in order of merit according to the value of $a+2b$, where a is the difference between the algebraically greatest and least of the weekly rates, and b the greatest difference in rate between two successive weeks. As in golf, the lowest score is the best. Pocket chronometers and chronometer watches are let off with an eighteen-week trial, notwithstanding the fact that, unlike the box chronometers, they are tried in a number of positions. Their place on the list is determined by a formula which takes account of the differences between the rates in the several positions. Even eighteen weeks is a long time compared to the duration of watch trials at the Swiss observatories, at Besançon or at Kew.

The chief obstacle to uniformity of rate, especially in box chronometers, is the effect of temperature, but a much shorter trial than twenty-nine or eighteen weeks would suffice to test the behaviour of the temperature compensation. The main object, presumably, in having so long a trial is to afford an opportunity for any weak point to declare itself. On this question one would like to know the views, both of the makers and of the Observatory authorities. A long trial means a lock-up of capital, which must presumably have an effect on the cost, especially as only a fraction—in the present case apparently only a small fraction—of the chronometers and watches were actually purchased for the Navy. In the present day, with the increase of speed, a ship is seldom isolated for any great length of time, and the breakdown of a single chronometer is unlikely to be a serious matter. Thus the case for a long trial does not seem so strong as it may have been a generation ago. Very probably ere long the development of wireless telegraphy may alter the whole situation.

NOTES.

A FINE specimen of a rare class among the scientifically eminent passed away when the Rev. Robert Harley, F.R.S., died on July 26, in his eighty-third year. Many friends will miss his hale face and hearty greeting at meetings of the Royal Society; and few of them can have had any idea that one so keen in his interest could be an octogenarian. Mathematics with him was a parergon, almost a hobby. He achieved distinction in it in early middle life, pursuing it in scanty intervals of leisure secured without neglect of engrossing non-scientific duties. The son of a Methodist minister, he had no early mathematical training. At the age of twenty-three he entered Airedale College as a student of theology, and shortly afterwards he was ordained as pastor of the Congregational Church at Brighouse, Co. Yorks. Here he found time to become a mathematician of mark. The application of mathematics to logic as developed by George Boole captivated his intelligence, and he became the most notable of Boole's admirers and followers, as also his biographer. His greatest mathematical achievements were, however, in another field. The unsolved problem of the solution of quintic equations fascinated him. Having once granted the impossibility of the solution by radicals, he proceeded to exhibit with remarkable power and patience the place of certain sextic resolvents in connection with such equations. Simultaneously, the late Sir James Cockle was engaged on like work; but Harley was the clearer writer on the difficult subject. Their work, and in particular Harley's, was welcomed enthusiastically by Cayley, who himself took it up and continued it. All three probably were not aware at the time that certain Continental writers had possessed some of their ideas beforehand; but everyone must recognise that Harley's development of the ideas was masterly. It secured for him the Fellowship of the Royal Society in 1863. Since then, as before, he carried on mathematical research only in such time as was allowed by devotion to pastoral, philanthropic, and temperance work. He laboured in Leicester, Oxford (where he was an original member of the Oxford Mathematical Society, and was given the honorary degree of Master of Arts by the University), Halifax, and elsewhere. From 1872 until 1881 he was vice-principal (and chaplain) of Mill Hill School. For the three years before his removal to Oxford in 1886 he was principal of Huddersfield College. In 1890 he took a period of rest (with pastoral work) in Sydney, Australia. Since 1895 his life was one of retirement, but far from one of inactivity, whether religious, benevolent, or scientific.

THE Berlin correspondent of the *Times* announces the death, in his seventy-sixth year, of Prof. A. Michaelis, who until three years ago was, since 1872, professor of classical archæology at Strassburg University. In addition to being the author of a large number of works on archæological subjects, Prof. Michaelis organised the admirable archæological museum of Strassburg University.

We learn from *Science* that Dr. Frank H. Bigelow has resigned his positions in Washington, D.C., as professor of meteorology, U.S. Weather Bureau, and professor of astrophysics, George Washington University, in order to travel in Europe for a few months. He will then resume his studies in solar physics and terrestrial meteorology.

In view of the removal of the work of the Meteorological Office to the new building in Exhibition Road, South Kensington, which is being arranged to take place in the autumn, Mr. R. G. K. Lempfert, superintendent of statistics, has been appointed by the Meteorological Committee to be superintendent of the forecast division; Mr. E. Gold, fellow of St. John's College, Cambridge, Schuster reader in dynamical meteorology, has been appointed superintendent of the statistics and library division; Mr. R. Corless has been reappointed special assistant to the director, with additional duties as secretary and clerk of publications. The appointments date from October 1.

Apropos of Prof. W. J. Pope's discourse on "The Chemical Significance of Crystal Structure" at the Royal Institution, a full report of which appeared in last week's number of Nature, it may be noted that the models which illustrated the lecture, together with explanatory labels, are exhibited by Prof. Pope in the Crystallography Section of the Science Hall at the Japan-British Exhibition. Next to this exhibit will be found also models of Bravais's fourteen space-lattices, and of certain of Sohncke's point-systems shown by Prof. H. L. Bowman. Among other interesting exhibits in the same section, in addition to those referred to in an article in Nature of July 28, may be mentioned the series of goniometers, showing the great change that has taken place in the form of the instrument since it was first devised, the refractometers and protractors, and the pictures, obtained in natural colours by direct photography on autochrome plates, of the interference figures displayed by certain crystal-sections.

In *L'Anthropologie* for May–June M. Louis Seret brings to a close his essay on the colonial empire of the Phœnicians. To this he attributes the spread of Neolithic culture in western Europe. In the sixteenth century B.C., the Phœnicians, after the first Egyptian incursions into Asia, started on their maritime career. The period of constant warfare which succeeded produced a demand for large supplies of arms of bronze, and the Cassiterides were the only source from which tin in the necessary quantity could be provided. But the accessible mines soon became exhausted, and in the twelfth century the increasing use of iron made the bronze trade much less important. He connects the menhirs of western France with the cult of a deity of reproduction, like the Greek Hermes. These brilliant generalisations will probably not meet with universal acceptance; but this important study throws new light upon the connection of the Phœnicians with the spread of Neolithic culture in western Europe.

In a third instalment of a "symposium" on the palæontological record, published in the August number of the *Popular Science Monthly*, Prof. R. S. Lull discusses the relation of embryology and vertebrate palæontology. He mentions that the dinosaur Compsognathus was probably viviparous, and refers to the importance of ascertaining the origin of the peculiarity that the presumed ribs of chelonians are external to the limb-girdles. He also comments on the similarity between the head of a fœtal manati and that of a modern ungulate.

In the course of a note on the first skull of the species obtained from the Pleistocene of Saxony, Dr. K. Wanderer, writing in *Sitzungsberichte und Abhandlungen der naturwis. Ges. Isis* for 1909 (1910), reviews recent literature relating to the local races of the musk-ox. In 1908 Dr. R. Kowarzik pointed out that the living representatives of the species are divisible into two main groups—an eastern and a western—distinguished by skull characters. The line of division between the two types is formed in North America by the Atlantic watershed and its continuation in the islands of the Arctic Ocean. The western type, *Ovibos moschatus mackenzianus* (of which Gidley's *O. yukonensis* appears to be a synonym), inhabits the Mackenzie Valley and the districts to the west, but appears to have been originally a native of Europe and northern Asia, whence it reached America by way of Bering Strait. The skull is characterised by the nearly quadrangular outline of the basioccipital, the flattened but large horn-bases, the close approximation of the stout sheaths of the horn-sheaths to the forehead, the presence of distinct lacrymal pits, the marked curvature of the tooth-line, and the long interval between the sphenomaxillary fossa and the last molar. The eastern American form is, it may be presumed, *O. m. typicus*, allied to which is the Greenland *O. m. wardi*. The skull described by Dr. Wanderer was obtained from Prohlis, near Dresden, in association with remains of *Rhinoceros antiquitatis*, and is referred to the western form.

Two volumes by Mr. J. Wright on the cultivation of allotments have lately been added to the series of "One and All" garden booklets. The first supplies information with regard to the preparation and improvement of the soil; the second deals with the production of vegetables, fruits, and popular flowers.

A new volume, the fifth, of the botanical section of the *Philippine Journal of Botany* begins with a number devoted to the first part of an enumeration of Philippine Leguminosæ, provided with keys to the genera and species, for which Mr. E. D. Merrill is responsible. The enumeration covers 90 genera and 285 species, of which 14 entire genera and 53 species are considered by the author to be introductions. The proportion of endemic species is low as compared with many other families. None of the genera are very large, Desmodium being predominant with twenty-nine species, while Monarthrocarpus and Luzaria are monotypic and endemic. Several species yield valuable timbers, notably *Pterocarpus indicus*, *P. echinatus*, *Albizzia acle*, *Intsia bijuga*, and *Pahudia rhomboidea*.

A note by Mr. W. R. G. Atkins on the cryoscopic determination of the osmotic pressures in some plant organs, chiefly fruits, appears in the Scientific Proceedings of the Royal Dublin Society (vol. xii., No. 34). Following the methods adopted in earlier experiments, the osmotic pressures were calculated from the data obtained by measurement of the freezing point of the expressed cell sap. The values so obtained justify the deduction that similar organs of any plant species have approximately equal osmotic pressures, although a wide range of values is obtained for similar organs of different plants. Thus tomato fruits gave a value varying from six to nearly eight atmospheres, and greengages a pressure of twenty-nine atmospheres. The variation in pressure recorded for the tomato is connected with the ripening of the fruit, the lower pressure in this case referring to the ripe fruit, and is accounted for by the chemical changes in the cell sap.

Bulletin No. 55 of the West of Scotland Agricultural College contains an account of experiments on soil inoculation for the lucerne crop. Lucerne is not at present cultivated in Scotland, and the necessary bacteria are presumably not present to any great extent in the soil. Addition of the organisms by inoculation has proved successful.

The changes taking place during the storage of butter have been investigated at the Michigan Agricultural College Experiment Station by Messrs. Rahn, Brown and Smith. There was a distinct increase in the non-protein nitrogen, indicating a certain amount of proteolysis, but the exact agent was not determined. There were, however, micro-organisms found multiplying even at $-6°$ C., whilst a torula proved extraordinarily resistant to salt, even growing in a 25 per cent. salt broth.

The use of insecticides containing arsenic appears to be attended with considerable disadvantage in India, and experiments have for some time past been carried out at the Agricultural Research Station, Pusa, with the view of discovering some other compounds equally effective. Lead chromate was finally selected; being yellow, it is easily visible on the plant; it does not burn the foliage, and it adheres well. A suspension of 1 lb. in 64 gallons of water proved effective on plants that are being attacked, while 1 lb. in 100 gallons of water proved a sufficient preventive.

A recent circular of the Royal Botanic Gardens, Ceylon, contains an account, by Mr. Petch, of the root disease of the cocoa-nut palm caused by the fungus *Fomes lucidus* (Leys). No method of curing a diseased tree is known; once a tree is attacked there is little hope of saving it unless some only of the roots are affected and can be cut off. This only rarely happens, and it is usually best to fell the tree at once. Methods of treatment are badly needed for cases such as this; there seems to be no prospect of successful treatment by the internal application of a fungicide, since the tree is more easily killed than the fungus.

The renewed interest now being taken in the United States in all questions affecting natural resources, and particularly the soil, is reflected in the articles in the *Popular Science Monthly* (No. 6). Dr. McGee describes the scientific work of the Department of Agriculture, which includes more than half of the official bureaus in the States. Prof. Brigham gives a popular account of soil formation and of weathering, and shows how such apparently trifling details as the lowering of the level of water in the soil through the operations of man may in course of time lead to profound changes. There is also a well-illustrated paper by Prof. Herrick on instinct and intelligence in birds.

The July number of the *Journal of the Board of Agriculture* contains a paper by Messrs. Robinson and Watt describing the Coombe plantation, Keswick, which was planted in 1848, and is now being cleared. It is remarkable in that careful accounts have been kept of all costs and of all returns, and further in that experimental groups of trees have been periodically measured. A discussion of the data is given, and there are a number of good photographs. Another paper, by Mr. A. B. Bruce, aims at giving the stock-breeder a general account of Mendelism which should go far to satisfy him that the scientific treatment of his problems is likely to lead to valuable results.

Recent bulletins from the United States Department of Agriculture Bureau of Entomology deal with (1) the western grass-stem saw-fly (*Cephus occidentalis*, Riley and Marlatt), which causes trouble to the wheat-growers of North Dakota and elsewhere; (2) the woolly white-fly (*Aleyrodes howardi*, Quaintance), a new enemy of the Florida orange, which hitherto has only been known to infest orange trees in some of the West India islands, and especially Cuba; (3) the oyster-shell scale (*Lepidosaphes ulmi*, L.) and the scurfy scale (*Chionaspis furfura*, Fitch), now very generally distributed through the States, and sometimes confounded with the more serious San José scale; although they do not actually kill the trees, they cause serious financial loss; (4) the "brown rot" (*Sclerotinia fructigenia*, P. Schröt.) and plum curculio (*Conotrachelus nenuphar*, Herbst.) of fruit trees; the former is a fungus disease of the flowers, twigs, and fruit, especially harmful at the time of ripening; the latter is an insect that, in the course of its feeding and egg-laying, punctures the fruit, often so copiously that much loss is suffered; (5) the sorghum midge (*Contarinia* [*Diplosis*] *sorghicola*, Coq.), which is by far the most destructive agent affecting sorghum. A general description of the insects attacking crops in Michigan is issued by the Michigan State Agricultural College Experiment Station; the bulletin is well illustrated, and contains a considerable amount of useful information.

Messrs. Burroughs, Wellcome and Co. have issued, in connection with their exhibit at the Japan-British Exhibition, an illustrated descriptive pamphlet (in English and in French) of the Wellcome Physiological Research Laboratories and of the work done there. This includes the preparation and standardisation of diphtheria anti-toxins and other therapeutic sera, bacterial vaccines, the physiological standardisation of drugs such as ergot, &c.

The fourth annual report of the Metropolitan Water Board, by Dr. Houston, on the results of the chemical and bacteriological examination of London waters for the year ending March 31 last, has recently been issued. It contains a mass of figures relating to the bacterial content and chemical composition of the raw, stored, and filtered water supplied to the metropolis, valuable on account of the systematic examination of the water and as showing how our water supply is, so far as possible, safeguarded. Dr. Houston again insists that the *raw* waters are undoubtedly unsatisfactory in quality, but that storage with sedimentation effects a considerable improvement, and he emphasises the supreme importance of storage as a means of preliminary purification of the raw water.

The new catalogue of the Cambridge Scientific Instrument Co., describing Duddell oscillographs, gives particulars of the latest type of these instruments. The improvements incorporated in this instrument include greater accessibility and ease of repair of the vibrators and alteration of the design in such a manner as to prevent the leakage of oil from the damping chamber, which was such an unpleasant feature of the old type. Particulars are given of the accessory apparatus required and of the methods of using the instrument, and an appendix contains reproductions of a number of interesting records of wave shapes.

We are in receipt of a copy of the "Catalogue of Mechanical Engineering and Electricity," containing information concerning the British exhibits in these sections at the Brussels Exhibition. The preface is written by Prof. W. C. Unwin and Mr. John Goodman, and gives a summary of the progression and tendencies of engineering science as exemplified by the exhibits referred to in the body of the catalogue. The nine sections include mechanical engineering, electricity, civil engineering, agriculture, horticulture and arboriculture, food products, mining and metallurgy, textile industries, and chemical industries. A plan at the end shows the positions of the stands of the various exhibitors.

The *Physikalische Zeitschrift* for August 1 contains a review of the present state of our knowledge of the properties of the α particles sent out by radio-active substances, by Dr. H. Geiger, of Manchester. The velocity of the homogeneous rays sent out by radium C appears to be $2{\cdot}06\times10^9$ centimetres per second, and the quotient of the electric charge by the mass $5{\cdot}07\times10^3$ electromagnetic units. The mean number of α particles sent out by a gram of radium per second is $3{\cdot}1\times10^{10}$, and each carries a charge $9{\cdot}3$ to $9{\cdot}6\times10^{-10}$ electrostatic units, and appears to be a helium atom. The progress of each is checked by the molecules of a gas, and in air the path described does not exceed a few centimetres in length. During the description of this path each is capable of producing $1{\cdot}72\times10^5$ ions by collision. The results of the recent measurements of the diminution of the velocity of the particles as they pass through solids, their scattering, and their ultimate absorption are all discussed in a clear and thorough manner.

A letter from Sir William Ramsay, in the *Chemical News* of August 5, directs attention to a new fact in the history of the development of the Leblanc process for the manufacture of soda. It has generally been believed that Leblanc perfected a process devised by De La Métherie in 1789. A letter to Dr. Black, written by a Mr. Geo. Golder, of Edinburgh, and dated March 19, 1782, shows, however, that the black ash process had already been devised and patented by an English inventor named Collinson. A specimen of black ash prepared by Collinson's process was submitted to Dr. Black, who reported that it contained "more alkali than the best Alicant Barilla in the proportion of 68 to 44, and more than the best keip in the ratio 68 to 10." "It is an excellent ash for the soap-boilers . . . and there is no need to use lime in drawing the leys from it, as it is already in a caustic state." "After this," the writer adds, "there appears little doubt who invented the black-ash furnace."

Many examples of smoky chimneys are no doubt owing to carelessness and lack of knowledge in those concerned with the work, but we also find many architects and builders of repute being occasionally nonplussed by the problem. Some important points in chimney design are given in the *Builder* for August 13. The grate should be provided with a blower to induce a good draught at the start. The flue should be expanded laterally to a width of about 2 feet a short distance above the grate, and then brought in again, forming what is usually termed a "bottle." Above this, one or two bends of about 150 degrees should be made. The top should be slightly contracted, and the chimney-cap sloped up sharply all round the aperture or pot; outside chimneys should be avoided; stacks should come as near the highest part of the roof as practicable; a number of flues should not be packed too closely together in a large stack, but kept as distinct as possible; the outer walls of stacks should be 9 inches thick.

In an article on the International Road Congress, which opened in Brussels on August 1, *Engineering* for August 12 gives the altered form of a rejected resolution, which in its original form condemned macadam. The resolution finally adopted is as follows:—"Macadam, carried out by the methods of Tresaguet and Macadam, causes dust and mud, is expensive to maintain, and is suitable in large cities only for streets where the traffic is not very great or heavy. The experimental work carried out in recent years with macadam, improved by using a bituminous or tarry coating or binder, ought to be continued to determine the best method of utilising this kind of construction under varying conditions, and the results considered at the next congress." Our contemporary directs attention to a point which requires scientific investigation, viz. the exact behaviour of a sand foundation under stone pavement. On the Continent, a bed of sand from 3 inches to 6 inches deep is almost invariably used, and the setts are bedded directly on and in the sand. The sand is spoken of as a "cushion," and is said to be elastic. Another view is that it absorbs the shock on the pavement, saves the stones from damage, and reduces the noise of traffic. It would be easy to settle the points in doubt by experiments in an engineering laboratory.

OUR ASTRONOMICAL COLUMN.

A New Comet.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by the Rev. J. H. Metcalf at Taunton, Mass., on August 9. The position, at 9h. 15·2m. (Taunton M.T.), is given as R.A. = 16h. 10m., dec. = 15° 20′ N., and the comet was said to be moving in a south-westerly direction; at the time of discovery the brightness of the comet was about equal to that of an eleventh-magnitude star.

A later telegram gives the position of the comet as observed by Mr. Burton at Boston on August 10; at 12h. 28·8m. (Boston M.T.) R.A. = 16h. 10m. 29·3s., and dec. = 14° 56′ 41″. The comet is on the meridian at about 6h. 30m. p.m.

Observations of Comets.—Dr. Max Wolf records an observation of comet 1910*a*, on July 15, in No. 4429 of the *Astronomische Nachrichten* (p. 210). The comet was then a little to the south-east of υ Cygni, and its photographic magnitude was 16·5.

In No. 4430 of the same journal he states that on plates taken on April 11 he has found images of comet 1909*e* (Daniel); the comet was then fainter than Halley's at the time of discovery, and was not shown at all on a plate which had a longer exposure on May 12. In compliance with a request from Herr Jan Krassowski for unpublished observations of comet 1909*e*, Dr. Rambaut also publishes some positions of this comet, secured at the Radcliffe Observatory during December, 1909, and January, 1910.

Observations of Mercury.—During July and September, 1909, observations of Mercury were made at the Revard (Aix-les-Bains) and the Massegros (Lozère) observatories by MM. G. and V. Fournier, and the drawings are now reproduced and discussed by M. Jarry-Desloges in the August number of the *Bulletin de la Société astronomique de France*. Those made at Massegros, with a refractor of 29 cm. (11·5 inches) aperture at an altitude of 900 m., show that there are definite markings on the surface of the planet which can be seen and delineated by different observers at different times with striking agreement, although the observing difficulties are very great. A dark patch on the southern horn is shown on all the drawings, and in some even obliterates the actual cusp. Other markings agree on different drawings, and can also be identified with some observed by Schiaparelli and Lowell. The observations confirm the statements that the rotation period of Mercury is probably equal in length to the planet's revolution period.

Dispersion of Light in Interstellar Space.—Recognising the importance of the results obtained by MM. Nordmann and Tikhoff regarding the differential velocities of light of different wave-lengths through interstellar space, Herr Beljawsky made a number of observations of the Algol variable RZ Cassiopeiæ during the autumn of 1909. Using filters which transmitted either visual rays alone or photographic rays alone, he photographed the star with short exposures, taking a large number of photographs in quick succession, and from these he subsequently reduced the times of the photographic and visual minima respectively. The results first obtained showed a time-difference of six minutes, on the average, between the two divisions of radiations. But this difference was in the opposite direction to that found by the earlier observers: that is to say, the visual rays were "retarded" more than the optical.

A subsequent revision and refinement of the data confirmed this result qualitatively, but slightly reduced the time-difference (*Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo*, vol. iii., No. 31, 1910).

Anomalous Scattering of Light.—No. 5, vol. xxxi., of the *Astrophysical Journal* contains an important paper in which Dr. Julius upholds his hypothesis as to the causes which produce the unequal distribution of light over the sun's disc, as shown on spectroheliograms. He states that the results so far obtained are no less favourable to the anomalous-dispersion theory than they are to that hypothesis which ascribes the variable illumination to absorption effects, and proceeds to support his statement by the discussion of the several phenomena.

Dr. Julius also defines his terms more rigorously than in former papers. "Anomalous dispersion" is reserved for the general property of matter, that its refracting power varies rapidly in the neighbourhood of an absorption line. Previously this term was used indiscriminately with "anomalous refraction"; but the latter is now to be used exclusively for the irregular phenomena with which Dr. Julius deals in all his papers; "anomalous scattering" is also introduced, and is shown to be an active agent in modifying various effects.

The Spiral Nebula M51 (Canum Venaticorum).—As an extract from the *Rivista di Astronomia* (Turin), we have received a paper in which Madame Dorothea Isaac-Roberts discusses in detail the numerous condensations, spires, &c., shown on Dr. Roberts's photograph of the spiral nebula M51 Canum Venaticorum. Each feature is described, and the position-angles, distances, &c., are given, so that any future worker may determine, with a minimum of labour, whether or not any variation has taken place since the epoch when Dr. Roberts's photograph was taken. Madame Roberts also shows that the present form indicates a process of evolution which has led, and will probably lead, to the partition of this remarkable object into secondary nebulæ and condensations.

Supplement to the "Astronomische Nachrichten."—We have received, as a supplement to the *Astronomische Nachrichten*, No. 17 of the *Astronomische Abhandlungen*, edited by Dr. Kobold. Among its six articles, it contains papers dealing with an experimental research on phase action in regard to heavenly bodies, a new explanation of the origin of comets, and a description by Prof. Lowell of the new canals discovered on Mars. The price of the supplement is 3 marks.

THE FIRST INTERNATIONAL CONGRESS OF ENTOMOLOGY.

THE first International Congress of Entomology was held at Brussels on August 1–6. The establishment of the congress was in great measure due to the initiative of Dr. Karl Jordan, of Tring, whose tact and energy have throughout contributed largely to the success of the undertaking. Having, in the first place, secured the support of leading entomologists in this country and abroad, Dr. Jordan organised, in the course of last year, a series of preliminary meetings in London, which were attended by Dr. Horn, of Berlin, M. Janet, of Paris, Prof. Poulton, F.R.S., of Oxford, and others, under the chairmanship of Dr. F. A. Dixey, F.R.S., president of the Entomological Society of London. At these meetings it was arranged that the first congress should be held at Brussels in 1910, and local secretaries were appointed to promote the interests of the movement in all countries of the civilised world. So well did these representatives perform their part, that no fewer than 292 entomologists assembled in Brussels for the opening of the congress.

Proceedings began on the evening of July 31 with an informal reception by Prof. Lameere (who, as president of the Entomological Society of Belgium, had been invited to preside over the congress) and the other members of the Belgian society. The gathering was highly enjoyable from the social point of view, and gave acceptable opportunities to entomologists from other parts of the world for making each other's personal acquaintance.

On August 1 the official proceedings were opened by Prof. Lameere in the Salle des Fêtes, a large building within the precincts of the exhibition, the use of which for the general and sectional meetings of the congress had been liberally granted by the authorities. His address of welcome to the delegates and other members of the congress included an eloquent vindication of the claims of entomology to serious attention, both as a science and also as a study having practical bearings of the highest importance. The address, which was well received, was followed by the reading of a report by the secretary of the congress, M. Severin, on whose shoulders the chief labour of organisation had fallen. After the conclusion of the more formal proceedings, the congress turned to the regular business of entomological communcations. Some of the most interesting items on the programme bore reference to subjects of economic importance. Prof. Theobald (Wye) had a paper on the artificial distribution of insect pests, and M. Andres (Alexandria) contributed notes on the lepidopterous enemies of the cotton-crop. Dr. R. Stewart MacDougall (Edinburgh) discoursed on the beetle *Galerucella lineola*, so destructive to the Midland osier-beds, and Sir Daniel Morris, formerly director of the Imperial Department of Agriculture in the West Indies, gave a graphic account of the progress of economic entomology in the West Indies and in India, to which progress, it may be noted, Sir Daniel's own efforts have very largely contributed. Among other items of interest were communications from Prof. Kolbe (Berlin) on the comparative anatomy of the Coleoptera, and from MM. Janet (Paris), Speiser (Sierakowitz), and Lyman (Montreal) on various points connected with classification.

The proceedings on August 2 opened with a luminous and admirably delivered discourse by M. Blanchard (Paris) on medical entomology. The eloquence of the lecturer, and the vast importance of the subjects with which he dealt—malaria, yellow fever, and the sleeping sickness, all of which are directly dependent for their spread on the agency of insects—made a great impression on his audience. The day's programme also included an excellent lecture by Father Wasmann on ants and their guests, illustrated by lantern-slides; communications by Prof. Theobald on the distribution of the yellow-fever mosquito, *Stegomyia fasciata*; by Prof. Carpenter (Dublin) on the warble-flies; and others of equal interest.

The business on August 3 was largely taken up with the subject of mimicry and its bearing on evolution. The proceedings began with the delivery of a discourse by Dr. F. A. Dixey, F.R.S. (Oxford), on the general subject of insect mimicry. The lecture, which was plentifully illustrated by lantern-slides, directed especial attention to the ascertained data of mimicry in relation to affinity and to sexual, seasonal, and geographical conditions. Various suggested explanations of the phenomena were discussed in the course of the lecture, and the opinion was advanced that natural selection afforded the only reasonable interpretation of the facts at present within the knowledge of entomologists. Special aspects of the subject were afterwards dealt with by Dr. Karl Jordan (Tring) and Prof. Poulton, F.R.S. (Oxford), the former exhibiting an interesting series of lantern illustrations, and the latter showing a wonderful series of models and mimics captured at the same time and place by Mr. Wiggins in Uganda. A note of scepticism was struck by Mr. Schaus, who, on the strength of many years' observation in the neotropical region, was disposed to deny that mimicry was of any service to the insects exhibiting it. A lucid exposition of Mendelism as applied to the Lepidoptera was given by Prof. Punnett (Cambridge), and an interesting account of his experiments on the influence of temperature on seasonally dimorphic moths was contributed by Mr. F. Merrifield (Brighton).

On August 4 much interest was excited by Mr. Donis-thorpe's lecture on ants, with their bidden and unbidden guests, and also by Prof. Sjostedt's narrative of the Swedish expedition to Kilimanjaro. Able communications were also received from Dr. Horn (Berlin), M. Bouvier (Paris), M. Honrath (Budapest), and others.

On August 5 Mr. Howlett, of the Agricultural Research Institute at Pusa, India, gave an excellent account, illustrated by numerous photographs, of the work of that most useful institution; and M. Lahille (Buenos Aires) discoursed to an appreciative audience of the progress of economic entomology in the Argentine. The sectional programme also contained, amongst others, contributions from Dr. W. J. Holland (Pittsburg), Mr. H. Skinner (Philadelphia), and Dr. Horn (Berlin); but the chief business of the day consisted in the winding-up address of the president, Prof. Lameere, and the selection of Oxford as the scene of the next International Congress of Entomology, to be held in 1912, with Prof. Poulton, F.R.S., as president.

The evening of August 5 was devoted to a banquet at the Taverne Royale, and on August 6 M. Max, Burgomaster of Brussels, entertained the members of the congress at a grand reception in the Hôtel de Ville. The exhibition buildings were open to members throughout the whole of the congress, and excursions were organised in the course of the week to the Congo Museum, the Ardennes, the Field of Waterloo, and other places of interest. The Brussels Museum of Natural History was also visited, and its treasures described by members of the staff.

The congress, as a whole, was an undoubted success. Any defect that may have been noticed in the arrangements was probably due to the fact that, this being the first occasion of the kind, there were no precedents to guide those responsible for the administration. Some inconvenience was suffered from the circumstance that the Salle des Fêtes was in request for other purposes, which interfered to an appreciable extent with the scientific business of the general and sectional meetings; for this, however, compensation was found in the varied attractions of the exhibition, free access to which, by the liberality of authorities, was allowed to all members of the congress.

It is satisfactory to be able to record that, of the 292 members, 67 were representatives of the United Kingdom, its colonies and dependencies. The contributions made by our countrymen to the scientific work of the congress may fairly be said to have surpassed in extent and value those of any other nation—a fact which is of good augury for the future of entomological research within the borders of the British Empire.

THE FIFTH INTERNATIONAL CONGRESS OF PHOTOGRAPHY.

THE International Congresses of Photography, the first of which was held in Paris in 1889, are arranged at irregular intervals as opportunities offer or necessity renders desirable, that representatives of all countries may meet and discuss questions of general importance. It is hoped by this means to avoid, or at least mitigate, the confusion that results from variations in standards, nomenclature, and methods, especially when such variations are due more to accident than intention.

The fifth congress, which has just been held in Brussels, was well supported, most of the European nations, as well as America, being represented. More than eighty communications were included in the programme, and these were classified into three main sections:—(1) Scientific questions; photochemistry; scientific applications of photography. (2) Technique of photography; artistic questions; industrial applications of photography. (3) Photographic documentation and archives; bibliography; legislation. The proceedings of the congress will be published in full in the report that will be issued in due time.

Several of the communications were of the nature of reports setting forth the present state of the section of photographic work dealt with. Captain Th. J. Saconney dealt with aërial photo-surveying. E. Deville gave details concerning photo-surveying in Canada, from which we learn that the extent of the region so surveyed is somewhat greater than the combined areas of Holland and Belgium, the most interesting application of the method being its application in defining the frontier between Alaska and Canada, a district of lofty mountains. A commission was given three years to report concerning a frontier of one thousand kilometres in length, and as only the short summer season of each year was available, on account of the climatic conditions, other than a photographic method would have been impossible. A satisfactory map was prepared from the three thousand photographs made. The photographic method of surveying employed in Canada is eminently practical, not excluding other methods, so that it should be understood merely that photography plays the most important part in it.

Prof. Wilder D. Bancroft contributed a long report on the photographic emulsion, and from the facts that he has set in due order concludes that the silver bromide grain is a complex of silver bromide, gelatine, and water, and that "the process of ripening consists in changing the composition of the silver bromide grain towards an unknown, optimum concentration." He concludes, too, that it seems theoretically possible to make an almost infinitely fast plate having a very fine grain. Dr. R. Luther set forth the various arguments concerning the nature of the developable image, and J. Desalme reported on present notions concerning the theory of development. The latter considers that the electrolytic hypothesis affords a much better explanation of development than that based on a reduction by a purely chemical process, that is, that a developing solution contains an electrolyte and a depolariser suitable to the positive ions produced. This explains the non-equivalence of the alkalies if substituted in the proportion of their combining weights.

The difficulties of measuring the true opacity or obstructive power of photographic plates were described by F. F. Renwick, who stated that the apparent opacity of a negative under any given conditions is the algebraic sum of several variable properties. These he classifies as the simple obstructing power, the diffracting power of small particles and of the slightly rough surface of the film, the increase in transmitted light when the incident light falls obliquely on the surface, and the increase when the plate being measured is placed close to a reflecting surface if the difference between the readings with the negative so placed, and when the negative is removed, is taken as the opacity. He also criticised adversely the use of acetylene flames as light standards unless many stringent precautions are taken. The principles involved in attempting to measure the diffuse reflecting power of photographic plates were enumerated by A. Callier and R. von Camvenberghe, but they gave no practical details. Drs. Mees and Sheppard described various improvements in acetylene burners when used as secondary light standards, to meet objections that have been urged against earlier forms, and referred shortly to other standards. Dr. E. Goldberg described an apparatus that he has devised (made by Schmidt and Haensch, of Berlin) by means of which the characteristic curve of a plate can be obtained without the more or less tedious plotting generally done. From the group of papers dealing with these branches of the subject, it is clear that the measurement of the densities of photographic plates is a process still set about with difficulties and confusions, and that much work remains to be done in this direction.

Coming to the more technical branches of the subject, we find that a great many widely different matters were treated of. Prof. R. W. Wood described how to take photographs with infra-red and ultra-violet lights. For the infra-red he uses, as a screen, a very dense cobalt glass with either a saturated solution of potassium bichromate or a suitable red aniline dye, and, of course, a suitably red-sensitised plate. Under such conditions grass and trees in full sunshine appear snowy white and the sky as black as midnight. All shadows are very black, as there is practically no light from the sky to illuminate them. For the ultra-violet photographs, quartz lens were used coated with metallic silver to such an extent that a brilliantly lighted window was barely visible through them, and appeared of a deep violet colour. The light transmitted was of wave-lengths from 3100 to 3250. When photographed under these conditions, certain white flowers (as phlox) and Chinese white (zinc oxide) appear as if absolutely black, but ordinary landscapes do not show points of much special interest. Prof. Wood suggests various possibly useful applications of such methods. Prof. R. Namias has examined prints toned with gold and platinum to ascertain the amount of precious metal entering into the finished print. C. W. Gamble described a method of determining the melting point of gelatine jellies. He uses capillary tubes, and notices when the concave meniscus changes to a flat surface.

A. and L. Lumière and A. Seyewetz classified and compared the various gelatine-hardening agents, and recommend the use of quinone and its sulphonic derivatives when the gelatine is on a rigid support, in preference to formalin, as the latter tends to contract the gelatine and detach it. They find that quinones in acid solution are serviceable for the reduction of photographic silver images, and that their action is comparable to that of ammonium persulphate in appearing to attack by preference the denser deposits. They suppose that the resulting hydroquinone tends to deposit silver, by reduction from the solution, on the surface, and so to prevent the loss of the thinner deposits.

A method for getting instantaneous exposures on autochrome plates was described by Ch. Simmen. The plate is sensitised to red by bathing, and with a suitable compensation filter is eight times more sensitive than the untreated plate. N. S. Amstutz reported on recent progress in process work in the United States of America. We notice that Paynetype has not yet come into general use; that collotype has not made much headway, in spite of the hopes of its adherents, presumably for lack of attention to climatic conditions; but illustrative telegraphy is taking its place as a practical method of transmitting pictures. W. F. Cooper and G. A. Freak have compared nickel (or nickel-surfaced plates) as a substitute for copper for half-tone work, and find that ferric chloride acts on it (for etching) at something less than half the rate that it acts on copper.

Telephotography is the subject of a report by Captain Owen Wheeler; other than this, photographic optics was hardly represented. It will, of course, be understood that in this summary it has not been possible to refer to more than a comparatively few of the communications made to the congress. C. J.

THE ORIGIN AND CLASSIFICATION OF MAMMALS.[1]

A HEARTY welcome may be accorded to the work referred to below, which contains a well-elaborated and highly philosophical digest of the present state of our knowledge of the past history and relationships of the various groups of mammals, and the inferences which may be legitimately drawn from such knowledge. The work owes its inception to the need for a brief outline of the history of the ordinal classification of mammals for use in Columbia University; but it was soon found inadvisable to limit its scope to this portion of the subject, and it consequently covers a much wider range. It retains, however, traces of its original limitation in consisting of two distinct parts, namely, an account of the typical stages in the history of the classification of mammals, and, secondly, of the genetic relations of the orders and a discussion of the origin of the class as a whole, with special reference to the problem of the auditory ossicles.

The first part, although of great value to the student, may be passed over without further mention on this occasion, and attention concentrated on the second. Before proceeding to a brief survey of the latter, reference may be made to the author's endeavours to give a rational explanation of the meaning of each important feature with which he has to deal, and not to rest content with a mere catalogue of bare facts. Indeed, the adherence to mere facts on the part of so many of his predecessors has been, in the author's opinion, a fruitful source of our lack of progress in getting a real grasp of mammalian evolution, and he specially urges the need of an osteological treatise written from this newer point of view. It is added that the importance of osteology in the study of mammals cannot be overestimated, as the clue to the origin of the class and the relationships of its constituent orders can be obtained from palæontology alone, which in this case is restricted to the osteology and dentition.

As regards the origin of mammals, Mr. Gregory adopts the view that the class is descended in all probability from that section of the anomodont reptiles which Dr. Broom has proposed to designate cynodonts, but which are more commonly included in the theriodonts, although not from any known member of the same. The features in which cynodonts approximate to mammals on the one hand and to more ordinary reptiles on the other are carefully formulated. The difficult question of the fate of the reptilian quadrate and the homology of the mammalian malleus and incus is left to a great extent open, although the author seems inclined to favour the view that the incus represents the quadrate and the body of the malleus the articular.

The second chapter of this part is devoted to the monotremes, which are regarded as undoubted mammals, with evident relationships to the marsupials, as is indeed indicated by their geographical distribution. Nevertheless, monotremes are taken to represent a subclass by themselves, while marsupials and placentals are brigaded together in a second group of equivalent value, and it is added that the divergence of the monotreme from the marsupio-placental stock must have taken place at a relatively early date. Within the same section as the marsupials are grouped, as a second and equivalent order, the Mesozoic triconodonts, which cannot be regarded as true marsupials, and it is noteworthy that the theory of the conversion of the triconodont into the tritubercular type of molar by means of torsion is now definitely abandoned. On the other hand, in view of Gidley's study of Ptilodus, the Multituberculata are now re-admitted to the marsupial order, although the author will not allow that they are diprotodonts. The evidence of the Triassic Microlestes, supplemented by that of the structure of the teeth themselves, indicates that the multituberculate molar is a far older type than the tritubercular, which is first known—in an incompletely developed condition—in the Middle Jurassic Amphitherium.

The view that the carnivores of the Santa Cruz beds are not only marsupials, but likewise members of the same family as the Tasmanian wolf, is definitely accepted, and it follows from this that there is no definite genetic relationship between creodonts and carnivorous marsupials. Indeed, the author considers each group to have been independently derived from small insectivorous and completely or partially arboreal Mesozoic forms, this being, if true, sufficient to indicate that the resemblance between the larger Tertiary forms is due to convergence. In opposition to some of his contemporaries, Mr. Gregory regards creodonts as nearly related to the Insectivora (from which tupais and jumping-shrews are separated as a distinct order, Menotyphla), and likewise considers the latter to be more closely related to marsupials than is the case with any other placental group. On the other hand, he looks upon the palatal vacuities of Erinaceus as secondary rather than marsupial features. The date of separation between Carnivora and Insectivora is considered to be pre-Tertiary, and it is left an open question whether the ancestors of the latter had their incisors extending along the sides of the jaw (instead of being restricted to the front) as in their modern representatives.

Only very brief reference can be made to some of the other orders, among which it is important to notice that the extinct zeuglodonts are included in the Cetacea. Perhaps the greatest changes in classification are proposed in the case of the ungulates, from which the Artiodactyla are removed to form a separate ordinal, and supraordinal, group, as the author believes they have no near relationship with Perissodactyla. On the other hand, the Ungulata are taken to include, not only elephants, hyraxes, perissodactyles, and the South American groups, which are brigaded as Notoungulata, but likewise sirenians. Much is to be said both for and against these proposed changes, but space does not admit of discussing the matter, and it must suffice to add that we find the Primates, with man at the head, forming part of a "superorder" in the middle of the class instead of standing at the head. Whether we accept all his views or not, there can be no question that in this volume Mr. Gregory has accomplished a most valuable and important piece of work. R. L.

[1] "The Orders of Mammals." By W. K. Gregory. Bull. Amer. Mus. Nat. Hist., vol. xxvii., 1910. Pp. 524.

THE MINERAL SURVEY OF PERU.

THE Cuerpo de Ingenieros de Minas del Peru continues to issue actively its valuable bulletins on mining areas. In No. 58 (1908) Mr. A. Jochamowitz reviews the mineral resources of the somewhat remote department of Apurimac, in the mountains south-east of Lima, where the rivers run northward along the ranges to join the great flow of the Amazon. The level lands are mainly devoted to the cultivation of sugar-cane for the production of alcohol; but alluvial gold-areas exist, and gold occurs in decomposed ferruginous zones among the prevalent stratified quartzites. Portuguese miners in old days appear to have secured most of the spoil that could be readily obtained.


FIG. 1.—View from the Lower Cretaceous Coal-beds of Cupisnique, Peru.

Mr. E. T. Dueñas describes, in *Boletin* 62, the provinces of Tayacaja, Angaráes, and Huancavelica, famous for their mineral wealth, from silver-lead to mercury and gold. Here again alcohol is one of the main agricultural products, and the soil of the valleys, when watered, is highly productive. The sugar-cane crop, however, at present suffers greatly from locusts. The three provinces lie in a basin of the Andes, between Lima and Cuzco, and at the head-waters of the Mantaro. The rocks are much faulted, with crystalline masses thrust in among them. A series of slates is regarded as Silurian, and a red-rock series, containing salt, and traceable into that of Cuzco, is referred to the Trias. Mesozoic limestones and sandstones occur in places, and fossils prove some of these to be Liassic and others Upper Cretaceous (p. 154). The author (p. 24) explains the course of the Mantaro as of double origin. The western cañon above Anco is ascribed to the overflow of a lost lake in the upland south of Jauja—this town, by the by, might have been just squeezed into the margin of the map. The second cañon past Coris and Surcubamba was cut by the waters of another lake, the "Lago de Huanta," which has left its gravels below Anco and as far south as Acobamba. The Jauja lake drained into this near Anco. Both cañons are connected with faults running out from the Andes, and their excavation in Quaternary times was thus facilitated, until they grew large enough to drain off their respective lakes and unite in the sinuous course that now forms the Mantaro. We wish that the resources available in the United States Survey for the topographical representation of such problems had been at the disposal of Mr. Dueñas in Peru. Wolfram occurs at Lircay, in the province of Angaráes, and the author reviews the world's production of tungsten, now so important an element (p. 118). Mesozoic coal-seams are found in Huancavelica. It would have been convenient for reference if the name of this province had not appeared at the top of all the pages of the memoir.

The great rise in the price of antimony in 1907 leads Mr. E. Weckwarth (No. 68) to review the occurrences of antimony ores throughout Peru, including antimonial lead and silver ores. The bulletin also forms a compact monograph on the uses of antimony and its metallurgical extraction. No. 69 (1909), by Mr. E. du Bois Lukis, has geographical and geological interest, in addition to its description of a mining area. It describes the coal-bearing strata of the country near Cajamarca, in the midst of the Andes, and contains numerous photographs of the somewhat barren scenery of the highland. Even at Cupisnique, only 40 km. from the coast, we are up among rocky walls and desert features that remind one of the Wittebergen of South Africa (Fig. 1). Steinmann has referred the coal-bearing sandstones at this point to the Lower Cretaceous. In the extensive Piñipata field away to the north-east, above the long Maranon valley, the coal is probably of much the same age (p. 31). These Peruvian coals, which crop out on the hillsides, among strata that can be traced for miles across a rocky country, are mostly anthracitic, with a rather high percentage of ash; but a considerable future is predicted for them, and the Department of Mining Engineers, as in other bulletins, sounds a patriotic note, and urges the Peruvians themselves to do something towards the development of their resources.

The coast of southern Peru, and the Pampas west of the Andes, are studied by Mr. V. F. Marsters in *Boletin* 70 (1909). Here again the numerous illustrations appeal to the geographer, and include several features due to recent volcanic outbreaks. The huge cone of Misti (Fig. 2), more than 22,000 feet in height, appears in several views. A small picture even shows the snow-flecked rim of the crater, with its broad central cone. The pampas are swelling plains of detrital material, which is often of volcanic origin, and volcanic cones sometimes break their surface. They rarely show features due to erosion, and in places contain traces of saline pools. The discovery of a limited deposit of caliche, or nitrate-bearing earth (p. 61),


FIG. 2.—Cultivated alluvial valley-floor near Arequipa, with the volcano of Misti beyond.

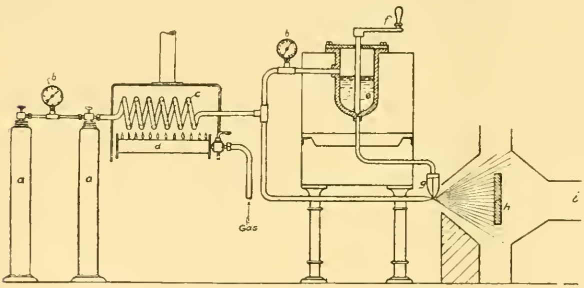
in the hollow of Indio Viejo, leads Mr. Marsters to urge a thorough examination of the pampas between the valleys of the Caraveli and the Chaparra.

Bulletins 71 and 73, on water-supply for agricultural districts, show the wide view taken of their responsibilities by this energetic body of engineers. G. A. J. C.

NEW PROCESS FOR PRODUCING PROTECTIVE METALLIC COATINGS.

THERE are various means of coating metals with other metals, generally of a protective nature; thus, for example, electroplating, galvanising, and drawing the metal. A new process of considerable interest, invented by M. U. Schoop, of Zurich, was described in a paper read before the Engineers and Architects Society of Zurich on April 13, and reproduced in *Metallurgical and Chemical Engineering* (vol. viii., p. 404).

The chief point in the new process is that the metal in the liquid condition is sprayed upon the surface to be coated. The atomising of the metal may be brought about in a variety of ways. The metal is melted in a closed crucible, and is forced out of a nozzle by the pressure of gases or vapours; or the subdivision of the metal may be brought about by causing two jets of metal to pass out of separate nozzles, so that they meet at a suitable angle. These, being under pressure, break up into a fine spray, which is carried forward and coats any object placed near to the spray.



Schoop Process for Production of Metallic Coatings.

The most satisfactory method, however, appears to be to cause the subdivision of the metal by the use of compressed gases. The metal which is to be employed for coating purposes is melted in a closed crucible which has a pipe at the bottom, ending in a nozzle with a capillary opening. Another pipe enters the upper part of the crucible, which is connected with a source of compressed gas, the gas being pre-heated by passing through a coil, *d*. Another tube is connected externally with the gas-pressure tube and ends in a nozzle, which is situated below the metal outlet. The compressed gas impinges with great pressure on the fine stream of metal, which is also being forced out under great pressure. The metal is thus very finely atomised, and is blown against the article to be coated, *h*. Various gases may be used to press the metal out of the nozzle, for example, an inert gas such as nitrogen, and this may also be used for atomising; but, on the other hand, for atomising agent an oxidising gas may be used. It has, for instance, been found possible to produce coatings of lead peroxide of a firmly adhering character.

Different metals naturally behave differently, depending upon their fluidity, melting point, oxidisability, and so on. The material of the crucible also depends upon the metal which is to be melted in it. Thus for melting aluminium and its alloys iron or steel crucibles cannot be used. It appears, indeed, that under high pressures metals alloy much more readily and quickly than under ordinary atmospheric pressure. Obviously alloys may be melted and sprayed, but the metals require to be mixed in their eutectic proportions.

What probably happens in the spray process is that when the metal forced out under pressure leaves the nozzle, it is met by the gas stream, also under pressure. The stream of metal is thus torn up and converted into a mist. The individual particles of the metal when sprayed on to the surface to be coated lose their surface tension and their globular form, and are pressed out on the surface in the form of a circular film. These circular films overlapping become automatically welded into a continuous homogeneous coating. Calculation shows that with a pressure of 25 atmospheres the metallic particles have a speed of 20 km. per second—*i.e.* twenty-five times the speed of the bullet from the gun used in the German Army. Owing to this enormous speed of the metal mist, metallic surfaces of a surprisingly high density are produced. For example, the density of rolled tin was found to be 7·47, and that of the sprayed tin 7·42.

A point of great interest is that the metallic mist is at a comparatively low temperature, at about 40° C. to 60° C., in spite of the fact that the molten metal as it is ejected has a temperature of several hundred degrees, and also the atomising gas. This rather surprising fact is probably due to the sudden reduction of tension of the gas, whereby the metal mist, which presents a relatively very great surface, is also cooled. This is, however, a very great advantage, because it is possible to give a metal coating to substances of low melting point or of high inflammability, such as paper, wood, celluloid, wax, &c.

The hardness of the metal film is greater than the hardness of metallic films produced by other methods, *e.g.* casting or rolling. This great hardness should be of advantage in the manufacture of electrotypes and cuts, in which hardness is an important feature. Microscopic examination also shows that the surface is absolutely homogeneous.

In carrying out the operation, the metallic surface to be coated is first freed from oxide or adhering dirt. In many cases, especially when metals are to be coated, it is found advantageous to pre-heat the surface before spraying on the metal. It is not, however, absolutely necessary to pre-heat; consequently, with a portable apparatus, metallic structures such as bridges, machinery, and so on, could easily be coated, and it is claimed that it would be no more expensive than painting. At to the applications, they are almost numberless. It may be used for all cases in which plaiting is at present employed. Paper may be coated with metal so that it can be used for packing such things as chocolate, tea, and so on, in place of tin foil. The cases of balloons can be coated—an aluminium coating 1 30th mm. thick is sufficient to render it quite gas-tight.

The wooden propellers of aëroplanes coated in this manner are protected against the action of the weather, and the air friction is considerably reduced. Wall-paper, stage scenery, and textiles can all be coated with metals.

Certainly the process is one of great interest; and one point of particular note is, it is now possible to coat metals with aluminium, which will be perhaps one of the most useful applications of this new process. In this case it will be necessary to employ a crucible the material of which will not alloy with the aluminium.

THE GALITZIN SEISMOGRAPH.

DR. SCHUSTER has recently presented to Eskdalemuir Observatory a pair of Galitzin seismographs, and the instruments have been set up under the personal direction of Prince Galitzin, member of the Imperial Academy, St. Petersburg. Similar instruments have been in use in Russia for some time, with very remarkable results, and they are rapidly being adopted by the principal Continental observatories.

The object secured by these instruments is that they record, not merely the occurrence of an earthquake on a large scale of magnification, but also give an exact reproduction of the horizontal motion of the earth at the observing station.

Primarily, the seismograph is a horizontal pendulum on the principle of Dr. Milne's apparatus, but instead of reducing friction to a small amount, Prince Galitzin increases it until the pendulum reaches the limit of "aperiodicity" or "dead-beatness." Electromagnetic damping is so strictly proportional to the velocity that it is immensely superior to other forms of frictional damping. A copper plate attached to the pendulum moves across the field produced by two strong horse-shoe magnets, and the pole distance is adjusted until the required degree of damping is attained. There is no other friction, as the pendulum is carried by steel wire.

A heavily damped and truly dead-beat pendulum reproduces with great precision the motion of the earth, which sets the pendulum in motion.

The actual movement of a heavily damped pendulum is very small, but Prince Galitzin has shown how to magnify the movement to any required degree without loss of accuracy. A coil of fine wire attached to the pendulum moves in the field of a second pair of horse-shoe magnets, and the currents so generated in the coil when the pendulum moves are measured by a D'Arsonval galvanometer which has the same natural period as the pendulum, but the circuit resistance is chosen so that the galvanometer is also "dead beat." It can be shown that, except for a few special cases, the motion of the galvanometer mirror is a precise reproduction of the pendulum motion, and hence of the earth motion. By means of an experimental table on which the instruments are tested, Prince Galitzin has shown that impressed motions of great complexity are faithfully reproduced on the galvanometer. It is true that the final scale of magnification differs for different periods of incident waves, but in actual seismological practice it is comparatively easy to allow for this.

The registration is made photographically by reflecting light from a fixed source and producing a dot of light on a strip of photographic paper carried on a rotating circular drum. The paper moves at a rate of 3 cm. per minute, and the drum is carried sideways, so that it can be used for a twelve-hour record. The trace is interrupted every minute by an electrical time break, and so the times can be estimated with ease to half a second.

The pendulum and galvanometer are duplicated, so that two records are obtained on the paper. One of these gives the motion of the earth from north to south and the other the motion east to west. They are arranged so that a movement of the earth to north or to east is represented by a motion of the corresponding dot up the sheet.

Prince Galitzin has shown that the ratio of the amplitudes of the very first impulse on the two pendulums gives the tangent of the azimuth of the epicentre. He has proved practically that this determination of the direction is accurate to $\frac{1}{2}°$ of arc.

The usual method (Wiechert Zöllpritz) of calculating the distance from the times of occurrence of the first and second phases is followed.

Thus a pair of Galitzin seismographs enable an observer at a given station to determine the epicentre of an earthquake with great precision. Further, one can follow the complete movement with confidence, although a certain amount of computation is strictly necessary when waves of widely different periods actually occur. Intelligent examination of the record shows when this is necessary.

Identity of natural period of pendulum and galvanometer and strict "aperiodicity" is the ideal. In practice it is sufficient to get approximate equality, and determine the differences by a simple process of standardisation. For information on this point the reader is referred to Prince Galitzin's original memoirs in the publication of the Imperial Academy, St. Petersburg. G. W. W.

RECENT AGRICULTURAL PUBLICATIONS IN GREAT BRITAIN.[1]

THE Board of Agriculture issues each month a Journal intended for farmers, small holders, and others interested in agriculture, and, in order that it shall be accessible to all, the price is fixed at the very low sum of fourpence. It represents a very laudable, and on the whole successful, attempt to bring to the farmer the best scientific work on the problems confronting him; it also deals with matters of agricultural importance in foreign countries.

A large proportion of the papers is devoted to plant diseases. In a recent issue, Mr. Salmon describes the Sclerotinia disease of the gooseberry. The mycelium of the fungus penetrates into the tissue of the stem, permeating the cortex and the bast; in time the stem is completely "ringed" and the bush dies. Sometimes the attack is not in the main stem, but in the young wood, the leaf, or the berry. Burning all infected old and dead wood has been found the best method of control. Mr. Salmon points out that this fungus is capable of developing vigorously on dead parts of the bush, while the American gooseberry mildew, with which growers have sometimes confused it, is not. Where burning is not practicable, recourse may be had to spraying with copper sulphate solution.

Other papers deal with possible improvements in agricultural practice. Of these, one is by Mr. Priestley on the effect of overhead electrical discharges on plant growth. It has been known for some time that an electrical discharge in some way increases plant growth, but the practical difficulties have only recently been overcome by the use of Sir Oliver Lodge's high-tension valves, in conjunction with a Ruhmkorf coil of a type similar to that used in X-ray work. The physiological problems are not yet solved, and the practical application of the method is, of course, very limited so far as can be seen at present. But the fastidiousness of the present generation demands fruit and vegetables in unnatural seasons, and the market gardener, in furnishing the supply, is prepared to adopt any methods likely to increase the rate of growth, provided the cost is not too high. Mr. Priestley's data show that a good case can be made out for the use of electrical discharges.

Supplements to the Journal are periodically issued, each dealing with a special subject. One deals with the work of the International Agricultural Institute, but it is not very clearly arranged. Another gives *in extenso* the papers read at the discussion on wheat at a joint meeting of Sections B and K with Subsection K of the British Association last year. As this discussion has already been dealt with in these columns, it is unnecessary to say any more here; the plan of printing and distributing widely these British Association discussions is admirable, and will, we trust, be acted upon again.

Under the able guidance of Mr. Mackenzie, the Journal of the Royal Agricultural Society is steadily making up lost ground. This Journal has had a remarkable history. The early volumes, from 1840 (when it began) to about 1860, contain some of the finest papers that have been written on agriculture and agricultural science. Then it had a long series of lean years, due, no doubt, in part to the decadence of agricultural science in England during that period. It is now taking its place in the remarkable revival that the last few years have witnessed. Mr. Hall gives a connected account of the various investigations he and other workers at Rothamsted have made on the secondary effects of manures on the soil. Sulphate of ammonia tends to make the soil acid, and therefore infertile, unless sufficient lime is present; the acidity is caused by certain fungi in the soil which decompose the salt to obtain the ammonia and thereby set free sulphuric acid. On the other hand, nitrate of soda tends to make the soil alkaline and to get it into a sticky, unworkable condition. The decomposition is in this case brought about at the roots of the plant in some way not yet understood, and results in the acid radicle entering the plant while the base remains outside as sodium carbonate. The latter substance is known to deflocculate clay, and is the cause of the unfavourable soil condition thus induced. Suitable methods of treatment are suggested.

Mr. F. H. A. Marshall discusses some of the physiological problems of the stock-breeder. This subject has been curiously neglected, and it is of interest that Cambridge, which has taken the lead in plant-breeding work on Mendelian lines, should now be turning its attention to stock-breeding. The practical man has acquired by long experience a vast fund of information, which, however, needs sorting out and systematising. Apart from the problems involved in raising pedigree stock—a highly

[1] Journal of the Board of Agriculture, and Supplements; Journal of the Royal Agricultural Society; Agricultural Students' Gazette.

specialised and valuable, though restricted, branch of agriculture—there are many other questions of interest to the physiologist. Thus it is a very common practice to castrate male animals in order to increase their docility and their capacity for laying on flesh. Ovariotomy of the females is also practised, though much less commonly, but with the same object. Abortion is another matter to which attention is directed. Enormous amounts of money are involved in these stock-breeding problems, and in addition many of them are of considerable physiological importance.

The *Agricultural Students' Gazette*, the organ of the Royal Agricultural College, Cirencester, contains articles by old students or members of the staff dealing with questions of general agricultural interest. Mr. B. Bathurst writes on tariff reform and the tenant farmer, and Mr. Boulger on the biology of the soil. The scientific work of the college is published in a separate bulletin, which has already been reviewed in these columns.

THE EDUCATIONAL VALUE OF THE SCHOOL GARDEN.[1]

It is becoming increasingly common for rural elementary schools to start a garden in which the scholars may take a certain number of lessons during the season. The idea of a school garden appeals to the village community; the village critic is nothing if not practical, and he insists, and with a good show of reason, that if book-learning is any good at all it ought to teach a man how to raise onions and potatoes well. So successful has the movement been that it has spread widely, and has reached a stage when the whole question of the relation of gardening to rural education may usefully be considered.

The circular before us contains a highly suggestive discussion of the place of the garden in the school curriculum. The garden, it is pointed out, makes two very powerful appeals to those who wish education in our public elementary schools to be more practical; it leads to the formation of habits of thoroughness, and it is eminently useful. But it may also be dealt with on a much higher plane. The purpose of the garden should be to educate boys and girls, and not merely to show them the usual ways of cultivating the common vegetables and flowers, or to practise them in the manual operations of gardening. The scholar must be led to understand the reasons of the common processes in their relation to the soil and climate, the causes and conditions of health or disease in plants, and something of the principles on which the selection and improvement of seeds and plants depend. It is, indeed, a branch of nature-study rather than a training for a profession, and it has two great advantages over many other branches: it produces visible and tangible results—thereby appealing forcibly to the utilitarian instincts of the child—and it does not, or should not, degenerate into the series of disconnected object-lessons of little educational value that sometimes passes under the name of nature-study.

Gardening has another great advantage over other subjects in that it is essentially experimental. Set experiments cannot easily be made because the areas are far too small for inequalities of the ground to be smoothed out; indeed, they may be wholly misleading. But throughout the scholar is trying and trying again, observing his results, attempting to account for his failures and to devise better methods for the future. The teacher has to strike the happy mean between doing too much for the scholars, thus relieving them of the responsibility of thinking, and of doing too little, and leaving them overwhelmed with a sense of failure.

Of course, the garden is not necessarily a success. If the teacher has no taste for gardening or nature-study he had much better let them alone; he will save himself a good deal of discredit and the children a good deal of trouble. There is no particular virtue in a wide curriculum. If the subjects are treated in a dry and illiberal fashion, no appeal is made to the child's natural interests and his imagination is left untouched, in spite of the range of the syllabus. On the other hand, a restricted choice of subjects liberally treated may have great educational value. It all turns on the teacher himself; his choice of material must be largely determined by what interests him most.

In order to get the fullest value out of the gardening lesson, it should be correlated as much as possible with the other school work—with drawing, arithmetic, composition, nature-study, and so on. A number of hints are given showing how this may be done.

The publication is very interesting, and shows a lively appreciation by the Board of the possibilities of the case. A teacher who works in accordance with the spirit of these suggestions will do some distinctly useful work.

[1] Suggestions for the Consideration of Teachers and others concerned in the Work of Public Elementary Schools. (Circular 746 of the Board of Education.)

THE TELEGRAPHY OF PHOTOGRAPHS, WIRELESS AND BY WIRE.[1]

It frequently happens that when two alternate processes are available for certain work, and one of them is considerably less practical than the other, the less practical one is possessed of much higher scientific interest. This may certainly be said of the telegraphy of pictures and photographs. The whole of the methods of transmission can be classed as either purely mechanical or dependent on the physical properties of some substance which, like selenium, is sensitive to light.

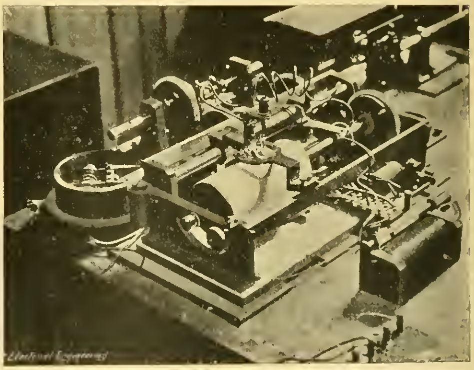


FIG. 1.—Photograph showing a Portion of the Photo-telegraphic Apparatus.

The latter methods are of no little scientific interest, and, although very delicate and for the moment obsolete, there is every likelihood of their coming into more extended use later on.

The telegraphy of pictures differs only from the transmission of ordinary messages in that the telegraphed signals, recorded by a marker on paper, must essentially occupy a fixed position. In the case of an ordinary telegram, it matters little whether the received message occupy two, three, or more lines when written out on paper, but when a picture is telegraphed every component part of it must be recorded in a definite position on the paper.

Suppose you greatly enlarge a portrait, and divide it up by ruled lines into a thousand square parts. Suppose, also, that the photograph is printed on celluloid, so that it is transparent. If, now, the portrait be held in front of some even source of illumination, it will be seen that each square—each thousandth part—is of different density. The light parts of the photograph will consist of squares of little density, the dark parts of squares of greater density, and so on. In this way the photograph is analysed into composite sections, each section corresponding precisely to a letter in a message; letters and spaces recombined form

[1] Discourse delivered at the Royal Institution on Friday, April 22, by Mr. T. Thorne Baker.

words and messages; squares of different densities recombined, in correct position, form a photograph.

I propose to deal with the more practical system first, which, as already pointed out, is perhaps the less interesting from the theoretical point of view. The telectrograph system has been employed by the *Daily Mirror* for the transmission of photographs since July, 1909, and has been worked very regularly between Paris and London and Manchester and London.

Instances of its use may be recognised in the publication of photographs taken in court in the recent Steinheil case at Paris, when photographs of witnesses or prisoners were sometimes received in London actually before the court rose at which they were taken, a clear day being gained in the time of publication.

The method of telegraphing photographs that has been employed on a large scale by the *Daily Mirror* may be called a practical modification of several early attempts.

Fig. 2.—Fashion Plate Transmitted by Prof. Korn's Telautograph.

The effect of an electric current to discolour certain suitable electrolytes or to set free an element or ion that can be used to form with a second substance a coloured product was employed in many early forms of instruments for telegraphing writing, &c. If we break up a photographic image in the way already described into lines which interrupt the current for periods depending on their width, these interrupted currents can be used at the receiving station to form coloured marks, which join up *en masse* to form a new image. My telectrographic process is thus briefly as follows:—

At the sending station we have a metal drum revolving under an iridium stylus, to the drum being attached a half-tone photograph printed on lead foil. Current flows through the photographic image to the line, and thence to the receiver. The receiver consists of a similar revolving metal drum, over which a platinum stylus traces. Every time the transmitter style comes in contact with a clear part of the metal foil, current flows to the receiver, and a black or coloured dot or mark appears on the chemical paper. But you will readily understand that if our reproduction—built up of these little marks, which have to be made at the rate of some two hundred per second—is to be accurate, each mark must be only exactly as long, in proportion, as the clear metal space traversed by the stylus.

It will be easier to explain the system by means of the rough diagram shown in the figure (Fig. 4). The transmitting instrument is shown on the left, the receiver on the right. A metal drum is revolved by a motor, one revolution every two seconds; over this a metal stylus or needle traces a spiral path in the same way as a phonograph. On the drum is fixed a half-tone photograph broken up into lines, and printed in fish-glue upon a sheet of lead foil. I will show one of these line photographs on the screen, and you will see that the light and shade of the picture are made up of masses of thinner or thicker lines, with clear spaces in between.

As the stylus traces over such a photograph, its contact with the metal base is interrupted every time one of these fish-glue lines comes beneath it, and for such a time as depends, of course, on the *width* of the line. The transmitting instrument thus sends into the telegraph lines a series of electric currents the periods of duration of which are determined by the width of the lines composing the photograph.

A similar stylus, S_2, traces an exactly similar path over a revolving drum in the receiving instrument, but round this drum is wrapped a piece of absorbent paper impregnated with a colourless solution, which turns black or brown when decomposed by an electric current.

Fig. 3.—Photograph Wired from Paris to London by the Author's Telectrograph.

What happens, then, is that every brief current which passes through the paper causes a mark to appear on it. The width of the mark depends on the duration of the current—or should do—so that you will see that these marks gradually combine to recompose the photographic image.

This method is all very well in the laboratory, but when we come to try it over a long distance the capacity of the line at once causes serious interference. It is well known that if a current be sent to some apparatus, such as a telegraph, from a distance, the current having to pass through long wires the capacity of which is appreciable, a certain time is taken for the current to charge the line, and the line discharges itself into the apparatus with comparative slowness. If the circuit be closed by means of a Morse key, the time of contact at the key being a sixth of a second—a common time of duration of a short tap—the discharge of current from the cable would be considerably longer than one-sixth of a second. When, therefore, we are sending signals through the line at the rate of 175 per second, it is not difficult to see that every signal will run into the next dozen or so at the receiving apparatus, and the result will be a hopelessly confused mass of overlapping marks. This is well illustrated in Fig. 5, where A shows a series of taps passed through a cable of high capacity into the telectrograph receiver; instead of getting a series of sharp dots or short lines, we get elongated lines ending off in tails. Without the capacity, we get the short lines as shown in the B series. These short, definite lines are again obtained, even when the capacity is present, in series C; but in this case I had shunted on to the receiver what I have termed the line balancer, a modified form of shunt apparatus embodying the principles of *wiping out* residuary currents from the cable in the way frequently made use of in duplex telegraphy.

The use of this apparatus has rendered commercial the old ideas of telegraphing by the electrolytic method, and as many as three hundred sharply defined chemical marks can be recorded in one second by its means. The method of application will be seen if we have the last slide shown again (Fig. 4); here, shunted on to the line (which is closed by the stylus S_2 and the metal drum), is a circuit containing two batteries, B_1 and B_2, and the two sections of a divided 1000-ohms resistance, W_1 and W_2. Shunted across the variable contacts of the resistances is a variable condenser K. By varying the resistances, W_1 and W_2, we can vary the power of the current used to sweep out the residuary charges in the line; the current can, of course, flow through the chemical paper on the drum, but the pole of the battery B_1, connected to the style, is of opposite sign to that of the line unit connected to it.

When the leakance on the line is great and evenly distributed, less reverse current from the balancer is necessary, this being quite in accordance with Heaviside's formulæ for telephony over lines with capacity and inductance. It is interesting to note, also, that by increasing the voltage of the reverse batteries B_1 and B_2, considerable greater contrast can be obtained in the pictures; the finer the half-tone screen employed in splitting up the photographs into lines, the higher, again, must the voltage of B_1 and B_2 be made.

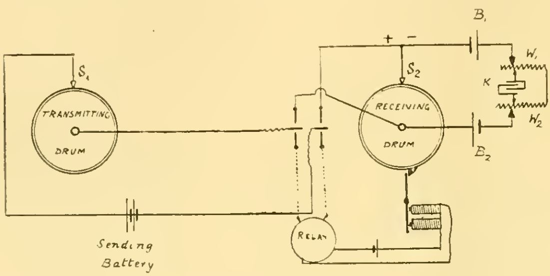


Fig. 4.

I should like to take up a few moments in referring to the actual utility of photo-telegraphy. The demand by the public for illustrations in their daily papers must be admitted. News is telegraphed in order to expedite its publication, and photographs illustrating this news can therefore be telegraphed advantageously. But where a large installation and establishment, with accumulators, a large instrument and an operator to work it are required, the cost of telegraphing every individual picture becomes quite out of proportion to its value. It is therefore desirable to direct especial attention to the portable instruments, the first one of which is shown for the first time to-night. A photographer going to obtain pictures of some important function or interesting event can take the machine with him, prepare his pictures, and telegraph them to his head office, and when the event is over he simply returns with the apparatus. For criminal investigations the portable instrument will, I feel sure, become of considerable value also. Through the continued courtesy shown by the Postmaster-General and Major O'Meara, the engineer-in-chief, we have been given every facility for developing the work, and I believe that the uses of the portable instrument will before long have been amply demonstrated.

If a picture revolving beneath a tracer has to re-draw itself, as it were, on a piece of paper perhaps hundreds of miles away, it is obvious that each mark re-drawn must occupy a precisely similar spot on the new paper as it does in the original picture. As cylinders or drums are used in picture telegraphy, this means that they must revolve in perfect unison. If one drum were to gain on the other we should have, in the case of a portrait, a nose being recorded where the eye ought to be, or something equally disastrous; in fact, if the two machines get the least bit out of step, the received picture is completely ruined. The method of synchronising used by Prof. Korn has proved very satisfactory, and has been adopted in practically all systems of photo-telegraphy. The motors which drive each drum are run at about 3000 revolutions per minute, and geared down very considerably, so that the drums themselves revolve, perhaps, at 30 revolutions per minute; the motors are run from secondary batteries of ample capacity to ensure smooth working, and should be run for a sufficient time before beginning a transmission, to allow of their warming up.

The speed of each motor is controlled by a regulating resistance in series with the field magnets, and the speed is ascertained by means of a frequency meter, which indicates the number of revolutions per second. The dial of this meter is shown on the screen. A set of tuned steel tongues are fixed in front of a magnet, which is supplied with alternating current obtained from slip rings on the motor, and each tongue has a different period of vibration. When the alternations in magnetism correspond with the period of vibration of any one spring, that spring vibrates, and thus serves as an indication of the speed of the motor.

The receiving drum is revolved a little quicker than the transmitting drum. It consequently completes its revolution before the transmitter. It is then stopped by a steel check, and is obliged to wait until the other drum has caught it up. When the transmitting drum has completed *its* turn, a fleeting contact comes into play, a reverse current is sent to the receiving instrument; this is led into a polarised relay, which actuates an electromagnet, and this magnet removes the check.

Thus, however much one drum gets out of step with the other, the fault is limited to each revolution, and both drums must always start off in unison for each new revolution. I have found that where each operator endeavours to keep his motor running uniformly by regulating the resistance according to the fluctuations recorded by the frequency meter, the personal element makes itself visible in the results; straight lines appear wavy, and the synchronism is not at all good. I therefore tried very carefully calibrating the motors by timing first, and then arranged that, once started, the motors should not be touched; the gain in speed of each is approximately the same if both motors are run from secondary batteries of the same ampere-hour capacity, and in this way we have obtained the most perfect results as regards synchronisation.

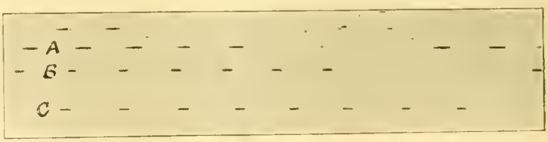


Fig. 5.

The great advantage of this process is that the whole operation is in full view, whereas with systems in which the received picture is obtained on a photographic film one has to develop such film before it is possible to discover whether anything is wrong. With the receiver described, the operator keeps his hand on the sliding contact of the resistances, and merely adjusts their position during the first two or three seconds, according to the condition of the electrolytic marks, *i.e.* whether crisp and concise or not. The transmitting cylinder can be used as the receiving cylinder, and the apparatus is thus reduced to the limits of simplicity.

Towards the end of last year I designed a portable machine, two of which Mr. Sanger-Shepherd has just completed, embodying in them a number of improvements of his own, and these machines, which have worked successfully on their trials, are shown on the lecture table to-night. They are suitable for line or wireless work, and will, I believe, prove of great value in naval and military operations.

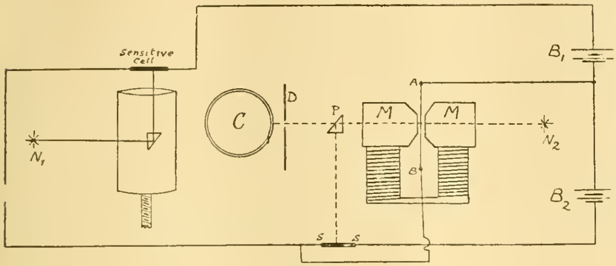


FIG. 6.

The *Daily Mirror* inaugurated the Paris-London photographic service in November, 1907, with Prof. Korn's selenium instruments, which I shall briefly describe, as Korn is now making two new selenium apparatus with the view of transmitting photographs from New York to London. In this system use is made of the fact that the electrical resistance of the metal selenium varies according to the strength of illumination to which it is subjected, a beam of light passed through the light and dark parts of a photograph in succession being used to vary the strength of an electric current sent to the receiving apparatus.

In Korn's selenium transmitter light is concentrated from a Nernst lamp to pass through a revolving glass cylinder, round which a transparent photograph (printed on celluloid) is fixed, the beam traversing the film at its brightest part, where the rays come to a focus (Fig. 6). The light which passes through the picture is reflected by a prism inside the cylinder on to the selenium cell, through which the current passes. Across the circuit is shunted a galvanometer of the Einthoven pattern, containing two fine silver strings free to move laterally in a strong magnetic field. These are represented by AB, the magnet poles being MM. When a bright part of the photograph admits of light falling on the sensitive cell, current passes through AB, and it shifts aside, allowing light from a Nernst lamp N_2 to enter the prism P, whence it is reflected on to the second cell SS. The telephone lines connecting the two instruments go direct to the wires of a similar galvanometer, which is in series with the galvanometer of the transmitting instrument. If we imagine MM to be the receiving galvanometer, then we remove the prism P, and the light acts on a sensitive photographic film attached to the drum C, which revolves synchronously with the glass cylinder of the sending instrument.

The inertia of selenium, once overcome, the metal immediately becomes of great use for many purposes. Prof. Korn's method of *compensation* is to let the light fall at the same time on two cells of opposite characteristics; one has great inertia and small sensitiveness, the other low inertia and great sensitiveness. By using the two cells on opposite sides of a Wheatstone bridge, dividing the battery into two parts for the other sides, the deflection in the galvanometer is very rapid. You will see the effect from the two curves now shown on the screen; that above the axis along which exposure is measured is the sensitive cell, that below this axis the cell of low sensitiveness. Clearly the current passed through the galvanometer is that obtained by joining the sums of the ordinates. This gives the small curve shown as the shaded portion. When the illumination is thrown on the cell the current rises very rapidly instead of gradually, whilst when it is suddenly shut off (at P in the upper curve) it drops to zero almost instantly instead of falling gradually.

I shall now show, by means of a meter, an image of the pointer of which will be projected on to the screen, how the inertia of selenium is overcome. You will first see that if I take away the screen so as to allow light to fall on the selenium cell, current passes into the galvanometer, and the needle slowly deflects several degrees. Now, I quickly shut off the light by intercepting it with the screen, and the needle comes slowly backwards. Such sluggish movement would be impossible for the purposes of photo-telegraphy, where at least half a dozen changes per second are required to be recorded abruptly even in transmitting the simple portraits to which the selenium process is limited.

Now, using two cells of different characteristics and a Wheatstone bridge arrangement, I will once more allow light to fall suddenly on the two cells simultaneously, and you will see that the galvanometer needle records the change in resistance of the combination quite quickly; the combination is even more noticeable when the light is suddenly shut off again, the needle returning to zero with great rapidity. This compensated arrangement of selenium cells at once renders their use of practical value for various physical and optical measurements. Prof. Korn has found that for an increase in the illumination δI, the current obtained is given by the equation $y = \alpha . \delta I . e^{-\beta t^{-\frac{1}{m}}}$, where y is the current, α the sensitiveness of the cell, β and m its inertia constants, and e the base of Naperian logarithms. For two cells to be combined to the greatest advantage, we must have them such that if their equations are respectively

$$y_1 = \alpha_1 \delta I . e^{-\beta_1 m^{-\frac{1}{t}}}$$

and

$$y_2 = \alpha_2 \delta I . e^{-\beta_2 m^{-\frac{1}{t}}}$$

then

$$\frac{d(y_1 - y_2)}{at} = 0.$$

This makes the condition for good compensation that

$$\alpha_1 \beta_1 = \alpha_2 \beta_2 .$$

m is usually almost constant, and with suitable Giltay cells is about two-thirds.

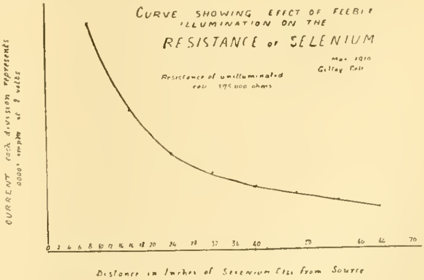


FIG. 7.

In practical language, the condition for compensation is that the principal cell should have great sensitiveness and a small inertia constant, the compensation cell low sensitiveness and a high inertia constant, the product of sensitiveness and inertia constant being the same in the case of both cells.

The physical properties of selenium are of such importance that I feel I may be allowed to digress for a few moments to show one way in which they may be utilised to solve a problem that has long occupied many investigators, viz. the satisfactory measurement of the beam of heterogeneous rays from an X-ray tube. Whenever a new tube is used in radiographic work, a different voltage, or different interrupter or coil, the time of exposure for the photographic plate has to be determined anew. The strength of the tube under any conditions can, however, be determined by means of a simple piece of apparatus which I have constructed, the working of which I shall now be able to show you.

If the X-rays fall on a fluorescent screen of barium platino-cyanide, the screen absorbs them and emits yellowish-green visible rays; this transformed energy is capable of affecting a very sensitive selenium cell when placed in contact with the screen, the resistance becoming less the greater the fluorescence. You will see here a selenium cell of approximately 395,000 ohms resistance, over which is placed a small fluorescent screen of the same size; the cell is put in series with a battery of 100 volts and a milliampere meter, the divisions of which may be made to correspond to some arbitrary scale or to the time necessary for the exposure of a given make of photographic plate.

The dividing of the dial depends on two things: first, the characteristic curve of the selenium cell connecting its resistance with the strength of illumination, the linear distance of the source from the cell being, in this case, the most convenient to employ.

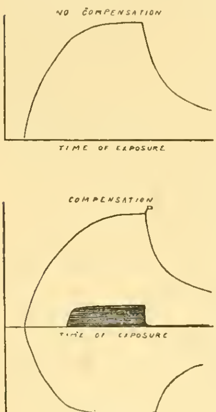


FIG. 8.

Second, this characteristic curve must be modified to meet the case of illumination by the rays from the anti-kathode, which do not necessarily diminish in their power to make the screen fluoresce as the square of the distance from it. You will see on the screen the characteristic curve of a selected selenium cell for feeble illumination, the maximum being of about the same wave-length as that of the fluorescence, showing the relation between resistance and distance separating the source of illumination and the cell, and also the modified curve showing a similar relation between resistance and distance between anti-kathode and cell, with the screen in contact. The portion of the first curve most nearly asymptotic is best to employ for the work, and from the second curve the dial scale of the metre can be easily calibrated. If, now, I vary the height of the X-ray tube from the measuring apparatus, you will see that the metre needle is deflected less as the distance between tube and cell is increased. The actual instrument is provided with a scale divided so as to show comparative times of exposure, and by its use radiographic work can be greatly facilitated.

It is interesting to note that the effect of the rays on the fluorescent screen, as estimated by the selenium cell, differs less with increasing distance the further the anti-kathode is from it:—

Distance of anti-kathode from apparatus Inches	Current recorded in milliamperes	Difference
6	0·33	—
8	0·27	0·06
10	0·22	0·05
12	0·20	0·02
14	0·18	0·02
16	0·16	0·02

A good deal of time has, I am afraid, been taken up in giving details of apparatus; but I will now show some of the results that have been obtained in practice. The selenium machines already referred to were operated between Paris, Manchester, and London until the end of the year 1908. The first photograph received (slide) was of King Edward, and was received at the *Daily Mirror* installation in November, 1907. Several results will now be shown in the lantern, and you will observe that they are all composed of parallel lines, which widen or "thin" according to the density of the picture. These lines correspond to the movement of the shutter attached to the strings of the Einthoven galvanometer, which regulates the thickness of the spot of light focussed on the revolving sensitive film. This spot of light traces a spiral line round the film, which, when developed, is laid flat, and the spiral becomes resolved into so many parallel lines.

Late in 1908 Prof. Korn introduced his telautograph, in which a Caselli transmitter, such as already described for the telectrograph, is used, and a line sketch or half-tone photograph is attached to the drum. The receiver is similar to that used in the selenium machines, a spot of light cast on a revolving sensitive film being shut off every time current flows through the wire of the galvanometer and displaces it; when displaced, the shadow of the wire falls over a fine slit placed in front of the film, and so prevents the light from passing through to it. A line sketch transmitted from Paris to London in this way is now shown (Fig. 2). The methods of synchronising the sending and receiving cylinders is the same as that used in

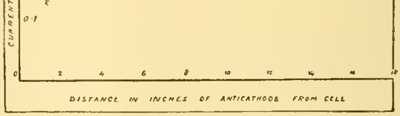


FIG. 9.

the telectrograph; but Prof. Korn's work was done prior to mine, and his arrangements were therefore copied by me. Similar methods have been adopted for many years, however, in certain systems of ordinary telegraphy.

There is a great deal of interesting matter connected with the efficiency of the galvanometer-receiving apparatus, and the vast amount of careful work done by Prof. Korn to increase it, which time quite forbids my mentioning; and I will therefore pass on to the latest phase of phototelegraphic work—the experiments now being carried out to effect wireless transmissions.

The wireless apparatus for transmitting sketches, writing, or simple photographic images over distances up to about fifty miles may perhaps be looked upon as rather rudimentary, but I shall be able to show, from actual results, that it is at any rate practicable, and it is certainly more simple than any method based on later wireless researches.

I will first show you an experiment, for the simplicity of which I must ask your pardon; but it illustrates so clearly how easy it really is to transmit a photograph by wireless under ideal conditions. I have here a small electric lamp, coupled up with the local side of a relay and battery, the relay being actuated by means of a coherer detector. At the other side of the platform there is a Morse key, which, when depressed, closes the primary circuit of an induction coil, the secondary being coupled up in the usual way to give oscillations. When I press the key, and thereby send a signal, you see that the lamp at once lights up. If the coherer be tapped, the lamp is extinguished, and another tap of the Morse key causes it to light again.

Now suppose that the taps of the Morse key were controlled by the lines in a photograph or sketch, and that the light from the lamp were concentrated on a revolving photographic film, and you will see at once how a photograph could be transmitted by wireless telegraphy.

Such a process would be utterly impracticable commercially, but my telectrographic system can be used with success in its place. A line picture prepared in the way already described is attached to the drum of the transmitter, and the intermittent current, which is ordinarily

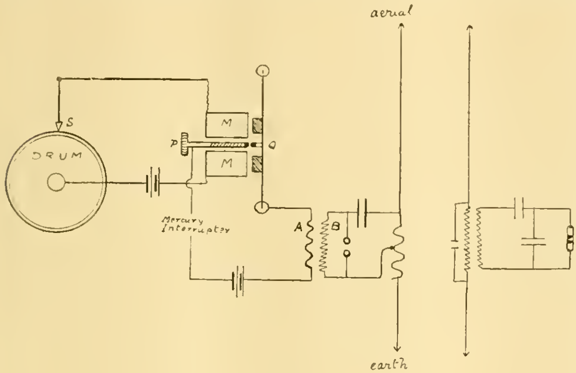


Fig. 10.

passed into the telephone line, goes into an electromagnet, M in Fig. 10, which then attracts a soft iron diaphragm attached to brass springs, which are fixed to two rigid supports. Every time current flows through the magnet coils this diaphragm is attracted to it, and the platinum contacts PQ are brought together; when the current flows, and PQ are in contact, the primary circuit of a transformer is closed, and the secondary having a spark gap and being inductively coupled to the aërial and earth, a signal is transmitted into space. Thus in the wireless transmitter the only difference from ordinary telegraphy lies in the fact that the length of the signals and their distance apart are regulated by the lines composing the sketch or photograph.

When working with high voltages in the primary, such as 110, arcing is liable to take place, and hence the distance between *p* and *q* when not attracted must be considerable. This means that the distance between the diaphragm clamps, *ss* in the figure, must be short, and the German-silver spring of which the diaphragm is made must be thick, these two conditions making the natural period of vibration very short. I have, however, found that by interposing a mercury motor-interrupter in the primary circuit, arcing is almost entirely avoided, as if an arc be formed the current is interrupted an instant later, and the arcing ceases in consequence.

The receiving apparatus is very simple, and depends, for short-distance work, upon a coherer cymoscope, the decohering apparatus being of a particular character. Every time an oscillation passes to the antenna, the coherer becomes conductive in the ordinary way, and a relay is actuated; this relay is usually made to start a hammer vibrating, the hammer hitting the coherer, and thus causing it to lose its conductive power. But a vibrating hammer is useless for the photo-telegraphic receiver, and it is essential to have one strike only on the coherer for each signal detected.

The form of apparatus I have employed for this purpose is seen diagrammatically in the next lantern-slide (Fig. 11). EE is the magnet which is actuated by the relay R. It then attracts an armature MN, which moves towards the magnet poles and brings a resilient hammer H, fitted with a platinum contact *p*, against the coherer. The coherer AB is also fitted with a collar F and contact pin, so that in the act of striking the coherer the hammer closes a local circuit, and so causes a black mark to appear on the chemical paper. Successive distinct marks can be obtained in 0·017 second in this way, which is considerably more rapid, I believe, than a decoherer was given credit for.

There is not sufficient time to show an actual transmission by wireless, and I should like to make it clear that only sketches of the simplest character are at present being transmitted; but, as you will see from the result thrown on the screen—a simple portrait of His Majesty the King—the images are recognisable, and merely require slightly more detail to make them quite comparable with the early results in line obtained by Prof. Korn's telautograph.

Another result shows a plan transmitted by wireless; here an island is seen represented, and a lighthouse—or it might be a fort—and by means of letters the positions of sections of an army on the island are supposed to be designated, while the shaded portion might mean that the "enemy" is in that part of the island. Such plans as these could be drawn direct in shellac ink on a slip of metallic foil, placed upon a portable machine coupled to a portable military wireless set, and communicated from one section of an army to another. The small portable machines I have already shown are used for the wireless transmissions, and they possess the advantage that "tapping" of the communications would be quite impossible. It is for this reason that I think the method would be of such value for military and naval purposes; even supposing that anyone wishing to intercept a plan or written message were to have an exactly similar instrument, with the same dimensions, screw-threads, and so on, by merely altering the rate of running by 5 or 10 per cent., according to prearranged signals, the picture as received by the intercepting party would be quite unintelligible and confused.

We have already seen that in the telegraphy of a picture by any system, accurate synchronising of the sending and receiving apparatus is essential. Where a metallic circuit links the transmitting and receiving instruments together, the matter is an easy one, and we have seen in what way it is effected. But when dealing with wireless work, the question of synchronism becomes more

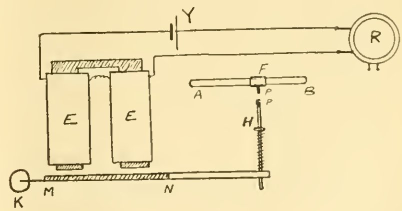


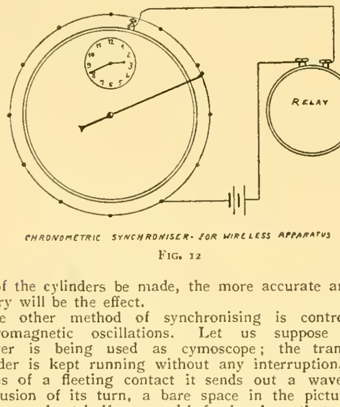
Fig. 11.

serious. I have employed two methods, each of which appears to answer satisfactorily, and as they are very important I will devote a few moments to their description.

The first method secures accurate synchronism independently of any wireless communication. You have already seen how, in the ordinary telegraphic work, the receiving cylinder is driven rather faster than the sending one, and when it finishes up a complete turn too soon it is arrested until the sending cylinder has caught it up, when the latter sends a reverse current, which is responsible for its release. But in the wireless apparatus both sending and receiving cylinders are driven too fast, so to speak—that is, they are made to revolve in $4\frac{7}{8}$ seconds instead of a nominal 5. A check comes into play at the end of the revolution, and the cylinder is stopped until the 5 seconds are completed, the motor working against a friction clutch in the ordinary way during the stop. At the end of the fifth second each cylinder is automatically released by chronometric means, in the manner shown in the next diagram (Fig. 12).

Here you will see that a special form of clock is used, with a centre seconds' hand which projects beyond the face by about an inch, and to the end of it is attached a brush of exceedingly fine silver wires. At every twelfth part of the circumference of the clock dial is fixed a platinum pin, and consequently every five seconds the little brush wipes against the convex surface of one of them. Each of these pins is connected with one terminal of a battery B, the other side of the battery leading to the relay R, as does also the centre seconds' hand. Therefore each time the brush wipes against a pin the circuit is closed, and the relay throws into action the local circuit connected up with the terminals TT. This circuit excites an electromagnet, which attracts an armature and pulls away the check which is holding back the cylinder. At the end of each 5 seconds the cylinders consequently recommence turning.

Well calibrated clocks of the pattern used will keep good time for the period taken to transmit a picture, one gaining on the other quite an inappreciable amount, depending on the friction of the brush against the pins. By this means the two cylinders are kept in very fair synchronism independently of any wireless communication, and the less the interval between the stopping and restart-



CHRONOMETRIC SYNCHRONISER. FOR WIRELESS APPARATUS

FIG. 12

ing of the cylinders be made, the more accurate and satisfactory will be the effect.

The other method of synchronising is controlled by electromagnetic oscillations. Let us suppose that a coherer is being used as cymoscope; the transmitting cylinder is kept running without any interruption, but by means of a fleeting contact it sends out a wave at the conclusion of its turn, a bare space in the picture being necessary about half a second beforehand, so that no waves are sent out for the half-second previously. The receiving cylinder is driven too quickly, and checked at the end of the revolution. It then, by means of a cam pressing down a spring lever, throws out of circuit the marking current, and brings into circuit the relay which actuates the electromagnetic release. Consequently, when the synchronising wave is received, the coherer causes the relay to work, the release is effected, and the receiving cylinder starts a new revolution in unison with the transmitter.

This means of synchronising is only possible in cases where a cymoscope is employed that is capable of actuating a relay, and you will therefore see that it is out of the question, except for short distances. I am therefore using the chronometric system already described in the apparatus, and it is being embodied in the quartz fibre apparatus I am now about to describe. I must first remark that the wireless work has been greatly facilitated by the courteous assistance so readily given by the Marconi Company.

The general form of the Einthoven galvanometer is well known, and the modified type of it used by Prof. Korn for photo-telegraphic purposes has been already shown. If, now, we make the magnetic field very much more intense by building the field magnets heavier, and using a large number of ampere turns in the winding, and also employ a "string," which is very much more elastic than the silver ribbon, the displacement of the string will be correspondingly greater. The silvered quartz fibre used by Duddell for this purpose gives an extremely sensitive instrument, and very appreciable displacement is obtained with the current from one dry cell passing through 35 to 90 megohms resistance.

It is not long since Prof. Fleming explained at this institution the valve receiver for detecting wireless oscillations; in ordinary wireless telegraphy, the minute alternating currents are rectified, and sounds are heard in the telephone in circuit owing to small unidirectional currents. If these currents be passed through the silvered quartz string of the galvanometer, the string is shifted. If, therefore, we cause a shadow of the string to lie over a fine slit, any displacement will cause the slit to be opened, as it were; the shadow will be shifted off the slit, and light will be free to pass through it. Oscillations corresponding to the lines in a photograph or sketch could therefore be utilised to cause shifting of the shutter in the manner I have already described for Korn's telautograph, and a sensitive photographic film could be revolved on a drum beind the slit to receive the picture. Such an apparatus is now in course of preparation; but the amount of light that passes through the slit is extremely small, owing to the fineness of the fibre. Mr. Sanger-Shepherd has therefore attached a minute shutter to the fibre, crossing the optic axis; this enables me to use a very much wider slit, and also to adopt the alternative procedure for reception, which you will now see represented in the diagram on the screen.

For photographic reception, the oscillation is passed into the valve detector, and thence to the quartz fibre AB, which is stretched across the field of the magnets (not shown), the poles of which are bored with a tunnel, through which the beam of light is directed. When the fibre is displaced, light is enabled to pass through a fine slit W, and so act on the photographic film. Where, however, the shutter is attached to the fibre, a much wider slit can be used, and then a pair of narrow compensated selenium cells SS are placed behind the slit W, a positive lens being interposed. When a signal corresponding to a dot in the photograph (*i.e.* the traversal of a line by the stylus) is received, the fibre shifts, light falls on the cells SS, and their resistance is decreased sufficiently to enable the battery E to actuate the relay R. This closes a local circuit, in which the telectrograph receiver is included, and a mark appears on the paper. In this way a visible record is obtained, which greatly facilitates the process.

Wireless photo-telegraphy may eventually prove of more utility than the closed-circuit methods, because it would bring America within reach of this country, and would enable communication to be made where telephone or telegraph lines did not exist. It is not limited to photographs—banking signatures, sketches, maps, plans, and writing could be transmitted. But I would point out most particularly that the work is as yet in the very earliest stages, and that in giving you some account of it to-night I may be bringing before your notice methods and systems on which a few years hence you will look back with a smile—as curious merely from a historical point of view.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE inaugural address on the occasion of the opening of the winter session of the London School of Tropical Medicine will be delivered by Prof. H. A. Miers, F.R.S., principal of the University of London, on Friday, October 14.

THE calendar of the faculty of medical sciences of University College, London, is now available. The college is a university centre for preliminary and intermediate medical studies, and its faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences); also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health and of pathological chemistry (post-graduate study). Prof. G. D. Thane is the dean of the faculty, and Prof. J. P. Hill the vice-dean. The calendar contains full particulars of the general arrangements for the coming session and of the scholarships and exhibitions open to competition.

THE following courses in illustration of recent progress in various departments of physical investigation will be delivered at the Royal College of Science (Imperial College of Science and Technology), South Kensington, during the autumn:—About ten lectures on "Colour Vision," by Sir William De W. Abney, K.C.B., F.R.S., beginning on Tuesday, November 8; about ten lectures on "Spectroscopy," by Assistant-Professor A. Fowler, F.R.S., beginning on October 10; about ten lectures on "The Internal-combustion Engine, illustrated by a Study of the Indicator Diagram," by Dr. W. Watson, F.R.S., beginning on October 13; about nine lectures on "Radio-activity and Electric Discharge," by Prof. the Hon. R. J. Strutt, F.R.S. The following courses, of about ten lectures each, will be given after January 11, 1911 (details to be announced later):—"Measurement of High Temperatures, and Optical Pyrometry," by Prof. H. L. Callendar, F.R.S.; "Magnetic Properties of Metals and Alloys," by Dr. S. W. J. Smith.

ON December 21, 1909, the London County Council decided to make a maintenance grant of 8000*l*. to the Imperial College of Science and Technology, South Kensington. In return for this grant it secures the privilege of nominating twenty-five students for one year's free instruction at the Imperial College. These are now to be filled for the first time. The instruction will be of an advanced nature, and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident in the administrative county of London, and must be students at an institution aided, maintained, or approved by the Council. The free studentships do not entitle the holders to any maintenance grants, but cover all ordinary tuition fees. No examination will be adopted for the final selection of the students from the applications received. The free studentships will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. It is quite possible that, in special cases, the free places may be extended to two or more years. Owing to the summer recess, it has been decided to accept entries for the free places until Saturday, October 1. Application forms (T. 2/268) can be obtained from the Education Officer, London County Council, Victoria Embankment, London, W.C.

THE new University of Queensland is now inviting applications in England and Australia for four professorships, in classics, in mathematics and physics, in chemistry, and in engineering. The selection committees will enter on their duties at the end of this month, and it is expected that the men who are to be the nucleus of the first staff of the University will be ready to begin work in the new year. The inauguration of the University was held on the fifteenth of last December, the fiftieth anniversary of the day when Queensland first became a self-governing colony. The event was the occasion of a very large gathering at Government House in Brisbane, when the Premier, Mr. Kidston, announced that his Government had set aside 50,000*l*. to meet initial costs; that 10,000*l*. a year was to be provided for working charges; that the historic building where the meeting was held, together with its beautiful grounds and gardens, was to be dedicated to university purposes; and, finally, that a large number of scholarships, including research scholarships, were to be offered to students. The unveiling of the commemorative tablet was one of the first acts performed by Sir William MacGregor in his capacity as Governor of Queensland. With one exception, all the Australasian States have now placed universities at the head of their educational systems, and it is expected that Western Australia will soon follow the example of her sister colonies. Considering the youth of these States—Queensland herself is only celebrating her jubilee—this is surely a very notable thing. Moreover, some of these universities are magnificently endowed and equipped, and all of them exercise considerable and fast-growing influence over the thoughts and the material progress of the countries which they serve.

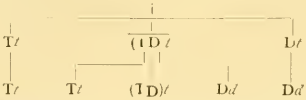
THE address on schools of dyeing, delivered by Mr. S. H. Higgins to the Manchester section of the Society of Chemical Industry last March, has been reprinted from the journal of the society, and a copy has reached us. Mr. Higgins thinks that British schools compare very favourably with those in other countries. England does not, he maintains, occupy a second place to Continental schools so far as equipment is concerned. Moreover, to quote from the paper, he says,—"In Germany the schools are not very particular as to the quality of the student they admit; they make an effort to get as many as possible. It has been said that students from the high schools pass through the schools of the Crefeld type before entering industry; but such cases are exceptional, as these men have other outlets for their training. A student from a technical high school does sometimes find his way into a trade school, and then the authorities show their delight; they do not say anything as to the educational standard of the bulk of their students. The technical high schools themselves are known to accept in their specialised technical chemical laboratories students who have had little previous chemical training. The volunteer departments of the German colour works are now much patronised in place of the schools mentioned, but it must be remembered that the training obtained in these departments, although good, cannot be a substitute for attendance at technical schools." The tone of the address is optimistic throughout, and by way of summary the address states:—"The dyeing schools of other countries do not compare with those at, *e.g.*, Leeds, Manchester, Bradford, and Glasgow, and even with many others of lesser importance in these islands. Just as we lead in the production, preparation, dyeing, bleaching, printing, and finishing of textiles, so also is this lead maintained as far as the technical instruction applied to these industries is concerned. Also it must be said that there is little difference between the positions of England, Germany, and America as regards the appreciation which manufacturers show of the training received at these institutions." In the discussion which followed, the principal of the Manchester School of Technology said he had more respect for the school at Crefeld than Mr. Higgins, and went on to emphasise the fact that in nine German technical high schools there were 13,500 students, none of whom were under eighteen years of age, while in ninety-nine English institutions, including the science sides of the universities, and students from fifteen years of age and upwards, they did not reach more than 5000 a few years ago. The greater number of students in technical schools in Germany were undoubtedly men who had passed the gymnasia or the Ober-Real Schule, where they remained until they were at least eighteen years of age. The technical schools in this country had comparatively few students in the daytime. The preparation of the student made all the difference.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, July 18.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—Francis J. **Lewis**: Plant remains in the Scottish peat mosses, part iv. Four areas are considered: (1) the Shetland Islands; (2) Poolewe district in Ross-shire; (3) Rhilochan district of east Sutherlandshire; (4) raised beaches at Ardgour and Banavie, with an appendix on some peat areas in south-west Iceland. In the Shetland deposits there are two peat growths at two distinct periods, the earlier being stratified, the newer not. Special attention was paid to the position and the flora of the forest bed, the wide distribution of well-grown trees of birch, alder, and mountain ash in districts now quite devoid of trees, indicating a decided change in meteorological conditions. Evidence was brought forward that the first and second Arctic beds and the lower and upper forest are true datum lines traceable through extensive areas in Scotland. The view is taken that the first Arctic bed, the lower forest, and the second Arctic bed represent distinct climatic phases during early post-Glacial times.—Dr. D. Berry **Hart**: The validity of the Mendelian theory. In Mendel's well-known experiment of the crossing of the tall and dwarf varieties of pea, the first generation of plants gave all talls, and these when self-fertilised gave *somatic* talls to dwarfs in the ratio of 3/1. The dwarfs then bred pure, while the somatic talls gave pure talls and impure talls in the ratio of 1/2, and so on. The tall character being called dominant and the dwarf recessive, the question has to be answered, "How is the recessive quality represented in the plant of the first generation?" By regarding the plant as having a propagative and somatic part, and the oospore or zygote as having a part set aside for the propagative and one for the somatic part, Dr. Hart proposed to amend the Mendelian scheme as follows. Using TD to represent the tall and dwarf propagative parts, and *td* their somatic parts, then T*t*, D*d* will represent pure talls and dwarfs respectively. In the first generation of plants only *t* is present, although T, D both exist pure or mingled. Hence the following scheme:—

Egg-cells of Dwarf × Pollen Grains of Tall.



All the Mendelian ratios are satisfied. The answer to the question, "Where is the recessive quality in the first generation?" is that it is present pure in the propagative part of a quarter of the zygotes, present along with the tall determinants in a half, and not at all in the somatic part of the zygotes. The unit characters segregate out in the Mendelian ratio in plants because the determinants of these combine in the propagative part by the law of frequency. This explains why biometric results, measurements of organs, &c., follow the law of frequency or some modification of it.—Dr. John **Aitken**: Did the tail of Halley's comet affect the earth's atmosphere? The measurement of the number of dust particles during the passing of Halley's comet was made in the West Highlands at a place where in previous years Dr. Aitken had made a series of similar measurements. Some curious results regarding the prevalence of haze during May of this year were obtained, but none of these could be connected with the comet.—Sir David **Gill** exhibited some photographs of the comet which had been taken in the Transvaal just before the comet passed in front of the sun.

PARIS.

Academy of Sciences, August 8.—M. Boussinesq in the chair.—H. **Deslandres**: The properties of the polar filaments of the sun. As the sun-spots diminish, the filaments at the centre are also reduced, but the filaments round the poles remain. The causes of this are discussed.—Ch. **Lallemand**: The changes of level caused by the Messina earthquake. The changes of level produced by the earthquake are shown on a map of the Messina and Reggio districts. In the neighbourhood of these two towns the displacement is about 60 centimetres.—A. **Laveran** and A. **Pettit**: An epidemic disease in trout. This disease has been proved to be identical with the *Taumelkrankheit* of B. Höfer, and is caused by a parasitic Protozoa, resembling *Rhinosporidium kinealyi*, described by Minchin and Fantham.—Alfred **Picard**: The floods in the basin of the Seine during January and February, 1910. Remarks on the report of the committee on the Paris floods. A comparison of this flood with earlier inundations, and a discussion of the various proposals for preventing a recurrence.—A. **Perot**: The rotation of hydrogen in the solar atmosphere. The results obtained by the application of the interferential method accords with observations recently published by Hale.—G. **Darmois**: Correspondences with concurrent normals.—R. **de Saussure**: Concerning a reclamation of priority by E. Study.—H. **Larose**: The problem of a cable with transmitter.—Gabriel **Sizes** and G. **Massol**: The vibration of a tuning-fork. Rotating vibrations. The fork has two sets of vibrations, one in the plane parallel to that of the prongs and the other perpendicular to this plane. From these two as fundamentals, sixteen notes are produced.—G. **Austerweil** and G. **Cochin**: Certain causes of geranium smells. A study of the connection between smell and composition. The results are applied to the question of the formula of nerol.—G. **Friedel** and F. **Grandjean**. Lehmann's anisotropic liquids. The authors regard the conception of these fluids as liquid crystals as erroneous; they should be considered as representing a new state of matter as different from the crystalline state as an ordinary isotropic liquid.—H. **Hérissey**: The preparation of pure arbutine. The arbutine of commerce is a mixture of arbutine with its methyl homologue. A method of separating these two substances is described, based on the conversion of the arbutine into a potassium salt, insoluble in alcohol.—C. **Tanret**: The relations between callose and fungose. In opposition to the views recently expressed by M. Mangin, the author regards callose and fungose as distinct substances.—Raoul **Bayeux**: Experiments made on Mt. Blanc in 1909 on the variations of glycemia and hematic glycolysis at very high altitudes.—C. **Jouan** and A. **Staub**: The presence of hæmolytic and bacteriocidal alexine in the plasma of birds.—Charles **Nicolle** and E. **Conseil**: Some new experimental data on exanthematic typhoid.—Ed. **Retterer** and Aug. **Lelièvre**: The epithelial origin and development of Peyer's patches in birds.—Armand **Dehorne**: New interpretation of reduction in *Zoogonus mirus*.

CONTENTS.

PAGE
Internal-Combustion Engines 197
Structure and Distribution of Ore Deposits. By J. W. G. 198
The Sugar-cane and its Products. By W. G. F. . 199
The Psychology of the Will 199
A Book of Characteristic Fossils 200
Metallography 200
Exercises in Physical Geography. By G. G. C. . 201
Our Book Shelf 202
Letters to the Editor:—
Wiltshireite: a New Mineral.—Prof. W. J. Lewis, F.R.S. 203
The Nomenclature of Radioactivity.—Norman R. Campbell 203
Perseid Meteoric Shower, 1910.—W. F. Denning . 204
Brilliant Meteor of July 31.—Father A. L. Cortie, S.J. 204
On Colour Vision at the Ends of the Spectrum. By the Rt. Hon. Lord Rayleigh, O.M., F.R.S. . 204
More Antarctic Natural History. (*Illustrated.*) . . 205
Atomic Weights. By T. E. T. 207
Tests for Colour Vision By N. B. H. 208
Greenwich Watch and Chronometer Trials . . . 210
Notes 210
Our Astronomical Column:—
A New Comet 213
Observations of Comets 213
Observations of Mercury 213
Dispersion of Light in Interstellar Space 213
Anomalous Scattering of Light 214
The Spiral Nebula M51 (Canum Venaticorum) . . . 214
Supplement to the "Astronomische Nachrichten" . 214
The First International Congress of Entomology 214
The Fifth International Congress of Photography. By C. J. 215
The Origin and Classification of Mammals. By R. L. 216
The Mineral Survey of Peru. (*Illustrated.*) By G. A. J. C. 217
New Process for Producing Protective Metallic Coatings. (*Illustrated.*) 218
The Galitzin Seismograph. By G. W. W. . . 218
Recent Agricultural Publications in Great Britain 219
The Educational Value of the School Garden 220
The Telegraphy of Photographs, Wireless and by Wire. (*Illustrated.*) By T. Thorne Baker 220
University and Educational Intelligence 226
Societies and Academies 227

THURSDAY, AUGUST 25, 1910.

RECENT AERONAUTICAL PUBLICATIONS.

(1) *The Art of Aviation. A Handbook upon Aëroplanes and their Engines, with Notes upon Propellers.* By R. W. A. Brewer. Pp. xiii+254+12 plates. (London: Crosby, Lockwood and Son, 1910.) Price 10s. 6d. net.

(2) *How to Build an Aëroplane.* By R. Petit. Translated by T. O'B. Hubbard and J. H. Ledeboer. Pp. xiii+118. (London: Williams and Norgate, 1910.) Price 2s. 6d. net.

(3) *How to Build a 20-foot Biplane Glider.* By A. P. Morgan. Pp. 60. (New York: Spon and Chamberlain; London: E. and F. N. Spon, Ltd., 1909.) Price 1s. 6d. net.

(4) *Les Aéroplanes, considérations théoriques.* By P. Raybaud. Pp. 24. (Paris: F. Louis Vivien, 1910.) Price 1 franc.

(5) *Ballons et Aéroplanes.* By G. Besançon. Pp. 346. (Paris: Garnier Frères, 1910.) Price 1.75 francs.

(6) *L'Aviation.* By Prof. Paul Painlevé and Prof. Emile Borel. Pp. viii+266. (Paris: Felix Alcan, 1910.) Price 3.50 francs.

(7) *Navigation in der Luft.* By Prof. A. Marcuse. Reprinted from the *Denkschrift der ersten Internationalen Luftschiffahrts-austellung zu Frankfurt a. M.*, 1909. 1., pp. 46–59. (Berlin: Julius Springer.)

(8) *Stabilitié des Aéroplanes, Surface métacentrique.* By Prof. M. Brillouin. Reprinted from the *Revue de Mécanique*, 1909. Pp. 80. (Paris: H. Dunod and E. Pinat, 1910.)

(9) *Die Seitensteuer der Flugmaschinen.* By Prof. H. Reissner. From *Flugtechnik und Motorluftschiffahrt*, 1910, 8, 10. (Munich and Berlin: R. Oldenbourg.)

(10) *IV. Congrès international d'Aéronautique*, 1909. *Procès verbaux, Rapports et Mémoires.* Pp. iv+473. (Paris: H. Dunod and E. Pinat, 1909.) Price 8 francs.

(11) *Bibliography of Aëronautics.* By Paul Brockett. Pp. xiv+940. (Washington: Smithsonian Institution, 1910.)

(12) *Petite Encyclopédie aéronautique.* By L. Ventou-Duclaux. Pp. 144. (Paris: F. Louis Vivien, 1910.) Price 1.75 francs.

(13) *The Encyclopaedia of Sports and Games.* Edited by the Earl of Suffolk and Berkshire. New and enlarged edition, in monthly parts. Part i., pp. 80, with numerous plain and coloured illustrations, including article "Aëronautics." (London: William Heinemann, 1910.) Price 1s. net each part.

THE present season has been, so far as aviation is concerned, a record of brilliant successes and terrible calamities. The recent fine performance of Mr. Moisant in flying from Paris to near Dover forms the fourth cross-Channel record, the preceding one being the late Mr. Rolls's flight to France and back without a stop on June 2. Mr. Moisant's performance differs from the previous ones in that he carried his mechanic as a passenger, and that he steered his entire course by compass, not having been over the ground before. His flight was not performed under by any means ideal weather conditions, for within a few miles of the English coast he ran into a rainstorm, which, owing to the high relative velocity at which the machine was being driven, or, as a newspaper reporter imagined, "with the high wind prevailing coupled with the speed at which the aëroplane was travelling" beat on the aviators' faces and on the machine with the violence of hail. Again, when approaching the English coast, the machine is stated to have been sucked down from 800 to about 200 feet, as the result of air currents set up by the cliffs. And while the Holyhead to Dublin course still awaits completion, it cannot but be said that Lorraine's preliminary flight from Blackpool to North Wales was an excellent performance, and it is quite possible that the Irish Channel may be crossed before this review is actually printed.

On the other side, we have a terrible list of fatalities, and the mere smash up of a machine that has cost hundreds to build has become a matter of such everyday occurrence as to confirm the view often expressed by the present reviewer, that it would have been better, cheaper, and probably quite as quick in the long run to have first got everything done that could be done in studying the problem of aviation by the methods of exact science and to have developed the practical side subsequently.

Mr. Brewer's book has only been out a short time, the preface being dated April, 1910, and yet in his introduction he directs attention to the small loss of life that has been incurred in the development of flying machines. The tide of good fortune would certainly seem to have recently turned, as we have before us records of no fewer than eleven deaths through accidents with either balloons or aëroplanes during the month of July, while the preceding three months claimed a death-roll of twenty-eight or more. The *Standard* of July 13 gave a list of eleven fatal accidents precedent to the death of Mr. Rolls, commencing with Lieutenant Selfridge in 1908, and not including previous fatalities, such as those of Lilienthal and Pilcher, and the death of the Marchese Vivaldi Pasqua has just been announced, following on a series of fatal accidents in Belgium, America, and elsewhere.

The fact that Mr. Brewer (1) has acted as assistant to Mr. Grahame White will probably secure for his book a large circulation, but for the more intelligent reader a greater recommendation probably arises from the fact that the author has concentrated his attention mainly on those features of the aviation problem on which he is most competent to speak with authority as the result of practical experience, namely, the structural details of aëroplanes, propellers, and particularly of internal-combustion engines. In fact, an important feature of the book is that we find here illustrated descriptions of the main features of the principal types of motor, such as the Antoinette, Gnome, Panhard, Wright, and similar information regarding the different leading types of monoplane and biplane. To add to the completeness, tables are given showing the numerical data (dimensions, weight, horse-power, speed, and so forth), both in regard to motors and aëroplanes. The reader can see at a glance what the present position is with regard to details of construction.

The book is a compilation of useful information, and not a mere exposition of the author's fads; in fact, it is conspicuously free from dogmatic expressions of opinion. Indeed, the author carefully states that "it is not intended that an aëroplane could be designed upon the data contained herein." He has, however, directed attention clearly to the great improvements still required in those details of construction with which he is most conversant. For example, he says:—

"The study of aërial propellers is only in its infancy, and an enormous amount of experimental work remains to be done. The efficiency of present-day designs is abnormally low, and in many cases not more than 50 per cent."

Again, in the chapter on "future developments," we are told:—

"The depreciation of the 1909 flying machine is enormous, the life of the engine is seldom more than 200 miles; in some cases it is a very few miles indeed, and breakdowns or seizures are a constant evil."

The author believes in an internal-combustion turbine. This might obviate the rotatory inertia of the present Gnome motor, which must affect the steering by its gyroscopic action. "Strength of materials" also receives discussion, and derives additional interest from the fact that it is a moot point whether defect in this respect or instability was the cause of certain recent fatalities. Mr. Brewer believes that the flying machine of the future will, like a ship, have living accommodation for passengers and crew; and had he permitted himself to go a little outside his own speciality he would have seen that a necessary condition for progress is the abolition of "ailerons," "gauchissement," or "warping." But the author very wisely fights shy of stability considerations, though he has, on the other hand, an instructive chapter on the art of flying, in which he says:— "Mr. Rolls has described the initial sensations as those received in driving a motor-car which is skidding in all directions at once."

The details of Henson's model of 1843 show that the conception of an aëroplane is by no means new, but that the want of a sufficiently light and powerful motor is the obstacle which has hitherto prevented its realisation.

As the author carefully disclaims any attempt to deal with mathematical considerations, one cannot, of course, take very serious exception if the few references which he gives are occasionally inaccurate or obscurely stated. It will be sufficient to take a few examples. On p. 12 he says, when speaking of the components of pressure he refers to the lift, as one of them, "and that, acting in a horizontal direction to overcome the skin friction of the machine, this is called the drift," forgetting that in an inclined plane drift exists independently of skin friction. On p. 15 he states Joessel and Avanzini's formula for the centre of pressure, and proceeds to explain that the coordinate of this point has a maximum value—a conclusion at variance with the formula in question. In the next sentence he speaks of "conditions of stability" where equilibrium is meant. On p. 87 he reminds us of the Irishman who said, "There were five of us; there was myself, that's one, there were the two Flynns, that's two, there was Mike Murphy, that's three," and so on. For of the "five variables" in propeller design, the first is "the speed of the machine and the power available." (This is, however, a trivial objection.) On p. 20 he says that the sum of the sine of a certain angle and the tangent of another angle may be written down as twice the sine or tangent of either angle; but there is no evidence that the angles are meant to be equal or nearly so. And the statement of von Loessl's law of resistance (p. 236) gives $P = P_0 \sin \alpha$, whereas on p. 15 we have $P = 2P_0 \sin \alpha$ with α small.

Criticisms of a similar character apply with greater force to M. Petit's book (2), for which we have to thank Messrs. Hubbard and Ledeboer, editors of the *Aëronautical Journal*, for an English translation.

It would have been better if M. Petit had confined his attention to the theme described by the title "How to Build an Aëroplane," and had not trenched on dangerous ground of a theoretical character. To begin with, the author bases his discussion of thrust on a moving plane on Wegner von Dallwitz's formula. According to this the thrust varies as the tangent-squared of the angle of attack. When this angle is small the thrust would thus become a quantity of the second order of small quantities, and the law would approximate to the "sine-squared" law originally proposed by Newton. That this result is not in accordance with experiment has been sufficiently shown by Langley and others. If in order to cut matters short it is necessary to confine the discussion to one theory of air resistance, the choice is therefore a bad one. English readers will do well to remember that tg stands for tangent, otherwise the printing of this in italics, while sin and cos are in Roman type, may mislead them.

On pp. 22–36, in discussing lateral stability, the author falls into a very common error in regard to the effects of varying the height of the centre of gravity, and when his treatment of the subject contains such statements as that "this application of the centre of gravity is shown in elementary physics by the pendulum," misunderstandings are likely to arise. In reality equilibrium and stability are but little affected by raising or lowering the main planes relatively to the centre of gravity, or, what is the same thing, lowering or raising the centre of gravity relatively to the main planes. If the resultant pressure always acts along a perpendicular to the main planes through their centre of pressure, and if this perpendicular passes through the centre of gravity, it will continue to do so when the aëroplane receives an angular displacement, and there will be no moment tending to right the machine. In this respect an aëroplane differs from a pendulum and a balloon. The matter is a little difficult to make clear, and will probably have to be explained elsewhere at greater length than is possible in this review; for this reason it is useful to have a name for the result, and I call it the Principle of Independence of Height. It is, of course, liable to modification in consequence of skin friction and other causes. In the meantime, it is an error, into which it is easy to fall, to imagine that because the weight has a moment about the centre of pressure, the aërodrome will swing about that point. It will acquire angular momentum about that point by slipping sideways without rotating. To examine the tendency to rotation, moments must be taken about the centre of gravity.

The mistake was indeed a very excusable one, but the wording of such statements as

"The force G_1E and the angle ϕ produce a component O_1D." "Which is the best way to obtain a low centre of gravity? The oldest method was to arrange the planes so that they formed an obtuse dihedral angle,"

hardly tends to make matters clearer.

The book contains much descriptive matter regarding motors, the fuselage, and methods of starting and landing, but the author would have been more convincing if he had been less dogmatic in the chapter on "The Future" in his attacks on the ornithopter and helicopter, and his claims for the monoplane as against the biplane.

We hope the criticisms contained in this review will not deter Messrs. Hubbard and Ledeboer from making further contributions to our aëronautical literature. So many books have recently appeared in France of about the same size and character as "How to Build an Aëroplane" that English translations are at present particularly useful in giving some insight into the state of progress on the other side of the Channel.

Theoretical considerations of all kinds have been carefully avoided in Mr. Morgan's little book (3), which deals purely with the details of construction of a biplane glider. Now that public attention has been centred on record-breaking flights, it is peculiarly important that the initial requirements for "learning to fly" should be brought before our notice, and the author strongly emphasises in his preface the fact that all our most successful flyers have commenced with gliders before taking to motor-driven machines, the Wright brothers having spent no fewer than three years in gliding flights. The author shows how anyone can build a glider of the type developed by Octave Chanute at a cost for the materials of about *2l.* or *3l.*, and it is much to be hoped that the book will induce would-be aviators to start in the right way.

M. Paul Raybaud's pamphlet (4) of twenty-four pages is intended to advance certain views regarding air resistance, such as, for example, that the air resistance on a moving surface does not act normally to the surface, but in a direction determined by the law of equality of action and reaction, that the centre of pressure of a plane area is fixed relative to the plane, that if any area is projected on a plane perpendicular to the line of relative motion, the projection of the centre of pressure is the centre of pressure of the projection (p. 9), and so forth. The arguments are of a superficial character, such as "it is evident" (p. 9), and when it comes to explaining the behaviour of a plane let fall obliquely (p. 13), he is compelled to introduce a force Q, which is statically equivalent to admitting a shifting of the centre of pressure, contrary to the previous statements.

Histories of balloons have been published in France at various times, some of them illustrated by grotesque figures of flying machines imagined or proposed. M. G. Besançon has now given us, in a small pocket-book (5), a pretty complete history of the actual development of aërial navigation from Galileo's experiments on the density of the atmosphere and Montgolfier's discovery of the balloon down to Blériot's cross-Channel flight. The first section, which deals with balloons, contains a brief account of the construction of their envelopes, of motors and propellers, and a reference to the advantages and disadvantages of various gases for the purpose of inflation.

Profs. Painlevé and Borel (6), on the other hand, condense their historical introduction into the first twenty pages, where they divide the history into four periods, namely, the legendary period, the heroic period, the scientific period, and the industrial period. They discuss the laws of air resistance, and briefly refer to the well-known controversy on the sine law *versus* the sine squared law, and the discussion embraces not only aëroplanes, but also bird-flight, ornithopters, and helicopters. Stability is referred to, but not at great length; the property which we have described as the principle of independence of height is, however, mentioned. In an appendix of more than eighty pages, certain elementary applications of mechanical principles are discussed at greater length than would be possible in the text.

The term "aërial navigation" is now used in so wide a sense that it is necessary to explain that Prof. Adolf Marcuse's article, "Navigation in der Luft" (7), deals with navigation proper, or the steering of a dirigible by means of charts and geodetic and astronomical observations. It is a general summary of progress made up until the autumn of 1909, in a subject which is much studied in Germany, but is altogether neglected in England. The author distinguishes three methods of place-determination, giving rise to terrestrial, astronomical, and magnetic navigation; of these the first three will be readily understood, while the third embraces not only steering by the compasses, but the determination of position by observation of the magnetic elements and the use of magnetic charts.

We now come to two papers which represent substantial progress in developing mathematical theories of equilibrium and stability. Prof. Marcel Brillouin's paper on metacentric curves and surfaces (8) is an important contribution to the theory of statical equilibrium and stability. When an aëroplane is moving uniformly and the lines of action of the resultant thrust are plotted relative to the aëroplane for different inclinations of the relative wind these lines will envelop a curve which the author calls the metacentric curve. Diagrams are given of these curves for different arrangements of two planes, showing that they are of very varied forms, and furnished, as a rule, with eight cusps, four of which correspond to grazing incidence of the air on one or other plane. Into the relative uses of statical and dynamical methods of approaching the problem of stability it is not necessary to enter at great length, although Prof. Brillouin refers to this question in the introduction. It must be pretty evident to anyone who has studied the problem that both methods must be pushed to their ultimate conclusions before aviation is reduced to an exact science; and further, our 1904 papers on dynamical stability were never intended to be final. What Prof. Brillouin has done is to reduce materially the amount of work still remaining to be done in a field of investigation of a new and difficult character.

Exactly the same remarks apply to Prof. Reissner's article (9). The steering of aëroplanes in turning curves is a difficult problem, which up to the present has not received the attention that it deserves, with the result that a great deal of an aviator's attention is devoted to counteracting the tendency of aëroplanes to turn in circles, or sometimes, not improbably, to describe spirals with decreasing convolutions until, if unchecked, they would twizzle round and fall like the seeds of certain trees. In fact, as Dr. Reissner himself points out in his introduction,

"on the motion in a curved path we find only meagre references, in which it is only attempted to satisfy one equation of equilibrium, instead of considering the six, as is necessary with every body moving in free space."

Dr. Reissner has used approximate methods; for example, in places he assumes the radius of the curve to be large. Anyone working at problems of this class will realise the necessity of employing such methods of approximation in order to reduce the mathematical work to a minimum in the early stages of the investigation. When one is thoroughly familiar with the simplest solutions, it becomes much easier to take account of modifications in which some of the terms previously neglected are re-introduced.

While on the subject of steering, it is interesting to refer to the Dunne biplane, of which a short account is given in the *Aëronautical Journal* for July, and of which a noticeable feature is that the planes actually have a negative angle of attack near the tips, so as to receive a downward pressure there. It is evident that by such a method it is possible to counteract the tendency of most aëroplanes to heel over excessively to the inside when rounding curves without making the lift vanish.

The report is before us (10) of the fourth International Congress of Aëronautics, which met at Nancy from September 18 to 23, 1909. The attendance at this congress was smaller than one might have expected, the membership list containing just over seventy names, but including Government delegates from the United States, Belgium, France, Italy, and Russia. The congress was divided into three sections, of which the first, devoted to aërostation, appears to have given considerable attention to aëronautical cartography and navigation proper. In the reports of the second section (aviation) we find discussions of propeller-thrust, laws of air resistance, the efficiency of motors, and other matters of like character, while the third section was devoted to scientific and other questions of a somewhat more miscellaneous nature.

The interest of the Smithsonian Institution in aëronautics dates almost from the commencement of its work, and this interest has been greatly stimulated through the secretaryship of the late Dr. Samuel Pierpont Langley, who brought with him to the institution the nucleus of a library of aëronautical literature. A most fitting memorial or tribute to his services to aëronautics is afforded by Mr. Paul Brockett's "Bibliography of Aëronautics" (11). While primarily intended as a catalogue of the material contained in the Smithsonian collection, this volume of 940 pages will prove a valuable—perhaps an indispensable—work of reference in the hands of every student of aëronautics.

A work of reference of a rather more popular character is M. Ventou-Duclaux's "Petite Encyclopédie aéronautique" (12). The reader who wishes to follow intelligently the records in the daily Press of aviation meetings and fatalities requires some information regarding the meaning of such terms as Gnome motor, carburettor, Curtiss biplane, Panhard motor, centre of pressure. All such expressions he will find explained if he consults this little dictionary. For some reason "Virage" does not occur.

The "Encyclopædia of Sport" (13), which is to be completed in thirty parts, opens with an article by Lord Montagu of Beaulieu on aëronautics. It contains a good, popular account of the subject, well illustrated by photographic reproductions of the chief aëroplanes and dirigibles, and of most of the "record" flights, such as Blériot's Channel flight, Paulhan's Manchester flight, and the flights of the principal French and German military dirigibles. The other articles in this number are on "Alligator," "Ammunition," "Angling," "Antelopes" (the last unfinished).

In the *Revue des Sciences* for June, 1908, Captain Paul Renard discussed the problem of the dirigible balloon. In the issues for April last he has given a couple of general articles on the problems of aviation.

Mr. Walter Child, of 35 Alfred Place West, London, S.W., has printed on a small card a diagram showing graphically the results of a new determination of the position of the centre of pressure of a lamina (a rectangular plate of magnalium) for varying angles of attack. According to him the centre of pressure approaches the front edge when the angle of attack vanishes. The method employed was to poise the plate on any assumed axis, to revolve it on a whirling table, and to read off the angle after the plate has come to the position of equilibrium. It may be mentioned that a rough and ready way of demonstrating the shift of the centre of pressure is by loading a rectangular glider and balancing it upon a finger, so that the centre of gravity occupies a known position, and then ascertaining by trial at about what angle the glider will fly if suitably projected. Mr. Child would have been wise to state the length and breadth of his lamina, and in view of the divergence of opinion regarding the limiting position of the centre of pressure for vanishing inclination, and the probable influence of skin friction, careful examination of the conditions of experiment seems desirable.

We have before us a prospectus, issued last April, of "Aviation Investment and Research, Limited," promoted with a share capital of £100,000, with Major J. A. Meldon and Mr. Ernest Dawe, 33 Southampton Street, as secretaries, a venture the progress of which will be watched with considerable interest.

If there is one inference to be drawn from a survey of the papers mentioned in this review, it is that a large amount of attention has been given to the application of the statical formulæ, $X = R \cos \alpha$, $Y = R \sin \alpha$, to problems of lift and drift, but that the other equations of equilibrium or of motion of a solid body have been until now largely left to chance, the skill of the aviator being made to take the place of exact mathematical calculation, with uncertain results. It may be safely stated, however, that the time is not very distant when "equilibrium and stability of aëroplanes" will become a subject suitable for courses of lectures in the mathematical departments of our universities. G. H. Bryan.

ECONOMIC MYCOLOGY.

Fungous Diseases of Plants; with Chapters on Physiology, Culture Methods, and Technique. By Prof. B. M. Duggar. Pp. xii+508. (London: Ginn and Co., n.d.) Price 8s. 6d.

Prof. Duggar's book, although intended primarily for the student in the United States, will be welcomed by the plant pathologist in all countries.

The plan on which the book is arranged is excellent, and the subject-matter is illustrated with 240 drawings and photographs, which are almost all good, while some of the photographs of diseased plants (especially those taken by Prof. H. H. Whetzel) stand out with an excellence which could not be surpassed. In the first fifty pages a full and lucid account is given of isolation and pure-culture methods and the technique of fixing, imbedding, and staining; this is followed by chapters on various physiological phenomena, such as the requirements of fungus spores for germination, aspects of parasitism and saprophytism, and so forth, concluding with a valuable chapter on environmental factors. A short chapter deals with the "principles of disease control," including the preparation of fungicides. This chapter might with advantage have been amplified, and information given on such points as the strength of Bordeaux mixture to be used in potato spraying, the nature of the spray required in the various washes, and the main types of spraying machinery. The information given concerning the lime-sulphur wash is too scanty to be of much practical value. With regard to the fungicidal action of Bordeaux mixture, the statement is made:—

"It has been fairly well demonstrated that the germinating spore will absorb from the nearly insoluble copper compounds of Bordeaux mixture sufficient toxic substances to cause its death."

No account is given of the legislative control of plant diseases, an omission which should be rectified in any future edition. America was the first country to take State action in this direction, and many inter-State regulations controlling the spread of diseases are now in force. At the present time the Government of the United States is considering the best means of putting into force an Act to secure the examination of all plants at the ports of entry in order to prevent the importation of fungus and insect pests.

The remaining part of the book, consisting of 400 pages, describes the various species of fungi and bacteria which are known to cause injury to plants of economic importance in America. The aim of the author has been, in the treatment of each disease, to keep in view three considerations—(1) to describe the pathological effects and other relations of host and parasite; (2) to make clear the life-history of the organism causing the disease; and (3) to indicate the methods of prevention and control. A short bibliography, which will be very valuable to the student in other countries besides America, precedes the account of each disease.

Considering the amount of information which is given on so large a number of diseases, the suggestion that some of the more important diseases might have been given a fuller treatment must seem somewhat ungracious. It is, however, unsatisfactory for a student to be merely told, *e.g.* concerning *Botrytis cinerea*, that "much interesting biological work has been done upon this fungus." The bare statement that follows, viz., "infection frequently fails when conidia germinate directly upon the surface of delicate parts," is likely to be somewhat misleading, since it is not qualified by any reference to the results obtained by Kissling (whose name is quoted in the bibliography), which demonstrated that certain plants can be easily infected in this way. One or two omissions in the list of diseases may be noticed. The mildew (*Sphaerotheca humuli*) which attacks the hop and other plants (but not the rose) in Europe is in the United States commonly found attacking the leaves of roses; no mention is made of this disease, the "mildew" of the rose being attributed entirely to *S. pannosa*, which, in the States, is apparently the less common of the two species. It is curious to find no reference to the "mildew" of the cultivated hop. Another omission is the "covered smut" of barley (*Ustilago hordei*), which is not uncommon in the States. The "crown gall" of lucerne (*Urophlyctis alfalfae*) is found, not only "in South America and Germany," but is known also in Switzerland and Italy, and has occurred in England in Kent.

Except for a few comparatively unimportant omissions, however, this manual is thoroughly comprehensive. Throughout the work there is evidence of much first-hand knowledge of the diseases described. In some cases Prof. Duggar has followed up his researches in the States by paying a visit to Europe to study the same disease there, and in this way he has been able to throw light on certain vexed questions of diagnosis and nomenclature. For instance, the true relationship of the Rhizoctonia fungus which causes diseases of various cultivated plants is made clear; the Rhizoctonia disease of potatoes is the same in Europe and America, while *R. medicaginis*, which attacks lucerne, asparagus, and sugar-beet in Europe, is a distinct species which does not occur in America.

Since many of the fungus diseases described occur in England, there is a considerable amount of information of direct practical value to the fruit-grower and market-gardener in this country. We find, for instance, an account of the recently discovered bud infection of peaches in the case of the peach "leaf-curl" fungus (*Exoascus deformans*), and of the best method of treating this disease. Excellent descriptions are given of such common diseases as the "brown rot" of fruit-trees (*Sclerotinia fructigena*) and apple and pear "scab" (*Venturia pomi* and *V. pirina*). Especially interesting is the account given of the various apple "cankers" which occur in the United States—the "blight canker" (*Bacillus amylovorus*), the "blister canker" (*Nummularia discreta*), the "European apple canker" (*Nectria ditissima*), the "bitter-rot canker" (*Glomerella rufo-maculans*), and the "black-rot canker" (*Sphaeropsis malorum*). A sharp look-out for the American "canker"-producing fungi should be kept by the apple-grower and economic mycologist in this country. It may be noted here that the Sphæropsis-canker has just been detected in Surrey. The exact appearance of the injury produced on the bark by the various "canker" fungi is shown by means of excellently reproduced photographs; one is tempted to say that Prof. Whetzel's photograph at Fig. 170 of the "Sphæropsis-canker" is the best of its class that has appeared in any book.

One of the most interesting chapters deals with the recent outbreak in the States of the European currant rust (*Cronartium ribicola*), a disease which was unknown in America until 1906. Investigation showed that the fungus was being introduced in its *aecidial* stage on seedlings of white pine (*Pinus strobus*) imported from Germany. A determined effort is being made to destroy all the diseased pines which have been introduced, and to prevent further importation of infected seedlings.

Sufficient has been said as to the scope of this work to indicate that it can be heartily recommended to the student of fungus diseases in this country; it is, in fact, indispensable, for no such manual previously existed in this country. E. S. SALMON.

HERTWIG'S TREATISE ON ZOOLOGY.

Lehrbuch der Zoologie. By Prof. R. Hertwig. Pp. xii+670. Neunte Auflage. (Jena: G. Fischer, 1910.) Price 11.50 marks.

THE new editions of Prof. Hertwig's text-book of zoology follow one another with such startling rapidity that it must be clear to everyone that on the continent at least it must have met with extraordinary success. This is perhaps not surprising, for, apart from the influence which Prof. Richard Hertwig's prominent position among the zoologists of the world must command, the "Lehrbuch der Zoologie" is certainly one of the best—if not the best—treatises on the subject in the German language.

There was a time not so very long ago when the English student of zoology was almost dependent upon the translations of the text-books of German authors, but in later years his wants have been supplied by his own countrymen, and it does not seem probable that Prof. Hertwig's book, excellent as it is in many respects, will find a large circulation in this country.

If it should fall into the hands of our own students, the parts which they will find most useful are those which deal with the more general problems of cytology, fertilisation, and inheritance. On these subjects the author writes with the authority of one whose own personal researches and those of a large number of his pupils have commanded the attention of the scientific world, and although there may be many who cannot fully accept the views set forth in explanation of the facts, the charm of their concise statement and the ingenious manner in which they are woven together are bound to create interest and reflection.

In dealing with the problem of fertilisation, for example, Prof. Hertwig considers that we can now accept—"mit grosses Bestimmtheit"—that it is the chromatic nuclear substance from which the chromosomes are derived that bear the hereditary characters, and in support of this he quotes some striking evidence drawn from the recent researches on the cytology of the germ-cells, and brings them into line with the results of the Mendelian experiments on inheritance. As Prof. Hertwig puts it, the theory seems very convincing, but there are some authorities who still doubt whether this theory will really bear the weight that is put upon it, and we should like to see the evidence that clearly tends to disprove it given some credit in a book that should be an impartial review of the present state of knowledge.

In the systematic part of the book the student will find a clear description of the principal characters of the classes and orders of the animal kingdom illustrated by many excellent figures. It cannot be expected that in the attempt to cover such a wide field within the limits of a single volume, the book will be entirely free from serious omissions and inequalities of treatment, but there are some features carried over from the earlier editions which really require some amendment if it is to maintain the undoubted success it has already achieved. The Enteropneusta, for example, are still classified as a class of worms. This is a position which has still some defenders, and in itself does not call for special comment; but as the author directs attention to the points of relationship between Balanoglossus, Rhabdopleura, and Cephalodiscus, surely the student will expect to find some position assigned in the text to the last two genera.

There are several other points, too, in which the book will hardly meet with the requirements of modern students. There is no figure, and a very meagre description of such important forms as Kœnenia and Anaspides; there is no mention made of the interesting trematode Temnocephalus, and, what is perhaps more astonishing still, there is no description or statement of any kind about the septibranch Pelecypoda. The statement that there are nephrostomes in Amphioxus needs correction, and the retention of the Ctenophora as a class of Cœlenterata justification.

Several new figures have been introduced into the ninth edition, and these are all of considerable value, but it is a pity that the only illustrations of the large and important order of the Alcyonaria are copied from the old, and in some respects incorrect, figures by de Lacaze Duthiers of *Corallium rubrum*. It is very desirable that a figure of a Pennatulid and some drawings of Alcyonarian spicules should be added. A better figure of Millepora should be found than that which appears on p. 217. But with all these faults, which are many when the book is critically examined, there can be no question that in general scope and breadth of treatment Hertwig's "Lehrbuch der Zoologie" is one of the most notable of the textbooks of our times.

COSMOGONY AND GEOPHYSICS.

Scientific Papers. By Sir George Howard Darwin, K.C.B., F.R.S. Vol. iii., Figures of Equilibrium of Rotating Liquid and Geophysical Investigations. Pp. xvi+527. (Cambridge: University Press, 1910.) Price 15*s*. net.

THIS volume opens with the well-known paper, "On the Influence of Geological Changes on the Earth's Axis of Rotation" (1877), in which Sir George Darwin investigated whether it was possible for known causes to produce a motion of the earth's axis comparable with that required by geologists to account for the supposed "Glacial period" in the earth's history. The result is definitely established that any change in the obliquity of the ecliptic which can have been produced by gradual deformation of the earth's shape is necessarily very small, about 1/2200 of a second of arc at most. The possibilities of wanderings of the pole are shown to be greater—from 1° to 3° in each geological period is possible. Cumulative motions of this type might account for the change since the supposed Glacial period, but any such explanation would be incompatible with the belief of geologists that where the continents now stand they have always stood.

This important paper is followed by six shorter ones, and the remaining eight papers, all of them of extreme complexity, deal with figures of equilibrium of rotating liquid.

A mass of fluid left to itself will, of course, form into a sphere under the gravitational action of its parts. If set into rotation this sphere will flatten at the poles, and Maclaurin showed that the flattened bodies corresponding to all degrees of rotation may be a series of spheriods so far as conditions of equilibrium are concerned, although obviously the very flat figures would be unstable. It has been known for some time that these spheroids are not the only figures of equilibrium. Jacobi found that certain ellipsoids with three unequal axes were possible figures, while Thomson and Tait pointed out that figures consisting of one, two, or more rings may be figures of equilibrium, although probably few of these will be stable.

The subject, of course, derives its great interest from its bearing on the origin of stellar systems and on Laplace's nebular hypothesis in particular; consequently the question of stability or instability is one of extreme importance. As an actual nebula in space loses its heat it will shrink in size, while keeping its angular momentum constant. For abstract discussion it is easier to deal with a fictitious mass of fluid of constant size, the angular momentum of which continually increases. Unless some cataclysmic breakdown occurs, this rotating mass must find for itself a continuous path through series of configurations of equilibrium all of which are stable. The problem of fundamental importance for cosmogony is that of discovering the far end of this path. Do we see it represented, as Kant and Laplace may have thought, in Saturn and his rings, or do we see it, as Sir George Darwin and others now think probable, in the earth-moon type of system? Or does the path lead only for a certain way through stable continuous configurations, and then end in a cataclysm?

This is the problem on which Sir George Darwin has for some years been leading the attack. Obviously there are the two methods of trying to trace out the path from the beginning to the end, and of trying to guess at the end and construct the path back to the beginning. Papers ix. and xv. of the present volume are devoted to the latter method. If increased rotation is going to lead to an earth-moon system, it ought to be possible to trace back the earth-moon system through diminishing rotation and through continuous stable configurations to the initial spherical form. In this connection, Sir George Darwin has directed attention to some almost overlooked, although highly important, work of Roche, who showed that a system consisting of a planet with an infinitesimal satellite in contact cannot be stable. He has accordingly attempted to examine above what limit the ratio of the masses of satellite to primary must lie for stability to be ensured. No perfectly definite conclusion is reached, but it seems as if the limit must be greater than the ratios observed in the solar system. This somewhat nugatory result is disappointing, and suggests that a better way of attacking the problem may be the direct one of examining all possible series of configurations, starting from the initial sphere.

The only road which the fluid can take on leaving the spherical form consists of the series of Maclaurin's spheroids, but this road is intersected by an infinite number of cross-roads at different points ("points of bifurcation"). At the first point of bifurcation, the series of Maclaurin's spheroids loses its stability, and the configurations represented on the cross-road through this point are found to be stable. Moreover, it appears that this particular cross-road represents the well-known series of Jacobian ellipsoids. Poincaré has shown that this road also is intersected by an infinite number of cross-roads, and that the first of these cross-roads represents a series of pear-shaped figures which look as though they might end by dividing into a large and a small mass. At this stage everything turns on the question of which is stable of the series of figures through this point of bifurcation, the Jacobian ellipsoids on the main road, or the pear-shaped figures on the cross-road. Sir George Darwin believes he has proved the pear-shaped figures to be stable, but M. Liapounoff challenges this, and, as the result of an independent investigation, thinks these figures are unstable. Each investigator has again verified his own calculations, and Sir George Darwin has applied various checks to his work which afford some evidence, although not proof, that his original conclusion was accurate.

Here the problem at present stands, at a deadlock. Short of discovering a serious error in one or other of the two investigations, the only explanation of the discrepancy seems to lie in the rejection of certain remote, and apparently very small, terms by Darwin. These might possibly be found to turn the balance, but it is almost inconceivable that they should.

Whatever the outcome may be, the present volume stands as a record of the amount of patient labour and degree of mathematical and scientific skill brought by one worker to the examination of one theory of cosmogony. Before the scientific world permits other theories to take their place by the side of this one, it will do well to ask whether the truth of these other theories has been investigated with a degree of patience, skill, and power at all comparable with what is shown here.

THE POLAR WORLD AND GLACIAL GEOLOGY.

Die Polarwelt und ihre Nachbarländer. By O. Nordenskjöld. Pp. vii+220; 77 figures. (Leipzig: B. G. Teubner, 1909.) Price 8 marks.

DR. OTTO NORDENSKJOLD is especially well qualified for a comparison of the Arctic and Antarctic regions, which he has personally explored in Greenland, Iceland, Spitsbergen, Alaska, Patagonia, and during his leadership of the Swedish Antarctic Expedition. He has now issued a short work on the polar world, in which he has given a general geographical description of the Arctic and Antarctic lands, and reference to the interesting problems connected with their geographical structure, inhabitants, and glacial geology. The book is based on a series of popular lectures and is issued without references. It is illustrated by seventy-six views, mostly taken by the author or on expeditions of which he was a member. The only map is a sketch of part of southern Patagonia.

The book owes its main value to its statement of the author's conclusions relating to various geographical and geological problems in which he is especially interested. Greenland is naturally described first, as it is the typical polar country, it being the most accessible and best-known land still covered with an ice-sheet. The author rejects Nansen's view of the nature of its ice gradient, and says that the problem of the Greenland inland ice was not solved by his expedition, which crossed the country at its narrow southern end, where the glacial conditions are not fully representative.

Dr. Nordenskjöld describes the fiord system of north-eastern Greenland, which he considers as the greatest in the world. Its valleys were once occupied by glaciers during a former greater extension of the Greenland ice cap; unless they had been filled with ice he would refuse them the name of fiords. He admits that part of Greenland has never been covered by ice, though he remarks that the evidence for this conclusion must be treated with caution. He briefly discusses the Eskimo, the most interesting of polar people. He accepts their Asiatic origin as apparently beyond question; the problem regarding them which he regards as still unsolved is the home of their present culture. Hamberg has suggested that the race developed its special characters in Alaska, but Dr. Nordenskjöld doubts this conclusion, as he thinks it probable that, if so, they would have spread westward into Asia, where but few of them occur, as well as eastward. He thinks their last home was probably within the centre of their present area of distribution, and not on its margin.

After describing Iceland and Jan Mayen, Dr. Nordenskjöld turns with enthusiasm to Spitsbergen, which he describes as the classical land of Arctic research. It is at present of little economic value, as it has been abandoned alike by whale, walrus, and seal hunters. Since 1905 attempts have been made to mine its coal, but Dr. Nordenskjöld regards the success of these attempts as very doubtful; and he thinks the country will be mainly of value as a tourist resort. He raises the question of the ownership of Spitsbergen, refers to the respective titles to its possession by Holland, Great Britain, Norway, Sweden, and Russia. A conference between the last States is now discussing the political status of the archipelago.

Dr. Nordenskjöld also describes the Arctic areas of America and Siberia, and gives a brief summary of recent work on the Antarctic, with an account of southern Patagonia, and a reference to Tasmania and New Zealand. He directs attention to the evidence of the former greater extension of ice in nearly all polar and subpolar countries, and he recurs frequently throughout the lectures to glacial problems. As the cause of the former glacier extension he regards Arrhenius's theory of refrigeration of the earth owing to the diminution in the carbonic dioxide in the atmosphere as inherently probable; he admits, however, that the chief different glacial centres of North America and elsewhere are not contemporaneous, that there was no equivalent glaciation of Siberia, and that there is no evidence of a former existence of ice in some parts of Alaska as in the Yukon district. The oft-made suggestion that the ice developed in localities which had a moist climate and heavy snowfall he rejects from the evidence of Kerguelen, where, in spite of these conditions, there is much ice-free land. Kerguelen, however, is only in the latitude of Paris.

Consideration of the westward extension of the Scandinavian ice-sheet leads him to consider the general belief that the Scandinavian ice filled the North Sea and deflected the local glaciers northward.

Dr. Nordenskjöld concludes that there is no proof that the Norwegian ice extended to the British coast, and an alternative explanation that the North Sea was filled with such heavy pack-ice as to press back the glaciers which flowed from the English mountains he rejects as "extraordinarily improbable" from all the evidence given by Arctic and Antarctic ice. He makes the interesting suggestion that the shallow areas of the North Sea were filled with barrier-ice formed *in situ*, like that of the Ross Sea, and that its obstruction was the cause of the deflection of the British glaciers.

J. W. G.

STRUCTURE AND CARE OF TEETH.

Our Teeth. How Built Up; How Destroyed; How Preserved. By R. Denison Pedley and Frank Harrison. Pp. 99. (London: Blackie and Son, Ltd.) Price 5*s*. net.

THE authors of this little book are well known to the members of the dental profession, but as the work is obviously intended for the lay public it may be as well to state at once that both Mr. Pedley and Mr. Frank Harrison occupy a high position in dental surgery; indeed, the fact that Mr. Harrison was chosen as president of the Odontological Section of the British Medical Association and Mr. Pedley as one of the vice-presidents in 1908 sufficiently demonstrates their title to advise and instruct the general public upon things dental. The book opens with a discussion of dental anatomy and physiology, illustrated with diagrams and photomicrographs of remarkable excellence. The authors have not hesitated to employ quite high powers, even such a magnification as ×2250; into the actual photomicrograph they have introduced explanatory labels with lines pointing to the special objects to which it is desired to direct attention.

Obviously in a work of this kind an abstruse dissertation upon tooth-development would be out of place; the authors plump for a theory and instal it as correct. Thus on p. 30 there occur illustrations and letterpress which would lead the reader to believe that the process of enamel calcification was quite understood, and that the process in the case of dentine was universally acknowledged to consist of the conversion of the odontoblast, whereas the former is very far from settled and the latter is supposed by some of the best living authorities to be a matrix calcification not involving the cells at all; however, the process as described in the book has the sanction of very good observers in the past, and it is no drawback for a writer on a technical subject addressing a lay audience to be dogmatic.

The pictures and description of dental caries and its pathology are both excellent; the valuable work done by Dr. Miller, of Berlin, is duly recognised, but the pioneer work of Milles and Underwood in 1881 (two years before Miller's first essay) is not noticed, which seems an omission. In the 100 pp. the authors run over structure, development, nourishment, growth, disease, allied disease, and treatment, so that the gift of condensation has been required to no small extent. The style throughout is lucid and interesting, the illustrations quite remarkably good and well reproduced, and if the opinions of the authors, or the authorities upon whom they rely, are stated occasionally as *ex cathedra* and unquestionable, such treatment of scientific questions is very difficult to avoid in a work addressed to a popular audience. The authors are to be congratulated upon having produced a thoroughly clear and useful manual, and on having left no doubt possible in the reader's mind as to their own views.

OUR BOOK SHELF.

The Funeral Papyrus of Ioniya. (Theodore M. Davies' Excavation: Bibân el Molûk.) With Introduction by Edouard Naville. Pp. viii+20; plates 34. (London: Archibald Constable and Co., Ltd.) Price 21*s*. net.

AMONG the objects discovered by the American explorer, Mr. Theodore M. Davies, in the tomb of Queen Thîy's parents in the Bibân el Mûlûk at Thebes was the funeral papyrus of Ioniya, the father of Amenophis III.'s great Queen. This was first worked over by Prof. Newberry in 1906, who published a summary of its contents in Mr. Davies' "The Tomb of Ioniya and Touiyou" (Constable and Co.) in 1907. Photographs of the document were then placed in Prof. Naville's hands for fuller publication, and the volume now before us is the Swiss Egyptologist's account of this important eighteenth-dynasty copy of the Book of the Dead. The papyrus itself measures 9 metres 70 cm. long; it is written in linear hieroglyphs with vignettes finely executed in colour, and contains some forty chapters, one of which is new to science. This new chapter is illustrated by a vignette of nine serpents, and is entitled "Coming out of the Day." It belongs to the group of chapters of the gates and pylons where the deceased has to show his knowledge of the names of the occupants and warders. To the finely reproduced facsimiles of the document M. Naville has added a translation, based mainly on that of the standard edition of the Book of the Dead by the late Mr. Le Page Renauf—the edition which Mr. Naville himself completed and edited.

Helmholtz. Eine Zeitschrift für die exakten Wissenschaften mit besonderer Berücksichtigung ihrer Anwendungen. Herausgegeben von Dr. Th. v. Simson. Bd. i., No. i. (Helmholtz-Verlag: Neustadt au der Haardt, April, 1910.) Price 16 marks per volume.

ANOTHER scientific journal! It must be confessed that the necessity for the existence of this journal is not at all evident. There is no particular reason, so far as the reviewer can see, why the contents of this number could not have found a place in many other quarters.

The *pièce de resistance* is the article by Arrhenius on "The Laws of Digestion and Resorbtion." This consists in a "quantification" of the experimental work of E. S. London in St. Petersburg, and is decidedly interesting. After this comes a series of portentously solemn "scientific aphorisms" by C. H. Walter, which the reviewer has been quite unable to digest. There is an article by F. Fittica on "The Transmutation of the so-called Elements," in which this author tells us again how he transmuted phosphorus into arsenic (by heating it with ammonium nitrate), &c. To borrow the language of a sister science, there exists a slight doubt as to the veridical nature of these phenomena. However, an editorial footnote commends them to the reader's notice.

In an interesting article, H. Lunden gives a description (with sketch-plans) of Arrhenius' new Nobel Institute laboratory at Stockholm. Several other short articles deal with such varied topics as sun-spots and magnetic storms, precautions against coal-dust explosions in mines, &c. Enough has been said to indicate the catholicity of the editor's views concerning the scope of his new journal.

List of Documents in Spanish Archives relating to the History of the United States, which have been printed or of which Transcripts are preserved in American Libraries. By J. A. Robertson. Pp. xv+368. (Washington, D.C.: Carnegie Institution of Washington, 1910.)

THIS publication of the Carnegie Institution is the most recent of the "papers" of the Department of Historical Research of the Institution at Washington. The editor of the series points out in a preface that the volume may be regarded as an accompaniment to Prof. W. R. Shepherd's "Guide to the Materials for the History of the United States in Spanish Archives."

The two lists contained in the present book concern the history of the territory included within the boundaries of the continental United States of to-day. All matter touching that territory only indirectly or by inference as a part of the Indies has been rejected. The first list consists of published material, the original manuscripts of which exist in Spanish archives, or which, with good reason, are conjectured to exist in Spain; the second is much the longer, and is a list of transcripts in libraries and archives in the United States from originals in Spanish archives.

Lightning and the Churches. By Alfred Hands. Second edition. Pp. 92. (London: J. W. Gray and Son, 1910.) Price 1s. net.

THE first edition of this interesting pamphlet was dealt with in a note in our issue of April 22, 1909 (vol. lxxx., p. 228), and we welcome this second edition as indicating that increased attention is being directed to the important matter of protecting buildings from damage by lightning. Mr. Hands, who has expert knowledge of the subject, says that investigation shows that about twenty churches are struck and damaged in Great Britain every year. In some years the number is much greater; in 1907, for instance, thirty-nine suffered from this cause, and in 1908 there were thirty-one. Architects and others, whose business makes them responsible for the protection of buildings against lightning, would do well to study this little work.

The British Isles in Pictures. A Geographical Reading Book. By H. Clive Barnard. Pp. 64, containing 58 illustrations. (London: A. and C. Black, 1910.) Price 1s. 6d.

THERE are thirty-two beautiful coloured pictures in this volume, which will delight young pupils of geography, and serve also to explain graphically to them the characteristics of many kinds of scenery found in their native land. The black and white illustrations will also help to secure and maintain the interest of a class. The letterpress provides useful information; and, though it is hardly suitable for a text-book, it will serve admirably to supplement the geography lesson proper. The cheapness of the volume should ensure it a wide popularity.

LETTERS TO THE EDITOR.

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

The Temperature Coefficients of the Ferromagnetic Metals.

EXPERIMENTS on the temperature coefficients of magnets published some years ago (Roy. Soc. Phil. Trans., vol. cciii., 1903) showed that the magnitude of the coefficient is largely dependent on the dimension ratio of the magnet, but that when the dimension ratio is sufficiently increased to make the self-demagnetising factor negligible, the coefficient is then characteristic of the ferromagnetic material. Observations made at that time, but not published, on iron, nickel, and cobalt magnets heated up to 100° C. showed that the coefficient was large in nickel, less in iron, and least in cobalt, the order being the inverse of the order of the magnetic critical temperatures of these metals.

I have recently repeated these experiments, carrying the temperature to 300°–400° C., and within this range it appears that when the magnetic intensity in the cyclic state is plotted against a scale, in which temperatures are calculated as percentages of the critical temperatures, then the points lie very nearly on one curve. In short, if corresponding temperatures are chosen, the temperature coefficient is the same for iron and nickel, and probably for cobalt. (The details of the experiments I omit here, but I should say that the cobalt employed was not pure, and behaved irregularly at 300° C.)

For example, the temperature coefficient of nickel between 15° and 115° C. is 0·0005, and it is the same for iron between 250° and 430° C., the corresponding temperatures; the temperature coefficient of iron between 7° and 107° C. is 0·0002, and it is nearly the same for cobalt between 90° and 220°, the corresponding temperatures.

Curie has shown that when iron is heated it passes continuously through the critical temperature from the ferromagnetic to the paramagnetic condition (in the latter state obeying the gas laws *mutatis mutandis*), and that the curves which trace the change from one state to the other are the counterpart of the curves which trace the passage of a liquid to a gas. An equation to the fluid curves may therefore be applied to the magnetic curves, and van der Waals's equation may be appropriately used, since it takes account of the facts that there is mutual attraction of the molecules and that there is a limit to fluid density, facts which have their counterpart in ferromagnetism in the mutual attraction of the molecular magnets and in the limit to magnetic intensity. One of the conclusions drawn from van der Waals's equation and the theory of corresponding states is that the coefficient of density, or expansion, of all liquids at corresponding temperatures is the same, and by similar reasoning this law is deducible for magnets. This is, in fact, the law to which the experiments cited above lead.

It is also worthy of notice that the temperature coefficient of density of liquids is of the same order as the temperature coefficient of intensity of ferromagnetics, just as the temperature coefficient of density of gases is of the same order as the temperature coefficient of intensity of paramagnetics.

Within the limits of this letter it is not possible to discuss these facts, but they show that certain magnetic problems may be treated by an application of van der Waals's equation with results consistent with experiment.

Manchester. J. R. ASHWORTH.

The Ratio between Uranium and Radium in Minerals.

DR. BOLTWOOD established the constancy of this ratio for all the minerals he examined (*Phil. Mag.*, April, 1905). He examined, however, no mineral in which uranium was present as phosphate, nor did he examine the then newly discovered mineral thorianite. Later, Mdlle. Gleditsch (*Comptes rendus*, cxlviii., 1451; cxlix., 267) found that the ratio radium to uranium was about

18 per cent. greater in thorianite than in Joachimsthal pitchblende, while in autunite, a phosphate of uranium, this ratio was about 20 per cent. less. She separated the radium chemically before estimating it.

This month appeared in the *Philosophical Magazine* (p. 345) a communication by Mr. F. Soddy and Miss Pirret on this subject. They find that, by determining the radium directly in the mineral, the ratio is practically the same for thorianite as for Joachimsthal pitchblende, but that in their specimen of autunite the ratio is only 44 per cent. of that of pitchblende. During the last three months I have been engaged on this problem also. I find that the ratio in thorianite from Java agrees within the limits of experimental error with that in specimens of pitchblende from Joachimsthal and from German East Africa, the latter of which is probably of primary formation. In my specimen of autunite, however (from Autun, in France), the ratio is only 27 per cent. of that of the pitchblendes. Thus, taking the ratio Ra to U in pitchblende as 1, in Mdlle. Gleditsch's specimen of autunite it is only 0·80; in Mr. Soddy and Miss Pirret's it is 0·44, and in mine 0·27.

To explain these somewhat exceptional results, it must be assumed either (1) that the Ra has been washed out of the mineral in some way, or (2) that the mineral is very young, and that therefore the Ra is not yet present in equilibrium amount.

To throw light on these points, I hope to determine the ratios uranium to ionium and to actinium in different specimens, not only of autunite, but of the family of minerals $R'(UO_2)_2(R''O_4)_2.8H_2O$ (R' = Ca, Ba, Cu; R'' = P, As), of which it is a member.

Alex. S. Russell.

Physik.-Chem. Institut der Universität, Berlin,
August 6.

Elemental Weight Accurately a Function of the Volution of Ideal Space-symmetry Ratios.

Suffering from a malady of the eyes, I may be excused the two following errors in my communication published in Nature of July 21:—

(1) For *hex*, or the cubic line-ratio, read throughout *oct*, or the octahedral line-ratio; and for *oct* similarly read throughout *hex*.

(2) In the table at the end, No. 6, read 1·00766 as the mean, in place of 1·00765, the product in this instance (No. 4 in the references to the general formula) deviating by 0·00001 from the experiment; in the other cases the figures are exact.

H. Newman Howard.

Aberdovey, North Wales.

The Jamaica Earthquake.

May I point out that in the review of "Recent Earthquake Investigations" (Nature, August 11, p. 165), the date of the Jamaica or Kingston earthquake (where the loss of life was 800, and of property about 2,010,000*l*.) is wrongly stated? It took place on January 14, 1907, and not on June 14, 1906.

D. Morris.

Boscombe, August 12.

CHOLERA AND ITS CONTROL.

Nothing is more striking, even to the casual observer, than the change that has taken place in the attitude of the public, no less than of those who have charge of the public health, towards those great epidemic outbreaks that swept Europe up to the end of the eighteenth century "and after." Until the Great Fire of London in 1666—indeed, until the rise of the great school of sanitary reformers of whom Chadwick and Simon may be taken as types—panic and despair were the predominant emotions aroused in the presence of plague, cholera, and the like. With a knowledge of the results of what could be done by the adoption of efficient sanitary measures, these two paralysing influences were gradually rendered less effective, especially as the call to preventive and curative work could be made to divert men's minds from brooding and evil anticipation. Men then realised how much could be done to ameliorate the conditions of communities attacked by these diseases, and how successful were the preventive measures adopted as regards transference not only from community to community, but from individual to individual, with the result that organisation took the place of panic and hope succeeded on despair. Still, men were working in the dark, and the mystery enshrouding the mode of spread of disease was profound until Pasteur, Koch, Lister, and their many disciples gradually evolved from the chaos of theory, fact, and fancy the germ-theory of disease, and isolated from the welter of organisms by which the patient was surrounded the one that in each case appeared to be the specific cause of the disease.

In no case is this more marked than in that of cholera, and at the present time one may see in different parts of Europe reproduced different phases of the history of the evolution of our methods of dealing with cholera epidemics at different periods. In Russia and in some parts of Italy, where fatalism and apathy prevail, and where sanitary science has not yet reared its head, cholera still arouses panic, only to be followed by the lethargy of despair. In other parts of Europe efforts—in many cases very inadequate—are made to combat the spread of the disease, whilst in northern Europe, including such places as Amsterdam and London, the announcement that cholera may invade the country, or that it has already gained a foothold, simply means a call to renewed sanitary efforts directed by intelligent experience and skill, which will prevent the disease from entering the country except as carried by isolated patients, and the treatment of patients in such fashion that there will be no further extension beyond a very limited area.

At the present juncture, when cholera may spread from Russia, Italy, Roumania, or elsewhere, the crisp instructions issued to port medical officers no less than timely account of the outbreak of cholera in Rotterdam last year about this time (see the *Times*, August 19), should give comfort and courage, both to those who have to deal with cholera in our ports, and to those who at one time would inevitably have been attacked in large numbers. Between August 20, 1909 (when cholera was found in three children in one family, who died suddenly with the clinical symptoms of cholera, the nature of the disease being at once confirmed by full bacteriological examination) and September 11, what might have expanded into a great epidemic in Rotterdam began and was crushed. The facilities for the spread of the diseases are perhaps greater in Rotterdam than in any other seaport town in the world, but by careful isolation, not only of the patient, but of "contacts," *i.e.* people who have come in contact with the patients at any time after the outbreak of the disease, in "isolation" wards, and "observation" sheds, by warning the people against the use of unfiltered water, the eating of green fruit, and excessive indulgence in the use of alcoholic liquors, the epidemic was cut short. Fines and imprisonment were awarded to those who interfered in any way with the authorities in carrying on their work, either by obstructing them or by failing to notify cases where the illness showed any symptoms of cholera. Careful observation of suspected cases, disinfection of houses, bed linen, clothing, of patients and contacts alike, were all resorted to; but, on the other hand, all who helped were well treated, receiving whatever wages they would have earned normally; indeed, we are told, they were so well treated generally that "many presented themselves as contacts in the hope of receiving food, clothing, and wages without working." It may be said that these methods were, on one hand, harassing, and, on the other, expensive; but as compared with the work and expense involved in outbreaks such as at one time or another have attacked our north European ports, the work and expense involved are absolutely trifling.

All this, of course, is exceedingly reassuring, but we have, on the other hand, as the outcome of our knowledge of the life-history of the cholera bacillus and its relation to the human subject, a fact which, disregarded, may be a source of great danger, though, knowing of its existence, precautionary measures may be taken which may render it harmless. Of 108 patients, presumably "contact patients," or patients who had recovered, examined at Rotterdam in 1909, nearly 4 per cent. were found to be bacilli-carriers, corresponding to the so-called typhoid-carriers which, only recently recognised, seem to play such an important part in the dissemination of the typhoid fever germ. The cholera bacillus was found in these carriers for periods of from five to twelve days after they came under observation. It is pointed out that, this being the case, out of more than 100 people leaving a cholera-infected port four (approximately), according to the above statistics, may carry these germs for twelve days, so that any port within twelve days' distance at which these carriers land might be infected by cholera. How far this observation accords with the experience of port officials it is impossible to say at present, but no doubt the matter will be carefully gone into now that attention has been directed to it.

A very interesting outcome of the curative treatment of the cases of cholera that occurred in the Rotterdam outbreak is that, although the epidemic death-rate in Holland during 1909 was about 45 per cent., the death-rate in the municipal hospitals, where special treatment was carried out, was only 13 per cent. Here the doctors resorted to the hypodermic injection of a normal saline solution, sometimes in quantities of several quarts a day, the effect of this mild saline solution, as pointed out by the *Times* correspondent, being not only a replacing of the moisture which the system loses as the result of the extreme watery diarrhœa, but "a direct stimulation of the heart and also an indirect stimulation of the heart by diluting the blood and thus reducing friction."

The whole treatment, both preventive and curative, of cholera is the outcome of modern methods of medical research, a fact that may be commended to those who, either through prejudice or ignorance, or both, would limit the study of bacteriology and experimental medicine to the field the bounds of which are those of their own narrow vision.

MALARIA PROPHYLAXIS IN INDIA.[1]

"A PROBLEM of Imperial magnitude." "Epidemics of smallpox, cholera, and plague are grievous afflictions, but neither singly nor even collectively are they responsible for so much economic inefficiency, and what is worse, actual human misery, as the recurrent scourge of malaria." These words of the Viceroy and the Lieutenant-Governor of the Punjab respectively impress us with the magnitude and seriousness of the problem that the conference had to consider. If we attempt to translate these words into figures, we are met with difficulties, owing to the fact that the registrar of deaths in India is often the ignorant village chowkidar, but as a rough approximation, it may be assumed that the mean death-rate is about 5 per 1000, *i.e.* over a million deaths annually throughout the country as a whole; whereas in the jails, owing to the care with which prisoners are treated, the mean death-rate from malaria is only 1 per 1000.

But even if the figures for the country as a whole be correct, an analysis of them does not reveal where the real mischief lies. If we assume, for example, that we know the malarial death-rate of a particular town or district the figures available still do not show us whether, as not uncommonly is the case, some parts of the town or district may not be quite free from malaria. It is evident, then, if prophylactic measures are to be applied economically and from financial considerations, this is a prime necessity: one of the first and most important steps must be to determine accurately what areas are malarial, or are so to such an extent as materially to affect the whole of the inhabitants; for it is obviously unnecessary to apply prophylactic measures to those areas which do not need them; but unfortunately there appears to be evidence that this has already been done, not to mention the "fatuous" instance recorded of oiling drains, under instructions, where minute examination showed that no anopheline larvæ existed. But on the other hand, there is already work waiting to be done. What is the nature of this work, and how is it to be done?

It is these questions that mainly occupied the attention of the delegates to the conference. It was pointed out that a multitude of different conditions exist in India, but that small villages surrounded by swamps are in the enormous majority, and again it was stated that the mitigation of malaria in India is chiefly the problem of its mitigation in small villages. For scattered populations, small villages, and rural areas we have the opinion of Major Ross quoted that we must generally fall back upon quinine, yet, rightly, the conference put mosquito destruction in the forefront of its policy, for no doubt—and this is also Ross's opinion—this is the fundamental method; the question is, to what extent is it financially possible?

The resolutions of the conference on this point are expressed in an apparently contradictory sentence. They state "that it will not be possible to protect rural areas by any scheme of drainage which is financially practicable, but it has been found that in some highly malarious tracts the level of subsoil water has been materially lowered with great permanent benefit by drainage operations, the cost of which was not prohibitive." This question of drainage was discussed at length by the conference, and very contradictory views were expressed, not only as to its practicability owing to expense, but as to its benefit, evidence being adduced to show that even in well-drained areas there had, in some cases, been no reduction in malaria.

It is a somewhat discouraging fact that no instance of a drainage scheme with successful result was put before the conference, but that already many unrecorded failures have occurred. It seems to us a matter of importance, then, to inquire into the cause of these failures, so as to ascertain if anything was left undone that could now be better done. Ill thought-out schemes are not uncommon. We ourselves know of a case where a large, shallow tidal area of water, quite free from anophelines, was converted into an ideal breeding-ground by partial filling with earth and by the consequent formation of many hundreds of pools. The danger, too, was pointed out of draining a permanently flooded area, whereby a comparatively healthy was converted into an unhealthy tract, with numerous pools in the rainy season. Some difference of opinion was expressed as to the effect

[1] Proceedings of the Imperial Malaria Conference held at Simla in October, 1909. Pp. vi+107. (Simla: Government Central Branch Press, 1910.

of a high subsoil water on the malaria rate, but it was eventually agreed that "pukka" surface drainage and the lowering of high subsoil water level were anti-malarial measures of primary importance.

It is clear, then, that although failures are on record, and although finance may be a great difficulty, the permanent policy which is adopted is to drain, and, moreover, large drainage schemes may not always be prohibitive from their expense, as the sale of the land re-drained may defray the cost. Any particular scheme must, however, be well thought out, *after*—and this, in our opinion, is essential—the extent of malaria in the particular area has, as far as possible, been accurately estimated, and with the help of sanitary engineers the conditions determining the mortality minutely investigated. Then, and then only, can the effect of the scheme be accurately gauged in all its bearings, and "the devastating flood of recommendations" be checked by concrete facts.

We are, perhaps, in the habit of regarding malaria as an endemic rather than an epidemic disease, but a study of the conditions in India shows clearly that it has indeed terrible epidemic manifestations, such as occurred in the Punjab in 1908. We cannot discuss here the cause of these epidemics, but refer those interested to the report itself. We mention them here because it was said that if we could check epidemic "fulminant" malaria "we should have removed the most urgent and distressing effect of this disease, and those manifestations which the people themselves are most impressed by." A study of this question of epidemics impresses on us more than anything the magnitude of the problem to be dealt with, and the urgent need for re-study of the many problems of endemic and epidemic malaria. With regard to these epidemics, the opinion was expressed that they could probably be predicted, and that the only possible way of dealing with them was by the use of quinine.

The importance of quinine as a prophylactic measure cannot be overrated. We have the fact that this is the main method adopted by the Italians; we have the experience of Canada as related by Prof. Osler; the "marked success" of this method on the Panama Canal; and, indeed, we have the striking fact that the only successful prophylactic experiment presented to the conference was that carried out in the Punjab jails, where, by the administration of 15 grains of quinine once a week to each prisoner, the malaria death-rate was, with one exception, reduced to the lowest figure on record, and this during the great epidemic of 1908. That the quinine question, like the drainage question, requires very careful study, the papers read at the conference show. We hope, too, that the period of rivalry, if not of actual animosity, between the advocates of drainage and quinine has passed, though it must surely be admitted by those who are impartial, that quinine has at least one advantage, that it can be applied at once in many cases where drainage is completely impossible. The difficulties of the administration of quinine in India cannot, however, be overlooked.

We would conclude by pointing out the need also for "minor" measures, if we might call them so. An extended study is necessary of the numerous enemies of larvæ—fish, and a variety of predaceous insects, &c.—and of the complete inhibitory effect on larvæ of weeds such as Lemna. We would venture to suggest the appointment of one or more officers to study solely the "bionomics" of the mosquito in all its aspects. We would also urge the appointment of officers for the study of the various malarial problems already alluded to. We think, too, that officers should visit Italy to study quinine prophylaxis there; and that the methods advocated by Major Ross in Mauritius, and those carried out in Panama, should also be studied on the spot.

Finally, there remains one method no less difficult, but one essential to the success of all the others, and that is the education of the people. That the Government has a many-sided and difficult problem before it is clear, but the problem has now been systematically taken up, and we feel confident that when the next malaria conference meets progress will be reported.

KENTISH BIRDS.[1]

THE latest book on the "Birds of Kent"—the third to appear in recent years—is entitled, very appropriately, a history of the birds of the county. For the author, who has been sixteen years preparing this work, has given especial attention to the present and past status of all those species the distribution of which within the county is not quite general, and of those which have become rarer or more common, or have begun or ceased to breed within what we may term historic times, that is, since Kentish birds were first noticed by the older writers; and he has most carefully worked out chronologically the histories of fading and vanished species, as, for instance, the chough, raven, harrier, buzzard, kite, avocet, &c. In this connection we may, however, point out that too much importance must not be attached to the use of the word chough in Shakespeare's description of the cliff at Dover,

"The Crows and Choughs that wing the midway air,"

for there is evidence to show that the older writers must have often meant jackdaws when they wrote choughs. The name chough, indeed, seems to have been originally as generic as pie; and just as they distinguished the mag-pie and the jay-pie, so in time they distinguished the less-known chough as the Cornish chough. Happily, this history is not obliged to confine itself to dealing with the decreases of all the more interesting species, but can detail the increases of some, and point out the gratifying fact of some kinds of wild ducks and other birds breeding in increasing numbers. Of that little wader which has always been associated with the county—and may be called *the* county bird—viz. the Kentish plover, it is extremely satisfactory to read of the steady increase in the number of breeding pairs of late years. Here again we have an exhaustive and valuable article. Very interesting details, too, are given of the nesting of the golden oriole in four localities and in some of them for several years in succession. The present status of the Sandwich tern is set forth, and of the Dartford warbler (the third bird the name of which connects it with Kent) we learn with regret that it is now extinct in the county, its history therein being admirably drawn up. Exact information on these points has been wanting hitherto.

In his accounts of the different species, the author has found it necessary, in order to treat adequately of their history, status, distribution, migratory movement, and economic aspects, to confine his remarks strictly to these questions, and to omit all references to plumages, songs, general and nesting habits, and anecdotes, except in so far as these affect the other questions or offer peculiarities of themselves, or bear some particular relation to the environment of the species in the county. Even so the volume is bulky,

[1] "A History of the Birds of Kent." By Norman F. Ticehurst. Pp. lvi + 568. (London: Witherby and Co., 1909.) Price 21s. net.

and if the omission of these lighter matters make the book less fascinating to read than some others, it detracts nothing from its solid worth. Beginning with a bibliography, the volume contains an introduction of twenty-seven pages, dealing with the topography, geology, rivers, vegetation, avifauna, migration, museums, and collections of and in the county, and of the former authors on the subject. Then follows the detailed account of each species on the lines indicated. Excluding forty-two "doubtful species," which are included in square brackets, these number 312; 107 birds breed regularly in Kent, thirteen have bred only once or on very rare occasions, and fifteen formerly bred and have ceased to do so.

Kent has of late years produced an extraordinary number of rare birds, accidental visitors to these shores, several of them having been "new" to the British list; and in reading the pages of this volume one is impressed with the enormous importance in the compilation of a long county list of rare birds of the existence on the spot of a bird-stuffer always on the look-out for a rare bird, and ready to offer it for the inspection of the trained ornithologist; for it is to be noticed that nearly all these rarities which have apparently been pouring like a stream upon the shores of Kent in the last few years have passed through the hands of one bird-stuffer. Another point which will strike the reader is the sharp eye for a rare bird possessed by some of the Kentish men—more than one great rarity has been secured by shepherds, and most of them by people who were ready to part with them—for we should be loth to think that these gunners shoot all and sundry that come within range on the chance of getting a good bird. At the same time, this apparent habit of men with guns patrolling the county during May and other parts of the close season is a little disquieting, and seems to require attention. Not that we suggest for one moment that the shooting of these stray wanderers far out of their usual range of distribution—does a tittle of harm to the respective species, or that their reaching the hands of the critical ornithologist serves any but a good purpose. But at the same time the habit—unchecked, it would appear of shooting on marsh and shore in the breeding season is essentially a bad and harmful one, and in the case of irresponsible people may easily lead to the death of breeding wildfowl or waders.

Among the many wonders of migration oversea is the fact disclosed in this volume of rare birds from remote countries arriving, not only singly, but in pairs and small parties. Thus two snow-finches (a sedentary species living in the Alps) were shot from a party of five; three white-winged larks observed together, and all secured, and three black larks (new to our list) out of five. So, too, sandpipers from America come not only singly, pairs of the solitary and spotted sandpipers being here recorded. In some years there has been quite an American invasion. In July, 1908, examples of the solitary, pectoral, and Bartram's sandpiper occurred; and 1906 produced both Bonaparte's and the pectoral sandpipers.

The "Hoppen Pits," Dungeness. Breeding Haunt of Black-headed Gulls, Moor-hens, Reed-warblers, &c. From "A History of the Birds of Kent."

The twenty-four plates comprise reproductions of the plates in old books of Kentish specimens, some modern Kentish rarities, and nesting sites and bits of Kentish scenery, the typical haunts in the county of various species. These are very pleasing and appropriate to the objects of the book. By permission of the publishers we are enabled to reproduce one of the illustrations. There is also a good map at the end of the volume, which is nicely got up and well printed on good unglossed paper, so that, despite its bulk, the book is not very heavy.

ON AND OFF DUTY IN ANNAM.[1]

THIS is the work of an Englishwoman, who accompanied her husband, a doctor in the French Colonial Service, to Nhatrang, on the coast of Annam. On landing in Saigon, the capital of Cochin China, she recounts her impressions of the city in terms much more favourable than one would

FIG. 1.—A Well-made Moi Dwelling. From "On and Off Duty in Annam."

expect who had visited the place in its early stages of development. It was then a scattered, sickly settlement; it is now "the Paris of the East," with its wide, well-appointed boulevards and imposing public buildings, the Governor's palace, cathedral, theatre, and hotels, after the best models in Europe. All the more praise to the Government for the transformation of this once swampy wilderness into probably the fairest city in further Asia, equipped with all the latest scientific appliances in effective operation. Its Pasteur Institute has done admirable work in arresting the ravages of plague, cholera, and diseases common to the tropics. The author and her husband were sent to Nhatrang, where the doctor was appointed assistant to the president of the Pasteur Institute, Dr. Yersin, who was one of Pasteur's first pupils, and justified his being chosen to carry out colonial work by his original discoveries, and his energy successfully displayed in other directions.

The author's notes on the native dread of the European treatment of disease are piquant, and enlivened by her keen sense of humour. Their superstitious treatment of the sick is in itself a plague, accountable for greatly increasing the death-rate. This lady's efforts in founding a home in this distant colony will fascinate the reader used to all the comforts and amenities of the West. Her servants had to be taught the elementary principles of truth and cleanliness, and to adopt her point of view regarding honesty, but she had other worries provided by the inroads of destructive insects that had to be dealt with. Her success in utilising the most unpromising material, and creating a pleasant home are worthy of all praise. The cost of living in this region, under the eye of a trained economist, compares favourably with that of the West. She found seven shillings a week sufficient allowance for the cook, who had to provide "three courses for lunch and the same for dinner." This may induce some of the "hard hit" at home to emigrate to the hospitable shores of Annam.

The manners and customs of the Annamites, which are ably set forth, may stem the tide of settlers flowing Eastward. Be that as it may, the author's pictures of life in this region are not without attraction.

The history of Annam is passed in review in this interesting work, and the part played by the aborigines, whose country she explored when off duty. Government and religion are also discussed. But in this vast section of eastern Asia some weighty problems await solution regarding the different races that people its area, and the religions which they follow.

Cambodia, the latest acquisition of France, is touched upon with a light hand, and in some respects it is the most important of her Eastern possessions. It was at one time an extensive and powerful kingdom, inhabited by a highly civilised race of men, whose stone temples, cities, and palaces remain to bear witness to their skill as builders, and to their knowledge of art. In the last and greatest temple reared, Nakhon Wat, one has evidence that this was an early stronghold of Brahmanism, a Far Eastern outpost of the faith. In its outer galleries, sculptured in low relief, half life-size, on the stone walls a series

FIG. 2.—The Verandah of the Pasteur Institute. From "On and Off Duty in Annam."

of illustrations meant for all time of the chief episodes of India's sacred epics, the Ramánayána, and Mahábhárata, in which the design, craftsmanship, and drawing are so excellent as to suggest Western influence. There is no Brahmanical temple in India so vast and imposing. Notices of Cambodia are found in the Chinese annals of the Tsin, Sui, and Tang

[1] "On and Off Duty in Annam." By Gabrielle M. Vassal. Pp. xi + 283 (London: William Heinemann, 1910.) Price 10s. net.

dynasties, which throw some light on the early history of this region.

The author describes the ancient temple at Nhatrang, stone built, with inscriptions in primitive Pali, similar to those found in Nakhon Wat, and other monuments scattered over a vast area.

In conclusion, the book covers a wide field of interest, and is a welcome addition to the literature of further Asia. J. THOMSON.

LAKE CHAD.[1]

THE first volume gives the geographical results of the mission presided over by Captain Tilho (which undertook, in connection with British delegates, a delimitation of the Anglo-French frontier in the region of Lake Chad and northern Nigeria). The main purport of this volume is the survey and delineation of that extraordinarily puzzling feature in African geography, Lake Chad—a "lake" described by Captain Tilho as being nothing but an immense marsh with variable stretches of open water nowhere more than 12 feet deep.

Probably the first definite mention of Lake Chad (under the name of Zad) occurs in the writings of Frederick Hornemann, at the very close of the eighteenth century. (Hornemann, who was taken into the employ of the English African Association, and sent by them to reveal this lake and also the central course of the Niger, is believed to have reached the Niger and to have died in the Nupe country about 1800.) But rumours of a great sheet of water in the heart of Africa, beyond the Sahara Desert, had probably reached the Romans in the first century of the the Christian era, through their connection with Tunis, Tripoli, and Fezzan, and these stories were reflected in the conjectured Libya Palus of Claudius Ptolemæus, who wrote in the middle of the second century. When the Arabs and Moors had become thoroughly acquainted with the geography of the Sudan they revived these traditions, but mixed them up with both the Niger and the Nile systems.

As a matter of fact, the basin of Lake Chad is curiously on the balance between the watersheds of the Nile and of the Niger. The work of other and earlier French expeditions (especially that of Dr. Auguste Chevalier) which preceded that of Captain Tilho has put before us evidence of a faunistic and geological character which prompts the supposition that Lake Chad is the very last vestige (shrinking annually, one might say) of a vast, *shallow*, inland sea, which covered much of the region north, east, and, above all, west of Lake Chad, of the basin of the Niger north of the mountains, and probably communicated with the sea along the basin of the Senegal River. Whether there was any north-eastern outlet towards the Nile basin is more doubtful. Looking at the most recent map of Africa in relief, it would seem more probable that there has been for ages a bridge of high land through the Tibesti country which has connected southern Tunis with Central Africa, and separated the Niger-Chad basins from that of the Nile; but it is more likely that down to the close of the Secondary epoch, or even at the very beginning of the Tertiaries, there may have been a connection between the Chad-Shari basin and that of the Congo. Nearly the whole of the Congo basin was, down to a relatively recent period, a vast freshwater lake. A rise of ground so slight as scarcely to be perceptible to the traveller separates at the present day the basin of the Shari River from that of the Mubangi-Wele, which, of course, marks the existing limits to the north of the former Congo Sea, that sea which in Tertiary times forced its present narrow outlet through the Crystal Mountains into the southern Atlantic. Many arguments for the justification of these hypotheses (as also for arguing the relatively early detachment of the Congo Sea from that of the Sahara) may be found in the remarkable works of Mr. G. A. Boulenger on the fresh-water fishes of Africa. From this same source, again, may be derived further arguments for the relatively recent existence of the Chad-Niger Sea, and perhaps also for the close geographical connection between that vast area of fresh water and the great lake which formerly filled up much of the Bahr-al-Ghazal-and-Upper-Nile regions, a lake represented at the present day by the Sudd region.

Other French expeditions dealing with the country between Lake Chad and the Mubangi-Congo have established the existence (it is said) of the manati in the Shari River, and, above all, in the isolated lakes and pools to the north-east of that stream. The manati is also stated to be found in the Niger River between Sego in the west and Yauri in the east. If this is really the case, it is further evidence for the existence and the relatively recent drying-up of this vast fresh-water Sahara Sea; for the manati is a Sirenian mammal the nearest relations of which are found fossil in lower Egypt, in the West Indies, and in Florida. The manati is still found as a living animal in the estuaries and broader rivers of West Africa, but it would be exceedingly difficult for it to reach the Upper Niger over the Busa Rapids, though it might, and perhaps does, pass up the river Benue, and thus reach the Shari by way of the Tuburi marshes. (The manati is not found in the Upper Congo.) With regard to these Tuburi marshes, we have here a very interesting problem to discuss. Another French scientific expedition established not long ago the feasibility of passing from the Upper Benue by canoe through the Tuburi marshes into the Logun River, and thus into the Shari and Lake Chad. Its leader (Lieut. Faure) has proved that at the height of the rainy season of that particular year there was continuous water communication between the mouth of the Niger and Lake Chad, so that Lake Chad was then nothing but a backwater of a river system in Central Africa which sent a superfluity of its waters to the Benue and the Niger.

Captain Tilho's work, however, though it touches on some of these hydrographical problems, deals mainly with the configuration of Lake Chad, in the volume under review. It shows that the average depth of the lake is only 1 metre 50 cm. (say 4 feet 10 inches), and in the great stretches of open water scarcely more than about 3 metres (say 10 feet). It is simply a vast swamp joining the waters of the Komadugu, which enters the Chad on the north-west, with the floods of the Shari coming in on the south-east. During the three years of study devoted by this mission, the only area of open water remaining in the Chad was quite outside British political limits, and lay to the north and north-west of the Shari delta. The rest of the lake surface was either completely dry land (north of the Komadugu River) or it consisted in the east of an archipelago of almost innumerable islands interspersed with lagoons, pools, and navigable creeks. Where Denham saw the waters of Lake Chad at Ngigmi in 1822 there may be a few tiny pools or a small area of moist ground, but the rest of the northern third of the lake has become absolutely dry land.

No doubt to the later expeditions of Barth and Vogel the surface of open water in Lake Chad was

[1] République Francaise. Ministère des Colonies. "Documents scientifiques de la Mission Tilho" (1906–9). First Volume. Pp. lx + 412 and Cartes. (Paris, Imprimérie nationale, 1910.)

already much restricted and blocked with swamp vegetation. There has been not only partial desiccation due to a lessening in the rainfall of West Central Africa, but also a raising of the lake level by the excessive growth of marsh vegetation—papyrus, reeds, rushes, grasses, and the ambatch tree. The water of Lake Chad would also seem to be increasing in salinity, which, however, does not appear to interfere with the growth of vegetation. On the contrary, when every now and then (according to the stories of the natives) the lake is partially recreated by floods from the Shari and the Komadugu and the water becomes fresh, the vegetation tends to disappear, partly by its being drowned, and partly because the water has lost some element suited to its growth.

Some further geographical information is given as to the Bahr-al-Ghazal Channel, or Soro, as it should preferably be called (in order not to confuse it with the name of the western basin of the Nile). This would seem to have been an ancient outlet of the flooded Chad, which carried these waters along a definite channel towards the north-east into the Bodele depression. Another possible *déversoir* of Lake Chad exists still in Lake Fitri, far away to the south-east, which this mission showed still to possess an area of open water of nearly 150 square miles.

H. H. JOHNSTON.

NOTES.

WE have received a programme of the International Congress on Radiology and Electricity to be held at Brussels on September 13–15. Among the important matters to be brought forward is the question of radium standards and nomenclature. The congress will be divided into three sections. In the first section, general questions of terminology and methods of measurement in radio-activity and subjects connected with ionisation will be discussed. The second section will be devoted to subjects relating to the fundamental theories of electricity, the study of radiations (including spectroscopy, the chemical effects of radiations, and allied subjects), radio-activity, atomic theory, and cosmical phenomena, such as atmospheric electricity and the radio-activity of the atmosphere. The third section is biological, and will be devoted to the consideration of the effects of radiations on living organisms. This section will deal with purely biological subjects, as well as the use and application of various radiations for medical purposes. A long list of papers already promised is given in the programme, as well as a list of members up to date. A special exhibit of apparatus relating to the work of members is to be held in connection with the congress, and members are invited to forward exhibits to the Physical Laboratory of the University of Brussels. A number of excursions have already been arranged to take place after the congress, and special facilities will be granted to members on the Belgian and French railways. Intending members should communicate with Dr. J. Daniel at Ostende, rue Wellington 28.

THE preliminary programme of the twenty-fifth congress of the Royal Sanitary Institute, to be held in Brighton on September 5–10 under the presidency of Sir John A. Cockburn, K.C.M.G., has now been issued. Dr. A. Newsholme (Principal Medical Officer, Local Government Board) will deliver the lecture to the congress on "The National Importance of Child Mortality." Dr. Alex. Hill will deliver the popular lecture on "The Bricks with which the Body is Built." In connection with the congress, a health exhibition of apparatus and appliances relating to health and domestic use will be held as practical illustration of the application and carrying out of the principles and methods discussed at the meetings. The congress will include general addresses and lectures, and there will be two section meetings for two days each, dealing with:—Section i., sanitary science and preventive medicine, *president*, Prof. E. W. Hope; Section ii., engineering and architecture, *president*, Mr. H. Rofe. Eight special conferences will be held, dealing respectively with municipal representatives; port sanitary authorities; medical officers of health; engineers and surveyors to county and other sanitary authorities; veterinary inspectors; sanitary inspectors; women on hygiene; and hygiene of childhood.

THE death is announced, at seventy-five years of age, of Prof. F. von Neumann, who from 1876 until 1909 held the chair of political economy at the University of Tübingen.

WE regret to see the announcement of the death of Dr. Louis Olivier, at fifty-six years of age. Dr. Olivier was the founder and editor of our esteemed contemporary the *Revue générale des Sciences*, which ever since it first appeared, twenty years ago, has taken a leading place among the scientific periodicals of the world.

THE International Horticultural Exhibition of 1912 will be held in the grounds attached to the Royal Hospital, Chelsea. These beautiful grounds were laid out by Sir Joseph Paxton, and they are well adapted for the purposes of a horticultural exhibition. The area leased to the exhibition authorities is approximately twenty acres, and nearly sixteen will be directly available for the accommodation of the exhibits. In the remaining portion, which includes some shrubberies, there are many fine specimen trees.

THE following news of north polar exploration has been sent to London by the manager of the Nordenfjeldske Steamship Company of Trondhjem:—*Kong Harold* has returned from polar ice. Reached 80° 10′, within 10° Pole. Met *Fram* expedition at Spitsbergen. *Fram* has discovered volcano and hot springs Wood Bay; beach covered with lava. Zeppelin has taken possession of tract of land at King's Bay, and has named it Zeppelinshafen.

IT is reported by the Polar Sea yacht *Laura*, which arrived at Tromsö on August 17 from East Greenland, that the expedition ship *Alabama*, belonging to the Danish explorer Captain Mikkelsen, was crushed by the ice at the end of March last. The crew were saved, and wintered on Shannon Island. The Copenhagen correspondent of the *Morning Post* states that Captain Mikkelsen with Mr. Iversen, who started from Shannon Island on March 3, are trying to reach Cape York, on the western coast of Greenland, travelling by way of Peary Channel and the inland ice. If insurmountable difficulties are encountered, they can return to Shannon Island, where a house, in which there are provisions sufficient for two years, has been built. On August 7 Captain Mikkelsen and his companion had not yet returned, and it is supposed that they continued their way through the Peary Channel to Cape York, or that they are returning along the east coast, having spent the summer there.

THE Anthropological Society of Paris, in the last issue of its *Bulletins et Mémoires*, gives a report of the meeting, attended by leading anthropologists from all parts of Europe, to commemorate the fiftieth anniversary of its foundation. An interesting feature in the report is a series of papers contributed by the foreign delegates describing the progress of research in the various parts of Europe. As representative of the Royal Anthropological

Institute, Prof. W. Ridgeway sketched the results attained in this country during the last fifty years. Describing the refusal of the Prime Minister of a grant in aid of the proposed Bureau of Anthropology, who at the same time admitted that a knowledge of the science was indispensable for our Indian and Colonial administrators, he added:—"If, then, in the United Kingdom we have not done all that we ought to extend the study of man, I beg you to remember that the Anthropological Institute has to depend upon the subscriptions of its members. Your distinguished society has long been recognised as of public utility by the State."

In *Folk-lore* for June Mr. Andrew Lang discusses the strange myth of Theseus and the Minotaur. He argues that the fact of human sacrifice in Minoan times is not established, and that the suggestion that Minos, like the priest kings described by Prof. J. G. Frazer, had to fight for his life at stated periods, rests upon a passage in Homer which cannot bear that meaning. He concludes that the historic fact in the Attic myth is the sending of Attic captives into the Cretan bull-ring, where boy and girl acrobats played perilous tricks with bulls, as often depicted in Cretan art. The rest of the myth is a common *marchen* localised.

In a recent number of the Journal of the Royal Society of Arts, a paper by Mr. H. Gibson is reprinted, embodying the investigations made by Mr. H. P. Slade of the dew-ponds on the Thorpe Downs, Berkshire. The result is to show that dew contributed nothing to the water supply, which appears to be entirely the consequence of rainfall. Dew, in fact, is only scantily deposited on such high grounds owing to draughts of air, which cause rapid re-evaporation. As the temperature of the water was found to be at night much lower than that of the surrounding air, the author believes that the possibility of dew condensation is disproved. He concludes that a catchment area consisting of galvanised corrugated iron stretched upon a wooden frame, with a roofed reservoir to collect and store the rainfall, would be more economical and sanitary, as a souce of water supply, than the most ingenious dew-pond ever constructed.

Information has been received by the *Times* that the new direct wire connecting Montreal with the Bamfield Creek cable station has been completed by the Canadian Pacific Railway, and was handed over to the Pacific Cable Board on Monday. The longest cable in the world (3458 nautical miles) is thus connected with a land line 3000 miles in length, and communication between Fanning Island (long. 159 W., lat. 3 N.) and Montreal (long. 75 W., lat. 45 N.) will be effected with only one retransmission. The Pacific Cable Board expects, as a result of this new arrangement, to be able to reduce the average time in transmission between Australasia and London by fifteen minutes.

A fifth report on research work carried out for the Metropolitan Water Board by Dr. Houston, director of water examination, has been issued. One important section contains the results of the examination of *raw* Thames and Lea water for the presence of the typhoid and Gartner bacilli. The total amount of water dealt with was 12 litres, averaging 62,688 microbes per cubic centimetre. From this vast number of bacteria, one was isolated having all the characters of a typhoid bacillus; another corresponded to the Gartner bacillus. If present, therefore, these microbes must be extremely scanty in the raw waters, for control experiments carried out with the raw waters artificially inoculated with these organisms showed that the methods employed sufficed to reveal a very small infection. Another search was for Morgan's bacillus No. 1, supposed to be a cause of summer diarrhœa of infants, but it was not found in the raw waters.

In the *Irish Naturalist* for August, Dr. A. R. Jackson records from Ireland a spider, *Erigone capra*, new to the fauna of the British Isles.

In the paragraph on the local forms of musk-ox in our last week's issue (p. 211), the statement that the range of the species extends to the west of the Mackenzie applies only to a past epoch.

To the August number of the *Naturalist* Mr. Sheppard contributes an illustrated article on Neolithic implements from Bridlington, where there appear to have been four sites for their manufacture, one of which occurs near Danes' Dyke, the ancient earthwork stretching across Flamboro' Head. All the implements are made from black flint, quite different from the local grey flint. Some of the specimens recently obtained, more especially a so-called sickle, are stated to be of unusual types.

To the Proceedings of the Philadelphia Academy for April Mr. J. P. Moore contributes the second part of an article on polychætous annelids dredged off the Californian coast by the *Albatross* in 1904. In the Polynoidæ twelve species are described as new, while four previously known from Japan are for the first time recorded from the American side of the Pacific. The other groups discussed are the Aphroditidæ and Segaleonidæ, of which new forms, including a new genus, are also described.

We have received from the author, Mr. P. H. Grimshaw, a copy of a paper from the July number of the *Annals of Scottish Natural History* on the species of insects frequenting Scotch grouse-moors. The list was compiled in connection with an investigation of the food of young grouse, undertaken at the instance of the Grouse Disease Committee, and it was considered that its publication might be of interest from a faunistic point of view. Species known to be eaten by grouse-chicken are denoted by asterisks.

In concluding an article on chromosomes and heredity, published in the August number of the *American Naturalist*, Prof. T. H. Morgan states, in a guarded manner, that some progress has been made in the interpretation of the mechanism by which sex is determined in the organism. He considers it certain "that we have discovered in the microscopic study of the germ cells a mechanism that is connected in some way with sex determination; and I have tried to show, also, that this mechanism accords precisely with that the experimental results seem to call for. The old view that sex is determined by external conditions is entirely disproven, and we have discovered an internal mechanism by means of which the equality of the sexes where equality exists is attained. We see how the results are automatically reached even if we cannot entirely understand the details of the process."

In reference to the recent article on "Wild Plants on Waste Land in London" (August 11, p. 184), a correspondent suggests that various seeds may have been brought to the ground in the nose-bags and hay trusses of horses employed during the demolition of the buildings or passing along the neighbouring streets. Many of the plants on the waste ground near the Strand are common weeds of arable land.

Much interest attaches to two palæobotanical papers by Dr. E. C. Jeffrey that have been published in the Proceedings of the Boston Society of Natural History (vol. xxxix., Nos. 9 and 10). In the first the author describes a petrified stem taken from the remains of a Triassic forest in Arizona, that presents several novel features. The wood structure resembles that of living representatives of the Araucarineæ, but the plant produced short shoots that persisted and elongated with the growth of the stem. The leaf traces, on the contrary, did not, as in present-day genera, persist in the secondary wood. The author regards the persistent short shoots as primitive, and therefore indicating the antiquity of the two coniferous groups of Abietineæ and Araucarineæ in which these characters occur. The second paper deals with fossil remains of a conifer, collected in Massachusetts in the Lower Cretaceous days, in the shape of two short shoots similar to, but distinct from, the brachyblasts of Pinus, and referred to the genus Prepinus previously proposed by the author.

A popular account of the date gardens of the Jerid at the northern fringe of the Sahara Desert is contributed by Dr. T. H. Kearney to the American *National Geographic Magazine* (July). The author's journey was undertaken with the object of obtaining palms for the date orchards established by the United States National Department of Agriculture in Arizona and California. The two largest oases in the Jerid district comprise about 6000 acres each. The ownership is much divided, as individual holdings range from a few square rods to several acres. More than a hundred distinct varieties are grown, differing in shape, colour, and flavour. The variety exported to Europe strikes the mean between the hard and very soft kinds, and is characterised by its translucent flesh and keeping quality. The method of propagation is by offshoots that arise from the base of the palm; these, when dipped in clay and bound with layers of leaf-stalk fibre, will travel safely any distance.

The Board of Agriculture and Fisheries reminds growers of potatoes that it is their duty under the Destructive Insects and Pests Order of 1910 to report to the Board all outbreaks of wart disease, otherwise known as black scab of potatoes, cauliflower disease, "fungus," &c., in counties in which no officer has as yet been appointed by the local authority to receive reports. The penalty for neglecting to report disease is 10*l*. The presence of disease should be again reported this year, notwithstanding the fact that it may have existed and been reported last year. A leaflet describing the disease may be obtained on application to the Secretary, Board of Agriculture and Fisheries, 4 Whitehall Place. Letters so addressed need not be stamped.

The West Indian Bulletin (No. 3, vol. x.) contains an article by Mr. Ballou on legislation in the West Indies for the control of pests and diseases of imported plants. Such control has been exercised since 1884, and was considerably developed in 1898, when the Imperial Department of Agriculture was organised. The text of the various laws and proclamations is given, and certain modifications are suggested. It appears that legislation has been distinctly beneficial. Messrs. Bancroft and South briefly describe the fungi which have from time to time proved injurious to cultivated crops in the West Indies. The account is brought up to date, only a few minor unidentified forms being omitted. A note is added containing a summary of the diseases, probably caused by bacteria, which have not yet been fully investigated.

From the Agricultural and Forestry Department of the Nyasaland Protectorate we have received a Bulletin, by Mr. McCall, on bacterial blight in cotton caused by *Bact. malvacearum*, by far the worst enemy of Egyptian cotton cultivators in Nyasaland, having reduced the output of several estates by at least 60 per cent. in the past season. The disease first appears on the leaves, causing them to shed; then the bacteria get into the branches, and soon the flowers and bolls die. No method of control is yet known. Mr. Purves deals with tree-planting in the highlands of the country. In general, the natural timber consists of small slow-growing hard-woods and shrubs. There is an increasing demand for building timber and firewood, and it seems likely that plantations may be profitable. A number of suitable trees are recommended.

We have received from the Agricultural Institute at Pusa copies of several of their recent publications. The *Agricultural Journal of India*, which is intended as much for the intelligent lay reader as for the professed agriculturist, contains an article on the outbreak of blister-blight (*Exobasidium vexans*, Massee) on tea in the Darjeeling district in 1908 and 1909, which caused a considerable amount of damage. In the first instance the leaves are attacked, then the disease spreads to the leaf stalks and the young green stems, where the damage is more serious, although less conspicuous. The disease is not new, and has been known for more than forty years in the Brahmaputra valley in Upper Assam, but not elsewhere. The districts are widely separated, yet the disease has not appeared in intervening places. A memoir is issued by Mr. Annett on the cause of the colour of black cotton soil. He finds several per cent. of titaniferous magnetite, and also a certain proportion of humus, both contributing to the colour. Mr. Howard issues a report on his fruit experiments. Of the numerous interesting results one may be noted: the effect of grass growing round the tree was apparently fully as injurious as in the Woburn experiments. Tillage of orchards, however, is not an unmixed advantage, as it exposes the soil to considerable washing in the rainy season. A system of embanking combined with monsoon leguminous cover crops seems to be the best means of preventing this loss. Dr. Butler describes the wilt-disease of pigeon pea, which he finds is brought about by *Fusarium udum*, n.sp.

The U.S. Weather Bureau has issued its useful meteorological charts of the North Atlantic and North Pacific Oceans for September, and of the South Atlantic and South Pacific for the season September–November, 1910. The North Atlantic chart contains an account of the violent West India hurricane of September 16–21 last, with synoptic charts showing the existing weather conditions at Greenwich noon over the North Atlantic and Gulf of Mexico during that period. On September 16 the storm was south-west of Jamaica, moving north-westward, and warnings of its approach were issued to various ports. It continued its north-westerly direction, reaching the Gulf ports on September 20, where exceptional severity was experienced, thence curving northwards and moving up the Mississippi Valley. About half the coal fleet anchored along the banks of that river were sunk, but the remainder were saved as a direct result of the action taken on the advice of the Weather Bureau. Arrangements have been made by the Bureau to obtain during the present hurricane season (July to November) wireless storm telegrams from vessels in the Gulf of Mexico and all West Indian waters.

IN connection with the production of undamped electrical oscillations of high frequency by the arc and condenser method, Messrs. M. Kimura and K. Yamamoto, of the Kyoto University, have carried out a series of determinations of the effects of atmospheres of various vapours on the volt-ampere "characteristic curves" of the carbon-copper arc. The carbon electrode was solid, and was used as the kathode. The copper anode was water-cooled. The curves obtained are all of the usual form, which suggests a rectangular hyperbola, and show that the vapours tried stand in the following order of relative efficiency:—hydrogen, hydrogen mixed with benzene, methyl alcohol, methyl and ethyl alcohols mixed, ethyl alcohol, air, the volts absorbed for a given current being highest for hydrogen. The complete paper is contained in part iv. of the second volume of the Memoirs of the College of Science and Engineering of Kyoto University, just to hand.

THE following figures for the solubility of ether in water are given by Mr. Y. Osaka in the Memoirs of the College of Science at Kyoto, and will be of interest to people who are constantly making use of this solvent:—

Temperature	0°	5°	10	15°	20°	25°	30°	
Solubility (Osaka)	13·13	11·18	9·55	8·22	7·08	6·13	5·39	gr. per 100 gr. water.
Solubility (Seidell)	13·12	11·4	9·5	8·2	6·95	6·05	5·4	gr. per 100 gr. water.

PROF. BONE and Dr. H. F. Coward have replied, in the Journal of the Chemical Society, to the criticisms by Berthelot and others of their work on the production of methane by the direct union of hydrogen with carbon. In their most recent experiments they have obtained yields of 95·8, 95·6, and 91 per cent. of that theoretically obtainable from the weight of carbon used. The carbon used was particularly pure, containing not more than 0·06 per cent. of hydrogen, or 0·06 per cent. of ash. The gas produced (at 1150°) contained only a trace of carbon monoxide, never exceeding 0·03 per cent., and the amount of nitrogen was also very small.

IT is seldom now that one firm is entrusted with the order for as many as ten vessels for any navy, and the successful completion of such an order by Messrs. Yarrow and Co. for the Brazilian Government forms the subject of an article in *Engineering* for August 19. The ten torpedo-boat destroyers are all of one design, an important advantage both from the tactical point of view and also from the standpoint of management by Brazilian officers and crews. They partake generally of the British "river" class, in which were embodied greater strength and other qualities to enable the vessels to maintain their speed in a heavy sea. The guaranteed speed of 27 knots has been easily exceeded by every ship. The length between perpendiculars is 240 feet, and the displacement is 650 tons. The ratio of length to beam is 10·2 to 1. Each vessel has two sets of four-cylinder triple-expansion engines, balanced on the Yarrow-Schlick-Tweedy system, and supplied with steam from two double-ended Yarrow boilers. The greatest power developed on an official trial was 8877 indicated horse-power, in the case of the *Parana*. The coal-consumption trials showed that at 14 knots speed the radius of action was 3690 nautical miles.

Engineering for August 19 directs attention to the important and continuous increase in Germany's imports of British coal—from 1899 to 1909 the increase is more than 115 per cent. The figures are 4,873,555 tons in 1899 to 10,498,118 tons in 1909. In no place, perhaps, has British coal to a more marked extent encroached upon German coal than in Berlin. In 1890 British coal consumption in Berlin amounted to 105,894 tons, or 7·53 per cent.; last year the respective figures were 946,102 tons, and 39·88 per cent. The total consumption in Berlin in the two years was respectively 1,406,961 tons and 2,372,310 tons. Coinciding with this increase in British coal consumption is a notable decrease in the consumption of coal from Silesia, and it is from this quarter also that complaints are loudest. Fears are openly expressed that British coal is in a fair way of, lastingly and fully, securing the Berlin market unless proper precautions are taken soon and with the greatest possible energy. The increase in import of British coal to Berlin is to a great extent owing to the growing consumption of British gas-coal at the Berlin gas-works.

MANY ingenious pieces of apparatus for illustrating the principles and laws of heat are described and illustrated in a new catalogue (List 56) just issued by Messrs. A. Gallenkamp and Co., Ltd. The aim of the makers has been to produce at a moderate price instruments which can be used continuously by students without getting out of order, and will yield accurate results. A noteworthy feature is the inclusion of a number of new devices which have been described in text-books or periodicals, or before scientific societies. Teachers of physics will find the catalogue of service in the selection of experiments for the lecture-room and laboratory.

OUR ASTRONOMICAL COLUMN.

THE PERSEID METEORIC SHOWER.—Observations of this phenomenon have been received by Mr. Denning from twelve stations, and he informs us that the results are fairly satisfactory. Clouds, it is true, greatly interfered with watching on the important nights of August 11 and 12, but August 10 was clear.

The character of the display seems to have been of an average character. Meteors were not strikingly abundant, but there were enough to make the event exciting and to attract the interest of the general public. In Norfolk one observer was very successful, and relates that he counted twenty-one meteors in eight minutes between 1h. 16m. and 1h. 24m. on the morning of August 12, and estimated that they were falling at the rate of about 250 per hour! Other observers give the number as much less, but testify as to the brilliancy of some of the individual meteors.

Mr. C. L. Brook, of Meltham, saw splendid Perseids on August 8, 11h. $26\frac{1}{2}$m., and on August 10, 12h. $5\frac{1}{2}$m., with paths from $319°+68°$ to $279°+50°$ and $7\frac{1}{2}°+41\frac{1}{2}°$ to $350°+25°$ respectively. Mr. W. H. Steavenson, at Cheltenham, recorded the latter as moving from $90°+58°$ to $120°+48°$, and saw another magnificent meteor at 13h. 11m., twice as bright as Venus, shooting from $120°+48°$ to $135°+40°$. Others, comparable with Jupiter, followed at 13h. 18m. and 13h. 30m. The fireball of 12h. $5\frac{1}{2}$m. fell from a height of 81 to 51 miles over the eastern region of Yorkshire. Its length of path was 45 miles, and velocity about 31 miles per second. It was a true Perseid, with radiant at about $45+56$, but the exact place is not defined, as at Meetham Mr. Brook saw the meteor moving westwards, while at Cheltenham Mr. Steavenson observed it travelling to east.

Miss Warner, at Bristol, saw a number of meteors on August 10, the finest being a Perseid equal to Venus at 10h. 25m. It was, however, very low in the east, passing under Andromeda and Pegasus. Mr. D. E. Packer, of Birmingham, saw 200 meteors in watches of twenty-one hours between July 31 and August 14. There were thirty of the apparent brightness of Jupiter and twenty equal to Saturn.

Mr. W. Johnson, of Lastingham, witnessed a fine meteoric display on August 12. During the evening there were many brilliant meteors, including two of quite exceptional lustre. The display seemed at its best between 11 and 12 p.m.; clouds prevented observations after midnight.

METCALF'S COMET, 1910*b*.—Numerous observations of the comet discovered by the Rev. J. H. Metcalf on August 9 are recorded in No. 4434 of the *Astronomische Nachrichten*.

The magnitudes given for the whole object range from 9·0 to 11·0, and show no marked increase or decrease with the date. While some observers report a stellar nucleus, others say that there is no definite nucleus, but there is a central condensation in the nebulosity forming the head. A short tail is reported by the majority of observers, M. Guillaume, using the equatorial *coudé* of the Lyons Observatory, with a power of 360, giving the length on August 11 as about 1·5′, and the direction as towards E.

From observations made on August 11, 13, and 15, Dr. Kobold has calculated parabolic elements and an ephemeris, the former giving the time of perihelion as August 30·018 (Berlin M.T.). The later part of the ephemeris is given below:—

Ephemeris for 12h. (M.T. Berlin).

1910	α h. m.	δ ° ′	Mag.
August 24	15 46·6	+16 15·0	
,, 25	15 45·4	+16 18·8	10·7
,, 26	15 44·2	+16 22·4	
,, 27	15 43·1	+16 25·9	
,, 28	15 42·1	+16 29·2	
,, 29	15 41·0	+16 32·3	10·9

Owing to the short arc yet observed, the elements are, of course, somewhat uncertain. From this ephemeris we see that the comet is now moving very slowly in a direction slightly N. of W. through the constellation Serpens.

PHOTOGRAPHS OF DANIEL'S COMET, 1907*d*.—The advantages to be secured from widespread cooperation, especially in the study of the physical features of comets, are well illustrated in a paper by Prof. Barnard which appears in No. 194, vol. xlix., of the Proceedings of the American Philosophical Society. There Prof. Barnard publishes twenty-five plate reproductions of photographs secured by him, with the 3·4 and 10-inch Bruce portrait lenses, during the period July 11 to September 8.

The physical changes depicted from day to day are very remarkable; but Prof. Barnard shows, by comparing his plates with series taken at Lick and Juvisy, that much shorter periods produced such great changes that some of the features became recognisable with difficulty. The time difference in the case of the Lick photographs is, generally, about two hours, for the Juvisy plates about six hours, yet even in the comparison between Yerkes and Lick there are very distinct changes shown. In several cases it is shown that a detached portion of the tail, although receding from the head, was still moving sunwards in the path followed by the comet.

PRECESSION AND THE SOLAR MOTION.—In No. 614 of the *Astronomical Journal* Prof. Boss publishes the results of an investigation of the proper motions of more than 5000 stars, uniformly distributed over the whole sky, and deduces therefrom the position of the solar apex and corrections to Newcomb's values for precessions and for the equinox of 1874. For the position of the apex he derives, for 1875·0, R.A. $=270·52° \pm 1·08°$ to $\pm 1·53°$, dec. $= +34·28° \pm 0·90°$ to $\pm 1·28°$. Other solutions, for selections of stars, such as those of different magnitudes or large proper motions, are obtained, but they show no sensible modifications of these values.

For the velocity of the sun in space Prof. Boss finds 24 km. per second as a useful constant to adopt for the present, and is of the opinion that the value (19·9 km.) determined from spectroscopic observations is open to objections inherent to that method.

Further, he finds that his results strongly support the hypothesis of the random motions of the stars, an hypothesis which is directly opposed to the several ideas of definite "star drifts" which have been published in recent years.

CALCIUM VAPOUR IN THE SUN.—No. 1, vol. xxxii., of the *Astrophysical Journal* contains a paper, by Mr. C. E. St. John, which is full of important results concerning the distribution and the circulation of calcium vapour in the solar atmosphere. The research was undertaken in order to provide data for the better interpretation of spectroheliograms in so far as they reveal the disposition and inter-relation of the various solar layers. In 1872 Young observed the reversal of the H and K lines in disturbed regions, in 1883 Lockyer photographed them, and in 1892 Hale and Deslandres noted the reversals distributed over the entire disc.

With the splendid apparatus available at Mount Wilson, Mr. St. John has measured the various parts of the K line (K_1, K_2, and K_3), and, referring these measures to Fabry and Buisson standards, has determined the apparent displacement at various points on the disc, thus deriving data which indicate the conditions, altitudes, &c., under which the emitting vapours exist.

Among other results, he finds that the vapours producing the K_3 (absorption) line show a descending motion of 1·14 km. per sec., while the vapours producing the K_2 (bright) line have, generally, an ascending motion of 1·97 km. per sec. A comparison of the angular velocities obtained points to the vapour-producing K_3 being at a greater elevation than the hydrogen which produces the Hα line. A comparison of the wave-lengths of K_2 and K_3 at, and away from, the limb indicates that these intermediate and higher levels of the sun's calcium atmosphere are not greatly disturbed by currents parallel to the solar surface.

From measurements of the widths of K_3 and H_3, and reasoning from their behaviour in the calcium arc spectrum, it appears that the quantity of calcium vapour in the upper levels must be extremely small, while, from similar considerations of the K_2 and H_2 lines, the emitting vapours would be relatively thick and dense. In approximate figures, the 5000 km. depth of the solar envelopes above the photosphere is divided into 1500 km. for the upper (absorbing) atmosphere and 3000 km. for the emitting layer, leaving 700 km. for the layer which emits the bright chromospheric radiations. A curious result is that the K line persists for some 500 or 600 km. above the level at which the H line ceases to show.

On determining the wave-lengths of H_3 and K_3, a difference of 34·810 A. was found, which differs by 0·010 A. from the value derived from Rowland's tables; this discrepancy is probably caused by an error of that amount in Rowland's wave-length for H.

Mr. St. John's paper takes up forty-seven pages of the journal, and there are other important results which are too numerous for full discussion in these columns.

OBSERVATIONS OF THE MOTION OF THE UPPER AIR.[1]

THE two publications before us evidence the progress which is being made in different ways in our knowledge of the upper currents of the atmosphere. Dr. Figee, invalided home owing to the trying climate of Java, has taken the opportunity of discussing the observations (286) of the height of clouds, made at Batavia, 7° S., 107° E., in 1896–7, and later observations of cloud-velocity. The results for *height* agree generally with the values obtained in the same period at Manila, 14° N., 121° E. The following table gives the heights in km., the mean values for Paris and Potsdam being added for comparison:—

Cloud	Ci.	Ci.S.	Ci.Cu.	A.Cu.	Cu.
Batavia	11·5	10·6	6·3	5·4	1·74
Manila	10·9	11·4	6·6	5·3	1·7
Paris and Potsdam	8·7	7·6	5·7	3·3	1·5

The *motion* of the higher clouds shows different features at the two places. In both the seasons, November–April, May–October, the drift is towards the south-west at Batavia, a result corroborated by the recent work of Van Bemmelen, while at Manila it is towards the south-west in the latter season, but nearly north in the former. The value of the results in Dr. Figee's paper can be rightly appreciated only when they come to be utilised in preparing an atlas of monthly charts showing the main features of the circulation at the cirrus-level, an atlas which is much needed at present.

The second paper is a discussion of fifty-one pilot-balloon

[1] (1) Royal Magnetical and Meteorological Observatory at Batavia: Report on Cloud-Observations at Batavia made during the International Cloud-year 1896–1897 and subsequent years. By Dr. S. Figee. Appendix ii. to vol. xxx. of the "Observations." Pp. 32. (Utrecht: Kemink and Sons, 1910.)

(2) "Velocità e Direzione delle Correnti Aeree alle diverse Altitudini Determinate a Mezzo dei Palloni-Sonde e Piloti." By Dr. G. Pericle. Pp. 55—126; 5 plates. (Milana: U. Hoepli, 1910.)

ascents made at the Geophysical Observatory, Pavia, during 1908. The balloons were observed to heights exceeding 10 km. in six cases, and exceeding 5 km. in thirty-one additional cases. The ascents were made generally during comparatively calm weather, so that the results cannot be taken as representative of average conditions, a restriction applying, of course, to all pilot-balloon observations.

The values of the observed wind are collected in a convenient table, which is accompanied by a brief description of the general pressure distribution on the days of the ascents, and by diagrams showing the paths of the balloons and the wind at all heights for each ascent. An outstanding feature of the results is the large proportion of cases, thirty-two out of forty-four, in which the wind above 3 km. has a northerly component, compared with three cases in which an extensive southerly current was found. This agrees with the cloud observations at Perpignan and Pola, and is markedly different from those at Paris and Berlin.

Dr. Pericle finds that the wind usually veers with increasing height up to 2 km., veers as often as it backs from 2 to 5 km., and usually backs above 5 km. A sudden increase in the velocity of the wind was observed in thirty-one cases at heights between 2 and 4 km., and this was accompanied generally, but not invariably, by a change in direction. The average change is from 5·2 m.p.s. below the level of the discontinuity to 9·4 m.p.s. above it. The wind veered in passing upwards in thirteen cases, backed in thirteen cases, and did not change in five cases. The "backing" is usually larger than the "veering," the average value being 29° for the former and 18° for the latter. These results confirm the temperature observations in indicating the intermediate layer from 2 to 5 km. as the region where the more immediate causes of remarkable meteorological phenomena are to be sought.

E. GOLD.

FURTHER RESULTS OF THE JESUP NORTH PACIFIC EXPEDITION.[1]

FORCE of circumstances has prevented Prof. F. Boas from giving to science a complete monograph of the Kwakiutl, but he has given a further instalment in the publications of the Jesup North Pacific Expedition, which, so far as it goes, together with his study of the sociology of these interesting Indians (Report U.S. Nat. Mus. for 1895 [1897]), practically supersedes the reports published by the British Association. The present memoir deals with the industries of the Kwakiutl, but the author acknowledges the "many gaps and imperfections," which he has endeavoured to supply by correspondence; even so, we have an important contribution on the technology of a representative tribe of the north-west coast, a district in which the natives have developed a culture which differs markedly from that of other American Indians.

FIG. 1.—Kwakiutl Village at Newettee, Vancouver Island.

The two key-notes from the material side of this culture are the cedar tree and the salmon. The former is utilised for a large number of purposes, and as the wood splits easily large planks are readily made; hence we have a peculiar type of house construction. Also, the manufacture of chests and boxes is very characteristic; boxes are made by bending a board, a kerf having been made where the corners are to come; the two ends are then sewn together. In the late summer enormous numbers of salmon migrate up the rivers, thus affording food which, with proper preparation, can be stored for future consumption. Fishing is carried on by means of traps, nets, hooks, and with the spear. In some cases, also, combinations of fish-weirs and nets are used, or fish are speared or hooked in pounds

[1] "The Jesup North Pacific Expedition." Mem. Am. Mus. Nat. Hist., N.Y. Vol. v., pt. ii. "The Kwakiutl of Vancouver Island." By Franz Boas. Pp. 301–522 (plates xxvii–lii)+ix. Vol viii., pt. i. "Chukchee Mythology." By Waldemar Bogoras (*loc. cit.*). Pp. 197. Vol. ix. pt. i. "The Yukaghir and the Yukaghirized Tungus." By Waldemar Jochelson (*loc. cit.*). Pp. 133; 1 map. (Leiden: E. J. Brill, 1909–10.)

connected with traps; many of these are described by the author.

In this favoured wooded region berries are abundant, and there are numerous land mammals and birds. The principal method of hunting the former is by means of traps; bow and arrow and spear are not used extensively for this purpose. Birds are generally snared or shot with arrows.

Fig. 2.—Kwakiutl Mask representing Whale and Thunder-Bird. Length 172 cm.

The peculiar socio-religious beliefs and practices of the Kwakiutl, together with their skill in working wood, have led to the decoration of the majority of their domestic tools and appliances with human and animal forms and motives. House posts are often decorated with human and animal forms, and human effigies are frequently carved; but their fancy runs riot in the masks which are employed on ceremonial occasions; these often have movable jaws, and are well carved and brilliantly painted; numerous plain and coloured illustrations of these are given, one of which is shown in Fig. 2.

Prof. Boas has "spared no trouble to collect descriptions of customs and beliefs in the language of the Indian, because in these the points that seem important to him are emphasised, and the almost unavoidable distortion contained in the descriptions given by the casual visitor and student is eliminated." He goes on to say he has for many years advocated a more extended application of this method in our studies of the American aborigines. Other field workers might with advantage adopt this suggestion, which has, however, been more or less systematically employed by previous investigators. In this particular instance, Prof. Boas has given a presentation of the culture as it appears to the Indian himself. These accounts by the Indians of their technical processes afford very interesting reading from various points of view, and it was a happy idea to publish them in full, but, as so many Kwakiutl texts have already been published, it seems hardly worth while to have gone to the expense of printing so many of the native texts in full in addition to the translations.

Dr. W. Bogoras gives us forty-seven Chukchee myths and tales, ten incantations, and several songs, proverbs, riddles, &c., the native text being given in many instances. The pronunciation of the women differs from that of the men; they generally use *s* instead of *c* and *r*, and *ss* instead of *rk* and *ch*; also contracted forms of words are never used by them. They are not unable to pronounce these letters, and in tales, when quoting a man's words, they use the male pronuciation; but in ordinary conversation the male pronunciation is considered unbecoming in a woman. The tales give a valuable insight into native life and thought, and, on the whole, appear to be very similar to those current among the tribes living on the north-west coast of America, but no comparisons are made or general conclusions drawn in the present memoir.

Of great interest and value is the first part of Dr. W. Jochelson's monograph on the Yukaghirs, a tribe now on the verge of complete physical and ethnic extinction. The whole area between the rivers Lena and Kolyma, and between the Arctic Sea and the Verkhoyansk Range, may be considered as the ancient boundary of the Yukaghir tribe. Probably Finnish tribes were formerly the neighbours of the Yukaghir west of the Lena, as the Yakut and Tungus appear to have come there in comparatively recent times, but the original home of the Samoyed tribes was evidently in the Sayan Mountains, whence they were driven northwards by the Turko-Tatar peoples; in their new abode they had to wage long wars with the Finnish tribes. Chukchee formerly inhabited the tundra between the mouths of the Alaseya and Kolyma rivers; when the Russians came they moved east, and only about sixty years ago one division crossed the Kolyma and spread west as far as the Yerchen (long. 150° E.). Now the Yukaghir are confined to the north and north-west of their ancient area.

The term Yukaghir is probably of Tungus origin; the people call themselves Odul, which means "strong," "powerful." A sufficiently full account is given of the physical characters of the people, accompanied by numerous excellent photographs of types. There is an admirable account of their physiological characteristics, and their nervous diseases are treated in detail, the description of arctic hysteria being the best we have seen. Two principal forms of arctic hysteria may be distinguished; one has little to distinguish it from fits of hysteria in civilised countries. The fits occur mostly in grown-up girls or young women, while in the young males they are principally due to the influence of religious imagination; they are observed in the nervously strained youths who are inclined to become shamans. The characteristic feature of this type is that the patient continues to sing a long time,

Fig. 3.—A Man of the Yukaghir Tribe

enunciating in the song the wishes of the spirit that tortures him or her. The other form is more strange and complicated, the first symptom being extreme impressionableness and a feeling of fright or timidity. At the least knock, shout, or unexpected noise, the patient shudders or falls backward, and the fright usually evokes the most obscene words or phrases. Another phase is akin to hypnotic aural suggestion; the visional auto-suggestion is also well known among other races, for example, the *latah* of the Malay peoples. Persons who are past thirty or forty years of age, and chiefly women, are subject to this second form of arctic hysteria.

The chapter on family life is of especial importance; a careful account is given of relationship terms and the ideas of kinship; the system is essentially classificatory, with some suggestive modifications, the information here given being more detailed than is usually the case with even professed ethnologists. A review of the facts pertaining to marriages shows that, just as in the period of courtship, there are two distinct tendencies, one towards loose sexual relations, and the other towards idealising constancy and mutual faithfulness. So, also, in marriage, there is a striving towards exogamy and an inclination towards consanguineous marriages, which, it seems, were common in former times. Both the Yakut (who in general practise very strict exogamy) and the Yukaghir observe that children born from consanguineous marriages are generally unhealthy. Dr. Jochelson has not only given us a detailed account of a vanishing people, but he alludes to problems that will interest the student of comparative ethnology.

A. C. HADDON.

INTERNATIONAL CONGRESS OF ANATOMISTS AT BRUSSELS.

THE second quinquennial Congress of Anatomists was held at Brussels on August 7–11. The societies participating in it were the Anatomische Gesellschaft of Germany, the Association des Anatomistes of France, the American Association of Anatomists, the Anatomical Society of Great Britain and Ireland, and the Unione Zoologica of Italy; there was an attendance of about one hundred members. Among the representatives from the various countries and associations were Waldeyer and Von Bardeleben, Nicolas and Laguesse, Minot and Piersol, Romiti, and Arthur Thomson, Paterson and Dixon.

Meetings for the reading and discussion of papers were held in the forenoons in the physics classroom of the university, and demonstrations were given in the afternoon in the anatomical department in the Parc Leopold. About fifty communications were read, of which the majority dealt with embryological or histological subjects; many of the papers were of great interest and importance.

Among the papers presented by members from Germany, Poll gave an important communication dealing with spermatogeneris and oogenesis in hybrids. Using material derived mainly from hybrid pheasants, he demonstrated that spermatogenesis in them never went beyond the primary stage, or to the production of fully formed sperms. Braus gave a communication and demonstration upon the distribution of motor nerve fibres to the muscle segments in the lateral fin of the skate, and showed that each muscle segment in it received an innervation from a number of spinal nerves, and he also demonstrated the contraction of from 5–8 muscle segments upon stimulation of a single spinal nerve.

Neumayer showed a beautiful series of models illustrating the development of the skeleton of the head in Bdellostoma St. L., and Fetzer showed a model and sections of a very early human embryo closely resembling the ovum of Peters. In it the fixation and the histological structure of the trophoblast were particularly well seen.

Lenhossek gave a communication on the nerve-cells of the ciliary and otic ganglia in man, and showed some very fine specimens of them. Several communications from members of the German and American societies dealt with the development of the blood cells, Maximow giving a communication upon the development in Selachians and Amphibians, Frau Wera Dantschakoff that in Reptiles, and Minot upon the nomenclature and morphology of blood cells in general. He appealed for a more rational and scientific terminology than at present exists, and for the abolition of terms such as "normoblasts."

The papers from French anatomists included one from Lams, accompanied by a demonstration of beautiful specimens on the fertilisation and early changes in the ovum of the guinea-pig, which gave rise to an interesting discussion upon the *rôle* of the tail segment of the entering spermatozoon, in which Brachet and Van der Stricht took part. Dubreuil showed the development of the lamellæ in the upper end of the femur, and the relation which they present to the entering vessels. Several communications from members of this society dealt with the presence and character of Mitochondria in various tissue cells.

Huntingdon and McClure, of the American Society, dealt with the development of the lymphatic system, and demonstrated a loosening of the intima of the early veins, by which lymph channels could take origin within the lumen, outside the intima.

Lee gave a communication upon the implantation of the ovum in various North American rodents, and Huber demonstrated some fine corrosion preparations, illustrating the morphology of the renal tubules and vessels in vertebrates.

Of the British and Irish Society, Hill (London) demonstrated, by a fine series of photographs, the growth and maturation of the marsupial ovum as illustrated by Dasyurus. Berry (Melbourne) gave a communication upon Tasmanian crania; Evatt (Winnipeg) advanced a new view of the homologies of the urethra and vagina in the sexes; Arthur Thomson and Whitnall (Oxford) dealt with the anatomy of the angle of the iris and a ligament acting as a check to the action of the levator palpebræ superioris; and Waterston (London) gave a communication upon the shape of the human stomach and the action of formalin. A paper from Cameron (London) was read, upon the development of the anterior commissure and adjacent parts.

Most of these papers will probably be published at an early date, and hence no description of them need be given here.

On the last day of the congress an important step was taken in the appointment of an international committee to consider the question of a uniform embryological nomenclature, on the model of the Basel anatomical nomenclature for general anatomy. A committee of representatives from each country represented at the congress was appointed, with power to co-opt additional members, and with Prof. Mall, of Baltimore, as general secretary.

The members of the congress were entertained at a municipal reception in the magnificent Hotel de Ville, and they also appreciated greatly a demonstration given by Dollo of the great collection of fossil Iguanodons in the Natural History Museum.

BRITISH MARINE ZOOLOGY.

THE Bureau of British Marine Zoology has been established under the directorship of Mr. S. Pace, late director of the Millport Marine Biological Station. The objects of the bureau, we learn from the prospectus before us, are twofold:—(1) to compile a bibliography of all works dealing with the biology of the European seas, and (2) to establish a marine biological station of a movable character with adequate staff, but relatively simple and inexpensive equipment, to work at faunistic problems at one or two points on the coast, with no reference to any question of their possible economic importance.

It is intended that the bibliography should be issued in a large number of parts each year, and that the issue of each part should follow the papers referred to in it at the shortest possible interval. From the specimen pages of such an issue submitted to us, we gather that the papers are classified both under the author's name and according to subject-matter, and they are accompanied by very brief synopses of their contents, the brevity of which is increased by the use of the numerous abbreviations employed. Such a bibliography should be of very considerable value to workers at marine biology. Whilst, of course, it cannot compare with such periodicals as the *Zoological Record* or the *Zoologisches Jahresbericht*, it will anticipate the appearance of these by many months.

With respect, however, to the second project for which the bureau has been established, viz. to carry on an exhaustive faunistic survey of the marine life at one or more points on our coasts, a point of cardinal importance is at once raised. We have at present about half a dozen "stations" for the study of marine biology. There is hardly one of these which receives anything like adequate support. The largest of them, the Marine Biological Association's station at Plymouth, is faced with a serious deficit, and is forced to contemplate the curtailment of its operations. The amount of sympathy and support which the cause of "pure" science can evoke in Great Britain is, unfortunately, very small. We should therefore regret very much to see another "station" started, especially as the staff at Plymouth have carried out just such a faunistic survey of the coast near Plymouth as Mr. Pace desiderates.

Mr. Pace believes that the intrusion of the economic motive "must arrest, if it does not entirely hinder, scientific research." If the zoological schools of this country would concentrate on supporting one station, economic work might be dispensed with, and we might have a purely scientific biological station like Wood's Hole in America. But this goal is far off. Each new zoological school seems to desire its own station, and since the "stations" must look outside the ranks of professional zoologists for support, this support must be attracted by the promise either to devote part of the energies of the staff to economic problems, as the council of the Plymouth station have done, or to undertake the dissemination of popular knowledge of natural history, as the council of the Millport station has done. After all, the foundations of our knowledge of natural history were laid by the splendid amateurs of the last generation, of whom the founder of the Millport station was one. A great service to science would be accomplished if we could resuscitate this race.

We agree with Mr. Pace that it would be an admirable thing if marine biological research in this country could be organised; but it seems to us that the first step in this direction would be the whole-hearted support of the Marine Biological Association, which was founded for this purpose, and this association, if adequately financed, could provide a steamer which would serve the purpose of faunistic investigation better than the movable laboratory which Mr. Pace desires. Mr. Pace's scheme is an admirable one for starting investigation in a new country—it was that adopted by Canada for seven years; but in Canada it has been given up, and a permanent station on the model of Plymouth has been substituted for it.

E. W. MacBride.

INHERITANCE IN THE DOMESTIC FOWL.[1]

In the conditions under which they work, students of genetics enjoy exceptional advantages in America, where the munificence of private benefactors or the enterprise of various States has already led to the creation of several institutions specially endowed for this line of research; and from time to time the record of their work may appear in the form of a sumptuous publication issued by the Carnegie Institution of Washington. Dr. Davenport is already known for his investigations on heredity in poultry, and the present volume forms a continuation of the account of his researches to which a volume in the same series was devoted in 1906.

The memoir deals mainly with characters which, at any rate in some cases, are remarkable for the considerable grading that is found among the offspring of the various crosses. To this category belong the feathering on the shanks and the extra toe, both normally found in certain breeds of fowl. It has been recognised for some years that the inheritance of polydactylism in poultry often exhibits irregularities as compared with that of other characters where the mode of transmission is of a simple Mendelian nature. There are cases where the polydactyl condition may behave as a dominant to the normal in the ordinary way, but there are also cases where a bird with normal feet, bred from a polydactyl strain, may transmit the polydactyl condition to some of its offspring, *i.e.* where the individual does not exhibit the extra toe, though breeding tests show that the factor or factors for it must be carried by some of its germ-cells. The dominance of such a character as exhibited by the zygote may range from completeness down to *nil.* Nevertheless, some of the F_2 birds are without the extra toe, and are incapable of transmitting it; in other words, some of the germ-cells of the F_1 birds are completely free from the element, whatever it may be, to which the extra toe is due.

Hitherto it has not been possible to express this case more precisely, and though Davenport's results confirm our previous knowledge, he has been unable to construct a definite factorial scheme to cover the facts. He concludes that in polydactylism, as also in other cases, such as rumplessness and the feathered shank, dominance varies quantitatively, and that the degree of dominance is inheritable; but, of course, this does not help us in understanding what these varying degrees of dominance are due to. It may be that further work will make this more clear, or it may be that the heredity of these meristic characters differs from that of other characters in some way that has not yet been perceived. For the present, we can only confess to ignorance.

An account is given of crosses between either Houdan or Polish and single combs, and an attempt is made to explain the results on the supposition that two comb factors are concerned. Here again the irregularities between normal expectation and observation are attributed to quantitative variation in the degree of dominance. Experiments with fowls' combs have hitherto given such well-defined results that it seems not impossible that the complexities encountered by the author are due to the fact that he is dealing with more than two comb factors in this particular cross. The author's statement that many forms of comb appear in the F_2 generation is probably not without significance.

A chapter is devoted to the inheritance of the high and widely open type of nostril found in the low-combed Polish and Houdan breeds. From an elaborate system of grading his data, the author concludes that the widely open condition is dominant to the more usual narrow form of nostril, and that the intermediate grades are the result of imperfection of dominance, though here again no suggestion is given of the cause of this imperfection. There is little doubt that this character of wide nostril is largely dependent upon the size of the comb, and we cannot help feeling that the treatment of the question would have been more satisfactory had the nostril and comb characters been worked out in relation to one another.

The inheritance of crest Davenport considers a somewhat more complex case than it was originally thought to be, and he suggests that its nature depends certainly upon two, and possibly upon more than two, factors.

A short chapter is devoted to the results of breeding from a wingless cock. When crossed with normal birds the offspring were all normal, and some of these bred together again produced nothing but normals. Davenport suggests that winglessness is dominant to the normal condition, that the wingless cock was heterozygous, and that dominance in subsequent generations was imperfect. It may be pointed out that the facts accord equally well with the view that the abnormality was a purely somatic one, and was not reflected in the germ-cells of this wingless bird.

A number of experiments were made on plumage colour, largely with the view of elucidating the nature of buff and of black, and the author has seen his way to express his results in simple terms. Perhaps one of the most interesting results is the appearance of a definite proportion of white birds in the F_2 generation from a cross between black and buff Cochins. The author is, however, less happy in his discussion of the inheritance of blue, and his attempt to make the colour-inhibiting factor of the white Leghorn partly responsible has led to an account that is inconsistent with itself.

The memoir concludes with a general discussion on topics connected with heredity.

[1] "Inheritance of Characteristics in Domestic Fowl." By C. B. Davenport. Publication No. 121. Pp. 100; 12 plates. (Washington: Carnegie Institution, 1909.)

AGRICULTURE AND ALLIED SCIENCES.[1]

The number of agricultural and horticultural publications has reached somewhat alarming proportions during the last few years, but there is always room for really good works; and in this category must be placed the Journal of the South-eastern Agricultural College, Wye, Kent, No. 18 of which is under notice. This publication

[1] "The Journal of the South-eastern Agricultural College, Wye, Kent." No. 18. Pp. 443. (London and Ashford: Headley Bros., 1909.) Price 6s.; Residents in Kent and Surrey, 3s.

deserves to be more widely known, for as a compendium of all that is latest and best in agricultural research it is far in advance of most of its compeers. The book is divided into parts dealing with the farm, chemical analysis, zoology, botany, veterinary work, and general notes. Where so much is good it is difficult to do more than merely direct attention to some of the most striking portions of the book. A masterful article on the financial aspect of sheep-washing will well repay perusal, and the splendid series of plates illustrative of sheep-shearing are so lucid as to be self-explanatory.

The report on zoology deals mainly with entomology, and is illustrated very fully by many striking plates, one of which is of especial interest, showing as it does female

Photo. *F. Edenden.*

FIG. 1.—Female March Moths: The lower one laying her egg-band beneath one of the Lackey Moth (× 4). From the Journal of the South-eastern Agricultural College.

March moths laying their eggs in proximity to the egg-band of a lackey moth. That insidious pest *Tylenchus devastatrix* receives attention, and further notes are promised for the next report. A very interesting article on the British Culicidæ concludes one of the most fascinating portions of the book.

In addition to the general analytical work, the analytical report deals, for the most part, with soya-bean cake and meal. Economic mycology and experiments on hops form the chief items in the botanical report. It is interesting to note that the good work carried on at Wye in dealing with American gooseberry mildew, apple "scab," and "black scab" of potatoes, is being continued. The notes on the making and application of Bordeaux mixture, with notes on Bordeaux injury, illustrated by no fewer than twenty-three plates, will be greatly appreciated by fruit-growers. Two plates showing the right and wrong kinds of spray for Bordeaux mixture are interesting. In addition to the American gooseberry mildew, the somewhat neglected but no less prevalent Sclerotinia (Botrytis), "die back," of the same plant is described.

In the previous issue of the journal attention was directed to the importance of the male plant in the growing out of hops, and it appears that the advice tendered in the article in question has borne good fruit, and that several Kentish hop-growers have obtained good results by retaining, or even planting, male hops. The veterinary report, always interesting, is especially so in this issue on account of the announcement of the termination of a long series of "struck sheep" experiments, and the probable discovery of a preventive treatment.

FIG. 2.—Diseased Gooseberry Branch, showing the Botrytis fructification at × and elsewhere. From the Journal of the South-eastern Agricultural College.

The general notes consist of a summary of the college events of the year, and will appeal to all old students. To those who desire to keep abreast of the times in matters agricultural the journal is indispensable. C. A. E.

THE BICENTENARY OF THOMAS SIMPSON.

ON August 20 occurred the bicentenary of the birth of Thomas Simpson, who may be regarded as one of the last of the English school of mathematicians of the eighteenth century. Newton, Halley, the Gregories, Muston, Demoivre, Brook Taylor, Maclaurin, had all passed away before Simpson reached middle age, and the study of mathematics in England was entering upon that period of stagnation which left us without a single mathematician in any way comparable with the great writers on the Continent.

Simpson was the son of a Leicestershire weaver, and was born at Market Bosworth, August 20, 1710. He was brought up as a weaver, and the little learning he obtained as a boy was gained in spite of many disadvantages and obstacles. Indeed, the opposition he received from his father at last drove him from home, and he went to Nuneaton, where, at about the age of twenty, he married his landlady, a widow of fifty.

His acquaintance with mathematics began at the age of twenty-four with "Cocker's Arithmetic," the study of which he combined with that of astrology, his tutor being a fortune-telling pedlar. Simpson's astrology, however, brought him more trouble than credit, and on the charge of frightening a girl into fits by "raising the devil" he had to leave the district. He spent some time at Derby, and in 1735–6 he went to London, worked as a weaver in Spitalfields, and taught mathematics in his spare time. A year or two afterwards, with the sole assistance of Edmund Stone's translation of L'Hôpital's "Analyse des Infiniments Petits," Simpson wrote "A New Treatise on Fluxions," which was considered a notable contribution to the literature of that comparatively new subject. Other publications followed, his pupils increased, and he gained a considerable reputation.

In 1743, through the influence of William Jones, the mathematician, Simpson obtained a post as professor of mathematics at the Royal Military Academy, Woolwich, and two years later he was elected a Fellow of the Royal Society, having already been made a member of the Academy of Sciences, Stockholm. After holding his post at Woolwich for eight years he was seized with illness, caused, it was thought, by overwork. Advised to try his native air, he journeyed to Bosworth in February, 1761, and died there on May 14, in the fifty-first year of his age. He was buried in the churchyard of Sutton Cheney, a parish a short distance from Market Bosworth, where in 1790 the Leicestershire antiquarian John Throsby placed a tablet over his grave. Simpson had one son, who became a captain in the Royal Artillery, and one daughter. His wife survived him many years, received a pension from the Crown, and died in 1782 at the great age of 102.

EDGAR C. SMITH.

ELECTRICAL AND OTHER PROPERTIES OF SAND.[1]

THIS material, which flows so freely through my fingers and may be poured in the manner of a liquid from one vessel to another, is common sand. Specimens from various parts of the world are here exhibited; there are sands from the Sahara Desert, from New Zealand, France, Scotland, and several parts of England. There are also bottles of the coloured sands from Alum Bay, in the Isle of Wight, and Redhill. It may be pointed out at once that this coloration is merely due to the presence of an adherent layer of oxides or hydroxide of iron, for even varieties which appear under the microscope to contain little or no coloured particles generally have a trace of iron clinging to the grains.

For instance, a small quantity of white sand from Charlton, having been wetted with strong sulphuric acid before the lecture, will yield on the addition of water a solution containing iron. A few drops of ferrocyanide of potassium give a strong blue characteristic precipitate.

FIG. 1.

Further, the so-called black iron sand from New Zealand consists almost entirely of magnetite. If some of it is poured out upon a sheet of paper and brought near to a powerful magnet, you see that the grains fly eagerly to the poles and form large clusters there. This powder, on account of the regularity of its grains, their highly magnetic character and freedom from dust, is particularly useful in the laboratory for tracing lines of magnetic force. It is interesting to compare this with the black oolitic sand from Compton Bay, in the Isle of Wight, for that is a silicate of iron, and therefore non-magnetic.

I wish now to direct your attention to some of the phenomena connected with sand in large quantities, such as are met with upon wide stretches or drifts.

Blown sand, having been stopped by hedges and grass, gradually accumulates to a mound (Fig. 1)—in some cases with serious consequences. Dr. Vaughan Cornish, who has made a special study of this subject, has clearly proved,

[1] Discourse delivered at the Royal Institution on Friday, February 11, by Mr. Charles E. S. Phillips.

however, that the formation of a sand dune is very frequently due to wind eddies. The second photograph was, in fact, taken by him in Egypt, and depicts the steady, irresistible march of millions of tons of sand, encroaching upon and slowly burying casuarina trees (Fig. 2).

To come nearer home, the seriousness of problems arising out of this state of things may be illustrated by two photographs obtained recently at Southport, in Lancashire. In the first one (Fig. 3), the back garden of a newly built house is nearly buried beneath the enormous hill, which will probably soon cover the whole property. The second (Fig. 4) shows that the familiar appearance of a sandy beach at low water, with regular lines of ripples, may be produced by the direct action of the wind, and, incidentally, the utter futility of constructing an esplanade in such a neighbourhood. All these phenomena depend, in some measure, upon the size, weight, and shape of the sand grains themselves.

FIG. 2.

Silica, a substance which occurs in numerous impure forms, and constitutes a large portion of the rock masses known to geologists, is also to be found in a pure state as crystalline quartz. Here is an actual specimen about 18 inches long, which, together with the beautiful group of quartz crystals by its side, known as amethysts (and tinted, probably, by a trace of organic matter), are the property of this institution. Sand, therefore, being the result of rock disintegration, assisted by the grinding action due to the motion of wind or water, varies in composition in different localities.

The next slides are photomicrographs taken with a low-power objective. They represent some grains of sand found at Charlton and the Isle of Eigg respectively (Figs. 5 and 6). The former are seen to consist of minute silica particles of very irregular form, whereas the larger grains of the Eigg sand are remarkable for their smoothness. It is owing to this fact that the latter possess a peculiar property, to be referred to later.

Owing to the Sahara Desert having once formed the bed of a vast sea, it is, of course, found to be rich in marine deposit.

The damage which sand is capable of doing has been already referred to. It must not be forgotten, however, that its utility in the arts and crafts is of the utmost importance. The Egyptians are reputed to have been the first to find a wide use for it. They were probably the earliest glass-workers in the world. By the time glass-making was begun in England, viz. about 1611, the Romans and Venetians had so far mastered the art of blending sand with other substances that almost all the technical difficulties had already been overcome.

Now the melting point of silica being about 3000° C., it cannot be worked in an ordinary furnace. In glass-making the sand is therefore heated with a salt of one or more of the alkaline group of metals, preferably with sodium carbonate. At a moderate temperature sodium silicate is formed, and if this be subsequently heated in the presence of either lead oxide or borax, the melting point of the mass is still further reduced. Here is a white-hot crucible containing sand so treated and melted. You see the glass pours out like treacle, and sets rapidly into a transparent slab upon a hot brass plate.

Many useful applications, besides providing us with windows and glass-ware, have been found for sand, such as the decorating of hard surfaces by means of an impinging stream of its particles, scouring and cleaning, preventing slip on the roads, and so on. By no means the least important of these is its employment in war as a protection against bullets: a thickness of 20 inches of dry sand is proof against the modern rifle.

Now a mass of sand grains moving down a slope, by a motion consisting of rolling and sliding, meets with great opposition, due to friction. The grains thus come into close contact with the surface, and a considerable charge of electricity may readily be obtained by the simple device of allowing them to impinge upon a suitable substance.

A stream of sand flowing from the base of this reservoir B (Fig. 7) strikes upon an oblique sheet of tin T, which is attached to an insulating pillar N. An electrostatic voltmeter connected with the metal plate serves to measure the electrical potential. You see that in a moment the tin becomes charged to 3000 volts. The needle, however, soon falls back. Something has changed. The plate has, in fact, become dulled and pitted where the sand struck it. A fresh part reproduces the high potential. Filter paper is far more serviceable, and so is a wooden surface. One may rapidly obtain a potential of 6000 volts if the sand fall upon paper or wood, and this can be maintained for a considerable time. If the reading of the voltmeter diminishes, a fresh portion of the surface offered to the sand stream immediately brings it to its original value as before. The greater efficiency of paper (preferably filter paper) as compared with a metal sheet in producing the electrification, appears to arise in the following way.

A fine layer of dust soon becomes firmly imbedded in the metallic surface, so that further sand falling does not come into contact with the metal itself. On the other hand, it is probable that these particles cut through the fibres of the paper, and thus free themselves. I need hardly point out that the filter papers used should not be specially dried. Pieces which have been left about in a room for a few hours absorb sufficient moisture to ensure the right degree of conductivity.

The sign of the charge is always positive, in spite of the fact that a rod of silica rubbed upon the paper electrifies it negatively. In 1843 Faraday had noticed this curious reversal, and briefly refers to it in his experimental researches. Even if the actual silica rod be broken up into pieces, say as large as an orange-pip, and allowed to fall upon the paper held obliquely, the sign of the electrification is still positive. Further experiments have shown, however, that the sign of the electricity caused by friction against glass or silica depends upon the form of the rubbed surface. For instance, a strip of paper stroked by the smooth side of a tube of either substance becomes negatively electrified, whereas if the sharp edges of the end graze the paper, the sign of the electrification of the latter is positive. Now sand consists of sharply angular particles of silica, and even the comparatively large pieces obtained by crushing the tube, as previously described, have razor-like jagged edges. We should therefore expect, from the result of the experiments just mentioned, that when either sand grains or even large silica chips fall upon paper they will electrify it positively—and this is what actually occurs. Why an edge of glass should give an opposite charge to that produced by a flat surface when rubbed, say, with paper, is a question of great interest and difficulty. But that this is the explanation of the strange electrical behaviour of practically all powders appears certain.

The sand grains themselves become, of course, negatively electrified after striking the paper, so that this is often a convenient method of obtaining a high potential of either sign. Further, a stream of sand falling upon a metal plate will give a comparatively low potential, say 600 volts, for an indefinite period, in spite of pitting, and a tolerably steady value may be obtained by catching the grains upon a second disc (previously dulled by a sand-blast) connected with the apparatus required to be constantly electrified. As the charge increases upon this, a point is reached when some of the impinging sand particles become deviated by repulsion, so as to completely miss it. If the potential falls below the critical value, a reverse action takes place, and the plate rapidly charges up.

Turning for a moment to the question of the electrification produced in sand by the friction between the grains, experiments upon this point may be conveniently made by catching the particles, which roll down the surface of a sand cone, upon a small wet insulated table. Any electrification of the latter may then be detected in the usual manner. If the grains are all of the same nature, we should not expect to find other than slight irregular charges. The friction between particles differing in composition would give more definite results. Thus white sand racing over iron sand might be expected to show a charge; but experiment gave only a feeble electrification. I mention this because it is of interest in connection with the atmospheric electrical phenomena which often accompany sand storms in hot climates. Even if the wind electrified the surface of the sand over which it blows, the charge would probably leak instantly to earth, for in common with all powders it readily absorbs moisture into the interstices between the grains. When making electrical experiments with this material, it is therefore essential to have it well warmed.

There is still much useful work to be done in studying the electrical conditions in the neighbourhood of wide stretches of warm sand swept by dry wind. Owing to lack of data, it is difficult to form an opinion as to the part which this substance plays in the remarkable electrical phenomena sometimes witnessed during a storm.

I spoke of allowing sand to run down itself. Here is a cell made by separating two glass plates, 14 inches square, by strips of wood along the bottom and top edges. The sides are open. Through a hole in the upper distance strip sand pours from a funnel, and builds itself into a beautifully symmetrical conic section. Presently the base will so far widen that any further increase shoots the

FIG. 3.

sand off through the open ends of the cell. When this point is reached the cone can no longer grow. A supply of white sand is then poured in, and seen to run down the sloping sides without carrying any of the coloured particles with it. The base has spread out proportionately as the cone increased in height, so that the angle which the sides make with the horizontal shall be 35°. If the sand be wet or damp, this law no longer holds. The addition of sufficient water materially diminishes the friction between the grains.

It is often observed when walking along the sea-shore, upon sand left wet by the receding tide, that for a moment the foot, on touching the ground, is surrounded by a comparatively dry area. This appearance is quickly followed, however, by one which indicates that the sand has gathered moisture, for on lifting the foot—which has by now probably sunk a little below the surface—the excess of water is particularly noticeable. In order to explain

Fig. 4.

this we must have recourse to some ingenious experiments made a few years ago by Prof. Osborne Reynolds. He pointed out that a number of particles, whether spheres or irregular grains, may fit together in such a way that the size of the spaces enclosed by them is either a maximum or minimum. Figs. 8 and 9 show a sectional view of a collection of spheres, arranged in what Prof. Reynolds calls abnormal and normal piling respectively. It is evident that the spaces between the spheres are far less in the second than in the first case. Now here is an elastic bag tied upon one end of a glass tube. The arrangement is partly filled with sand and coloured water—the latter standing 2 inches in the tube, so as to serve as an index. If the bag is now tapped, all the particles in it become normally piled. We have seen that any departure from this arrangement will enlarge the spaces between them. It is no longer surprising to notice, therefore, when the bag is pinched and the grains are thus made to ride up on one another, that the liquid in the tube, instead of rising, actually sinks.

Returning to the effect observed upon the sea-shore, we see that the pressure of the foot disturbs the arrangement of the sand-particles from one of normal piling to one in which the interstices between the grains become larger. Since these spaces were originally full of water (held up by capillarity), they are now no longer filled, and we obtain a comparatively dry area. Water is rapidly drawn in from all sides, however, by the partial vacuum formed in the interstices, and the internal friction diminishes. The sand feels insecure. On withdrawing the foot normal piling is resumed, the excess of water producing a puddle, until it slowly percolates away whence it came.

This brings me to the subject of quicksands.

A certain amount of unnecessary mystery seems to surround this matter. I hasten to point out that the grains of quicksands appear to be in no way extraordinary. Nevertheless, the fact remains that sand in certain localities upon the coast readily gives way under a load. Instances are recorded where a cart driven over a wet shore has rapidly disappeared below the surface. The general opinion seems to be that this is due to a soft underlying layer of clay or mud, which no doubt in some instances is the true explanation. Mr. Carus-Wilson, who is an expert in these matters, pointed out to me recently, however, that another factor may be the imprisoning of gas between the grains, due to decomposition of organic matter. Experiment certainly supports this view, for you see that one of these beakers of wet sand easily sustains a weight which sinks down in the other. Yet both appear similar. The sand in the second beaker, however, was mixed when dry with a powder capable of effervescing if wetted. In the neighbourhood of dangerous bogs, in Ireland especially, it is evident that a quantity of gas is imprisoned in the mud.

It must also be borne in mind that any surface in so good a contact with wet sand that the air is excluded will be held fast by atmospheric pressure; and further, that an object so situated, and tilted this way and that, will rapidly become embedded and swallowed up. It is by this simple process that the celebrated Goodwin Sands have claimed so many victims. A large percentage of the vessels stranded upon them, however, float safely off on the rising tide, but now and then one is caught and doomed. In the past they have been responsible for many a shipping tragedy; and there is a pathetic interest attaching to the fact that ribs and other remains of ships, long lost and forgotten, sometimes reappear for a time above the surface. Since the advent of steam, it is happily a rare occurrence for a vessel to be lost upon a sandbank.

In 1849 boring operations were carried out on the Goodwins by the engineering staff of Trinity House. The Deputy Master and Brethren, whose generous offer of assistance on all matters relating to this subject I gratefully acknowledge, have kindly lent a model made at the time, which shows the nature of the sand found at increasing depths. Solid chalk was reached at 80 feet below the surface.

Let us now turn to some experiments upon the flow of sand through a tube. This long glass barrel is filled and ready. I free the nozzle, and collect the powder which flows out during ten seconds. The quantity so obtained is placed in one pan of a balance. When the height of sand in the tube has fallen to only a few inches above the outlet, I repeat the operation, placing the second amount collected in the opposite one. You see that the pans again stand level. It is therefore clear that the sand pours out at the same rate, irrespective of its height in the tube.

The question now is, how has the "head" been so completely destroyed? This may be answered by a further experiment.

A glass cell 2 feet high, 14 inches wide, and $\frac{1}{2}$ inch deep, is closed in at the sides only (Fig. 10). A movable section of a cone O, made of wood and imitating one of sand, is pushed up through the lower opening. Resting upon this, and fitting its sloping sides, is a strip of felt D. If the wood section be lowered (as shown in the figure), the felt, resembling an inverted V, remains wedged between the glass back and front of the cell. A very small force, however, will dislodge it.

Suppose we replace the wood model and hold it in position by a strut S. Regarding this as a section of a sand cone, we see that its entire weight would be carried upon the base of the cell. Sand is now poured in from the centre of the top opening, and rests upon the sloping felt. The point to notice is that it supports its own weight. When the particles are interlocked it resembles the span of an arch, for if I now remove the wood section the sand remains in position. When more is added, and the cell is nearly filled, the net weight is considerable, yet the felt bridge is not deformed in the least. Further, a wooden plunger P, fitting the top opening, and carrying heavy weights, may be inserted without increasing the pressure upon the felt.

Since the angle which the slope of a dry sand-cone makes with the horizontal is 35°, the height, h, to which the particles will build in a tube of radius r, so that the base of the cone corresponds to the diameter of the tube, is $h=r\tan 35°$. If we consider an element of the section just referred to, it is evident that a vertical downward force applied to the top of the sand becomes resolved in two directions, making an angle of 55° with the vertical. Now, applying the well-known formula for a symmetrical triangular frame loaded at its apex, we have

$$H=\frac{Wl}{4h} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where H is the horizontal thrust, W the load, l the span, and h the height.

Regarding the cell as the section of a tube, $l=2r$ and $h=r\tan 35°$. Therefore, substituting these values in (1), we have

$$H=\frac{W}{2\tan 35°}=\frac{W}{1\cdot 4}.$$

The ratio of the force applied vertically to that of the lateral thrust is thus equal to twice the tangent of the angle which the slope of a cone makes with the horizontal, viz. 1·4.

For instance, if the vertical force due to a weight placed on the sand is 100 lb., the lateral pressure will amount to about 71 lb. A piston resting upon a column of sand only a few diameters high, contained in a strong tube closed at its lower end by merely a thin membrane, is capable, therefore, of sustaining very heavy loads.

In order to demonstrate this on a moderate scale, I have arranged a sort of gallows, through the projecting arm of which a flanged brass tube is inserted vertically. This tube is 0·5 inch in diameter, and closed at its lower extremity with a piece of cigarette paper held in position by an indiarubber band. A small quantity of sand is tipped into the tube from above—enough to fill it to a height of 3 inches. The column within will therefore measure 6 diameters. The tube is then well tapped to ensure normal piling of the grains, and a loosely fitting iron plunger is inserted so as to rest upon the sand. Attached to the plunger is a cross-piece carrying a ring at each end, which may be grasped with the hands. My assistant (who weighs about 11 stone) thus suspends himself safely, his weight being supported by the small sand column. If the piece of cigarette paper is now removed, he is let down with an unpleasant jerk.

Some idea of the close arrangement of the particles may be gathered by noticing that a long column of sand,

FIG. 5.

FIG. 6.

moving downward within such a tube, will produce a vacuum above it sufficient to lift water to a height of about 6 feet. (Experimentally shown.)

These experiments upon loaded sand columns clearly prove, therefore, how it is that the "head" is destroyed, and explain why the powder issues from an orifice at a uniform rate.

Lord Rayleigh applied this principle to a very interesting device, which he used here some years ago, for the purpose of slowly rotating a smoked disc. A weight stood upon a sand column contained in a glass tube. Its downward motion as the column lowered, due to escape of powder from a nozzle at the end, served to operate a train of wheels. The question arises, however, as to whether such a motion is quite uniform. In other words, does the sand move regularly in the tube? Experiments

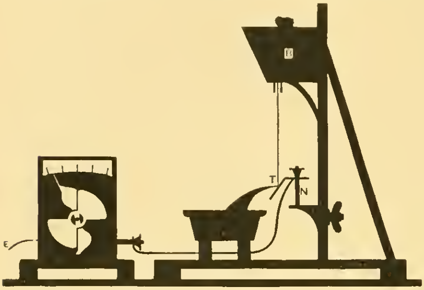


Fig. 7.

indicate that it is very difficult to obtain an absolutely uniform motion by this means. Friction appears to be the controlling factor. A tube, oiled upon its inner surface, is now filled. On freeing the nozzle, you see that the sand moves out by slow regular jerks. Certain curious rattling sounds, emitted occasionally by the column descending in a glass tube, also drew attention to the intermittent motion of the grains.

It seemed reasonable to hope, therefore, that this might be made sufficiently rapid and regular to give rise to a musical note.

Now many strange noises have been heard in the neighbourhood of large sand masses when surface layers have been disturbed by someone walking over them; and there are curious shrieking sands—rarely met with upon the coast.

Thanks to the great kindness of Mr. Carus-Wilson, whose work in this direction is so well known, I am able to exhibit a remarkable specimen of sand from the Isle of Eigg, in the Hebrides. When a plunger strikes down upon the grains contained in a suitable cup, you hear a

Fig. 8.—Abnormal Piling.

Fig. 9.—Normal Piling.

piercing musical sound. Mr. Carus-Wilson attributes this to the friction between the particles, the effect being produced in much the same manner as that which results from gently rubbing an agate style upon glass. He has discovered musical sand in Poole Harbour, as well as at other places.

The essential conditions for the production of this sound are:—

(1) That the grains be nearly of the same size and rounded.

(2) That they be clean and free from adherent fine dust.

(3) That the vessel in which they are struck have sloping sides, and be made of a suitable material.

But to return to the question of obtaining musical sounds from ordinary sand.

There stands, fixed to the wall, a large glass-fronted section of a tube. It is filled with alternate bands of white and black sand, the latter being about one-sixth as deep as the former. An outlet is provided at the bottom. This arrangement enables the motion of the different portions of the sand column to be observed while the powder issues from the orifice.

On freeing the nozzle, we see that the centre of the lowest black band immediately falls, and that, as the sand continues to escape, successive bands become similarly deformed. It is clear that the grains from the central part of the column are moving rapidly downward, and, since no eddies can form in the remainder, the whole becomes divided into a core of moving particles and a large surrounding mass of dead sand (Fig. 11).

The diminished density of the axial region releases the lateral pressure upon the sides of the tube, and the upper part of the column suddenly slips until the grains again pack and seize as before.

Now if sand of a suitable fineness be slowly passed in this manner through a glass tube of correct dimensions, a musical note may be produced.

The tube should be about 1 inch in diameter, and filled with sand resembling that found in the Charlton pits. The length of the one now ready is 3 feet. When the flow begins, a curious rattling sound is heard, which finally changes to a distinct musical note. It may be varied slightly, say to the extent of a whole tone or so, by gripping a part of the tube while the sand pours out. The two upper dark bands (Fig. 11) have not become deformed, except slightly at their ends, owing to friction between the sand and tube. It is essential for the production of musical sounds that the ratio of the length of a column to its diameter be such that the upper portion moves downward without central deformation. In order to explain the cause of the sound, we must therefore consider the motion of this more or less compact body of particles.

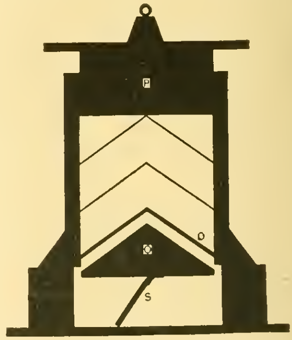


Fig. 10

Now, if the lower half of the tube be filled with mercury and the rest with well-packed sand, the regular lowering of the liquid causes the granular piston apparently to stretch until its extension is about 2 per cent. of its original length. It is not until that point is reached that the upper layers begin to move downward. The particles, however, are no longer normally piled. A further slight movement of the lower layers causes the upper ones to follow and to overrun a little (owing to their momentum). Therefore, even if the mercury is adjusted to pour out uniformly from the orifice, the upper part of the sand column moves downward with an intermittent motion, analogous, in fact, to that of a weight drawn over a rough surface by an elastic string. It is also clear that, within wide limits, the motion of the upper layers may be independent of, or completely out of phase with, that of the lower ones, and still produce a musical note.

The glass wall of the tube is thrown into violent vibration by the intermittent rise and fall of the lateral pressure upon it, so that damping the barrel raises the pitch of the note. The greater part of the sound is due, however, to the direct action of the sand column upon the air above it, for even a tight wrapping of tape but slightly affects its

THURSDAY, SEPTEMBER 1, 1910.

COLOUR-VISION.

Colour-Blindness and Colour-Perception. By Dr. F. W. Edridge-Green. Second edition. Pp. xii + 322. International Scientific Series. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1909.) Price 5s.

DR. EDRIDGE-GREEN has been engaged for more than twenty years in advocating opinions about colour-blindness which he has not the gift of stating with extreme lucidity, which most people find it by no means easy to understand, and it is therefore somewhat difficult either to accept or to refute. The general basis on which the opinions rest appears to be his conception of something called by him a "psycho-physical unit," by which he appears to mean the limit, in any individual, of the power to perceive actual difference between two things closely resembling one another, as, for example, between two similar colours, or between two masses of the same substance that are of nearly the same magnitude. There are, no doubt, great personal differences of this kind, differences which may be partly congenital and partly the results of training; but it does not appear to us that the prefix "psycho," whatever it may mean, bears any intelligible relation to them. The differences are differences of the acuteness of sense-perception, and, if we regard simple sense-perception, colour-perception, for example, as "psychical," we must postulate the activity of a "psyche" in the humblest fly which is guided to the nectary of a flower by the colour of the corolla.

We do not know whether Dr. Edridge-Green is prepared for such an extension of the domain of "psychology," and may leave him to settle the question with the professors of that branch of speculation, but we may admit that the condition known as "colour-blindness" may fairly be said to consist of an inability to respond by accurate sense-perception to the impact of light-waves of certain amplitudes, and of a consequent liability either to ignore them completely or to confound them with waves of other amplitudes. It is at least highly probable that minute differences of this kind are extremely common, and Lord Rayleigh long ago showed that some persons, whose colour-sense could only be described as normal, nevertheless differed from others in respect of the precise admixtures of light from different portions of the spectrum, more especially in respect of the admixtures of red and green, which they were prepared to accept as a perfect "match" for a test-spot given as a standard.

It is probable that such terms as "red-blind" or "green-blind" might be extended not only to the six classes (hexachromic, pentachromic, &c.), described by Dr. Edridge-Green, but to a much larger number; and, by the way, we do not know on what ground our author regards the normal-sighted as "hexachromic" only, and so apparently excludes from the spectrum, as they see it, the seventh distinct colour, indigo, which was described by Newton, and has commonly been accepted by later observers. The limitations of our space forbid us to follow these questions into detail, and the chief practical importance of colour-blindness depends upon the fact that a liability to make mistakes about colour-signals involves dangers to life and property on railways and in navigation.

As regards protection against these dangers, we do not see that Dr. Edridge-Green has furnished us with any increased security, or, indeed, that any better security is needed than is obtained from Holmgren's wool test, when this is employed in the precise manner directed by its originator, whose very definite instructions are too often departed from. The elaborate lanterns and slides described by Dr. Edridge-Green are in all essential respects identical with many of the tests used by the Royal Society's committee; and, if we may admit that they afford means of distinguishing one case of colour-blindness from another of a slightly different type, we cannot admit that they are calculated to afford any increased security to the industries in which the power to distinguish promptly between different signal colours is required.

A HISTORY OF BIOLOGICAL THEORIES.

Geschichte der biologischen Theorien. By Dr. Em. Rádl. II. Teil. Geschichte der Entwicklungstheorien in der Biologie des XIX. Jahrhunderts. Pp. x + 604. (Leipzig: W. Engelmann, 1909.) Price 16 marks.

THE author of this scholarly work attaches great importance to the cultivation of the historical sense among biologists, believing that progress is impeded because there is relatively little of it, and one of the aims of his book is to stimulate a study of the history of the science. To this end it is admirably adapted. It is learned, but at the same time wisely selective; it is at once appreciative and critical; and it is written in a fresh, interesting way. We had the pleasure of welcoming the first volume, published four years ago, which dealt with ancient history, and we would congratulate the author again on the success with which he has accomplished a very difficult task in dealing with what has occurred in biology, or in biological ætiology, since the end of the eighteenth century. It seems to us, indeed, that the author has added to his strength since he completed the first part of his great work.

There are forty-one chapters in the book, and we may note some of the titles to suggest the range of discussion:—Lamarck and Cuvier, idealistic morphology, embryology before Darwin, the cell-theory, physiology before Darwin, transition from Naturphilosophie to modern science, origin of Darwinism, Darwin, Wallace, reception of Darwin's theory, influence of Darwinism, Haeckel, spontaneous generation, anthropology, Darwinian morphology and embryology, geographical distribution, palæontology, natural selection, heredity, psychology, Lamarckism, species, reproduction, crossing, developmental mechanics, Driesch, decline of Darwinism, the history of science.

What the author aims at is a historical appreciation of the significance of the various stages in the development of ætiology, and this involves a critical judgment

 K

of the contributions made by the succession of workers. He seeks to show how one step is related to others, often beyond the boundaries of biology. There is, for example, a very interesting passage in which he maintains that Darwin projected upon nature the contemporary ideal of the English state, his theory being, in fact, "a sociology of Nature." In parts Rádl's book shows an interpretative insight, which reminds us of Merz's "History of Intellectual Development in the Nineteenth Century," which is great praise; in other parts we think that he is quite unsound—notably in his curiously non-evolutionary contention that Darwinism is dead. Nor do we think that he is uniformly fair and accurate in his treatment of Darwinism, *e.g.*, in a sentence like this:—"Die Theorie Darwins, welche jeden Glauben an die Gesetzmässigkeit der organischen Welt vernichtete, und alles Geschehen für eine Häufung von Zufällen hielt, konnte zwar für kurze zeit die Welt blenden."

It is unsatisfactory to do no more than record dissent from Dr. Rádl's pronouncement that Darwinism is discredited, but the matter cannot be argued out in a few sentences. We might refer him, however, to some weighty considerations set forth in the fifth chapter of Sir Ray Lankester's "Science from an Easy Chair," which is entitled "Darwin's Theory Unshaken."

As we lay down the big book, our dominant impressions are that it is stimulating and even provocative, that it shows an extraordinary acquaintance with the literature, that it expresses a sometimes surprising appreciation of the importance of thinkers outside the ordinary schools (Samuel Butler, for instance), and that it carries one on with an undeniable swing, though it passes our understanding to discover the meaning of the detailed arrangement of the chapters.

SCIENCE IN SCHOOL.

Broad Lines in Science Teaching. Edited by F. Hodson, with an introduction by Prof. M. E. Sadler. Pp. xxxvi+267. (London: Christophers, n.d.) Price 5*s.* net.

IN the curricula of English schools a place, sometimes an important place, has been allotted to "science." The result has been to kindle intellectual interest in certain boys to whom the other work of the class-room made no appeal, as well as to direct the interests of the more studious to a wider field of intellectual exploration. Even more important has been the influence of the science-masters, who, having no well-worn groove of tradition along which to travel with the minimum of effort, have brought scientific method to the investigation of methods of teaching. Nevertheless, to many observers the effects of science teaching have been disappointing. Such critics demand that the average youth shall acquire the scientific way of looking at things. This is a very much larger demand than was realised in the early days, and it is the special aim of the book before us to present a broad view of the work which is involved in any sound curriculum which can make boys and girls of secondary-school age the possessors of that which science has to give.

The volume contains a number (not strictly a series) of essays by writers who desire that the methods of science teaching should be built upon a fundamental study of the right relation of the growing mind towards new knowledge, new dexterities, new perceptions of duty. We may at once congratulate the editor on the *personnel* of the contributors and on the manner in which he and they have justified the title of the work. Prof. Sadler contributes an introduction, which is also somewhat in the nature of a review, and emphasises the necessity of first-hand study of nature. The place of science in the curriculum, its position in Germany, and the utility of examinations are discussed by the editor and Mr. Badley. Biological subjects receive a goodly share of attention in articles contributed by Miss von Wyss, Mr. Oswald Latter, and Miss Ravenhill. The chapter on geography is written by Mr. J. N. Stephenson, and is full of useful and sound criticism—obviously the work of an experienced and shrewd teacher. The relation of school work to the spiritual side of the pupil is discussed by the headmaster of Bedales and Miss Sanders, and in a measure by Prof. Powicke in his chapter on "Science in the Teaching of History." It is impossible within the limits of a short review to deal with these; the mention of them will serve to show the breadth of the editor's objective. Consideration is also given to the preliminary training of those who are to become farmers, housewives, engineers. In the last-mentioned case the writer considers the administrative and economic difficulties, but so rapidly are changes taking place in the organisation of educational courses for boys leaving school between the ages of fourteen and seventeen that no demerit attaches to the essays in which these aspects are omitted, as is usually the case in this volume.

Physics, chemistry, mathematics, are dealt with in the short space of forty to fifty pages. It would have been an improvement if more space had been given to these branches, even if this had involved the loss of the chapter on laboratory planning, which is not quite on the "broad lines" of the rest of the book. Teachers of chemistry should certainly read Dr. T. P. Nunn's essay on "The Place of Hypotheses in Science Teaching"; those who wish to train their pupils in the habit of independent thinking about phenomena and theories cannot fail to gain help from this searching probe into the tissues of our chemical belief.

The general impression produced by this book is encouraging. Especially marked is the thoroughness with which correlation between branches of the curriculum is made the basal plan of the educational structure. Correlation has ceased to be a word merely (blessed or the reverse), or at best a number of adventitious links between subjects mainly pursued apart; it is fast becoming an influence pervading the more progressive common-rooms and giving unity—but not monotony—to aims and methods in adjoining class-rooms. The subject of the chemistry-master is not primarily chemistry but boy. The writers of "Broad Lines" realise this. They also realise the claims of practical application to health, morals, and livelihood, and seek to imbue school work and school life with the research habit and attitude of mind.

The volume is pleasant to read and handle; our main regret is that the essays are not twice their present length. We hope that this most opportune book will be widely read.

CLASSIC WALL-PAINTING.

Greek and Roman Methods of Painting: Some Comments on the Statements made by Pliny and Vitruvius about Wall and Panel Painting. By Dr. A. P. Laurie. Pp. vi+124. (Cambridge: University Press, 1910.) Price 2*s*. 6*d*. net.

Dr. Laurie, who is principal of the Heriot-Watt College at Edinburgh, has devoted much time and considerable ingenuity to the study of the materials and methods of painting. Many of his results are recorded in the Journal of the Royal Society of Arts and in other periodicals. But in the little book now before us we possess, in a detached and accessible form, an account of Dr. Laurie's latest studies on fresco- and wax-painting as described by Pliny and Vitruvius and practised in classic times. As the volume is not supplied with a table of contents, and is not divided into chapters, it may be well, in the present notice, to describe, in the order followed by the author, the several topics which he discusses.

The book opens with a review of the conditions under which the inquiry into ancient painting methods should be conducted. Then we pass on to the consideration of the pigments, both natural and artificial, which were available for use in early days. Dr. Laurie's list and his observations on several of the items which it comprises are of considerable interest. The murex purple, lately ascertained to be a dibromindigotin, and Egyptian blue, which was investigated by the late Dr. W. H. Russell, are important constituents of the ancient palette. A madder pigment was also in use, as well as indigo.

Primitive vehicles are next discussed, size, gum, milk, white and yolk of egg being included in the series of available mediums. Both bitumen and turpentines, or liquid resins and balsams, were known, but neither drying oils nor spirit varnishes. Beeswax played an important part as a painting vehicle; our author's studies and experiments confirm the modern view as to the process of encaustic painting as described by Pliny and illustrated by the wax portraits brought from the Hawara cemetery in the Fayum by Prof. Flinders Petrie. The doubts once expressed by Eastlake and other authorities as to the feasibility of painting with melted coloured waxes may now be regarded as not warranted. In some places the wax was mixed with a liquid resinous body, such as Venice turpentine; this mixture was more easy to manipulate than wax alone, but acquired greater hardness in the course of time.

Wax-painting was, however, not the ancient process in use for the decoration of walls; this was painting on wet or wetted lime-plaster with pigments mixed with water, or possibly on occasion with glue or size. Such fresco-painting is discussed by Dr. Laurie at some length. The process is not precisely that of the fourteenth century and the Italian Renaissance, the *buon fresco* of the historians of art. There are no joins or seams in the ground, and the painting could not have been completed on the freshly spread plaster while its surface was in the best state to receive and incorporate the paint. The surface must have been wetted with water admixed with a little slaked lime from time to time, while later applications of colours must have contained milk of lime. Such a process approaches closely to that known as *fresco secco*, and can be traced back to a much earlier date than can the true *buon fresco*.

We must not linger over the technical questions connected with fresco-painting as discussed by Dr. Laurie, but may now pass on to consider his criticism of the views as to old mural painting advocated by Herr Ernst Berger, in his "Maltechnik des Alterthums." These views are shown to be untenable, deriving no support either from the chemical examination of ancient examples, from modern experimental trials, or from the careful study of the language used by Pliny and by Vitruvius. The method imagined by Herr Berger was allied to the modern *stucco lustro*, and involved the use of an emulsion of beeswax, oil, and soda or potash; our author shows (pp. 107–9) that there is no valid evidence in favour of the use of this dangerous and ineffective mixture.

Dr. Laurie will, we hope, pursue his interesting and illuminating inquiries into the materials and methods of ancient painting, and of modern painting also; but in his next book will he not give us, besides such an adequate index as appears in the present work, a table of contents? This will involve the arrangement of his material in chapters or sections, which will prove more easy to study or to consult than an unbroken discussion occupying no less than 112 pages.

A. H. C.

OUR BOOK SHELF.

A Monograph of the Foraminifera of the North Pacific Ocean. Part i., Astrorhizidæ and Lituolidæ. By J. A. Cushman. Pp. xiv+134. United States National Museum Bulletin 71. (Washington: Government Printing Office, 1910.)

This is the first instalment of a work on the foraminiferal fauna of the North Pacific. It embodies the results of Brady, in the *Challenger* report, in so far as concerns this area, and of Goës, Flint, Rhumbler, Bagg, and others, and presents the outcome of the author's own investigations. These are based on the examination of material dredged by the United States s.s. *Albatross*, *Nero*, and *Alert*, parts of which have been already used in the reports of Goës, Flint, and Bagg.

In many cases the author extends the range of previously known species, and several are regarded as new. New generic names are given to divisions of recognised genera, particularly of the Lituolids Haplophragmium and Trochammina. Of wider interest is the author's identification of *Ammodiscus tenuis* as the megalospheric form of *A. incertus*, under which name the microscopic form has been described.

Each species is illustrated, and the figures are in most cases quite sufficient.

(1) *A First Year's Course of Inorganic Chemistry.* By G. F. Hood. Pp. iv+107. (London: Rivingtons, 1910.) Price 1s. 6d.

(2) *A Manual of Elementary Practical Chemistry for Use in the Laboratory.* By P. W. Oscroft and R. P. Shea. Pp. viii+134. (London: Rivingtons, 1910.) Price 2s.

THESE two little volumes are for use in schools, and are intended to serve as an introduction to chemistry. Oscroft and Shea's manual carries the subject to the stage of equivalent weight estimations and simple gravimetric and volumetric analysis, whilst Hood's book, which is a first year's course, stops short of this point. Both books contain descriptions of a series of easy quantitative experiments on loss and gain in weight, as well as a detailed account of a variety of thoroughly instructive preparations.

There is nothing in either that strikes one as very new or original in conception or arrangement; but, on the other hand, there is nothing to which objection can be taken, and both volumes may be recommended without reservation. It might be well in a future issue to give the actual results of the quantitative experiments so that both teacher and student might form some idea of the accuracy attainable. In conclusion, we question to what extent it is permissible to adapt a classical discovery to the intelligence of a schoolboy; for it may be doubted if either Berthollet, Gay-Lussac, or Davy ever thought of chlorine as "murium dioxide" (Hood, p. 51). J. B. C.

Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History). Vol. iii. (L–O). Pp. iv+1039–1494. (London: British Museum (Natural History), 1910.) Price 20s.

THE long interval which has elapsed since the publication of the second volume of this catalogue (see NATURE, August 25, 1904)—which followed the first (*ibid.*, October 22, 1903) in reasonable time—is explained in the preface as due to other library work. Apparently the earlier sheets of this volume were completed and printed off before 1907, as we find no title associated with the name of Sir E. Ray Lankester, while the latest of his works referred to bears the date of 1906. In this connection it may be noted that in some cases the full Christian names of authors, as in the case of Sir E. R. Lankester and Sir R. Owen, are repeated in each entry, whereas in other instances, as in the case of Sir Charles Lyell, these are reduced to the initials after the first entry. Apparently the compiler was compelled to follow the order adopted in the library catalogue at Bloomsbury, which will probably account for the sundering of such names as Loennbohm (p. 1163) and Lönnberg (p. 1175). Like its predecessors, this volume contains valuable bibliographical information, and it is to be hoped that we shall have the pleasure of welcoming the fourth volume at an early date. R. L.

The Calendar of Garden Operations. New and enlarged edition. By members of the staff of the *Gardener's Chronicle.* Pp. vi+175. (London: *Gardeners' Chronicle*, Ltd., 1910.) Price 6d. net.

THIS is a new edition of a work prepared originally by Sir Joseph Paxton, and published in 1842. It is a concise and practical manual from which possessors of small gardens in country or town may obtain much useful advice and guidance. Chapters have been added on the cultivation of trees and shrubs in towns, and on the principles of intensive culture or French gardening. In its enlarged form the continued success of the book is ensured.

LETTERS TO THE EDITOR.

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

Separating Power of a Telescope.

CAN an observer inform me what are the proper telescopic powers, and apertures or sizes of glasses, required to see stars which are apart from each other the following distances, and of different magnitudes?

(1)	... $0''$ to $1''$	(5)	... $8''$ to $12''$
(2)	... 1 to 2	(6)	... 12 to 16
(3)	... 2 to 4	(7)	... 16 to 24
(4)	... 4 to 8	(8)	... 24 to 32

Gore made a table showing the magnitude of the faintest star visible in any telescope in his "Stellar Heavens," but I would like to see if anybody can make a table out from *experience and ordinary practical observation* in the case of double and multiple stars. Where the glare of one star interferes with the definition of another star, I am inclined to think a larger aperture is needed in the case of doubles and multiples than in singles, and where the stars are very close. If a table could be made out for reference by students it would be useful.

Grimscar, Huddersfield. J. W. SCHOLES.

THE questions proposed cannot be answered quite so definitely as Mr. Scholes would appear to think. To begin, we must have a clear idea of what is meant by the separating power of a telescope. Put in a theoretical form, it means: Given two points of light (stars) a certain angular distance apart, what is the size objective which will just give two distinct images in the focus? For practical purposes, this is answered by the formula

$$\text{Separating power} = \frac{4''\cdot 56}{a}$$

where a is the aperture of the object-glass in inches.

This can easily be remembered; or, if it is preferred, a table can readily be formed, thus:—

Size of O.G. Inches	Separating power
1	$4''\cdot56$
4	1·4
8	0·57
28	0·17
36	0·13

A second of arc in the focus of the 28-inch Greenwich refractor is 0·00103 inch. Let it be clearly understood that this table gives the theoretical size of object-glass to obtain *separate points in focus.*

If the points are not separated in the focus, no amount of magnifying power will afterwards separate them.

This does not imply that the unaided eye, looking at the focal images in the telescope, can detect duplicity. The points to be thus seen must subtend at the eye an angle of at least $60''$. It is here that the eye-piece comes in, for, given two separated points, we can magnify the separation until the eye can not only detect, but can see it sufficiently to enable micrometric measures to be made.

Hence we use eye-pieces magnifying 2, 3, 4, 5 times, and so on.

These eye-pieces bring up the total magnifying power, which is quoted as the power used. It is stated in textbooks that a power of 50 or 60 per inch aperture is the practical limit; but it is readily seen, however, that the power used is dependent on several conditions:—

(1) Size of object-glass.
(2) Quality of object-glass.
(3) Condition of the atmosphere.
(4) Personality of the observer.
(5) Subject observed.

The questions asked refer especially to double-star work, and confining ourselves to this simplifies matters.

If we allow 50 per inch aperture, we should expect to find observers with the

36-inch Lick, using a power of ...	1800
28-inch Greenwich ,, ,, ...	1400
18½-inch Dearborn ,, ,, ...	950
8-inch (Maw) ,, ,, ...	400
6-inch (Solà) ,, ,, ...	300

Atmospheric conditions affect the large glasses much more than the smaller, for we find in actual practice that the Lick observers prefer powers of 1000 and 1500; the Greenwich observers prefer 670 and 1120; Hough, with the 18½-inch, used generally a power 390, and less frequently 925.

Maw uses powers of about 300 and 400 on both his 6-inch and 8-inch, while Solà uses 350 on his 6-inch.

When an observer is quite used to his instrument and his eye-pieces, he develops a preference for one particular eye-piece under most all conditions.

One element, as yet not mentioned, has naturally a great influence in the choice of an object-glass, viz. the range of visibility, or the ability to show faint objects. The above remarks apply to pairs the components of which are fairly equal; but, in general, distant companions are very faint.

The light-grasping power of a telescope depends on the surface or diameter squared of the object-glass. A good 1-inch object-glass should show a ninth-magnitude star, and one star is said to be a magnitude fainter than another when its light is 2·5 times less.

Consequently, the aperture must be $\sqrt{2{\cdot}5}$ greater to show it. Roughly, $\sqrt{2{\cdot}5}=1{\cdot}6$, and hence if 1 inch shows a ninth magnitude $1\times1{\cdot}6$, or a 1·6-inch shows a tenth magnitude, or generally

Star magnitude	9	10	11	12	13	14
Aperture in inches	1·0	1·6	2·5	4·0	6·3	10·0

Of course, this table is not to be taken too seriously, as it is governed by much the same conditions as already mentioned for separating power. Bear in mind Burnham's words: "An object-glass of 6 inches one night will show the companion to Sirius perfectly; on the next night, just as good in every respect, so far as one can tell with the unaided eye, the largest telescope in the world will show no more trace of the small star than if it had been blotted out of existence."

I hope, with a little twisting and adaptation, the foregoing remarks may be made to answer the fundamental principles underlying the apparently easy questions.

Mr. Scholes is quite right as to the glare, and the larger aperture by increasing the separation, and by making the apparent discs smaller, does make observation easier.

T. LEWIS.

Colour-vision.

As one who was responsible for the testing for colour-vision of several thousands of drivers and firemen, I should like to refer to the method of testing by means of different coloured skeins of wool.

The usual method is to take a particular skein of wool and request the person who is being tested to select in succession the three or more skeins which mostly resemble it. In some cases I found that men who were clearly colour-blind succeeded in passing such a test satisfactorily.

It must be remembered that a colour-blind person has been accustomed to consider his capacity for appreciating colour differences in the light of other people's statements. It thus comes about that they learn to consider differences, which are really colour differences to those whose sight is normal, as being partly due to intensity of light, texture, or other considerations. They are aware, of course, that they cannot always detect differences of colour in the ready way that others can, but they also feel that they can often see differences much more quickly than can others. With the colour-blind, therefore, the capacity for matching or naming colours becomes more and more perfect the greater their experience becomes of the objects to be compared. Now, in the case of the wool test, the different coloured skeins are certainly in many cases of different texture, coarseness, or gloss. The skeins are also frequently numbered. With a little careful study of the wools with which the tests are carried out, it may be quite possible for a colour-blind man to get through the tests satisfactorily unless great care is exercised.

I found the following to be a ready method of detecting colour-blindness. The wool skeins were arranged in the order of their brightness, the white skein being at one end and the black at the other. It is, of course, somewhat difficult to estimate the comparative brightness of a red and a yellow object. I found, however, that with a little practice and care this could be done satisfactorily. If a person whose vision is normal be asked to pick out the darkest skeins, he will at once pick the black one and afterwards those next to it. On the other hand, a colour-blind person will probably pick the black skein first and then the reds or greens, the darker shades being selected first. A test of this kind is most striking. In one case, a man who had got through the ordinary tests with some hesitation selected all the reds before the dark greys, neutral tints, greens, &c., although some of the reds were much brighter colours than the greens.

The better plan is to take a number of different coloured skeins of wool and ask the person who is being tested to arrange them in their order of brightness. A markedly colour-blind person cannot do this properly.

R. M. DEELEY.

Melbourne House, Osmaston Road, Derby.

LAKE EDWARD, RUWENZORI, AND THE UGANDA-CONGO FRONTIER.

THE argument lately arrived at by the representatives of Great Britain and the Congo has affected the settlement of a troublesome boundary dispute, in which the competence of any diplomacy to deal with a geographical question in a scientific manner has not shown itself in a particularly favourable light.

The original agreement, the *fons et origo* of all the subsequent mischief, was signed at Brussels on May 9, 1894. By this it was enacted:—

"That the sphere of influence of the Independent Congo State shall be limited to the north of the German sphere in East Africa by a frontier following the thirtieth meridian east of Greenwich up to its intersection by the watershed between the Nile and the Congo, and thence following this watershed in a northerly and north-westerly direction."

At the time this agreement was made the 30th meridian was shown on the maps as dividing Lake Edward into two approximately equal parts, and as passing to the west of the whole Ruwenzori range. It is, however, a commonplace among geographers and surveyors that a determination of longitude in an unsurveyed country is liable to large errors, and that a meridian line is, of all possible boundaries, the worst that can be selected. In this case the actual event proved that the selection of this line had resulted in the maximum of inconvenience and loss. The true position of the meridian was found to be about half a degree east of its position as assumed in 1894, and a strict interpretation of the letter of the treaty would have involved our retirement from Lake Edward and from practically the whole of the Ruwenzori district. Such a contingency was obviously intolerable, and the only practicable course was to arrive at some sort of compromise which should, as far as possible, minimise our loss. The commissioners entrusted with the recent negotiations arrived at what perhaps was the best solution available at this date, and by surrendering to the Congo the whole of the north shore of Lake Albert, they regained the eastern half of Lake Edward, and about half Ruwenzori. The net result of the whole transaction is therefore that we lose all the country lying between Lake Albert and the Congo-Nile watershed and the western half of the Ruwenzori range.

From the geographical point of view the great error that was committed was the definition of a frontier by a meridian line, and what makes the error the more regrettable is that this unscientific boundary was a gratuitous importation, which was substituted for the perfectly precise and scientific frontier laid down in the original act constituting the Congo State. This frontier was the watershed line dividing the Congo basin from the surrounding river basins, of all natural geographical frontiers the most satisfactory.

It was defined, with ideal precision, in the "Berlin Act" of February 26, 1885, in the following words:—

"All the regions forming the basin of the Congo and its outlets. This basin is bounded by the watersheds (or mountain ridges) of the adjacent basins, namely, in particular, those of the Niari, the Ogowé, the Schari and the Nile on the north. . . . It therefore comprises all the regions watered by the Congo and its affluents."

Apart therefore from the actual method of frontier definition, we cannot avoid the conclusion that to have allowed the Congo State to acquire claims to any territory outside the actual Congo basin was a surrender of our clear rights. We may remind those of our readers who have not got a map in front of them that both the Lakes Albert and Edward and the Semliki river, which connects the two, lie wholly within the Nile basin.

Our knowledge of the interior of Africa has so progressed since 1894 that there is no locality where a mistake, at all comparable in magnitude, could be made at the present time. We may further be permitted to hope that the spirit in which our great departments of State approach this and similar questions has undergone such a change in the last few years that a total setting aside of all expert opinion, on which alone the agreement of 1894 is explicable, is no longer probable. E. H. H.

WILLIAM JAMES.

THE announcement of the death, at the comparatively early age of sixty-eight, of William James, emeritus professor of philosophy in Harvard University, will have been received with regret by an unusually wide circle of readers of philosophic literature, and with deep sorrow by an unusually large circle of friends, who knew from experience how much greater was the charm of his personality than the charm even of his writings. But few even of his friends can have suspected under what physical disabilities were produced the utterances of which the sunny geniality, irrepressible vitality, coruscating vividness, and brave optimism, unstained by any shadow of insincerity or cowardice in facing the ills of life, so deeply fascinated them, or realised that they were listening to a martyr to a grave cardiac affection, whose life for the last ten years had hung by a thread.

This is not the place for an estimate of James's achievements as a philosopher, but it will not be amiss to signalise the intimacy of his relations to science. It is not often that a philosopher of the first rank has had the good fortune to receive a scientific education or the literary genius to gain by losing a literary education. But William James is a shining example of how stimulus and freshness may be imparted even to philosophic subjects by one who is allowed to approach the real problems direct, and without wandering through a thick fog of historic errors. Originally trained for the medical profession, he became interested in "pure" science; accompanied Agassiz on an expedition to Brazil; was appointed to teach anatomy at Harvard; proceeded to the teaching of physiology; approached psychology from the physiological side; became a peerless master in the art of psychological description; applied his psychology with revolutionising and revivifying effect to the study of religion, superstition, logic, and to that chamber of horrors for unsolved puzzles which is called metaphysics; and, finally, before he could formulate his conclusions, was taken from the world he had studied so variously and with such eager human sympathy. But at heart perhaps his attitude towards life always remained psychological. He was more interested in discovering and describing facts than in dogmatising and system-building with them, and almost as disregardful of formality as of technicality and pedantry.

To scientific psychology his services are admittedly immense. His work on "The Principles of Psychology" (1890) at once became a classic, and is likely to remain so. He found the science entangled in metaphysical obscurities and based on false descriptions. He insisted that it should be made a natural science, descriptive, and, wherever possible, experimental, and described its facts anew. His fundamental innovation was to perceive that the "facts" of consciousness form a continuous flow and *not* a succession or series of separate facts, as, since Hume, psychologists and their metaphysical opponents had alike assumed. The consequence was that the problem of *synthesis* disappeared, and that the function of scientific knowing became the *analysis* of a continuum. When the meaning of this has been fully grasped, it will be seen that a number of metaphysical puzzles (*e.g.* about "the one" and "the many") answer themselves.

But James also saw that if psychology was to progress further on the road to an exact science, it must not be only descriptive, but must devise applications of its theories sufficiently precise to discriminate between alternative interpretations by their differential values. This probably was one of the main motives that led him to make the great generalisation of scientific method which is known as pragmatism, though he also conceived it in another aspect as an extension to psychology and logic of the biological conception of survival and the Darwinian principle of selection. Of pragmatism he was practically the founder, though he took a hint and the name (which is a bad one) from his friend C. S. Peirce, and it was to the explanation and advocacy of this method that the last dozen years of his life were devoted. The controversy which was thereby started is still unfinished, and, indeed, is only just beginning to bear fruit.

But it is a psychological curiosity how few of the many who denounced James as a dangerous revolutionary perceived that the doctrine that the meaning of an assertion depends on the value of its consequences enunciated merely the scientific postulate that all assertions must be *tested*, and that any doctrine which could not be applied to any problem was unmeaning. One can only suppose that this philosophic generalisation of scientific practice was propounded to persons who, as a matter of psychological fact, were not in the habit of subjecting their pet convictions to any test, and therefore aroused so great an emotional disturbance that the actual doctrine was hardly attended to. A similar reception was accorded to James's account of the will and the right to believe. James, after pointing out that, as a matter of psychological fact, there existed a strong bias in men to believe what they desired, had restricted the right to believe to cases where a choice between a number of intellectually possible alternatives was practically necessitated, and asserted that in such cases the empirical consequences of the belief, favourable or otherwise, formed the test of its truth. Whereupon he was, in spite of repeated disclaimers, universally credited by his critics with exhorting men to believe whatever they pleased without regard to the consequences!

But all the world over the old dies hard, and the new has to struggle into birth so slowly that it is adult by the time it comes out, and the pioneers have to rough it. Logic will be the last science to submit to the sway of Darwinism, but there is no doubt that in the end it, too, will yield to the pragmatist followers of William James.

In addition to writing a large number of articles and reviews which have never been republished, James was the author of the following substantive works:—"The Principles of Psychology" (1890), the "Text-book of Psychology" (1892), "The Will to Believe" (1896), the Ingersoll lecture on "Human Immortality" (1898), "Talks to Teachers" (1899), probably the easiest and most delightful introduction to psychology extant, the "Varieties of Religious Experience" (1902), "Pragmatism" (1907), "A Pluralistic Universe" (1909), and "The Meaning of Truth" (1909).

DR. LOUIS OLIVIER.

DR. LOUIS OLIVIER, whose death we announced last week, was one of the best-known men of science in France, and had many friends also in Great Britain. He was only fifty-six years of age, and that the scientific world should have been deprived of his influence and activities when years of further work were anticipated has caused widespread regret.

For most of the following particulars of his career we are indebted to M. Louis Brunet. Louis Olivier was born at Elbeuf on June 29, 1854. He studied at the Museum of the Sorbonne, and obtained the degree of doctor of science in 1881, with a thesis entitled "L'appareil tegumentaire des racines," which was awarded the Bordin prize of the Paris Academy of Sciences. Entering Pasteur's laboratory, he carried on bacteriological work, which led to some valuable results, such as the reduction of sulphates by micro-organisms, and, in collaboration with M. Ch. Richet, the existence of various bacteria in the lympth and blood of healthy fishes. In 1888 he went to Havre as director of the municipal laboratory there, and to form a course in bacteriology for medical men.

But the work for which Dr. Olivier deserves the lasting gratitude of the scientific world was the foundation of the *Revue générale des Sciences pures et appliquées* in 1890. When making arrangements for the establishment of that journal, Dr. Olivier was kind enough to state that he desired it to have much the same scope and character as NATURE. Possessed of vast knowledge of men and matters in all departments of science, he was able to exercise sound judgment upon the numerous contributions submitted to him, and was successful in securing authoritative collaborators, not only in France, but also in other countries, to deal with subjects of wide interest and prime importance. During numerous visits to England, he obtained the active support of many men of science here, and they mourn his loss as that of a friend as well as of an editor.

At the outset, the *Revue générale des Sciences* was recognised as a substantial addition to the periodical literature of science. The outlook was wide, the contributors men of distinguished eminence and sound knowledge, and the subjects important; and the journal has maintained this character throughout its existence. As an example of the breadth of view, we may mention that arrangements were made by Dr. Olivier for special reports to be supplied to his journal of the meetings of the Royal Society of London and of other leading scientific societies in Europe. So far as we are aware, no other journal abroad gives such attention to the progress of science in Great Britain as is still devoted to it by the *Revue générale des Sciences.*

In 1897 Dr. Olivier established a series of cruises which have enabled many of his countrymen to visit various places, with guides well acquainted with the aspects of scientific interest presented by them. Among the countries to which he thus introduced many travellers are Spitsbergen, the Canary Islands, Scotland, Egypt, and the Caucasus.

Though Dr. Olivier was not a member of the Paris Academy of Sciences, Prof. Bouchard, who presided at the meeting of the academy on August 16, expressed sorrow at his death, and this testimony to the esteem in which he was held was put on record in the *Comptes rendus.* This exceptional mark of honour shows the high regard in which Dr. Olivier was held in France, and we are sure that in our own country there is real regret that one whose life has been of such great service should have passed into silence while actively engaged in his work for the extension of scientific knowledge.

NOTES.

IN accordance with previous announcements, arrangements have been made to hold the autumn meeting of the Iron and Steel Institute at Buxton, on Monday to Friday, September 26–30. The following are among the subjects of papers to be brought before the meeting:—Electric steel refining, D. F. Campbell; manganese in cast iron and the volume changes during cooling, H. I. Coe; sulphurous acid as a metallographic etching medium, E. Colver-Glauert and S. Hilpert; the theory of hardening carbon steels, C. A. Edwards; the influence of silicon on pure cast iron, A. Hague and T. Turner; the preparation of magnetic oxides of iron from aqueous solutions, S. Hilpert; the utilisation of electric power in the iron and steel industry, J. Elink Schuurman; some experiments on fatigue of metals, J. H. Smith.

AT the autumn meeting of the Institute of Metals, which is to take place in Glasgow on September 21–23, the following papers will probably be read:—The heat treatment of brass: experiments on 70:30 alloy, Messrs. G. D. Bengough and O. F. Hudson; some common defects occurring in alloys, Dr. C. H. Desch; shrinkage of the antimony-lead alloys, and of the aluminium-zinc alloys, during and after solidification, Mr. D. Ewen; the effect of silver, bismuth, and aluminium upon the mechanical properties of "tough-pitch" copper containing arsenic, Mr. F. Johnson; metallography as an aid to the brass founder, Mr. H. S. Primrose; magnetic alloys formed from non-magnetic materials, Mr. A. D. Ross.

A HITHERTO unknown region in New Guinea, near the central mountain range in Netherlands territory and west of the Fly River, has been visited by a Dutch explorer, Dr. H. A. Lorentz, who has published an account of the inhabitants. These, unlike the people found further west by the English expedition under Captain Rawling, are not pigmies, and most of Dr. Lorentz's description shows that they are not very far removed from the typical dwellers in the Fly River region. They wore no clothes, and lived in small huts about ten feet from the ground, as do some of the people of the Fly delta. As usual among the western Papuans, they used the bow and arrow, and had stone axes, the common weapon of all Papuans, until the advent of the white man. Mutilation was practised. The women cut off the middle finger of the left hand, the men removed the upper portion of one ear. This tribe was found to smoke and grow tobacco, which is not used on the coast of

Netherlands New Guinea, though used in the valley of the Fly River, and in the central district of British New Guinea, whence it has spread along the coast. The discovery of its use and culture among these mountaineers suggests that the custom was introduced into New Guinea from the north. Dr. Lorentz suggests intercourse with the northern coast, as the mountaineers wore large sea-shells as breast ornaments. No accurate information was obtainable, as intercourse was carried on only by signs.

MR. J. HEWITT, assistant for lower vertebrates in the Transvaal Museum, and formerly curator of the Sarawak Museum, has been appointed director of the Albany Museum, Grahamstown, South Africa, in succession to Dr. S. Schonland, who has resigned owing to pressure of other work. The herbarium is still under the care of Dr. Schonland.

A REUTER telegram from Spezia announces the death, on August 28, of Prof. Paolo Mantegazza. From a short notice in the *Times*, we learn that Prof. Mantegazza was born at Monza on October 31, 1831. After having studied at Milan and at Pisa he devoted himself to the study of medicine, and took his degree as doctor of medicine at Pavia. He early acquired a reputation, which increased steadily until he came to be regarded as one of the most learned physicians and the first hygienist of Italy. His method of exposition was easy, brilliant, and attractive, and did much to popularise the teaching of medical science. His devotion to his profession, however, did not prevent him from taking an active part in public affairs. A member of the Consiglio Superiore di Sanità, Mantegazza was also professor of general and experimental pathology in the University of Pavia, whence he proceeded to teach anthropology in the Istituto di Studii Superiori in Florence, in which city he founded the first anthropological and ethnographical museum ever established in Italy. In November, 1876, he was included by Royal decree amongst the Senators of the Kingdom.

DURING the past month sixteen advanced students and researchers have been at work at the Port Erin Biological Station. The Oceanography course conducted by Prof. Herdman, with Dr. Dakin and Dr. Roaf, during the first half of August was attended by eight, and consisted partly of lectures and laboratory work in the Biological Station and partly of work at sea. One day was spent in fish-trawling on board the Lancashire Sea-fisheries steamer, and other occasions in plankton work and dredging from the s.y. *Ladybird*. The contemplated addition of a new research wing at the back of the present building has now been decided on, and the work will be commenced in a few days. This new building will provide an addition to the library and a large experimental-tank room and two smaller research rooms with large tanks for physiological and other experimental work on the ground floor, and a series of eight separate research rooms, each with two windows, on the upper floor. The whole will be completed in time for use during next Easter vacation. The addition is made necessary by the increase in the number of students and research workers at the Port Erin Biological Station. A circular letter stating that 350*l.* would be required to build the new wing was issued by Prof. Herdman in May last, and since then the sum of about 250*l.* has been raised. It is hoped that the balance will soon be found; and in the faith that the work of the laboratory justifies the extension, the building is to be commenced.

THE eleventh annual meeting of the Astronomical and Astrophysical Society was held at the Harvard College Observatory, August 17–19. The programme included about fifty papers, and the meeting was well attended, among those present being many astronomers and physicists, who have gone to the United States in order to attend this meeting and that of the International Solar Union at Pasadena.

THE subject of the celebrated skull discovered at Galley Hill, Kent, in 1888, and now in the possession of Dr. F. Corner, formed the subject of a full-dress debate before the Anthropological Society of Paris, of which a report is included in the last issue of its *Bulletins et Mémoires*. The character of this skull has been discussed by many British anthropologists. Mr. E. T. Newton attributed it to the race known as that of Néanderthal; and this view was more or less accepted by M. Paul Raymond, while it was questioned by authorities such as MM. Fraipont, Hervé, and A. de Mortillet. The result of the debate was thus inconclusive. But, on the whole, the doubts of Prof. Boyd Dawkins and the late Sir John Evans, the latter expressing surprise at the discovery of an entire cranium in the diluvium, will suggest an attitude of caution in arriving at any definite conclusion on the age and racial affinities of this remarkable specimen.

THE forty-fourth volume (Series 3, vol. v.) of the *Journal of Anatomy and Physiology* is completed by the number published in July last. The papers which it contains nearly all refer to the human subject, and are therefore of interest more particularly to medical men. We may direct special attention to an elaborate account of the development of the larynx by Mr. J. E. Frazer, which illustrates very well the important part now played by wax model reconstruction in the study of human embryology.

IN the August number of the *Zoologist* Colonel C. E. Shepherd gives the results of investigations in regard to the relative sizes of the otoliths in various species and groups of bony fishes. Among the catfishes, it is noteworthy that while in the fresh-water *Synodontis schal* all these bones are very small, in the marine *Ælurichthys gronovii* one of them is very large. This suggests a difference between deep- and shallow-water fishes in this respect, but the idea is negatived by the fact that deep- and shallow-water members of the Berychidæ have otoliths of nearly similar relative size. All flat fishes likewise agree in the large size of these bones, so that in both instances adherence to a constant family type overrides adaptation in this matter. More promise seems to be afforded by the idea that the size of the otoliths may vary in proportion to the degree of development of visual power, long rectal ocular muscles, which indicate a quickly mobile eye, being correlated in the Scombridæ in most cases with small otoliths. In the Gadidæ, on the other hand, the eye-muscles are short, indicating an eye with little mobile power, while the otoliths are large. Although his investigations show that such a correlation holds good in the case of a large number of the species examined, Colonel Shepherd remarks that it cannot yet be regarded as proved that quickness of sight among fishes is compensated for by dullness of hearing, or that acute hearing accompanies an increase in the size of the otoliths. It is added that in sharks and rays the otoliths are represented by "ear-dust," although why this should be so is at present a mystery.

CONSIDERABLE interest attaches to a paper by Dr. Einar Lönnberg published in vol. vii., No. 2, of *Arkiv för Zoologi*, in which it is shown that the hinder teeth of very young white whales (*Delphinapterus leucas*) constantly display a more or less distinctly tricuspid character, as was suggested by Mr. True would prove to be the case. In certain respects the white whale is known to be a primitive type, and this is now further emphasised by its tooth-structure. The teeth of the species are, however, in some ways distinctly specialised, so that they could not have given rise to those of typical dolphins. Consequently, the author is of opinion that the white whale should be separated from the Delphinidæ as a distinct family (Delphinapteridæ), and also that each of these families should be regarded as divergent branches from a common ancestral type.

WE have to acknowledge the receipt of a copy of the report of the Otago University Museum for 1909–10, which is illustrated with a view of the building showing the new wing built for the reception of the library and pictures recently presented by Dr. Hocken.

THE natural features of the Australian Grampians, a mountain range accessible from Stawell, in Victoria, forms the subject of a note by Mr. A. G. Campbell in the *Victorian Naturalist* (vol. xxvii., No. 2). The sandstone hills are the habitat of several rare plants, including the singular little *Candollea sobolifera*; here, too, the native heath, *Epacris impressa*, luxuriates in a magnificent and long-flowering season. The cliff faces are veritable rock-gardens of Epacrids and Grevilleas, while the foot-slopes are favourable to the growth of orchids. *Caleya major* and *C. minor* are two rare orchids found by the author.

THE two "Master's lectures" on the adaptation of the plant to the plant, delivered by Mr. A. D. Hall before the Fellows of the Royal Horticultural Society, are published in the journal of the society (vol. xxxvi., part i.). Perhaps the most instructive lessons are based on the reading of crop-distribution maps, from which the author deduces the primary importance of the mechanical composition of the soil. Following these articles, the journal contains, amongst the contributions, a paper by Mr. C. C. Hurst on the application of Mendel's laws of heredity to horticulture, an account by Miss E. Armitage of cultivation by the peasants in Madeira, and notes on insect pests in the West Indies by Mr. R. Newstead. Mr. Hurst quotes from recent experiments by Cambridge workers in connection with the elucidation of the complicated colours of the snapdragon and variation in sweet peas, and discusses the origin of "albino" orchids, which can be explained upon the assumption of two complementary colour factors.

BULLETIN 419 of the United States Geological Survey contains a collection of analyses of rocks and minerals made in the laboratory of the Survey during the years 1880–1908. It is compiled by Dr. F. W. Clarke, chief chemist, who has also furnished an interesting introduction. This is the third collection issued by the U.S. Geological Survey, and will be of great use to petrologists in general. The analyses are 2420 in number, half of these belonging to igneous and crystalline rocks, and in all the later ones a large number of constituents are separately estimated. The analyses not included in the last edition (Bulletin 228) are mostly those of igneous rocks from the western States, and there are also numerous analyses of minerals isolated from crystalline rocks. An innovation which we regret is the use of a smaller type, presumably with the object of saving space.

THE summary of the weather issued by the Meteorological Office for the week ending August 27 shows that the rainfall for the period was exceptionally heavy in nearly all parts of the country. Falls of an inch or more within twenty-four hours are noted as having occurred over a wide area: on August 23 in various parts of England and Wales, on August 25 in Scotland and at Waterford, and on August 26 at Stonyhurst. The largest measurements were 2·38 inches at Crieff on August 24 and 1·69 inches on August 25, 2·2 inches at Stornoway and 1·60 inches at Stonyhurst on August 26. At Crieff the total for the week was 5·89 inches, the three days, Tuesday to Thursday, giving 5·19 inches, of which 3·50 inches fell in twenty-three hours. The succeeding days were also very wet in many parts of the country, and at Bath the aggregate for the two days, August 28 and 29, amounted to 2·57 inches, which is nearly equal to the average aggregate fall for August.

THE report of the Meteorological Committee for the year ended March 31 shows that the business of the year was exceptionally important. Arrangements for new premises at South Kensington claimed much attention; these will include space for a museum and better accommodation for the library, which now contains some 21,500 books and pamphlets, and is rapidly increasing, in addition to which space is required for a very large number of valuable documents from ships and land stations. The negotiations relating to the control of the observatories at Kew and Eskdalemuir resulted in making the committee responsible for the whole of the work, except the verification of instruments, aided by the scientific advice of a committee appointed by the Royal Society (see NATURE, June 23). Important changes have been made in some of the periodical publications of the office, *e.g.* the daily weather report includes important telegrams from Funchal, Madeira, and for the new year the ordinary forecasts for twenty-four hours have been extended when conditions are regarded as favourable. Weekly editions of the monthly North Atlantic charts are now issued showing the weather conditions over that ocean up to the day prior to that of publication. The director points out that these promise to be of considerable use to the forecast branch of the office. Wireless reports from the Royal Navy are found to be of much value, and those from the Atlantic liners have improved; in the course of the year, 4388 reports were received from the latter, and 42 per cent. arrived within twenty-four hours of the time of observation. The percentage of success (complete and partial) of the forecasts issued at 8h. 30m. p.m. for the whole of the British Islands in 1909 was 93, the highest on record, but the percentage of complete success, although higher than the mean for the last ten years, was lower than in 1906; the success or otherwise depends to some extent on the character of the weather, as shown more particularly by the harvest forecasts. Investigation of the upper air was actively continued, and the results were published, as before, in the Weekly Weather Report.

AN editorial note in the August number of the *Illuminating Engineer* of New York directs attention to the movement now on foot to educate the employees of American lighting companies through the medium of the American Gas Institute and the National Commercial Gas Association, in much the same way as some of the larger electrical firms have afforded facilities to their employees. According to the editor, it is felt that the time to sneer at "book larnin'" is now past, and the "self-made" practical man, while continuing "to worship his maker," must do it "secretly in his closet." On the other hand, when the college-trained man thinks he "knows it all," he "has no further mission in this world, and should be translated to some other sphere." To the man who is interested in every detail, whether scientific or commercial, of the business, each item of knowledge is of positive value, and the more he has the better it is for himself and his employer.

ALTHOUGH the use of "invar" wire with a very small coefficient of expansion in the measurements of the base lines of geodetic surveys has rendered an accurate knowledge of the temperature of the wire of less importance than it formerly was, it is still necessary if an accuracy of one part in a million is desired to know that temperature to within 1° C. In general, the temperature of the air, determined by means of a swinging thermometer, has been taken as identical with that of the wire; but Mr. B. F. E. Keeling, in a communication to the July number of the *Cairo Scientific Journal*, shows that, under field conditions, the wire temperature is about 2° C. higher than the air temperature owing to the absorption of sunlight at the surface of the wire. His method consists in substituting for the invar wire two wires of copper and constantan of the same diameter as the invar wire soldered together, so as to constitute a thermocouple, and connected to a galvanometer. The temperature of the junction exposed under field conditions is then determined from the galvanometer deflections.

THE *Builder* for August 27 comments on the facilities provided at the Brussels Exhibition for the beginning and rapid spread of fire. The liberal employment of canvas and other textile fabrics as structural and decorative materials doubtless served to render the sections affected by the disastrous fire even more than usually vulnerable. Apart from this characteristic, there is no reason for believing the average exhibition to be much safer from fire than that which has paid so heavy a price for attempted economy. No exhibition within recent times has been better conceived from the structural point of view than the Paris Exposition of 1900, where numerous important buildings were constructed entirely in reinforced concrete so as to afford safe accommodation for artistic, historical, and other treasures beyond all price. The example thus set is one that should always be followed, regardless of cost. We must break finally with the traditional flimsy structure of wood, canvas, and plaster. Steel is quite permissible if inexpensively sheathed in fire-protective casing, and is essential in roof construction. But timber wall panels, interior partitions, floors, roof framing, and roof covering must be given up. Expanded metal, wire netting, and steel lathing can easily be stretched between the main stanchions as the basis for incombustible walls and partitions formed of cement, mortar, or fire-resisting plaster.

FOR nearly four years past, the firm of Westinghouse, Church, Kerr and Co. has had in hand an investigation of the rust-preventing properties of protective coatings for structural steel. The *Engineering Magazine* for August contains a brief account of the results in the form of a paper read by Mr. C. M. Chapman before the American Society for Testing Materials. More than 500 coatings were tested, each paint being applied to two mild steel plates of about No. 16 gauge, 2 inches wide and 6 inches long. One plate was given one coat and the other two coats. After drying, the plates were fastened to boards with galvanised iron tacks, and exposed on the roof at an angle of 45 degrees, facing south. On the day the plates were exposed, scratch marks were made with a sharp instrument across two opposite corners of each plate, leaving bright metal exposed, so that rusting started immediately along these lines. At regular intervals each plate was examined, and a record made of its condition. The one quality which was being sought was protection against rust. The tabulated results show that with one coating the red leads take first place, both for one year's and two years' exposure. With two coatings and one year's exposure the white leads take best place; with two years' exposure the red leads are best. Red-lead primers, zinc oxides, iron oxides, carbons, and graphites also come out very good in these tests.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN SEPTEMBER:—

Sept. 1. 8h. 3m. Venus in conjunction with Moon. (Venus 4° 26′ S.)
14. 6h. 5m. to 7h. 23m. Moon occults ω Sagittarii. (Mag. 4·8.)
,, 7h. 56m. to 9h. 15m. Moon occults A Sagittarii. (Mag. 4·9.)
15. Saturn. Major axis of outer ring = 45·36″, minor axis = 13·94″.
17. 12h. 36m. Minimum of Algol (β Persei).
20. 9h. 25m. Minimum of Algol (β Persei).
21. 11h. 30m. Saturn in conjunction with Moon (Saturn 1° 31′ S.)
23. 10h. 31m. Sun enters Libra. Autumn commences.
23. 13h. 43m. to 14h. 5m. Moon occults κ' Tauri. (Mag. 4·1.)
23. 14h. 13m. to 14h. 59m. Moon occults v' Tauri. (Mag. 4·2.)

THE PARIS OBSERVATORY.—M. Baillaud's report of the Paris Observatory, for 1909, opens with a fitting tribute to the memory of MM. Fraissinet and Paul Gautier, and then proceeds to give an account of each department of the work and its labours during the year. Among other things, he mentions that the "cercle méridien du Jardin" has been completely overhauled and made perfect, while the programme has been greatly modified; the instrument is now being employed to observe fundamental stars, and will eventually undertake observations for the large catalogue proposed at the last meeting of the Paris Conference.

When not in use for spectroscopic work, the large *coudé* equatorial was employed by MM. Puiseux and Le Morvan for photographing the moon and planets; 218 images of Jupiter were secured between February and May, and later in the year more than 1200 images of Mars were secured.

A reproduction of the spectrum of Arcturus, original size, shows how effective are the new arrangements for employing the large *coudé* for stellar spectroscopy; the definition is magnificent, and the length of the spectrum between λ 4100 and λ 4800 is 15·4 cm.

The small equatorial *coudé* was employed by Dr. Nordmann in his photometric determination of stellar temperatures, and, with M. Salet, he has undertaken the observation of 300 stars of various spectral types.

OBSERVATIONS OF COMET 1910*a*.—In No. 4433 of the *Astronomische Nachrichten* Dr. Karl Bohlin publishes an excellent photograph and two drawings of the great comet, 1910*a*, as observed at Stockholm on January 28. The photograph shows the main tail 18° long, cleft at its extremity. The two drawings show enlarged views in the neighbourhood of the head, and in the second the head appears to stand out from the general plane in the form of a half moon.

THE SUN'S VELOCITY THROUGH SPACE.—In No. 1, vol. xxxii., of the *Astrophysical Journal* Profs. Frost and Kapteyn discuss the value of the sun's velocity through space as derived from the radial velocity of Orion stars. The reasons for employing this class of stars are fully discussed, and the stars considered were taken from within a moderate distance of the apex, or the antapex; for the former, the position $\alpha = 269{\cdot}7°$, $\delta = +30{\cdot}8°$ (1875·0), was taken, and the fact is elucidated that the Orion stars are, as a rule, at a great distance from the sun. This fact may account for the result that the velocity now determined is some 2 km. per sec. greater than that found by Hough and Halm, who employed many stars relatively near to our system; tentatively, it is suggested that these proximate stars appear to participate to some extent in the sun's motion through space.

A remarkable feature of the results is that the solar velocity, relatively to the stars near the apex, is some 10 km. per sec. less than the velocity relative to those near the antapex, separate solutions giving −18·38 km. and −28·38 km. respectively. It is suggested that this difference may be due to the stars near each point, or near both, belonging to the two great star streams. The mean value given as the definitive result of the paper is $v = -23·3$ km. per sec.

As further results, it was found that the average radial velocity of the stars, independent of the sun's motion, is −6·3 km. per sec., and that the average parallax of the sixty-one stars employed is 0·00924″.

PARALLAX OF FOURTH-TYPE STARS.—The question of the absorption of light in interstellar space led Prof. Kapteyn to look for classes of stars of which the probable distances are very great; such stars would best indicate any existing absorption. The fact that the proper motions of fourth- and fifth-type stars are, so far as is known, insensible, suggested that such stars would have extremely small parallaxes; therefore Prof. Kapteyn calculated the probable average parallax for some 120 stars of this type from data determined by Mr. Nörlund at Copenhagen.

The result is striking, for the average parallax of these fourth-type stars is found to be extremely small, 0·0007″, and does not exceed the probable error. Taking a previous result for the selective absorption in space, the quantity (photographic—visual magnitude) must amount, for these stars, to at least half a magnitude; it may be much greater. Therefore, to be satisfactory, any interpretation of the spectra of these stars cannot neglect the effect of the possible light-absorption in space.

For comparison, Prof. Kapteyn computed the probable average parallaxes of other types and for Orion stars of magnitude 5·0; he found the value 0·0068″ ± 0·0004″, which agrees satisfactorily with the value 0·0064″ determined, by an absolutely different method, in the discussion of the sun's velocity published by him, in collaboration with Prof. Frost, in the same number of the *Astrophysical Journal* (No. 1, vol. xxxii.).

THE MAXIMUM OF MIRA IN 1909.—Two papers dealing with the maximum of Mira in 1909 are published in No. 4434 of the *Astronomische Nachrichten*. In the former Prof. Nijland discusses his observations at Utrecht, which covered the period July 20, 1909, to March 3, and finds that a maximum, of magnitude 3·1, took place on September 7, 1909. This agrees with Guthnick's ephemeris, and gives a period, since last maximum, of 336 days.

In the second paper Mr. Ichinohe discusses the observations made by him at the Tokio Observatory during approximately the same period. According to him, the maximum took place on September 3, nearly four days before the predicted epoch, and the magnitude was 3·2.

THE STUDY OF DOUBLE STARS FOR AMATEURS.—Possessors of small instruments desiring to take up a useful study will find an interesting article by Mr. G. F. Chambers in the August number of *Knowledge and Scientific News*. This is the first of a series of articles on double stars, and in it Mr. Chambers discusses the question as to what constitutes a double star, and also pays attention to the question of coloured doubles.

METCALF'S COMET, 1910*b*.—Further observations of, and a continuation of the ephemeris for, Metcalf's comet are published in No. 4435 of the *Astronomische Nachrichten*; the following is an extract from the ephemeris:—

Ephemeris 12h. M.T. Berlin.

1910	α (1910) h. m.	δ (1910·0) ° ′	log r	log Δ	Mag.
Sept. 2	15 37·5	+16 43·7	0·2886	0·3027	10·9
,, 10	15 32·4	+17 3·0	0·2897	0·3342	11·0
,, 18	15 29·4	+17 20·6	0·2918	0·3614	11·2

THE ROYAL PHOTOGRAPHIC SOCIETY'S EXHIBITION.

AS the New Gallery is now used for other than exhibition purposes, the Royal Photographic Society have had to return to the Gallery of the Royal Society of Painters in Water Colour, 5A Pall Mall East, and hold their exhibition earlier than usual. It is now open, and closes on September 16. The trade and professional sections have had to be omitted for want of room, and the number of exhibits in the other sections considerably reduced. The diminution in the number of exhibits may cause disappointment to many who had prepared work for the occasion; but it is not an unmixed misfortune to the visitor, for it seems to have led to a general raising of the standard of quality. The pictorial section has a certain measure of scientific interest, as the method of production of almost all the prints is stated in the catalogue. They indicate, therefore, in an intelligible way the possibilities of the various processes, and at the same time a purchaser knows what he is buying. The proportion of bromides seems to be unduly large, and to indicate that many prefer ease of production to an unassailable permanency. There are two notable oil prints in colour, a still-life subject by MM. Séeberger Frères, and "Carmencita" by Messrs. Tilney and Corke; but such work is on the very borderland of photography.

In the colour-transparency section, the large majority of the exhibits are autochromes. Some of these are of a very high standard of excellence. Mr. J. C. Warburg's "Court of Honour, Ivory and Azure," and "Grey Hound Inn, Corfe," and Mr. Ellis Kelsey's "Beachy Head, Reflections," show how truly it is possible to reproduce the effects of neutral and sober colours. The few transparencies by the Dioptichrome Dufay Process are chiefly of the garish colour type, and do not serve to indicate the characteristics or possibilities of these plates. The application of colour photography to natural history and scientific purposes is illustrated by several transparencies, and several photomicrographs of polarised light effects show how well such slides can represent the actual appearances. A set of nine slides of mineral sections in polarised light by Mr. E. J. Garwood, made by the Sanger Shepherd colour process, by the side of the autochromes of similar subjects, demonstrates the superior brilliancy of the Sanger Shepherd plates, and that this process, although more trouble to work than the other, still holds its own.

In the natural history section, those exhibitors whose work we expect to see year by year continue to contribute. Mr. Douglas English shows the black ratton, the probable type of the old English *black* rat, and the "plague" rat of the East. Mr. William Farren shows five photographs of the "whiskered tern" (taken in Spain), three showing various phases of wing elevation in the act of alighting. When Miss Turner and Mr. E. J. Bedford exhibit rows of birds, each in the same row in a similar attitude and sometimes a strange attitude, we should like to know whether the birds were alive or dead when photographed. And this question might perhaps be asked with regard to some other exhibits. Among the entomological subjects, special note may perhaps be made of Mr. Hugh Main's series of thirteen photographs of the metamorphoses of the glow-worm in natural size, and Mr. P. J. Barrand's "queen wasp" in the attitude assumed during hybernation (×6).

The photomicrographs include many notable works. Dr. G. H. Rodman's series of fourteen photographs illustrating the life-history and structure of the stick insects, all low magnifications (×3 to ×14) except the complete insects, which are half size, and Mr. J. T. Holder's low magnifications of the twelve excellent sections, prepared, we believe, by himself, showing the eyes and adjacent parts of various living creatures, deserve especial mention. Dr. Max Poser's diatoms are, of course, good, but the interest of them would be much increased if the optical conditions under which they were photographed were stated. The only apparent advantage of the enormous magnification of nine thousand diameters of the *Pleurosigma angulatum* seems to be that all that is to be seen can be seen from the other side of the room. His bacilli with flagellæ (×1000) and his trypanosome (×3000) are fine examples.

A reproduction of the latter, which is almost equal to the original, is given in the catalogue.

Among several interesting radiographs, Dr. C. Thurstan Holland exhibits one of an "Adult male chest, through all the clothing, taken with a Snook Transformer. Instantaneous exposure." Dr. H. Ronen, Dr. W. J. S. Lockyer, and Stonyhurst College contribute astronomical and spectroscopical photographs. There are two or three excellent telephotographs, and a single exhibit of photomechanical work.

THE BRITISH ASSOCIATION AT SHEFFIELD.

WRITING on the eve of the meeting, there is every prospect that the Sheffield meeting of the association will be a successful one, and a certainty that, with an improvement in the weather conditions, it will be an enjoyable one. A considerable amount of private hospitality is being dispensed, but, even so, late arrivals will have some difficulty in finding accommodation. Local interest is considerable, and all classes are combining to give a welcome worthy of the city. One special feature will be the opportunity afforded to members to inspect the operations connected with armour and armament, all the firms engaged in naval shipbuilding opening their works to large parties. Members should be, however, careful to apply for tickets immediately on arrival, as some are open only on the Thursday. The technical instruction and investigations in iron and steel metallurgy carried on in the University have been of very material assistance in enabling Sheffield to maintain its leading position as the centre of high-class steel production, and the University is arranging to run its furnaces and special plants on afternoons at the close of the sectional meetings. Amongst the most interesting may be mentioned the crucible house, the Kjellin electric melting furnace, the electric hardening furnace, and the new form of the Siemens' acid open-hearth furnace. Interest will also be taken in the exhibition of Dr. Sorby's original micro-sections.

The Sheffield Musical Union is giving a concert to the association on the Saturday evening, under the conductorship of Dr. Coward. This is an innovation which will enable members to hear the famed Sheffield Choir, the programme including, besides part-songs, choral selections from the "Messiah" and the "Golden Legend."

In consonance with the growing fancy in England for ceremonial, the local committee have arranged for a procession on Sunday of representatives of the association, the Town Council, and the University from the Town Hall to the Parish Church, where the Archbishop of York is to preach the official sermon.

On Tuesday the University will hold a congregation to confer honorary degrees on leading representatives of the association. The recipients are to be:—The President (Dr. Bonney), the Lord Mayor (Earl Fitzwilliam, chairman of the local committee), Mr. W. H. Bateson, Sir W. Crookes, Mr. Francis Darwin, Sir A. Geikie, Prof. Hobson, Sir J. Jonas, Sir Norman Lockyer, Sir O. Lodge, Principal Miers, Sir W. Ramsay, Prof. Rhys Davies, Prof. Sherrington, Mr. J. E. Stead, Sir J. J. Thomson, and Sir W. White. Later the same evening the Chancellor of the University (the Duke of Norfolk, E.M., K.G.) will hold a reception. In connection with this an attempt is being made to arrange a scientific exhibition, more especially in relation to papers read before the various sections. It is hoped thereby to encourage this method of illustrating papers and at the same time to render them available to a wider circle of members. Simultaneously with the reception at the University, the Lord Mayor is receiving local guests at the Art Gallery; and the Weston Park, between it and the University, is to be the scene of an evening garden-party, with a military tattoo and torchlight procession.

Inaugural Address by the Rev. Prof. T. G. Bonney, Sc.D., LL.D., F.R.S., President of the Association.

Thirty-one years have passed since the British Association met in Sheffield, and the interval has been marked by exceptional progress. A town has become a city, the head of its municipality a Lord Mayor; its area has been enlarged by more than one-fifth; its population has increased from about 280,000 to 479,000. Communication has been facilitated by the construction of nearly thirty-eight miles of electric tramways for home service and of new railways, including alternative routes to Manchester and London. The supplies of electricity, gas, and water have more than kept pace with the wants of the city. The first was just being attempted in 1879; the second has now twenty-three times as many consumers as in those days; the story[1] of the third has been told by one who knows it well, so that it is enough for me to say your water supply cannot be surpassed for quantity and quality by any in the kingdom. Nor has Sheffield fallen behind other cities in its public buildings. In 1897 your handsome Town Hall was opened by the late Queen Victoria; the new Post Office, appropriately built and adorned with material from almost local sources, was inaugurated less than two months ago. The Mappin Art Gallery commemorates the munificence of those whose name it bears, and fosters that love of the beautiful which Ruskin sought to awaken by his generous gifts. Last, but not least, Sheffield has shown that it could not rest satisfied until its citizens could ascend from their own doors to the highest rung of the educational ladder. Firth College, named after its generous founder, was born in the year of our last visit; in 1897 it received a charter as the University College of Sheffield, and in the spring of 1905 was created a University, shortly after which its fine new buildings were opened by the late King; and last year its library, the generous gift of Dr. Edgar Allen, was inaugurated by his successor, when Prince of Wales. I must not now dwell on the great work which awaits this and other new universities. It is for them to prove that, so far from abstract thought being antagonistic to practical work, or scientific research to the labour of the factory or foundry, the one and the other can harmoniously cooperate in the advance of knowledge and the progress of civilisation.

You often permit your President on these occasions to speak of a subject in which he takes a special interest, and I prefer thus trespassing on your kindness to attempting a general review of recent progress in science. I do not, however, propose, as you might naturally expect, to discuss some branch of petrology; though for this no place could be more appropriate than Sheffield, since it was the birthplace and the lifelong home of Henry Clifton Sorby, who may truly be called the father of that science. This title he won when, a little more than sixty years ago, he began to study the structure and mineral composition of rocks by examining thin sections of them under the microscope.[2] A rare combination of a singularly versatile and active intellect with accurate thought and sound judgment, shrewd in nature, as became a Yorkshireman, yet gentle, kindly, and unselfish, he was one whom his friends loved and of whom this city may well be proud. Sorby's name will be kept alive among you by the Professorship of Geology which he has endowed in your University; but, as the funds will not be available for some time, and as that science is so intimately connected with metallurgy, coal-mining, and engineering, I venture to express a hope that some of your wealthier citizens will provide for the temporary deficiency, and thus worthily commemorate one so distinguished.

But to return. I have not selected petrology as my subject, partly because I think that the great attention which its more minute details have of late received has tended to limit rather than to broaden our views, while

1 "History and Description of Sheffield Water Works." W. Terrey, 1908.

2 His subsequent investigations into the microscopic structure of steel and other alloys of iron, in the manufacture of which your city holds a foremost place, have been extended by Mr. J. E. Stead and others, and they, besides being of great value to industrial progress, have thrown important sidelights on more than one dark place in petrology.

for a survey of our present position it is enough to refer to the suggestive and comprehensive volume published last year by Mr. A. Harker;[1] partly, also, because the discussion of any branch of petrology would involve so many technicalities that I fear it would be found tedious by a large majority of my audience. So I have preferred to discuss some questions relating to the effects of ice which had engaged my attention a dozen years before I attempted the study of rock slices. As much of my petrological work has been connected with mountain districts, it has been possible for me to carry on the latter without neglecting the former, and my study of ice-work gradually led me from the highlands into the lowlands.[2] I purpose, then, to ask your attention this evening to some aspects of the glacial history of Western Europe.

At no very distant geological epoch the climate in the northern part of the earth was much colder than it is at present. So it was also in the southern; but whether the two were contemporaneous is less certain. Still more doubtful are the extent and the work of the ice which was a consequence, and the origin of certain deposits on some northern lowlands, including those of our own islands, namely, whether they are the direct leavings of glaciers or were laid down beneath the sea by floating shore-ice and bergs. Much light will be thrown on this complex problem by endeavouring to ascertain what snow and ice have done in some region which, during the Glacial Epoch, was never submerged, and none better can be found for this purpose than the European Alps.

At the present day one school of geologists, which of late years has rapidly increased in number, claims for glaciers a very large share in the sculpture of that chain, asserting that they have not only scooped out the marginal lakes, as Sir A. Ramsay maintained full half a century ago, but have also quarried lofty cliffs, excavated great cirques, and deepened parts of the larger Alpine valleys by something like two thousand feet. The other school, while admitting that a glacier, in special circumstances, may hollow out a tarn or small lake and modify the features of rock scenery, declares that its action is abrasive rather than erosive, and that the sculpture of ridges, crags, and valleys was mainly accomplished in pre-Glacial times by running water and the ordinary atmospheric agencies.

In all controversies, as time goes on, hypotheses are apt to masquerade as facts, so that I shall endeavour this evening to disentangle the two, and direct attention to those which may be safely used in drawing a conclusion.

In certain mountain regions, especially those where strong limestones, granites, and other massive rocks are dominant, the valleys are often trench-like, with precipitous sides, having cirques or corries at their heads, and with rather wide and gently sloping floors, which occasionally descend in steps, the distance between these increasing with that from the watershed. Glaciers have unquestionably occupied many of these valleys, but of late years they have been supposed to have taken a large share in excavating them. In order to appreciate their action, we must imagine the glens to be filled up and the district restored to its former condition of a more or less undulating upland. As the mean temperature[3] declined, snow would begin to accumulate in inequalities on the upper slopes. This, by melting and freezing, would soften and corrode the underlying material, which would then be removed by rain and wind, gravitation and avalanche. In course of time the hollow thus formed would assume more and more the outlines of a corrie or a cirque by eating into the hillside. With an increasing diameter it would be occupied, as the temperature fell, first by a permanent snowfield, then by the *névé* of a glacier. Another process now becomes important, that called "sapping." While ordinary glacier-scour tends, as we are told, to produce "sweeping curves and eventually a graded slope," "sapping" produces "benches and cliffs, its action being horizontal and backwards," and often dominant over scour. The author of this hypothesis[4] convinced himself of its truth in the Sierra Nevada by descending a *bergschrund* 150 feet in

[1] "The Natural History of Igneous Rocks," 1909.

[2] May I add that hereafter a statement of facts without mention of an authority means that I am speaking from personal knowledge.

[3] In the remainder of this address "temperature" is to be understood as mean temperature. The Fahrenheit scale is used.

[4] W. D. Johnson, *Science*, N.S., ix. (1899), pp. 106, 112.

depth, which opened out, as is so common, beneath the walls of a cirque. Beginning in the *névé*, it ultimately reached the cliff, so that for the last 30 feet the bold investigator found rock on the one hand and ice on the other. The former was traversed by fracture planes, and was in all stages of displacement and dislodgment; some blocks having fallen to the bottom, others bridging the narrow chasm, and others frozen into the *névé*. Clear ice had formed in the fissures of the cliff; it hung down in great stalactites; it had accumulated in stalagmitic masses on the floor. Beneath the *névé* the temperature would be uniform, so its action would be protective, except where it set up another kind of erosion, presently to be noticed; but in the chasm, we are informed, there would be, at any rate for a considerable part of the year, a daily alternation of freezing and thawing. Thus the cliff would be rapidly undermined and be carried back into the mountain slope, so that before long the glacier would nestle in a shelter of its own making. Farther down the valley the moving ice would become more effective than subglacial streams in deepening its bed; but since the *névé*-flow is almost imperceptible near the head, another agency must be invoked, that of "plucking." The ice grips, like a forceps, any loose or projecting fragment in its rocky bed, wrenches that from its place, and carries it away. The extraction of one tooth weakens the hold of its neighbours, and thus the glen is deepened by "plucking," while it is carried back by "sapping." Streams from melting snows on the slopes above the amphitheatre might have been expected to cooperate vigorously in making it, but of them little account seems to be taken, and we are even told that in some cases the winds probably prevented snow from resting on the rounded surface between two cirque-heads.[1] As these receded, only a narrow neck would be left between them, which would be ultimately cut down into a gap or "col." Thus a region of deep valleys with precipitous sides and heads, of sharp ridges, and of more or less isolated peaks, is substituted for a rather monotonous, if lofty, highland.

The hypothesis is ingenious, but some students of Alpine scenery think more proof desirable before they can accept it as an axiom. For instance, continuous observations are necessary to justify the assumption of diurnal variations of temperature sufficient to produce any sensible effect on rock at the bottom of a narrow chasm nearly fifty yards deep and almost enclosed by ice. Here the conditions would more probably resemble those in a *glacière*, or natural ice cave. In one of these, during the summer, curtains and festoons of ice depend from the walls; from them and from the roof water drips slowly, to be frozen into stalagmitic mounds on the floor, which is itself sometimes a thick bed of ice. On this the quantity of fallen rock débris is not greater than is usual in a cave, nor are the walls notably shattered, even though a gap some four yards deep may separate them from the ice. The floors of cirques, from which the *névé* has vanished, cannot as a rule be examined, because they are masked by débris which is brought down by the numerous cascades, little and big, which seam their walls; but glimpses of them may sometimes be obtained in the smaller corries (which would be cirques if they could), and these show no signs of either "sapping" or "plucking," but some little of abrasion by moving ice. Cirques and corries also not infrequently occur on the sides as well as at the heads of valleys, such, for instance, as the two in the *massif* of the Uri Rothstock on the way to the Surenen Pass and the Fer à Cheval above Sixt. The Lago di Ritom lies between the mouth of a hanging valley and a well-defined step, and just above that is the Lago di Cadagno in a large, steep-walled corrie, which opens laterally into the Val Piora, as that of the Lago di Tremorgio does into the southern side of the Val Bedretto. Cirques may also be found where glaciers have had a comparatively brief existence, as the Creux des Vents on the Jura; or have never been formed, as on the slopes of Salina, one of the Lipari Islands, or in the limestone desert of Lower Egypt.[2] I have seen a miniature stepped valley carved by a rainstorm on a slope of Hampstead Heath; a cirque, about a yard in height and breadth, similarly excavated in the

[1] This does not appear to have occurred in the Alps.

[2] A. J. Jukes-Browne, *Geol. Mag.*, 1877, p. 477.

vertical wall of a gravel pit; and a corrie, measured by feet instead of furlongs, at the foot of one of the Binns near Burntisland, or, on a much reduced scale, in a bank of earth. On all these the same agent, plunging water, has left its marks—runlets of rain for the smaller, streams for the larger; convergent at first, perhaps, by accident, afterwards inevitably combined as the hollow widened and deepened. Each of the great cirques is still a "land of streams," and they are kept permanent for the greater part of the year by beds of snow on the ledges above its walls.

The "sapping and plucking" process presents another difficulty—the steps already mentioned in the floors of valleys. These are supposed to indicate stages at which the excavating glacier transferred its operations to a higher level. But, if so, the outermost one must be the oldest, or the glacier must have been first formed in the lowest part of the incipient valley. Yet, with a falling temperature, the reverse would happen, for otherwise the snow must act as a protective mantle to the mature pre-glacial surface almost down to its base. However much age might have smoothed away youthful angularities, it would be strange if no receptacles had been left higher up to initiate the process; and even if sapping had only modified the form of an older valley, it could not have cut the steps unless it had begun its work on the lowest one. Thus, in the case of the Creux de Champ, if we hesitate to assume that the sapping process began at the mouth of the valley of the Grande Eau above Aigle, we must suppose it to have started somewhere near Ormont Dessus and to have excavated that gigantic hollow, the floor of which lies full 6000 feet below the culminating crags of the Diablerets.

But even if "sapping and plucking" were assigned a comparatively unimportant position in the cutting out of cirques and corries, it might still be maintained that the glaciers of the Ice Age had greatly deepened the valleys of mountain regions. That view is adopted by Profs. Penck and Brückner in their work on the glaciation of the Alps,[1] the value of which even those who cannot accept some of their conclusions will thankfully admit. On one point all parties agree—that a valley cut by a fairly rapid stream in a durable rock is **V**-like in section. With an increase of speed the walls become more vertical; with a diminution the valley widens and has a flatter bed, over which the river, as the base-line is approached, may at last meander. Lateral streams will plough into the slopes, and may be numerous enough to convert them into alternating ridges and furrows. If a valley has been excavated in thick horizontal beds of rock varying in hardness, such as limestones and shales, its sides exhibit a succession of terrace walls and shelving banks, while a marked dip and other dominant structures produce their own modifications. It is also agreed that a valley excavated or greatly enlarged by a glacier should be **U**-like in section. But an Alpine valley, especially as we approach its head, very commonly takes the following form. For some hundreds of feet up from the torrent it is a distinct **V**; above this the slopes becomes less rapid, changing, say, from 45° to not more than 30°, and that rather suddenly. Still higher comes a region of stone-strewn upland valleys and rugged crags, terminating in ridges and peaks of splintered rock, projecting from a mantle of ice and snow. The **V**-like part is often from 800 to 1000 feet in depth, and the above-named authors maintain that this, with perhaps as much of the more open trough above, was excavated during the Glacial Epoch. Thus the floor of any one of these valleys prior to the Ice Age must often have been at least 1800 feet above its present level.[2] As a rough estimate, we may fix the deepening of one of the larger Pennine valleys, tributary to the Rhone, to have been, during the Ice Age, at least 1600 feet in their lower parts. Most of them are now hanging valleys, the stream issuing, on the level of the main river, from a deep gorge. Their tributaries are rather variable in form, the larger, as a rule, being more or less **V**-shaped; the shorter, and especially the smaller, corresponding more with the upper part of the larger valleys, but their lips generally are less deeply notched. Whatever may have been the cause, this rapid change in slope must indicate a corresponding change of action in the erosive agent. Here and there the apex of the **V** may be slightly flattened, but any approach to a real **U** is extremely rare. The retention of the more open form in many small, elevated recesses, from which at the present day but little water descends, suggests that where one of them soon became buried under snow,[1] but was insignificant as a feeder of a glacier, erosion has been for ages almost at a standstill.

The **V**-like lower portion in the section of one of the principal valleys, which is all that some other observers have claimed for the work of a glacier, cannot be ascribed to subsequent modification by water, because ice-worn rock can be seen in many places, not only high up its sides, but also down to within a yard or two of the present torrent.

Thus valley after valley in the Alps seems to leave no escape from the following dilemma: Either a valley cut by a glacier does not differ in form from one made by running water, or one which has been excavated by the latter, if subsequently occupied, is but superficially modified by ice. This, as we can repeatedly see in the higher Alpine valleys, has not succeeded in obliterating the physical features due to the ordinary processes of erosion. Even where its effects are most striking, as in the Spitallamm below the Grimsel Hospice, it has not wholly effaced those features; and wherever a glacier in a recent retreat has exposed a rock surface, that demonstrates its inefficiency as a plough. The evidence of such cases has been pronounced inadmissible, on the ground that the glaciers of the Alps have now degenerated into senile impotence; but in valley beds over which they passed when in the full tide of their strength, the flanks show remnants of rocky ridges only partly smoothed away, and rough rock exists on the "lee-sides" of ice-worn mounds which no imaginary plucking can explain. The ice seems to have flowed over rather than to have plunged into the obstacles in its path, and even the huge steps of limestone exposed by the last retreat of the Unter Grindelwald Glacier have suffered little more than a rounding off of their angles, though that glacier must have passed over them when in fullest development, for it seems impossible to explain these by any process of sapping.

The comparatively level trough, which so often forms the uppermost part of one of the great passes across the watershed of the Alps, can hardly be explained without admitting that in each case the original watershed has been destroyed by the more rapid recession of the head of the southern valley, and this work bears every sign of having been accomplished in pre-Glacial times. Sapping and plucking must have operated on a gigantic scale to separate the Viso from the Cottian watershed, to isolate the huge pyramid of the Matterhorn, with its western spur, or to make, by the recession of the Val Macugnaga, that great gap between the Strahlhorn and Monte Rosa. Some sceptics even go so far as to doubt whether the dominant forms of a non-glaciated region differ very materially from those of one which has been half buried in snowfields and glaciers. To my eyes, the general outlines of the mountains about the Lake of Gennesaret and the northern part of the Dead Sea recalled those around the Lake of Annecy and on the south-eastern shore of Leman. The sandstone crags, which rise here and there like ruined castles from the lower plateau of the Saxon Switzerland, resembled in outlines, though on a smaller scale, some of the Dolomites in the Southern Tyrol. The Lofoten Islands illustrate a half-drowned mountain range from which the glaciers have disappeared. Those were born among splintered peaks and ridges, which, though less lofty, rival in form the Aiguilles of Chamonix, and the valleys become more and more ice-worn as they descend, until the coast is fringed with skerries every one of which is a *roche moutonnée*. The *névé* in each of these valleys has been comparatively ineffective; the ice has gathered strength with the growth of the glacier. As can be seen from photographs, the scenery of the heart of the

[1] "Die Alpen in Eiszeitalter," 1900.

[2] The amount varies in different valleys; for instance, it was fully 2880 feet at Amsteg on the Reuss, just over 2000 feet at Brieg in the Rhone Valley, about 1000 feet at Guttanen in the Aare Valley, about 1550 feet above Zermatt, and 1100 feet above Saas Grund.

[1] My own studies of mountain districts have led me to infer that on slopes of low grade the action of snow is preservative rather than destructive. That conclusion was confirmed by Prof. Garwood in a communication to the Royal Geographical Society on June 20 of the present year.

Caucasus or of the Himalayas differs in scale rather than in kind from that of the Alps. Thus the amount of abrasion varies, other things being equal, with the latitude. The grinding away of ridges and spurs, the smoothing of the walls of troughs,[1] is greater in Norway than in the Alps; it is still greater in Greenland than in Norway, and it is greatest of all in the Antarctic, according to the reports of the expeditions led by Scott and Shackleton. But even in Polar regions, under the most favourable conditions, the dominant outlines of the mountains, as shown in the numerous photographs taken by both parties, and in Dr. Wilson's admirable drawings, differ in degree rather than in kind from those of mid-European ranges. It has been asserted that the parallel sides of the larger Alpine valleys—such as the Rhone above Martigny, the Lütschine near Lauterbrunnen, and the Val Bedretto below Airolo—prove that they have been made by the ice-plough rather than by running water; but in the first I am unable to discern more than the normal effects of a rather rapid river which has followed a trough of comparatively soft rocks; in the second, only the cliffs marking the channel cut by a similar stream through massive limestones—cliffs like those which elsewhere rise up the mountain flanks far above the levels reached by glaciers; while in the third I have failed to discover, after repeated examination, anything abnormal.

Many lake basins have been ascribed to the erosive action of glaciers. Since the late Sir A. Ramsay advanced this hypothesis, numbers of lakes in various countries have been carefully investigated and the results published, the most recent of which is the splendid work on the Scottish lochs by Sir J. Murray and Mr. L. Pullar.[2] A contribution to science of the highest value, it has also a deeply pathetic interest, for it is a father's memorial to a much-loved son, F. P. Pullar, who, after taking a most active part in beginning the investigation, lost his life while saving others from drowning. As the time at my command is limited, and many are acquainted with the literature of the subject, I may be excused from saying more than that even these latest researches have not driven me from the position which I have maintained from the first, namely, that while many tarns in corries and lakelets in other favourable situations are probably due to excavation by ice, as in the mountainous districts of Britain, in Scandinavia, or in the higher parts of the Alps, the difficulty of invoking this agency increases with the size of the basin—as, for example, in the case of Loch Maree or the Lake of Annecy—until it becomes insuperable. Even if Glas Llyn and Llyn Llydaw were the work of a glacier, the rock basins of Gennesaret and the Dead Sea, still more those of the great lakes in North America and in Central Africa, must be assigned to other causes.

I pass on, therefore, to mention another difficulty in this hypothesis—that the Alpine valleys were greatly deepened during the Glacial Epoch—which has not yet, I think, received sufficient attention. From three to four hundred thousand years have elapsed, according to Penck and Brückner, since the first great advance of the Alpine ice. One of the latest estimates of the thickness of the several geological formations assigns 4000 feet[3] to the Pleistocene and Recent, 13,000 to the Pliocene, and 14,000 to the Miocene. If we assume the times of deposit to be proportional to the thickness, and adopt the larger figure for the first-named period, the duration of the Pliocene would be 1,300,000 years, and of the Miocene 1,400,000 years. To estimate the total vertical thickness of rock which has been removed from the Alps by denudation is far from easy, but I think 14,000 feet would be a liberal allowance, of which about one-seventh is assigned to the Ice Age. But during that age, according to a curve given by Penck and Brückner, the temperature was below its present amount for rather less than half (0·47) the time. Hence it follows that, since the sculpture of the Alps must have begun at least as far back as the Miocene period, one-seventh of the work has been done by ice in not quite one-fifteenth of the time, or its action must be very potent. Such data as are at our command make it probable that

[1] If one may judge from photographs, the smoothing of the flanks of a valley is unusually conspicuous in Milton Sound, New Zealand.

[2] "Bathymetrical Survey of the Scottish Freshwater Lochs." Sir J. Murray and Mr. L. Pullar, 1910.

[3] I have doubts whether this is not too great.

a Norway glacier at the present day lowers its basin by only about 80 millimetres in 1000 years; a Greenland glacier may remove some 421 millimetres in the same time, while the Vatnajökul in Iceland attains to 647 millimetres. If Alpine glaciers had been as effective as the last-named, they would not have removed, during their 188,000 years of occupation of the Alpine valleys, more than 121·6 metres, or just over 397 feet; and as this is not half the amount demanded by the more moderate advocates of erosion, we must either ascribe an abnormal activity to the vanished Alpine glaciers, or admit that water was much more effective as an excavator.

We must not forget that glaciers cannot have been important agents in the sculpture of the Alps during more than part of Pleistocene times. That sculpture probably began in the Oligocene period; for rather early in the next one the great masses of conglomerate, called *Nagelfluh*, show that powerful rivers had already carved for themselves valleys corresponding generally with, and nearly as deep as, those still in existence. Temperature during much of the Miocene period was not less than 12° F. above its present average. This would place the snow-line at about 12,000 feet.[1] In that case, if we assume the altitudes unchanged, not a snowfield would be left between the Simplon and the Maloja, the glaciers of the Pennines would shrivel into insignificance, Monte Rosa would exchange its drapery of ice for little more than a tippet of frozen snow. As the temperature fell, the white robes would steal down the mountain-sides, the glaciers grow, the torrents be swollen during all the warmer months, and the work of sculpture increase in activity. Yet with a temperature even 6° higher than it now is, as it might well be at the beginning of the Pliocene period, the snow-line would be at 10,000 feet; numbers of glaciers would have disappeared, and those around the Jungfrau and the Finster Aarhorn would be hardly more important than they now are in the Western Oberland.

But denudation would begin so soon as the ground rose above the sea. Water, which cannot run off the sand exposed by the retreating tide without carving a miniature system of valleys, would never leave the nascent range intact. The Miocene Alps, even before a patch of snow could remain through the summer months, would be carved into glens and valleys Towards the end of that period the Alps were affected by a new set of movements, which produced their most marked effects in the northern zone from the Inn to the Durance. The Oberland rose to greater importance; Mont Blanc attained its primacy; the *massif* of Dauphiné was probably developed. That, and still more the falling temperature, would increase the snowfields, glaciers, and torrents. The first would be, in the main, protective; the second, locally abrasive; the third, for the greater part of their course, erosive. No sooner had the drainage system been developed on both sides of the Alps than the valleys on the Italian side (unless we assume a very different distribution of rainfall) would work backwards more rapidly than those on the northern. Cases of trespass, such as that recorded by the long level trough on the north side of the Maloja Kulm and the precipitous descent on the southern, would become frequent. In the interglacial episodes—three in number, according to Penck and Brückner, and occupying rather more than half the epoch—the snow and ice would dwindle to something like its present amount, so that the water would resume its work. Thus I think it far more probable that the **V**-like portions of the Alpine valleys were in the main excavated during Pliocene ages, their upper and more open parts being largely the results of Miocene and yet earlier sculpture.

During the great advances of the ice, four in number, according to Penck and Brückner,[2] when the Rhone glacier covered the lowlands of Vaud and Geneva, welling on one occasion over the gaps in the Jura, and leaving its erratics in the neighbourhood of Lyons, it ought to have given

[1] I take the fall of temperature for a rise in altitude as 1° F. for 300 feet or, when the differences in the latter are large, 3° per 1000 feet. These estimates will, I think, be sufficiently accurate. The figures given by Hann (see for a discussion of the question, Report of Brit. Assoc., 1909, p. 93) work out to 1° F. for each 318 feet of ascent (up to about 10,000 feet).

[2] On the exact number I have not had the opportunity of forming an opinion.

signs of its erosive no less than of its transporting power. But what are the facts? In these lowlands we can see where the ice has passed over the Molasse (a Miocene sandstone); but here, instead of having crushed, torn, and uprooted the comparatively soft rock, it has produced hardly any effect. The huge glacier from the Linth Valley crept for not a few miles over a floor of stratified gravels, on which, some eight miles below Zurich, one of its moraines, formed during the last retreat, can be seen resting, without having produced more than a slight superficial disturbance. We are asked to credit glaciers with the erosion of deep valleys and the excavation of great lakes, and yet, wherever we pass from hypotheses to facts, we find them to have been singularly inefficient workmen!

I have dwelt at considerable, some may think undue, length on the Alps, because we are sure that this region from before the close of the Miocene period has been above sea-level. It accordingly demonstrates what effects ice can produce when working on land.

In America also, to which I must now make only a passing reference, great ice-sheets formerly existed: one occupying the district west of the Rocky Mountains, another spreading from that on the north-west of Hudson's Bay, and a third from the Laurentian hill-country. These two became confluent, and their united ice-flow covered the region of the Great Lakes, halting near the eastern coast a little south of New York, but in Ohio, Indiana, and Illinois occasionally leaving moraines only a little north of the 39th parallel of latitude.[1] Of these relics my first-hand knowledge is very small, but the admirably illustrated reports and other writings of American geologists[2] indicate that, if we make due allowance for the differences in environment, the tills and associated deposits on their continent are similar in character to those of the Alps.[3]

In our own country and in corresponding parts of Northern Europe we must take into account the possible cooperation of the sea. In these, however, geologists agree that, for at least a portion of the Ice Age, glaciers occupied the mountain districts. Here ice-worn rocks, moraines and perched blocks, tarns in corries, and perhaps lakelets in valleys, demonstrate the former presence of a mantle of snow and ice. Glaciers radiated outwards from more than one focus in Ireland, Scotland, the English Lake District, and Wales, and trespassed, at the time of their greatest development, upon the adjacent lowlands. They are generally believed to have advanced and retreated more than once, and their movements have been correlated by Prof. J. Geikie with those already mentioned in the Alps. Into that very difficult question I must not enter; for my present purpose it is enough to say that in early Pleistocene times glaciers undoubtedly existed in the mountain districts of Britain, and even formed piedmont ice-sheets on the lowlands. On the west side of England, smoothed and striated rocks have been observed near Liverpool, which can hardly be due to the movements of shore-ice, and at Little Crosby a considerable surface has been cleared from the overlying Boulder Clay by the exertions of the late Mr. T. M. Reade and his son, Mr. A. Lyell Reade. But, so far as I am aware, rocks thus affected have not yet been discovered in the Wirral peninsula. On the eastern side of England similar markings have been found down to the coast of Durham, but a more southern extension of land ice cannot be taken for granted. In this direction, however, so far as the tidal valley of the Thames, and in corresponding parts of the central and western lowlands, certain deposits occur which, though to a great extent of glacial origin, are in many respects different from those left by land ice in the Alpine regions and in Northern America.

They present us with problems the nature of which may be inferred from a brief statement of the facts. On the Norfolk coast we find the glacial drifts resting, sometimes on the chalk, sometimes on strata of very late Pliocene or early Pleistocene age. The latter show that in their time the strand-line must have oscillated slightly on either side of its present level. The earliest of the glacial deposits, called the Cromer Till and Contorted Drift, presents its most remarkable development in the cliffs on either side of that town. Here it consists of Boulder Clays and alternating beds of sand and clay; the first-named, two or three in number, somewhat limited in extent, and rather lenticular in form, are slightly sandy clays, full of pieces of chalk, flint, and other kinds of rock, some of the last having travelled from long distances. Yet more remarkable are the huge erratics of chalk, in the neighbourhood of which the sands and clays exhibit extraordinary contortions. Like the beds of till, they have not been found very far inland, for there the group appears as a whole to be represented by a stony loam, resembling a mixture of the sandy and clayey material, and this is restricted to a zone some twenty miles wide, bordering the coast of Norfolk and Suffolk, not extending south of the latter county, but being probably represented to the north of the Humber. Above these is a group of false-bedded sands and gravels, variable in thickness and character—the Mid-glacial Sands of Searles V. Wood and F. W. Harmer. They extend over a wider area, and may be traced, according to some geologists, nearly to the western side of England, rising in that direction to a greater height above sea-level. But as it is impossible to prove that all isolated patches of these materials are identical in age, we can only be certain that some of them are older than the next deposit, a Boulder Clay, which extends over a large part of the lowlands in the Eastern Counties. This has a general resemblance to the Cromer Till, but its matrix is rather more clayey and is variable in colour. In and north of Yorkshire, as well as on the seaward side of the Lincolnshire wolds, it is generally brownish or purplish, but on their western side, and as far as the clay goes to the south, it is some shade of grey. Near to these wolds, in mid-Norfolk, and on the northern margin of Suffolk, it has a whitish tint, owing to the abundance of comminuted chalk. To the south and west of this area it is dark, from the similar presence of Kimeridge Clay. Yet further west it assumes an intermediate colour by having drawn upon the Oxford Clay. This Boulder Clay, whether the chalky or the purple, in which partings of sand sometimes occur, must once have covered, according to Mr. F. W. Harmer, an area about ten thousand square miles in extent. It spreads like a coverlet over the pre-glacial irregularities of the surface. It caps the hills, attaining sometimes an elevation of fully 500 feet above sea-level;[1] it fills up valleys,[2] sometimes partly, sometimes wholly, the original floors of which occasionally lie more than 100 feet below the same level. This Boulder Clay, often with an underlying sand or gravel, extends to the south as far as the neighbourhood of Muswell Hill and Finchley; hence its margin runs westward through Buckinghamshire, and then, bending northwards, passes to the west of Coventry. On this side of the Pennine Chain the matrix of the Boulder Clay is again reddish, being mainly derived from the sands and marls of the Trias; pieces of chalk and flint are rare (no doubt coming from Antrim), though other rocks are often plentiful enough. Some authorities are of opinion that the drift in most parts of Lancashire and Cheshire is separable, as on the eastern coasts, into a lower and an upper Boulder Clay, with intervening gravelly sands, but others think that the association of the first and third is lenticular rather than successive. Here also the lower clay cannot be traced very far inland, eastward or southward; the others have a wider extension, but they reach a greater elevation above sea-level than on the eastern side

[1] Some of the glacial drifts on the eastern side of the continent, as we shall find, may have been deposited in the sea.

[2] See the "Reports of the United States Geological Survey" (from vol iii. onwards), *Journal of Geology*, *American Journal of Science*, and local publications too numerous to mention. Among these the studies in Greenland by Prof. Chamberlin are especially valuable for the light they throw on the movement of large glaciers and the transport of débris in the lower part of the ice

[3] Here, however, we cannot always be so sure of the absence of the sea.

[1] Not far from Royston it is found at a height of 525 feet above O.D. *See* F. W. Harmer, "Pleistocene Period in the Eastern Counties," p. 115.

[2] At Old North Road Station, on a tributary of the Cam, the Boulder Clay was pierced to a depth of 180 feet, and at Impington it goes to 60 feet below sea level Near Hitchin, a hidden valley, traced for seven or eight miles, was proved to a depth of 68 feet below O.D., and one near Newport in Essex, to 140 feet. Depths were also found of 120 feet at West Horseheath in Suffolk, of 120 feet on low ground two miles S.W. of Sandy in Bedfordshire, of from 100 to 160 feet below the sea at Fossdyke, Long Sutton, and Boston, and at Glemsford in the valley of the Stour, 477 feet of drift was passed through before reaching the chalk. *See* F. W. Harmer, Quart. Journ. Geol. Soc., lxiii. (1907), p. 404.

of England. The sand is inconstant in thickness, being sometimes hardly represented, sometimes as much as 200 feet. The upper clay runs on its more eastern side up to the chalky Boulder Clay, and extends on the south at least into Worcestershire. On the western side it merges with the upper member of the drifts radiating from the mountains of North Wales, which often exhibit a similar tripartite division, while (as we learn from the officers of the Geological Survey) Boulder Clays and gravelly sands, which it must suffice to mention, extend from the highlands of South Wales for a considerable distance to the south-east and south. Boulder Clay has not been recognised in Devon or Cornwall, though occasional erratics are found which seem to demand some form of ice-transport. A limited deposit, however, of that clay, containing boulders now and then more than a yard in diameter, occurs near Selsey Bill on the Sussex coast, which most geologists consider to have been formed by floating rather than by land ice.

Marine shells are not very infrequent in the lower clays of East Anglia and Yorkshire, but are commonly broken. The well-known Bridlington Crag is the most conspicuous instance, but this is explained by many geologists as an erratic—a piece of an ancient North Sea bed caught up and transported, like the other molluscs, by an advancing ice-sheet. They also claim a derivative origin for the organic contents of the overlying sands and gravels, but some authorities consider the majority to be contemporaneous. Near the western coast of England, shells in much the same state of preservation as those on the present shore are far from rare in the lower clay, where they are associated with numerous striated stones, often closely resembling those which have travelled beneath a glacier, both from the Lake District and the less distant Trias. Shells are also found in the overlying sands up the valleys of the Dee and Severn, at occasional localities, even as far inland as Bridgnorth, the heights of the deposits varying from about 120 feet to more than 500 feet above the sea-level. If we also take account of the upper Boulder Clay, where it can be distinguished, the list of marine molluscs, ostracods, and foraminifers from these western drifts is a rather long one.[1]

Marine shells, however, on the western side of England are not restricted to the lowlands. Three instances, all occurring more than 1000 feet above sea-level, claim more than a passing mention. At Macclesfield, almost thirty miles in a straight line from the head of the estuary of the Mersey, Boulder Clays associated with stratified gravels and sands have been described by several observers.[2] The clay stops at about 1000 feet, but the sands and gravels go on to nearly 1300 feet, while isolated erratics are found up to about 100 feet higher. Sea shells, some of which are in good condition, have been obtained at various elevations, the highest being about 1200 feet above sea-level. About forty-eight species of molluscs have been recognised, and the fauna, with a few exceptions, more Arctic in character and now found at a greater depth, is one which at the present day lives in a temperate climate at a depth of a few fathoms.

The shell-bearing gravels at Gloppa, near Oswestry, which are about thirty miles from the head of the Dee estuary, were carefully described in 1892 by Mr. A. C. Nicholson. He has enumerated fully sixty species, of which, however, many are rare. As his collection[3] shows, the bivalves are generally broken, but a fair number of the univalves are tolerably perfect. The deposit itself consists of alternating seams of sand and gravel, the one generally about an inch in thickness, the other varying from a few inches to a foot. The difference in the amount of rounding shown by the stones is a noteworthy feature. They are not seldom striated; some have come from Scotland, others from the Lake District, but the majority from Wales, the last being the more angular. Here and there a block, sometimes exceeding a foot in diameter, and usually from the last-named country, has been dropped among the smaller material, most of which ranges in diameter from half an inch to an inch and a half. The beds in one or two places show contortions; but, as a rule, though slightly wavy and with a gentle dip rather to the west of south, they are uniformly deposited. In this respect, and in the unequal wearing of the materials, the Gloppa deposit differs from most gravels that I have seen. Its situation also is peculiar. It is on the flattened top of a rocky spur from higher hills, which falls rather steeply to the Shropshire lowland on the eastern side, and on the more western is defined by a small valley, which enlarges gradually as it descends towards the Severn. If the country were gradually depressed for nearly 1200 feet, this upland would become, first a promontory, then an island, and finally a shoal.

The third instance, on Moel Tryfaen in Carnarvonshire, was carefully investigated and described by a Committee of this Association[1] about ten years ago. The shells occur in an irregularly stratified sand and gravel, resting on slate, and overlain by a Boulder Clay, no great distance from, and a few dozen feet below, the rocky summit of the hill, being about 1300 feet above the level of the sea and at least five miles from its margin. About fifty-five species of molluscs and twenty-three of foraminifers have been identified. According to the late Dr. J. Gwyn Jeffreys,[2] the majority of the molluscs are littoral in habit, the rest such as live in from ten to twenty fathoms of water. Most of the erratics have been derived from the Welsh mountains, but some rocks from Anglesey have also been obtained, and a few pebbles of Lake District and Scotch rocks. If the sea were about 1300 feet above its present level, Moel Tryfaen would become a small rocky island, open to the storms from the west and north, and nearly a mile and a half away from the nearest land.

I must pass more rapidly over Ireland. The signs of vanished glaciers—ice-worn rocks and characteristic Boulder Clays—are numerous, and may be traced in places down to the sea-level, but the principal outflow of the ice, according to some competent observers, was from a comparatively low district, extending diagonally across the island from the south of Lough Neagh to north of Galway Bay. Glaciers, however, must have first begun to form in the mountains on the northern and southern side of this zone, and we should have expected that, whatever might happen on the lowlands, they would continue to assert themselves. In no other part of the British Islands are eskers, which some geologists think were formed when a glacier reached the sea, so strikingly developed. Here also an upper and a lower Boulder Clay, the former being the more sparsely distributed, are often divided by a widespread group of sands and gravels, which locally, as in Great Britain, contains, sometimes abundantly, shells and other marine organisms; more than twenty species of molluscs, with foraminifers, a barnacle, and perforations of annelids, having been described. These are found in Counties Dublin and Wicklow, at various altitudes,[3] from a little above sea-level to a height of 1300 feet.

Not the least perplexing of the glacial phenomena in the British Isles is the distribution of erratics, which has been already mentioned in passing. On the Norfolk coast, masses of chalk, often thousands of cubic feet in volume, occur in the lowest member of the glacial series, with occasional great blocks of sand and gravel, which must have once been frozen. But these, or at any rate the larger of them, have no doubt been derived from the immediate neighbourhood. Huge erratics also occasionally occur in the upper Boulder Clay—sometimes of chalk, as at Roslyn Hill near Ely, and at Ridlington in Rutland, of Jurassic limestone, near Great Ponton, to the south of Grantham, and of Lower Kimeridge Clay near Biggleswade.[4] These also probably have not travelled more than a few miles. But others of smaller size have often made much longer journeys. The Boulder Clays of eastern England are full of pieces of rock, commonly ranging from about half an inch to a foot in diameter. Among these are samples of the Carboniferous, Jurassic, and Cretaceous rocks of Yorkshire and the adjacent counties,

[1] W. Shone, Quart. Journ. Geol. Soc., xxxiv. (1878), p. 383.

[2] "Memoirs of the Geological Survey: Country around Macclesfield." T. I. Pocock (1906), p. 85. For some notes on Moel Tryfaen and the altitudes of other localities at which marine organisms have been found, *see* J. Gwyn Jeffreys, Quart. Journ. Geol. Soc., xxxvi. (1880), p. 351. For the occurrence of such remains in the Vale of Clwyd see a paper by T. McK. Hughes in Proc. Chester Soc. of Nat. His., 1884.

[3] Now deposited in the Oswestry Museum.

[1] Brit. Assoc. Report, 1899 (1900), pp. 414–423.

[2] Quart. Journ. Geol. Soc., xxxvi (1880), p. 355.

[3] *See* T. M. Reade, Proc. Liverpool Geol. Soc. 1893–4, p. 183, for some weighty arguments in favour of a marine origin for these deposits.

[4] H. Hume, Quart. Jour. Geol. Soc., lix. (1903), p. 375.

the Red Chalk from either Hunstanton, Speeton, or some part of the Lincolnshire wolds being found as far south as the northern heights of London. Even the chalk and flint, the former of which, especially in the Upper Boulder Clay, commonly occurs in well-worn pebbles, are frequently not the local, but the northern varieties. And with these are mingled specimens from yet more distant sources—Cheviot porphyrites, South Scotch basalts, even some of the crystalline rocks of the Highlands. Whatever was the transporting agent, its general direction was southerly, with a slight deflection towards the east in the last-named cases.

But the path of these erratics has been crossed by two streams, one coming from the west, the other from the east. On the western side of the Pennine watershed the Shap granite rises at Wasdale Crag to a height of about 1600 feet above sea-level. Boulders from it have descended the Eden valley to beyond Penrith; they have travelled in the opposite direction almost to Lancaster,[1] and a large number of them have actually made their way near the line of the Lake District watershed, across the upper valley of the Eden, and over the high pass of Stainmoor Forest,[2] whence they descended into Upper Teesdale. Subsequently the stream seems to have bifurcated, one part passing straight out to the present sea-bed, by way of the lower course of the Tees, to be afterwards driven back on to the Yorkshire coast. The other part crossed the low watershed between the Tees and the Ouse, descended the Vale of York, and spread widely over the plain.[3] Shap boulders by some means penetrated into the valleys tributary to the Ouse on its west bank, and they have been observed as far to the south-east as Royston, near Barnsley. It is noteworthy that Lake District rocks have been occasionally recorded from Airedale and even the neighbourhood of Colne, though the granite from Shap has not been found there. The other stream started from Scandinavia. Erratics, some of which must have come from the north-western side of the Christiania Fjord, occur on or near the coast from Essex to Yorkshire, and occasionally even as far north as Aberdeen, while they have been traced from the East Anglian coast to near Ware, Hitchin, and Bedford.[4] It may be important to notice that these Scandinavian erratics are often water-worn, like those dispersed over Denmark and parts of northern Germany.

On the western side of England the course of erratics is not less remarkable. Boulders from south-western Scotland, especially from the Kirkcudbright district, both water-worn and angular, are scattered over the lowlands as far south as Wolverhampton, Bridgnorth, and Church Stretton. They may be traced along the border of North Wales, occurring, as has been said, though generally small, up to about 1300 feet on Moel Tryfaen, 1100 feet at Gloppa, and more than that height on the hills east of Macclesfield. Boulders from the Lake District are scattered over much the same area and attain the same elevation, but extend, as might be expected, rather farther to the east in Lancashire. They also have been found on the eastern side of the Pennine watershed, perhaps the most remarkable instances being in the dales of the Derbyshire Derwent and on the adjacent hills as much as 1400 feet above the sea-level.[5] A third remarkable stream of erratics from the neighbourhood of the Arenig mountains extends from near the estuary of the Dee right across the paths of the two streams from the north, its eastern border passing near Rugeley, Birmingham, and Bromsgrove. They also range high, occurring almost 900 feet above sea-level on Romsley Hill, north of the Clents, and being common at Gloppa. Boulders also from the basalt mass of Rowley Regis have travelled in some cases between four and five miles, and in directions ranging from rather west of south to north-east; and, though the mass hardly rises above the 700-feet contour line, one lies with an Arenig boulder on Romsley Hill. From Charnwood

1 A pebble of it is said to have been identified at Moel Tryfaen.

2 The lowest part of the gap is about 1400 feet. A little to the south is another gap about 200 feet lower, but none of the boulders seem to have taken that route.

3 A boulder was even found above Grosmont in the Eske valley, 345 feet above sea-level.

4 R. H. Rastall and J. Romanes, Quart. Journ. Geol. Soc., lxv. (1909), p. 246.

5 Communication from Dr. H. Arnold-Bemrose.

Forest, the crags of which range up to about 850 feet above sea-level, boulders have started which have been traced over an area to the south and west to a distance of more than twenty miles.

Such, then, are the facts which call for an interpretation. More than one has been proposed; but it will be well, before discussing them, to arrive at some idea of the climate of these islands during the colder part of the Glacial Epoch. Unless that were associated with very great changes in the distribution of sea and land in northern and north-western Europe, we may assume that neither the relative position of the isotherms nor the distribution of precipitation would be very materially altered. A general fall of temperature in the northern hemisphere might so weaken the warmer ocean current from the south-west that our coasts might be approached by a cold one from the opposite direction.[1] But though these changes might diminish the difference between the temperatures of London and Leipzig, they would not make the former colder than the latter. At the present day the snow-line in the Alps on either side of the Upper Rhone Valley is not far from 8000 feet above sea-level, and this corresponds with a temperature of about 30°. Glaciers, however, are not generally formed until about 1000 feet higher, where the temperature is approximately 27°. Penck and Brückner place this line during the coldest part of the Ice Age at about 4000 feet.[2] In that case the temperature of the Swiss lowland would be some 15° lower than now, or near the freezing point.[3] If this fall were general, it would bring back the small glaciers on the Gran Sasso d'Italia and Monte Rotondo in Corsica; perhaps also among the higher parts of the Vosges and Schwarzwald.[4] In our own country it would give a temperature of about 35° at Carnarvon and 23° on the top of Snowdon, of 32° at Fort William and 17·5° on the top of Ben Nevis. If, in addition to this, the land were 600 feet higher than now (as it probably was, at any rate in the beginning of the Glacial Epoch), there would be a further drop of 2°, so that glaciers would form in the corries of Snowdon, and the region round Ben Nevis might resemble the Oetzthal Alps at the present day. This change of itself would be insufficient, and any larger drop in the ocean-level would have to be continental in its effects, since we cannot assume a local upheaval of much more than the above amount without seriously interfering with the river system of North Central Europe. But these changes, especially the former, might indirectly diminish the abnormal warmth of winter on our north-western coasts.[5] It is difficult to estimate the effect of this. If it did no more than place Carnarvon on the isotherm of Berlin (now lower by 2°), that would hardly bring a glacier from the Snowdonian region down to the sea. At the present time London is about 18° warmer than a place in the same latitude near the Labrador coast or the mouth of the Amur River, but the removal of that difference would involve greater changes in the distribution of sea and land than seems possible at an epoch, comparatively speaking, so recent. I am doubtful whether we can attribute to changed currents a reduction in British temperatures of so much as 11°; but, if we did, this would amount to 28° from all causes, and give a temperature of 20° to 22° at sea-level in England during the coldest part of the Glacial Epoch.[6] That is now

1 Facts relating to this subject will be found in "Climate and Time," by J. Croll, ch. ii. and iii. (1875). Of course the air currents would also be affected, and perhaps diminish precipitation as the latitude increased.

2 *Loc. cit.*, p. 586, *et seq.* They say the snow-line, which would mean that the temperature was only 12° lower than now; but as possibly this line might then more nearly correspond with that of glacier formation, I will provisionally accept the higher figures, especially since Corsica, the Apennines, and some other localities in Europe, seem to require a reduction of rather more than 12°.

3 It would be 32·5° at Zurich, 31·6° at Bern, 34·1° at Geneva, about 39·0° on the plain of Piedmont, and 36·0° at Lyons.

4 See for particulars the author's "Ice Work" (International Scientific Series), p. 237.

5 For much valuable information on these questions see a paper on Climate of the Pleistocene Epoch (F. W. Harmer, Quart. Journ. Geol. Soc., lvii. 1901, p. 405).

6 The present temperature in Ireland over the zone (from S. of Belfast to N. of Galway Bay) which is supposed to have formed the divide of the central snowfield may be given as from 49° to 50°, nearly the same as at the sea-level in Carnarvonshire. Thus, though the district is less mountainous than Wales, it would not need a greater reduction, for the snowfall would probably be rather larger. But this reduction could hardly be less than 20°, for the glaciers would have to form nearly at the present sea-level.

found, roughly speaking, in Spitsbergen, which, since its mountains rise to much the same height, should give us a general idea of the condition of Britain in the olden time.

What would then be the state of Scandinavia? Its present temperature ranges on the west coast from about 45° in the south to 35° in the north.[1] But this region must now be very much, possibly 1800 feet, lower than it was in pre-Glacial, perhaps also in part of Glacial, times.[2] If we added 5° for this to the original 15°, and allowed so much as 18° for the diversion of the warm current, the temperature of Scandinavia would range from 7° to −3°, approximately that of Greenland northwards from Upernivik. But since the difference at the present day between Cape Farewell and Christiania (the one in an abnormally cold region, the other in one correspondingly warm) is only 7°, that allowance seems much too large, while without it Scandinavia would correspond in temperature with some part of that country from south of Upernivik to north of Frederikshaab.[3] But if Christiania were not colder than Jakobshavn is now, or Britain than Spitsbergen, we are precluded from comparisons with the coasts of Baffin Bay or Victoria Land.

Thus the ice-sheet from Scandinavia would probably be much greater than those generated in Britain. It would, however, find an obstacle to progress westwards which cannot be ignored. If the bed of the North Sea became dry land, owing to a general rise of 600 feet, that would still be separated from Norway by a deep channel extending from the Christiania Fjord round the coast northward. Even then this would be everywhere more than another 600 feet deep, and almost as wide as the Strait of Dover.[4] The ice must cross this and afterwards be forced for more than 300 miles up a slope, which, though gentle, would be in vertical height at least 600 feet. The task, if accomplished by thrust from behind, would be a heavy one, and, so far as I know, without a parallel at the present day; if the viscosity of the ice enabled it to flow, as has lately been urged,[5] we must be cautious in appealing to the great Antarctic barrier, because we now learn that more than half of it is only consolidated snow.[6] Moreover, if the ice floated across that channel, the thickness of the boulder-bearing layers would be diminished by melting (as in Ross's Barrier), and the more viscous the material the greater the tendency for these to be left behind by the overflow of the cleaner upper layers. If, however, the whole region became dry land, the Scandinavian glaciers would descend into a broad valley, considerably more than 1200 feet deep, which would afford them an easy path to the Arctic Ocean, so that only a lateral overflow, inconsiderable in volume, could spread itself over the western plateau.[7] An attempt to escape this difficulty has been made by assuming the existence of an independent centre of distribution for ice and boulders near the middle of the North Sea bed[8] (which would demand rather exceptional conditions of temperature and precipitation); but in such case either the Scandinavian ice would be fended off from England, or the boulders, prior to its advance, must have been dropped by floating ice on the neighbouring sea-floor.

If, then, our own country were but little better than Spitsbergen as a producer of ice, and Scandinavia only surpassed southern Greenland in having a rather heavier snowfall, what interpretation may we give to the glacial phenomena of Britain? Three have been proposed. One asserts that throughout the Glacial Epoch the British Isles generally stood at a higher level, so that the ice which almost buried them flowed out on to the beds of the North and Irish Seas. The Boulder Clays represent its moraines. The stratified sands and gravels were deposited in lakes formed by the rivers, which were dammed up by ice-sheets.[1] A second interpretation recognises the presence of glaciers in the mountain regions, but maintains that the land, at the outset rather above its present level, gradually sank beneath the sea, until the depth of water over the eastern coast of England was fully 500 feet, and over the western nearly 1400 feet, from which depression it slowly recovered. By any such submergence Great Britain and Ireland would be broken up into a cluster of hilly islands, between which the tide from an extended Atlantic would sweep eastwards twice a day, its currents running strong through the narrower sounds, while movements in the reverse direction at the ebb would be much less vigorous. The third interpretation, in some respects intermediate, was first advanced by the late Prof. Carvill Lewis, who held that the peculiar Boulder Clays and associated sands (such as those of East Anglia), which, as was then thought, were not found more than about 450 feet above the present sea-level, had been deposited in a great fresh-water lake, held up by the ice-sheets already mentioned and by an isthmus, which at that time occupied the place of the Strait of Dover. Thus these deposits, though indirectly due to land-ice, were actually fluviatile or lacustrine. But this interpretation need not detain us, though the former existence of such lakes is still maintained, on a small scale in Britain, on a much larger one in North America, because, as was pointed out when it was first advanced, it fails to explain the numerous erratic blocks and shell-bearing sands which occur far above the margin of the hypothetical lake.

Each of the other two hypotheses involves grave difficulties. That of great confluent ice-sheets creeping over the British lowlands demands, as has been intimated, climatal conditions which are scarcely possible, and makes it hard to explain the sands and gravels, sometimes with regular alternate bedding, but more generally indicative of strong current action, which occur at various elevations to more than 1300 feet above sea-level, and seem too widespread to have been formed either beneath an ice-sheet or in lakes held up by one, for the latter, if of any size, would speedily check the velocity of influent streams. Also the mixture and crossing of boulders, which we have described, are inexplicable without the most extraordinary oscillations in the size of the contributing glaciers. To suppose that the Scandinavian ice reached to Bedfordshire and Herts, and then retired in favour of north British glaciers, or *vice versâ*, assumes an amount of variation which, so far as I am aware, is without a parallel elsewhere. So also the mixture of boulders from South Scotland, the Lake District, and North Wales, which lie, especially in parts of Staffordshire and Shropshire, as if dropped upon the surface, far exceeds what may reasonably be attributed to variations amplified by lateral spreading of mountain glaciers on reaching a lowland, while the frequent presence of shells in the drifts, dozens of miles away from the present coast, implies a rather improbable scooping up of the sea-bed without much injury to such fragile objects. The ice also must have been curiously inconstant in its operations. It is supposed in one place to have glided gently over its bed, in another to have gripped and torn out huge masses of rock.[2] Both actions may be possible in a mountain region, but it is very difficult to understand how they could occur in a lowland or plain. Besides this, we can only account for some singular aberrations of boulders, such as Shap granite well above Grosmont in Eskdale, or the Scandinavian rhomb-porphyry above Lockwood,[3] near Huddersfield, by assuming a flexibility in the lobes of an ice-sheet which it is hard to match at

[1] It is 44·42° at Bergen, 38·48° at Bodo, 35·42° at Hammerfest, 41·36° at Christiania and Stockholm.

[2] For particulars see *Geol. Mag.*, 1899, p. 97 (W. H. Hudleston) and p. 282 (T. G. Bonney).

[3] Christiania and Cape Farewell (Greenland) are nearly on the same latitude.

[4] For details see *Geol. Mag.*, 1899, pp. 97 and 282.

[5] H. M. Deeley, *Geol. Mag.*, 1909, p. 239.

[6] E. Shackleton, "The Heart of the Antarctic," ii., p. 277.

[7] It has indeed been affirmed (Brögger, *Om de senglaciale og postglaciale nivaforandringer i Kristianiafeltet*, p. 682) that at the time of the great ice-sheet of Europe the sea-bottom must have been uplifted at least 8500 feet higher than at present. This may be a ready explanation of the occurrence of certain dead shells in deep water, but, unless extremely local, it would revolutionise the drainage system of Central Europe.

[8] *Geol. Mag.*, 1901, pp. 142, 187, 284, 332.

[1] See Warren Upham, Monogr. U.S. Geol. Survey, xxv. (1896). This explanation commends itself to the majority of British geologists as an explanation of the noted parallel roads of Glenroy, but it is premature to speak of it as "conclusively shown" (Quart. Journ. Geol. Soc., lviii. (1902) p. 473) until a fundamental difficulty which it presents has been discussed and removed.

[2] That this has occurred at Cromer is a very dubious hypothesis (see *Geol. Mag.*, 1905, pp. 397, 524). The curious relations of the drift and chalk in the islands of Möen and Rügen are sometimes supposed to prove the same action. Knowing both well, I have no hesitation in saying that the chalk there is, as a rule, as much *in situ* as it is in the Isle of Wight.

[3] About half-way across England and 810 feet above sea-level. P. F. Kendall, Quart. Journ. Geol. Soc., lvii. (1902), p. 498.

the present time. Again, the Boulder Clay of the eastern counties is crowded, as we have described, with pebbles of chalk, which generally are not of local origin, but have come from north of the Wash. Whether from the bed of a river or from a sea-beach, they are certainly water-worn. But if pre-Glacial, the supply would be quickly exhausted, so that they would usually be confined to the lower part of the clay. As it is, though perhaps they run larger here, they abound throughout. The so-called moraines near York (supposed to have been left by a glacier retreating up that vale), those in the neighbourhood of Flamborough Head and of Sheringham (regarded as relics of the North Sea ice-sheet), do not, in my opinion, show any important difference in outline from ordinary hills of sands and gravels, and their materials are wholly unlike those of any indubitable moraines that I have either seen or studied in photographs. It may be said that the British glaciers passed over very different rocks from the Alpine; but the Swiss molasse ought to have supplied abundant sand, and the older interglacial gravels quantities of pebbles; yet the differences between the morainic materials on the flank of the Jura or near the town of Geneva and those close to the foot of the Alps are varietal rather than specific.

Some authorities, however, attribute such magnitude to the ice-sheets radiating from Scandinavia that they depict them, at the time of maximum extension, as not only traversing the North Sea bed and trespassing upon the coast of England, but also radiating southward to overwhelm Denmark and Holland, to invade northern Germany and Poland, to obliterate Hanover, Berlin, and Warsaw, and to stop but little short of Dresden and Cracow, while burying Russia on the east to within no great distance of the Volga and on the south to the neighbourhood of Kief. Their presence, however, so far as I can ascertain, is inferred from evidence[1] very similar to that which we have discussed in the British lowlands. That Scandinavia was at one time almost wholly buried beneath snow and ice is indubitable; it is equally so that at the outset the land stood above its present level, and that during the later stages of the Glacial Epoch parts, at any rate of southern Norway, had sunk down to a maximum depth of 800 feet. In Germany, however, erratics are scattered over its plain and stranded on the slopes of the Harz and Riesengebirge up to about 1400 feet above sea-level. The glacial drifts of the lowlands sometimes contain dislodged masses of neighbouring rocks like those at Cromer, and we read of other indications of ice action. I must, however, observe that since the glacial deposits of Möen, Warnemünde, and Rügen often present not only close resemblances to those of our eastern counties, but also very similar difficulties, it is not permissible to quote the one in support of the other, seeing that the origin of each is equally dubious. Given a sufficient "head" of ice in northern regions, it might be possible to transfer the remains of organisms from the bed of the Irish Sea to Moel Tryfaen, Macclesfield, and Gloppa; but at the last-named, if not at the others, we must assume the existence of steadily alternating currents in the lakes in order to explain the corresponding bedding of the deposit. This, however, is not the only difficulty. The "Irish Sea glacier" is supposed to have been composed of streams from Ireland, south-west Scotland, and the Lake District, of which the second furnished the dominant contingent, the first-named not producing any direct effect on the western coast of Great Britain, and the third being made to feel its inferiority and "shouldered in upon the mainland." But even if this ever happened, ought not the Welsh ice to have joined issue with the invaders a good many miles to the north of its own coast?[2] Welsh boulders, at any rate, are common near the summit of Moel Tryfaen, and I have no hesitation in saying that the pebbles of riebeckite-rock, far from rare in its drifts, come from Mynydd Mawr, hardly half a league to the E.S.E., and not from Ailsa Craig.[1]

[1] A valuable summary of it is given in "The Great Ice Age," J. Geikie, ch. xxix., xxx. (1894)

[2] From Moel Tryfaen to the nearest point of Scotland is well over a hundred miles, and it is a few less than this distance from Gloppa to the Lake District. In order to allow the Irish Sea ice-sheet to reach the top of Moel Tryfaen the glacier productive power of Snowdonia has been minimised (Wright, "Man and the Glacial Epoch," pp. 171, 172). But the difference between that and the Arenig region is not great enough to make the one incompetent to protect its own borderland while the other could send an ice-sheet which could almost cover the Clent Hills and reach the neighbourhood of Birmingham. Anglesey also, if we suppose a slight elevation and a temperature of 29° at the sea-level, would become a centre of ice-distribution and an advance guard to North Wales.

As such frequent appeal is made to the superior volume of the ice-sheet which poured from the northern hills over the bed of the Irish Sea, I will compare in more detail the ice-producing capacities of the several districts. The present temperature of West-Central Scotland may be taken as 47°, its surface as averaging about 2500 feet, rising occasionally to nearly 4000 feet above sea-level. In the western part of the Southern Uplands the temperature is a degree higher, and the average for altitude at most not above 1500 feet. In the Lake District and the Northern Pennines the temperature is increased by another degree, and the heights are, for the one 1800 feet with a maximum of 3162 feet, for the other 1200 feet and 2892 feet. In North Wales the temperature is 50°, the average height perhaps 2000 feet, and the culminating point 3571 feet. For the purpose of comparing the ice-producing powers of these districts, we may bring them to one temperature by adding 300 feet to the height for each degree below that of the Welsh region. This would raise the average elevation of Central and Southern Scotland to 3400 feet and 2100 feet respectively, for the Lake District and Northern Pennines to 2100 feet and 1500 feet. We may picture to ourselves what this would mean, if the snow-line were at the sea-level in North Wales, by imagining 8000 feet added to its height and comparing it with the Alps. North Wales would then resemble a part of that chain which had an average height of about 10,000 feet above sea-level, and culminated in a peak of 11,571 feet; the Lake District would hardly differ from it; the Northern Pennines would be like a range of about 9000 feet, its highest peak being 11,192 feet. Southern Scotland would be much the same in average height as the first and second, and would rise, though rarely, to above 11,000 feet; the average in Central Scotland would be about 11,400 feet, and the maximum about 13,000 feet. Thus North Wales, the Lake District, and the Southern Uplands would differ little in ice-productive power, while Central Scotland would distinctly exceed them, but not more than the group around the Finsteraarhorn does that giving birth to the Rhone glacier. In one respect, however, all these districts would differ from the Alps—that, at 8000 feet, the surface, instead of being furrowed with valleys, small and great, would be a gently shelving plateau, which would favour the formation of piedmont glaciers. Still, unless we assume the present distribution of rainfall to be completely altered (for which I do not know any reason), the relative magnitudes of the ice coming from these centres (whether separate glaciers or confluent sheets) could differ but little. Scotch ice would not appreciably "shoulder inland" that from the Lake District, nor would the Welsh ice be imprisoned within its own valleys.

During the last few years, however, the lake-hypothesis of Carvill Lewis has been revived under a rather different form by some English advocates of land-ice. For instance, the former presence of ice-dammed lakes is supposed to be indicated in the upper parts of the Cleveland Hills by certain overflow channels. I may be allowed to observe that, though this view is the outcome of much acute observation and reasoning,[2] it is wholly dependent upon the ice-barriers already mentioned, and that if they dissolve before the dry light of sceptical criticism, the lakes will "leave not a rack behind." I must also confess that, to my eyes, the so-called "overflow channels" much more closely resemble the remnants of ancient valley-systems, formed by only moderately rapid rivers, which have been isolated by the trespass of younger and more energetic streams, and they suggest that the main features of this picturesque upland were developed before rather than after the beginning of the Glacial Epoch. I think that even "Lake Pickering," though it has become an accepted fact with several geologists of high repute, can be more simply explained as a two-branched "valley of

[1] The boulders of picrite near Porth Nobla, from Llanerchymedd, though they have travelled southward, have moved much to the west.

[2] P. F. Kendall, Quart. Journ. Geol. Soc., lviii. (1902), 471.

strike," formed on the Kimeridge Clay, the eastern arm of which was beheaded, even in pre-Glacial times, by the sea.[1] As to Lake Oxford,[2] I must confess myself still more sceptical. Some changes, no doubt, have occurred in later Glacial and post-Glacial times; valleys have been here raised by deposit, there deepened sometimes by as much as 100 feet; the courses of lowland rivers may occasionally have been altered; but I doubt whether, since those times began, either ice-sheet or lake has ever concealed the site of that university city.

The submergence hypothesis assumes that, at the beginning of the Glacial Epoch, our islands stood rather above their present level, and during it gradually subsided, on the west to a greater extent than on the east, until at last the movement was reversed, and they returned nearly to their former position. During most of this time glaciers came down to the sea from the more mountainous islands, and in winter an ice-foot formed upon the shore. This, on becoming detached, carried away boulders, beach pebbles, and finer detritus. Great quantities of the last also were swept by swollen streams into the estuaries and spread over the sea-bed by coast currents, settling down especially in the quiet depths of submerged valleys. Shore-ice in Arctic regions, as Colonel H. W. Feilden[3] has described, can striate stones and even the rock beneath it, and is able, on a subsiding area, gradually to push boulders up to a higher level. In fact, the state of the British region in those ages would not have been unlike that still existing near the coasts of the Barents and Kara Seas. Over the submerged region southward, and in some cases more or less eastward, currents would be prevalent, though changes of wind[4] would often affect the drift of the floating ice-rafts. But though the submergence hypothesis is obviously free from the serious difficulties which have been indicated in discussing the other one, gives a simple explanation of the presence of marine organisms, and accords with what can be proved to have occurred in Norway, Waigatz Island, Novaia Zemlya, on the Lower St. Lawrence, in Grinnell Land, and elsewhere,[5] it undoubtedly involves others. One of them—the absence of shore terraces, caves, or other sea marks—is perhaps hardly so grave as it is often thought to be. It may be met by the remark that unless the Glacial Age lasted for a very long time and the movements were interrupted by well-marked pauses, we could not expect to find any such record. In regard also to another objection, the rather rare and sporadic occurrence of marine shells, the answer would be that, on the Norway coast, where the ice-worn rock has certainly been submerged, sea-shells are far from common, and occur sporadically in the raised deltaic deposits of the fjords.[6] An advocate of this view might also complain, not without justice, that, if he cited an inland terrace, it was promptly dismissed as the product of an ice-dammed lake, and his frequent instances of marine shells in stratified drifts were declared to have been transported from the sea by the lobe of an ice-sheet; even if they have been carried across the path of the Arenig ice, more than forty miles as the crow flies, from the Irish Sea up the Valley of the Severn, or forced some 1300 feet up Moel Tryfaen.[7] The difficulty in the latter case, he would observe, is not met by saying the ice-sheet would be able to climb that hill "given there were a sufficient head behind it."[1] That ice can be driven uphill has long been known, but the existence of the "sufficient head" must be demonstrated, not assumed. There may be "no logical halting-place between an uplift of ten or twenty feet to surmount a *roche moutonnée* and an equally gradual elevation to the height of Moel Tryfaen," yet there is a common-sense limitation even to a destructive *sorites*. The argument, in fact, is more specious than valid, until we are told approximately how thick the northern ice must be to produce the requisite pressure, and whether such an accumulation would be possible. The advocates of land ice admit that, before it had covered more than a few leagues on its southward journey, its thickness was less than 2000 feet, and we are not entitled, as I have endeavoured to show, to pile up ice indefinitely on either our British highlands or the adjacent sea-bed. The same reason also forbids us largely to augment the thickness of the latter by the snowfall on its surface, as happens to Antarctic barrier ice. Even if the thickness of the ice-cap over the Dumfries and Kirkcudbright hills had been about 2500 feet, that, with every allowance for viscosity, would hardly give us a head sufficient to force a layer of ice from the level of the sea-bed to a height of nearly 1400 feet above it, and at a distance of more than 100 miles.

Neither can we obtain much support from the instance in Spitsbergen, described by Profs. Garwood and Gregory, where the Ivory Glacier, after crossing the bed of a valley, had transported marine shells and drift from the floor (little above sea-level) to a height of about 400 feet on the opposite slope. Here the valley was narrow, and the glacier had descended from an inland ice-reservoir, much of which was at least 2800 feet above the sea, and rose occasionally more than a thousand feet higher.[2]

But other difficulties are far more grave. The thickness of the chalky Boulder Clay alone, as has been stated, not unfrequently exceeds 100 feet, and, though often much less, may have been reduced by denudation. This is an enormous amount to have been transported and distributed by floating ice. The materials, also, are not much more easily accounted for by this than by the other hypothesis. A continuous supply of well-worn chalk pebbles might indeed be kept up from a gradually rising or sinking beach, but it is difficult to see how, until the land had subsided for at least 200 feet, the chalky Boulder Clay could be deposited in some of the East Anglian valleys or on the Leicestershire hills. That depression, however, would seriously diminish the area of exposed chalk in Lincolnshire and Yorkshire, and the double of it would almost drown that rock. Again, the East Anglian Boulder Clay, as we have said, frequently abounds in fragments and finer detritus from the Kimeridge and Oxford Clays. But a large part of their outcrop would disappear before the former submergence was completed. Yet the materials of the Boulder Clay, though changing as it is traced across the country, more especially from east to west, seem to vary little in a vertical direction. The instances, also, of the transportation of boulders and smaller stones to higher levels, sometimes large in amount, as in the transference of "brockram" from outcrops near the bed of the Eden valley to the level of Stainmoor Gap, seem to be too numerous to be readily explained by the uplifting action of shore-ice in a subsiding area. Such a process is possible, but we should anticipate it would be rather exceptional.

Submergence also readily accounts for the above-named sands and gravels, but not quite so easily for their occurrence at such very different levels. On the eastern side of England gravelly sands may be found beneath the chalky Boulder Clay well below sea-level to three or four hundred feet above it. Again, since, on the submergence hypothesis, the Lower Boulder Clay about the estuaries of the Dee and the Mersey must represent a deposit from piedmont ice in a shallow sea, the mid-glacial sand (sometimes not very clearly marked in this part) ought not to be more than forty or fifty feet above the present Ordnance datum. But at Manchester it reaches more than 200 feet, while near Heywood it is at least 425 feet. In other

[1] See for instance the courses of the Medway and the Beult over the Weald clay (C. Le Neve Foster and W. Topley, Quart. Journ. Geol. Soc., xxi. (1865), p. 443).

[2] F. W. Harmer, Quart. Journ. Geol Soc., lxiii. (1907), p. 470.

[3] Quart. Journ. Geol Soc., xxxiv. (1878), p. 556.

[4] See p. 23, and for the currents now dominant consult Dr. H. Bassett in Prof. Herdman's Report on the Lancashire Sea Fisheries, Trans. Biol. Soc. Liverpool, xxiv. (1910), p. 123.

[5] See "Ice Work," p. 221, and *Geol. Mag.*, 1900, p. 289.

[6] If, as seems probable, the temperature was changing rather rapidly the old fauna would be pauperised and the new one make its way but slowly into the British fjords.

[7] Critics of the submergence hypothesis seem to find a difficulty in admitting downward and upward movements, amounting sometimes to nearly 1,400 feet during Pleistocene Ages; but in the northern part of America the upheaval, at any rate, has amounted to about 1,000 feet, while on the western coast, beneath the lofty summit of Mount St. Elias, marine shells of existing species have been obtained some 5,000 feet above sea level. It is also admitted that in several places the pre-glacial surface of the land was much above its present level On the Red River, whatever be the explanation, foraminifers, radiolarians, and sponge spicules have been found at 700 feet above sea-level, and near Victoria, on the Saskatchewan, even up to about 1,900 feet.

[1] P. F. Kendall in Wright's "Man and the Glacial Period." p. 171.

[2] Quart. Journ. Geol. Soc., liv. (1898), p. 205. Earlier observations of some upthrust of materials by a glacier are noted on p. 219.

words, the sands and gravels, presumably (often certainly) mid-glacial, mantle, like the Upper Boulder Clay, over great irregularities of the surface, and are sometimes found, as already stated, up to more than 1200 feet. Either of these deposits may have followed the sea-line upwards or downwards, but that explanation would almost compel us to suppose that the sand was deposited during the submergence and the upper clay during the emergence, so that, with the former material, the higher in position is the newer in time, and with the latter the reverse. We must not, however, forget that in the island of Rügen we find more than one example of a stratified gravelly sand between two beds of Boulder Clay (containing Scandinavian erratics) which present some resemblance to the Boulder Clays of eastern England, while certain glacial deposits at Warnemünde, on the Baltic coast, sometimes remind us of the Contorted Drift of Norfolk.

Towards the close of the Glacial Epoch, the deposition of the Boulder Clay ceased[1] and its denudation began. On the low plateaux of the Eastern Counties it is often succeeded by coarse gravels, largely composed of flint, more or less water-worn. These occasionally include small intercalations of Boulder Clay, have evidently been derived from it, and indicate movement by fairly strong currents. Similar gravels are found overlying the Boulder Clay in other parts of England, sometimes at greater heights above sea-level. Occasionally the two are intimately related. For instance, a pit on the broad, almost level, top of the Gogmagog Hills, about 200 feet above sea-level and four miles south of Cambridge, shows a current-bedded sand and gravel, overlain by a Boulder Clay, obviously rearranged, while other pits in the immediate neighbourhood expose varieties and mixtures of one or the other material. But, as true Boulder Clay occurs in the valley below, these gravels must have been deposited, and that by rather strong currents, on a hill-top—a thing which seems impossible under anything like the existing conditions; and, even if the lowland were buried beneath ice full 200 feet in thickness, which made the hill-top into the bed of a lake, it is difficult to understand how the waters of that could be in rapid motion. Rearranged Boulder Clays also occur on the slopes of valleys[2] which may be explained, with perhaps some of the curious sections near Sudbury, by the slipping of materials from a higher position. But at Old Oswestry gravels with indications of ice action are found at the foot of the hills almost 700 feet below those of Gloppa.

Often the plateau gravels are followed at a lower level by terrace gravels,[3] which descend towards the existing rivers, and suggest that valleys have been sometimes deepened, sometimes only re-excavated. The latter gravels are obviously deposited by rivers larger and stronger than those which now wind their way seawards, but it is difficult to explain the former gravels by any fluviatile action, whether the water from a melting ice-sheet ran over the land or into a lake, held up by some temporary barrier. But the sorting action of currents in a slowly shallowing sea would be quite competent to account for them, so they afford an indirect support to the hypothesis of submergence. It is, however, generally admitted that there have been oscillations both of level and of climate since any Boulder Clay was deposited in the districts south of the Humber and the Ribble. The passing of the Great Ice Age was not sudden, and glaciers may have lingered in our mountain regions when Palæolithic man hunted the mammoth in the valley of the Thames or frequented the caves of Devon and Mendip. But of these times of transition, before written history became possible, and of sundry interesting topics connected with the Ice Age itself —of its cause, date, and duration, whether it was persistent or interrupted by warmer episodes, and, if so, by what number, of how often it had already recurred in the history of the earth—I must, for obvious reasons, refrain from speaking, and content myself with having endeavoured to place before you the facts of which, in my opinion, we must take account in reconstructing the physical geography of Western Europe, and especially of our own country, during the Age of Ice.

[1] Probably deposits of a distinctly glacial origin (such as those near Hessle in Yorkshire) continued in the northern districts, but on these we need not linger

[2] For instance, at Stanningfield in the valley of the Lark.

[3] These contain the instruments worked by palæolithic (Acheulean) man who, in this country at any rate, is later than the chalky boulder clay.

Not unnaturally you will expect a decision in favour of one or the other litigant after this long summing up. But I can only say that, in regard to the British Isles, the difficulties in either hypothesis appear so great that, while I consider those in the "land-ice" hypothesis to be the more serious, I cannot as yet declare the other one to be satisfactorily established, and think we shall be wiser in working on in the hope of clearing up some of the perplexities. I may add that, for these purposes, regions like the northern coasts of Russia and Siberia appear to me more promising than those in closer proximity to the North or South Magnetic Poles. This may seem a "lame and impotent conclusion" to so long a disquisition, but there are stages in the development of a scientific idea when the best service we can do it is by attempting to separate facts from fancies, by demanding that difficulties should be frankly faced instead of being severely ignored, by insisting that the giving of a name cannot convert the imaginary into the real, and by remembering that if hypotheses yet on their trial are treated as axioms, the result will often bring disaster, like building a tower on a foundation of sand. To scrutinise, rather than to advocate any hypothesis, has been my aim throughout this address, and, if my efforts have been to some extent successful, I trust to be forgiven, though I may have trespassed on your patience and disappointed a legitimate expectation.

SECTION A.

MATHEMATICAL AND PHYSICAL SCIENCE.

OPENING ADDRESS BY PROF. E. W. HOBSON, Sc.D., F.R.S., PRESIDENT OF THE SECTION.

SINCE the last meeting of our Association one of the most illustrious of the British workers in science during the nineteenth century has been removed from us by the death of Sir William Huggins. In the middle of the last century Sir William Huggins commenced that pioneer work of examination of the spectra of the stars which has ensured for him enduring fame in connection with the foundation of the science of Astrophysics. The exigencies of his work of analysis of the stellar spectra led him to undertake a minute examination of the spectra of the elements with a view to the determination of as many lines as possible. To the spectroscope he later added the photographic film as an instrument of research in his studies of the heavenly bodies. In 1864 Sir William Huggins made the important observation that many of the nebulæ have spectra which consist of bright lines, and two years later he observed, in the case of a new star, both bright and dark lines in the same spectrum. In 1868 his penetrating and alert mind made him the first to perceive that the Doppler principle could be applied to the determination of the velocities of stars in the line of sight, and he at once set about the application of the method. His life-work, in a domain of absorbing interest, was rewarded by a rich harvest of discovery, obtained as the result of most patient and minute investigations. The "Atlas of Representative Stellar Spectra," published in the names of himself and Lady Huggins, remains as a monumental record of their joint labours.

The names of the great departments of science, Mathematics, Physics, Astronomy, Meteorology, which are associated with Section A, are a sufficient indication of the vast range of investigation which comes under the purview of our Section. An opinion has been strongly expressed in some quarters that the time has come for the erection of a separate Section for Astronomy and Meteorology, in order that fuller opportunities may be afforded than hitherto for the discussion of matters of special interest to those devoted to these departments of Science. I do not share this view. I believe that, whilst the customary division into sub-sections gives reasonable facilities for the treatment of questions interesting solely to specialists in the various branches with which our Section is concerned, a policy of disruption would be injurious to the wider interests of science. The close association of the older Astronomy with Mathematics, and of the newer Astronomy with Physics, form strong presumptions against the change that has been suggested. Meteorology, so far as it goes beyond the purely empirical region, is, and must always remain, a branch of Physics. No doubt the more technical problems which arise in connection with these subjects, though of great importance to specialists, are often of little or no interest to workers in cognate departments. It appears to me, however, that it is unwise, in view of the general objects of the British Association, to give too much prominence in the meetings to the more technical aspects of the various departments of science. Ample opportunities for the full discussion of all the detailed problems, the solution of which forms a great and necessary part of the work of those who are advancing science in its various branches, are afforded by the special Societies which make those branches their exclusive concern. The British Association will, in my view, be performing its functions most efficiently if it gives much prominence to those aspects of each branch of science which are of interest to a public at least in some degree larger than the circle of specialists concerned with the particular branch. To afford an opportunity to workers in any one department of obtaining some knowledge of what is going on in other departments, to stimulate by means of personal intercourse with workers on other lines the sense of solidarity of men of science, to do something to counteract that tendency to narrowness of view which is a danger arising from increasing specialisation, are functions the due performance of which may do much to further that supreme object, the advancement of science, for which the British Association exists.

I propose to address to you a few remarks, necessarily fragmentary and incomplete, upon the scope and tendencies of modern Mathematics. Not to transgress against the canon I have laid down, I shall endeavour to make my treatment of the subject as little technical as possible.

Probably no other department of knowledge plays a larger part outside its own narrower domain than Mathematics. Some of its more elementary conceptions and methods have become part of the common heritage of our civilisation, interwoven in the everyday life of the people. Perhaps the greatest labour-saving invention that the world has seen belongs to the formal side of Mathematics; I allude to our system of numerical notation. This system, which, when scrutinised, affords the simplest illustration of the importance of Mathematical form, has become so much an indispensable part of our mental furniture that some effort is required to realise that an apparently so obvious idea embodies a great invention, one to which the Greeks, with their unsurpassed capacity for abstract thinking, never attained. An attempt to do a multiplication sum in Roman numerals is perhaps the readiest road to an appreciation of the advantages of this great invention. In a large group of sciences, the formal element, the common language, so to speak, is supplied by Mathematics; the range of the application of mathematical methods and symbolism is ever increasing. Without taking too literally the celebrated dictum of the great philosopher Kant, that the amount of real science to be found in any special subject is the amount of Mathematics contained therein, it must be admitted that each branch of science which is concerned with natural phenomena, when it has reached a certain stage of development, becomes accessible to, and has need of, mathematical methods and language; this stage has, for example, been reached in our time by parts of the science of Chemistry. Even Biology and Economics have begun to require mathematical methods, at least on their statistical side. As a science emerges from the stages in which it consists solely of more or less systematised descriptions of the phenomena with which it is concerned in their more superficial aspect; when the intensive magnitudes discerned in the phenomena become representable as extensive magnitudes, then is the beginning of the application of mathematical modes of thought; at a still later stage, when the phenomena become accessible to dynamical treatment, Mathematics is applicable to the subject to a still greater extent.

Mathematics shares with the closely allied subject of Astronomy the honour of being the oldest of the sciences. When we consider that it embodies, in an abstract form, some of the more obvious, and yet fundamental, aspects of our experience of the external world, this is not altogether surprising. The comparatively high degree of development which, as recent historical discoveries have disclosed, it had attained amongst the Babylonians more than five thousand years B.C., may well astonish us. These times must have been preceded by still earlier ages, in which the mental evolution of man led him to the use of the tally, and of simple modes of measurement, long before the notions of number and of magnitude appeared in an explicit form.

I have said that Mathematics is the oldest of the sciences; a glance at its more recent history will show that it has the energy of perpetual youth. The output of contributions to the advance of the science during the last century and more has been so enormous that it is difficult to say whether pride in the greatness of achievement in his subject, or despair at his inability to cope with the multiplicity of its detailed developments, should be the dominant feeling of the mathematician. Few people outside the small circle of mathematical specialists have any idea of the vast growth of mathematical literature. The Royal Society Catalogue contains a list of nearly thirty-nine thousand papers on subjects of Pure Mathematics alone, which have appeared in seven hundred serials during the nineteenth century. This represents only a portion of the total output, the very large number of treatises, dissertations, and monographs published during the century being omitted. During the first decade of the twentieth century this activity has proceeded at an accelerated rate. Mathematical contributions to Mechanics, Physics, and Astronomy would greatly swell the total. A notion of the range of the literature relating, not only to Pure Mathematics, but also to all branches of science to which mathematical methods have been applied, will be best obtained by an examination of that monumental work, the "Encyclopädie der mathematischen Wissenschaften"—when it is completed.

The concepts of the pure mathematician, no less than those of the physicist, had their origin in physical experience analysed and clarified by the reflective activities of the human mind; but the two sets of concepts stand on different planes in regard to the degree of abstraction which is necessary in their formation. Those of the mathematician are more remote from actual unanalysed precepts than are those of the physicist, having undergone in their formation a more complete idealisation and removal of elements inessential in regard to the purposes for which they are constructed. This difference in the planes of thought frequently gives rise to a certain misunderstanding between the mathematician and the physicist, due in the case of either to an inadequate appreciation of the point of view of the other. On the one hand it is frequently and truly said of particular mathematicians that they are lacking in the physical instinct, and on the other hand a certain lack of sympathy is frequently manifested on the part of physicists for the aims and ideals of the mathematician. The habits of mind and the ideals of the mathematician and of the physicist cannot be of an identical character. The concepts of the mathematician necessarily lack, in their pure form, just that element of concreteness which is an essential condition of the success of the physicist, but which to the mathematician would often only obscure those aspects of things which it is his province to study. The abstract mathematical standard of exactitude is one of which the physicist can make no direct use. The calculations in Mathematics are directed towards ideal precision; those in Physics consist of approximations within assigned limits of error. The physicist can, for example, make no direct use of such an object as an irrational number; in any given case a properly chosen rational number approximating to the irrational one is sufficient for his purpose. Such a notion as continuity, as it occurs in Mathematics, is, in its purity, unknown to the physicist, who can make use only of sensible continuity. The physical counterpart of mathematical discontinuity is very rapid change through a thin layer of transition, or during a very short time. Much of the skill of the true mathematical physicist and of the mathematical astronomer consists in the power of adapting methods and results carried out on an exact mathematical basis to obtain approximations sufficient for the purposes of physical measurement. It might perhaps be thought that a scheme of Mathematics on a frankly approximative basis would be sufficient for all the practical purposes of application in Physics, Engineering Science, and Astronomy, and no doubt it would be possible to develop, to some extent at least, a species of Mathematics on these lines. Such a system would, however, involve an intolerable awkwardness and prolixity in the statement of results, especially in view of the fact that the degrees of approximation necessary for various purposes are very different, and thus that unassigned grades of approximation would have to be provided for. Moreover, the mathematician working on these lines would be cut off from his chief sources of inspiration, the ideals of exactitude and logical rigour, as well as from one of his most indispensable guides to discovery, symmetry, and permanence of mathematical form. The history of the actual movements of mathematical thought through the centuries shows that these ideals are the very life-blood of the science, and warrants the conclusion that a constant striving towards their attainment is an absolutely essential condition of vigorous growth. These ideals have their roots in irresistible impulses and deep-seated needs of the human mind, manifested in its efforts to introduce intelligibility into certain great domains of the world of thought.

There exists a widespread impression among physicists, engineers, and other men of science that the effect of recent developments of Pure Mathematics, by making it more abstract than formerly, has been to remove it further from the order of ideas of those who are primarily concerned with the physical world. The prejudice that Pure Mathematics has its sole *raison d'être* in its function of providing useful tools for application in the physical sciences, a prejudice which did much to retard the due development of Pure Mathematics in this country during the nineteenth century, is by no means extinct. It is not infrequently said that the present devotion of many mathematicians to the interminable discussion of purely abstract questions relating to modern developments of the notions of number and function, and to theories of algebraic form, serves only the purpose of deflecting them from their proper work into paths which lead nowhere. It is considered that mathematicians are apt to occupy themselves too exclusively with ideas too remote from the physical order in which Mathematics had its origin, and in which it should still find its proper applications. A direct answer to the question *cui bono?* when it is raised in respect of a department of study such as Pure Mathematics, seldom carries conviction, in default of a standard of values common to those who ask and to those who answer the question. To appreciate the importance of a sphere of mental activity different from our own always requires some effort of the sympathetic imagination, some recognition of the fact that the absolute value of interests and ideals of a particular class may be much greater than the value which our own mentality inclines us to attach to them. If a defence is needed of the expenditure of time and energy on the abstract problems of Pure Mathematics, that defence must be of a cumulative character. The fact that abstract mathematical thinking is one of the normal forms of activity of the human mind, a fact which the general history of thought fully establishes, will appeal to some minds as a ground of decisive weight. A great department of thought must have its own inner life, however transcendent may be the importance of its relations to the outside. No department of science, least of all one requiring so high a degree of mental concentration as Mathematics, can be developed entirely, or even mainly, with a view to applications outside its own range. The increased complexity and specialisation of all branches of knowledge makes it true in the present, however it may have been in former times, that important advances in such a department as Mathematics can be expected only from men who are interested in the subject for its own sake, and who, whilst keeping an open mind for suggestions from outside, allow their thought to range freely in those lines of advance which are indicated by the present state of their subject, untrammelled by any preoccupation as to applications to other departments of science. Even with a view to applications, if Mathematics is to be adequately equipped for the purpose of coping with the intricate problems which will be presented to it in the future by Physics, Chemistry, and other branches of physical science, many of these problems probably of a character which we cannot at present forecast, it is essential that Mathematics should be allowed to develop itself freely on its own lines. Even if much of our present mathematical theorising turns out to be useless for external purposes, it is wiser, for a well-known reason, to allow the wheat and the tares to grow together. It would be easy to establish in detail that many of the applications which have been actually made of Mathematics were wholly unforeseen by those who first developed the methods and ideas on which they rest. Recently, the more refined mathematical methods which have been applied to gravitational Astronomy by Delaunay, G. W. Hill, Poincaré, E. W. Brown, and others, have thrown much light on questions relating to the solar system, and have much increased the accuracy of our knowledge of the motions of the moon and the planets. Who knows what weapons forged by the theories of functions, of differential equations, or of groups, may be required when the time comes for such an empirical law as Mendeléeff's periodic law of the elements to receive its dynamical explanation by means of an analysis of the detailed possibilities of relatively stable types of motion, the general schematic character of which will have been indicated by the physicist? It is undoubtedly true that the cleft between Pure Mathematics and Physical Science is at the present time wider than formerly. That is, however, a result of the natural development, on their own lines, of both subjects. In the classical period of the eighteenth century, the time of Lagrange and Laplace, the nature of the physical investigations, consisting largely of the detailed working out of problems of gravitational Astronomy in accordance with Newton's law, was such that the passage was easy from the concrete problems to the corresponding abstract mathematical ones. Later on, mathematical physicists were much occupied with problems which lent themselves readily to treatment by means of continuous analysis. In our own time the effect of recent developments of Physics has been to present problems of molecular and sub-molecular Mechanics to which continuous analysis is not at least directly applicable, and can only be made applicable by a process of averaging the effects of great swarms of discrete entities. The speculative and incomplete character of our conceptions of the structure of the objects of investigation has made the applications of Dynamics to their detailed elucidation tentative and partial. The generalised dynamical scheme developed by Lagrange and Hamilton, with its power of dealing with systems, the detailed structure of which is partially unknown, has, however, proved a powerful weapon of attack, and affords a striking instance of the deep-rooted significance of mathematical form. The wonderful and perhaps unprecedentedly rapid discoveries in Physics which have been made in the last two decades have given rise to many questions which are as yet hardly sufficiently definite in form to be ripe for mathematical treatment, a necessary condition of which treatment consists in a certain kind of precision in the data of the problems to be solved.

The difficulty of obtaining an adequate notion of the general scope and aims of Mathematics, or even of special branches of it, is perhaps greater than in the case of any other science. Many persons, even such as have made a serious and prolonged study of the subject, feel the difficulty of seeing the wood for trees. The severe demands made upon students by the labour of acquiring a difficult technique largely accounts for this; but teachers might do much to facilitate the attainment of a wider outlook by directing the attention of their students to the more general and less technical aspects of the various parts of the subject, and especially by the introduction into the courses of instruction of more of the historical element than has hitherto been usual.

All attempts to characterise the domain of Mathematics by means of a formal definition which shall not only be complete, but which shall also rigidly mark off that domain from the adjacent provinces of Formal Logic on the one side and of Physical Science on the other side, are almost certain to meet with but doubtful success: such success as they may attain will probably be only transient, in view of the power which the science has always shown of constantly extending its borders in unforeseen directions. Such definitions, many of which have been advanced, are apt to err by excess or defect, and often contain distinct traces of the personal predilections of those who formulate them. There was a time when it would have been a tolerably sufficient description of Pure Mathematics to say that its subject-matter consisted of magnitude and geometrical form. Such a description of it would be wholly inadequate at the present day. Some of the most important branches of modern Mathematics, such as the theory of groups, and Universal Algebra, are concerned, in their abstract forms, neither with magnitude nor with number, nor with geometrical form. That great modern development, Projective Geometry, has been so formulated as to be independent of all metric considerations. Indeed, the tendency of mathematicians under the influence of the movement known as the Arithmetisation of Analysis, a movement which has become a dominant one in the last few decades, is to banish altogether the notion of measurable quantity as a conception necessary to Pure Mathematics, Number, in the extended meaning it has attained, taking its place. Measurement is regarded as one of the applications, but as no part of the basis, of mathematical analysis. Perhaps the least inadequate description of the general scope of modern Pure Mathematics—I will not call it a definition—would be to say that it deals with *form*, in a very general sense of the term; this would include algebraic form, geometrical form, functional relationship, the relations of order in any ordered set of entities such as numbers, and the analysis of the peculiarities of form of groups of operations. A strong tendency is manifested in many of the recent definitions to break down the line of demarcation which was formerly supposed to separate Mathematics from formal logic; the rise and development of symbolic logic has no doubt emphasised this tendency. Thus Mathematics has been described by the eminent American mathematician and logician B. Pierce as "the Science which draws necessary conclusions," a pretty complete identification of Mathematics with logical procedure in general. A definition which appears to identify all Mathematics with the Mengenlehre, or Theory of Aggregates, has been given by E. Papperitz: "The subject-matter of Pure Mathematics consists of the relations that can be established between any objects of thought when we regard those objects as contained in an ordered manifold; the law of order of this manifold must be subject to our choice." The form of definition which illustrates most strikingly the tendencies of the modern school of logistic is one given by Mr. Bertrand Russell. I reproduce it here, in order to show how wide is the chasm between the modes of expression of adherents of this school and those of mathematicians under the influence of the ordinary traditions of the science. Mr. Russell writes:[1] "Pure Mathematics is the class of all propositions of the form 'p implies q,' where p and q are propositions containing one or more variables, the same in the two propositions, and neither p nor q contains any constants except logical constants. And logical constants are all notions definable in terms of the following: Implication, the relation of a term to a class of which it is a member, the notion of *such that*, the notion of relation, and such further notions as may be involved in the general notion of propositions of the above form. In addition to these, Mathematics *uses* a notion which is not a constituent of the propositions which it considers—namely, the notion of truth."

The belief is very general amongst instructed persons that the truths of Mathematics have absolute certainty, or at least that there appertains to them the highest degree of certainty of which the human mind is capable. It is thought that a valid mathematical theorem is necessarily of such a character as to compel belief in any mind capable of following the steps of the demonstration. Any considerations tending to weaken this belief would be disconcerting, and would cause some degree of astonishment. At the risk of this, I must here mention two facts which are of considerable importance as regards an estimation of the precise character of mathematical knowledge. In the first place, it is a fact that frequently, and at various times, differences of opinion have existed among mathematicians, giving rise to controversies as to the validity of whole lines of reasoning, and affecting the results of such reasoning; a considerable amount of difference of opinion of this character exists among mathematicians at the present time. In the second place, the accepted standard of rigour, that is, the standard of what is deemed necessary to constitute a valid demonstration, has undergone change in the course of time. Much of the reasoning which was formerly regarded as satisfactory and irrefutable is now regarded as insufficient to establish the results which it was employed to demonstrate. It has even been shown that results which were once supposed to have been fully established by demonstrations are, in point of fact, affected with error. I propose here to explain in general terms how these phenomena are possible.

In every subject of study, if one probes deep enough, there are found to be points in which that subject comes in contact with general philosophy, and where differences of philosophical view will have a greater or less influence on the attitude of the mind towards the principles of the particular subject. This is not surprising when we reflect that there is but one universe of thought, that no department of knowledge can be absolutely isolated, and that metaphysical and psychological implications are a necessary element in all the activities of the mind. A particular department, such as Mathematics, is compelled to set up a more or less artificial frontier, which marks it off from general philosophy. This frontier consists of a set of regulative ideas in the form of indefinables and axioms, partly ontological assumptions, and partly postulations of a logical character. To go behind these, to attempt to analyse their nature and origin, and to justify their validity, is to go outside the special department and to touch on the domains of the metaphysician and the psychologist. Whether they are regarded as possessing apodictic certainty or as purely hypothetical in character, these ideas represent the data or premises of the science, and the whole of its edifice is dependent upon them. They serve as the foundation on which all is built, as well as the frontier on the side of philosophy and psychology. A set of data ideally perfect in respect of precision and permanence is unattainable—or at least has not yet been attained; and the adjustment of frontiers is one of the most frequent causes of strife. As a matter of fact, variations of opinion have at various times arisen within the ranks of the mathematicians as to the nature, scope, and proper formulation of the principles which form the foundations of the science, and the views of mathematicians in this regard have always necessarily been largely affected by the conscious or unconscious attitude of particular minds towards questions of general philosophy. It is in this region, I think, that the source is to be found of those remarkable differences of opinion amongst mathematicians which have come into prominence at various times, and have given rise to much controversy as to fundamentals. Since the time of Newton and Leibnitz there has been almost unceasing discussion as to the proper foundations for the so-called infinitesimal calculus. More recently, questions relating to the foundations of geometry and rational mechanics have much occupied the attention of mathematicians. The very great change which has taken place during the last half-century in the dominant view of the foundations of mathematical analysis—a change which has exercised a great influence extending through the whole detailed treatment of that subject—although critical in its origin, has been constructive in its results. The Mengenlehre, or theory of aggregates, had its origin in the critical study of the foundations of analysis, but has already become a great constructive scheme, is indispensable as a method in the investigations of analysis, provides the language requisite for the statement in precise form of analytical theorems of a general character, and, moreover, has already found important applications in geometry. In connection with the Mengenlehre, there has arisen a controversy amongst mathematicians which is at the present time far from having reached a decisive issue. The exact point at issue is one which may be described as a matter of mathematical ontology; it turns upon the question of

[1] "Principles of Mathematics," p. 1.

what constitutes a valid definition of a mathematical object. The school known as mathematical "idealists" admit, as valid objects of mathematical discussion, entities which the rival "empiricist" school regard as non-existent for mathematical thought, because insufficiently defined. It is clear that the idealist may build whole superstructures on a foundation which the empiricist regards as made of sand, and this is what has actually happened in some of the recent developments of what has come to be known as Cantorism. The difference of view of these rival schools, depending as it does on deep-seated differences of philosophical outlook, is thought by some to be essentially irreconcilable. This controversy was due to the fact that certain processes of reasoning, of very considerable plausibility, which had been employed by G. Cantor, the founder of the Mengenlehre, had led to results which contained flat contradictions. The efforts made to remove these contradictions, and to trace their source, led to the discussion, disclosing much difference of opinion, of the proper definitions and principles on which the subject should be based.

The proposition $7+5=12$, taken as typical of the propositions expressing the results of the elementary operations of arithmetic, has since the time of Kant given rise to very voluminous discussion amongst philosophers in relation to the precise meaning and implication of the operation and the terms. It will, however, be maintained, probably by the majority of mankind, that the theorem retains its validity as stating a practically certain and useful fact, whatever view philosophers may choose to take of its precise nature—as, for example, whether it represents, in the language of Kant, a synthetic or an analytic judgment. It may, I think, be admitted that there is much cogency in this view; and, were Mathematics concerned with the elementary operations of arithmetic alone, it could fairly be held that the mathematician, like the practical man of the world, might without much risk shut his eyes and ears to the discussions of the philosophers on such points. The exactitude of such a proposition, in a sufficiently definite sense for practical purposes, is empirically verifiable by sensuous intuition, whatever meaning the metaphysician may attach to it. But Mathematics cannot be built up from the operations of elementary arithmetic without the introduction of further conceptual elements. Except in certain very simple cases, no process of measurement, such as the determination of an area or a volume, can be carried out with exactitude by a finite number of applications of the operations of arithmetic. The result to be obtained appears in the form of a limit, corresponding to an interminable sequence of arithmetical operations. The notion of "limit," in the definite form given to it by Cauchy and his followers, together with the closely related theory of the arithmetic continuum, and the notions of continuity and functionality, lie at the very heart of modern analysis. Essentially bound up with this central doctrine of limits is the concept of a non-finite set of entities, a concept which is not directly derivable from sensuous intuition, but which is, nevertheless, a necessary postulation in mathematical analysis. The conception of the infinite, in some form, is thus indispensable in Mathematics; and this conception requires precise characterisation by a scheme of exact definitions, prior to all the processes of deduction required in obtaining the detailed results of analysis. The formulation of this precise scheme gives an opening to differences of philosophical opinion which has led to a variety of views as to the proper character of those definitions which involve the concept of the infinite. Here is the point of divergence of opinion among mathematicians to which I have alluded above. Under what conditions is a non-finite aggregate of entities a properly defined object of mathematical thought, of such a character that no contradictions will arise in the theories based upon it? That is the question to which varying answers have been offered by different mathematical thinkers. No one answer of a completely general character has as yet met with universal acceptance. Physical intuition offers no answer to such a question; it is one which abstract thought alone can settle. It cannot be altogether avoided, because, without the notion of the infinite, at least in connection with the central conception of the "limit," mathematical analysis as a coherent body of thought falls to the ground.

Both in geometry and in analysis our standard of what constitutes a rigorous demonstration has in the course of the nineteenth century undergone an almost revolutionary change. That oldest text-book of science in the world, "Euclid's Elements of Geometry," has been popularly held for centuries to be the very model of deductive logical demonstration. Criticism has, however, largely invalidated this view. It appears that, at a large number of points, assumptions not included in the preliminary axioms and postulates are made use of. The fact that these assumptions usually escape notice is due to their nature and origin. Derived as they are from our spatial intuition, their very self-evidence has allowed them to be ignored, although their truth is not more obvious empirically than that of other assumptions derived from the same source which are included in the axioms and postulates explicitly stated as part of the foundation of Euclid's treatment of the subject. The method of superimposition, employed by Euclid with obvious reluctance, but forming an essential part of his treatment of geometry, is, when regarded from his point of view, open to most serious objections as regards its logical coherence. In analysis, as in geometry, the older methods of treatment consisted of processes of deduction eked out by the more or less surreptitious introduction, at numerous points in the subject, of assumptions only justifiable by spatial intuition. The result of this deviation from the purely deductive method was more disastrous in the case of analysis than in geometry, because it led to much actual error in the theory. For example, it was held until comparatively recently that a continuous function necessarily possesses a differential coefficient, on the ground that a curve always has a tangent. This we now know to be quite erroneous, when any reasonable definition of continuity is employed. The first step in the discovery of this error was made when it occurred to Ampère that the existence of the differential coefficient could only be asserted as a theorem requiring proof, and he himself published an attempt at such proof. The erroneous character of the former belief on this matter was most strikingly exhibited when Weierstrass produced a function which is everywhere continuous, but which nowhere possesses a differential coefficient; such functions can now be constructed *ad libitum*. It is not too much to say that no one of the general theorems of analysis is true without the introduction of limitations and conditions which were entirely unknown to the discoverers of those theorems. It has been the task of mathematicians under the lead of such men as Cauchy, Riemann, Weierstrass, and G. Cantor, to carry out the work of reconstruction of mathematical analysis, to render explicit all the limitations of the truth of the general theorems, and to lay down the conditions of validity of the ordinary analytical operations. Physicists and others often maintain that this modern extreme precision amounts to an unnecessary and pedantic purism, because in all practical applications of Mathematics only such functions are of importance as exclude the remoter possibilities contemplated by theorists. Such objections leave the true mathematician unmoved; to him it is an intolerable defect that, in an order of ideas in which absolute exactitude is the guiding ideal, statements should be made and processes employed, both of which are subject to unexpressed qualifications, as conditions of their truth or validity. The pure mathematician has developed a specialised conscience, extremely sensitive as regards sins against logical precision. The physicist, with his conscience hardened in this respect by the rough-and-tumble work of investigating the physical world, is apt to regard the more tender organ of the mathematician with that feeling of impatience, not unmingled with contempt, which the man of the world manifests for what he considers to be over-scrupulosity and unpracticality.

It is true that we cannot conceive how such a science as Mathematics could have come into existence apart from physical experience. But it is also true that physical precepts, as given directly in unanalysed experience, are wholly unfitted to form the basis of an exact science. Moreover, physical intuition fails altogether to afford any trustworthy guidance in connection with the concept of the infinite, which, as we have seen, is in some form indispensable in the formation of a coherent system of mathematical analysis. The hasty and uncritical extension to the region of the infinite, of results which are true and often obvious in the region of the finite, has been a fruitful source of error in the past, and remains as a pitfall for the unwary student in the present. The notions derived from physical intuition must be transformed into a scheme of exact definitions and axioms before they are available for the mathematician, the necessary precision being contributed by the mind itself. A very remarkable fact in connection with this process of refinement of the rough data of experience is that it contains an element of arbitrariness, so that the result of the process is not necessarily unique. The most striking example of this want of uniqueness in the conceptual scheme so obtained is the case of geometry, in which it has been shown to be possible to set up various sets of axioms, each set self-consistent, but inconsistent with any other of the sets, and yet such that each set of axioms, at least under suitable limitations, leads to results consistent with our perception of actual space-relations. Allusion is here made, in particular, to the well-known geometries of Lobatchewsky and of Riemann, which differ from the geometry of Euclid in respect of the axiom of parallels, in place of which axioms inconsistent with that of Euclid and with one another are substituted. It is a matter of demonstration that any inconsistency which might be supposed to exist in the scheme known as hyperbolic geometry, or in that known as elliptic geometry, would necessarily entail the existence of a corresponding inconsistency in Euclid's set of axioms. The three geometries therefore, from the logical point of view, are completely on a par with one another. An interesting mathematical result is that all efforts to prove Euclid's axiom of parallels, *i.e.* to deduce it from his other axioms, are doomed to necessary failure; this is of importance in view of the many efforts that have been made to obtain the proof referred to. When the question is raised which of these geometries is the true one, the kind of answer that will be given depends a good deal on the view taken of the relation of conceptual schemes in general to actual experience. It is maintained by M. Poincaré, for example, that the question which is the true scheme has no meaning; that it is, in fact, entirely a matter of convention and convenience which of these geometries is actually employed in connection with spatial measurements. To decide between them by a crucial test is impossible, because our space perceptions are not sufficiently exact in the mathematical sense to enable us to decide between the various axioms of parallels. Whatever views are taken as to the difficult questions that arise in this connection, the contemplation and study of schemes of geometry wider than that of Euclid, and some of them including Euclid's geometry as a special case, is of great interest, not only from the purely mathematical point of view, but also in relation to the general theory of knowledge, in that, owing to the results of this study, some change is necessitated in the views which have been held by philosophers as to what is known as Kant's space-problem.

The school of thought which has most emphasised the purely logical aspect of Mathematics is that which is represented in this country by Mr. Bertrand Russell and Dr. Whitehead, and which has distinguished adherents both in Europe and in America. The ideal of this school is a presentation of the whole of Mathematics as a deductive scheme in which are employed a certain limited number of indefinables and unprovable axioms, by means of a procedure in which all possibility of the illicit intrusion of extraneous elements into the deduction is excluded by the employment of a symbolism in which each symbol expresses a certain logical relation. This school receives its inspiration from a peculiar form of philosophic realism which, in its revolt from idealism, produces in the adherents of the school a strong tendency to ignore altogether the psychological implications in the movements of mathematical thought. This is carried so far that in their writings no explicit recognition is made of any psychological factors in the selection of the indefinables and in the formulation of the axioms upon which the whole structure of Mathematics is to be based. The actually worked-out part of their scheme has as yet reached only the mere fringe of modern Mathematics as a great detailed body of doctrine; but to any objection to the method on the ground of the prolixity of the treatment which would be necessary to carry it out far enough to enable it to embrace the various branches of Mathematics in all the wealth of their present development, it would probably be replied that the main point of interest is to establish in principle the possibility only of subsuming Pure Mathematics under a scheme of logistic. It is quite impossible for me here to attempt to discuss, even in outline, the tenets of this school, or even to deal with the interesting question of the possibility of setting up a final system of definables and axioms which shall suffice for all present and future developments of Mathematics.

I am very far from wishing to minimise the high philosophic interest of the attempt made by the Peano-Russell school to exhibit Mathematics as a scheme of deductive logic. I have myself emphasised above the necessity and importance of fitting the results of mathematical research in their final form into a framework of deduction for the purpose of ensuring the complete precision and the verification of the various mathematical theories. At the same time, it must be recognised that the purely deductive method is wholly inadequate as an instrument of research. Whatever view may be held as regards the place of psychological implications in a completed body of mathematical doctrine, in research the psychological factor is of paramount importance. The slightest acquaintance with the history of Mathematics establishes the fact that discoveries have seldom, or never, been made by purely deductive processes. The results are thrown into a purely deductive form after, and often long after, their discovery. In many cases the purely deductive form, in the full sense, is quite modern. The possession of a body of indefinables, axioms, or postulates, and symbols denoting logical relation, would, taken by itself, be wholly insufficient for the development of a mathematical theory. With these alone the mathematician would be unable to move a step. In face of an unlimited number of possible combinations, a principle of selection of such as are of interest, a purposive element, and a perceptive faculty are essential for the development of anything new. In the process of discovery, the chains in a sequence of logical deduction do not at first arise in their final order in the mind of the mathematical discoverer. He divines the results before they are established; he has an intuitive grasp of the general line of a demonstration long before he has filled in the details. A developed theory, or even a demonstration of a single theorem, is no more identical with a mere complex of syllogisms than a melody is identical with the mere sum of the musical notes employed in its composition. In each case the whole is something more than merely the sum of its parts; it has a unity of its own, and that unity must be, in some measure at least, discerned by its creator before the parts fall completely into their places. Logic is, so to speak, the grammar of Mathematics; but a knowledge of the rules of grammar and the letters of the alphabet would not be sufficient equipment to enable a man to write a book. There is much room for individuality in the modes of mathematical discovery. Some great mathematicians have employed largely images derived from spatial intuition as a guide to their results; others appear wholly to have discarded such aids, and were led by a fine feeling for algebraic and other species of mathematical form. A certain tentative process is common, in which, by the aid of results known or obtained in special cases, generalisations are perceived and afterwards established, which take up into themselves all the special cases so employed. Most mathematicians leave some traces, in the final presentation of their work, of the scaffolding they have employed in building their edifices, some much more than others.

The difference between a mathematical theory in the making and as a finished product is, perhaps, most strikingly illustrated by the case of geometry, as presented in its most approved modern shape. It is not too much to say that geometry, reduced to a purely deductive form—as presented, for example, by Hilbert, or by some of the modern Italian school—has no necessary connection with space. The words "point," "line," "plane" are employed to denote any entities whatever which satisfy certain prescribed conditions of relationship. Various premises are postulated that would appear to be of a perfectly arbitrary nature, if we did not know how they had been suggested. In that division of the subject known as metric geometry, for example, axioms of congruency are assumed which, by their purely abstract character, avoid the very real difficulties that arise in this regard in reducing perceptual space-relations of measurements to a purely conceptual form. Such schemes, triumphs of constructive thought at its highest and most abstract level as they are, could never have been constructed apart from the space-perceptions that suggested them, although the concepts of spatial origin are transformed almost out of recognition. But what I want to direct attention to here is that, apart from the basis of this geometry, mathematicians would never have been able to find their way through the details of the deductions without having continual recourse to the guidance given them by spatial intuition. If one attempts to follow one of the demonstrations of a particular theorem in the work of writers of this school, one would find it quite impossible to retain the steps of the process long enough to master the whole, without the aid of the very spatial suggestions which have been abstracted. This is perhaps sufficiently warranted by the fact that writers of this school find it necessary to provide their readers with figures, in order to avoid complete bewilderment in following the demonstrations, although the processes, being purely logical deductions from premises of the nature I have described, deal only with entities which have no necessary similarity to anything indicated by the figures.

A most interesting account has been written by one of the greatest mathematicians of our time, M. Henri Poincaré, of the way in which he was led to some of his most important mathematical discoveries.[1] He describes the process of discovery as consisting of three stages: the first of these consists of a long effort of concentrated attention upon the problem in hand in all its bearings; during the second stage he is not consciously occupied with the subject at all, but at some quite unexpected moment the central idea which enables him to surmount the difficulties, the nature of which he had made clear to himself during the first stage, flashes suddenly into his consciousness. The third stage consists of the work of carrying out in detail and reducing to a connected form the results to which he is led by the light of his central idea; this stage, like the first, is one requiring conscious effort. This is, I think, clearly not a description of a purely deductive process; it is assuredly more interesting to the psychologist than to the logician. We have here the account of a complex of mental processes in which it is certain that the reduction to a scheme of precise logical deduction is the latest stage. After all, a mathematician is a human being, not a logic-engine. Who that has studied the works of such men as Euler, Lagrange, Cauchy, Riemann, Sophus Lie, and Weierstrass, can doubt that a great mathematician is a great artist? The faculties possessed by such men, varying greatly in kind and degree with the individual, are analogous to those requisite for constructive art. Not every great mathematician possesses in a specially high degree that critical faculty which finds its employment in the perfection of form, in conformity with the ideal of logical completeness; but every great mathematician possesses the rarer faculty of constructive imagination.

The actual evolution of mathematical theories proceeds by a process of induction strictly analogous to the method of induction employed in building up the physical sciences; observation, comparison, classification, trial, and generalisation are essential in both cases. Not only are special results, obtained independently of one another, frequently seen to be really included in some generalisation, but branches of the subject which have been developed quite independently of one another are sometimes found to have connections which enable them to be synthesised in one single body of doctrine. The essential nature of mathematical thought manifests itself in the discernment of fundamental identity in the mathematical aspects of what are superficially very different domains. A striking example of this species of immanent identity of mathematical form was exhibited by the discovery of that distinguished mathematician, our General Secretary, Major Macmahon, that all possible Latin squares are capable of enumeration by the consideration of certain differential operators. Here we have a case in which an enumeration, which appears to be not amenable to direct treatment, can actually be carried out in a simple manner when the underlying identity of the operation is recognised with that involved in certain operations due to differential operators, the calculus of which belongs superficially to a wholly different region of thought from that relating to Latin squares. The modern abstract theory of groups affords a very important illustration of this point; all sets of operations, whatever be their concrete character, which have the same group, are from the point of view of the abstract theory identical, and an analysis of the properties of the abstract group gives results which are applicable to all the actual sets of operations, however diverse their character, which are dominated by the one group. The characteristic feature of any special geometrical scheme is known when the group of transformations which leave unaltered certain relations of figures has been assigned. Two schemes in which the space elements may be quite different have this fundamental identity, provided they have the same group; every special theorem is then capable of interpretation as a property of figures either in the one or in the other geometry. The mathematical physicist is familiar with the fact that a single mathematical theory is often capable of interpretation in relation to a variety of physical phenomena. In some instances a mathematical formulation, as in some fashion representing observed facts, has survived the physical theory it was originally devised to represent. In the case of electromagnetic and optical theory, there appears to be reason for trusting the equations, even when the proper physical interpretation of some of the vectors appearing in them is a matter of uncertainty and gives rise to much difference of opinion; another instance of the fundamental nature of mathematical form.

One of the most general mathematical conceptions is that of functional relationship, or "functionality." Starting originally from simple cases such as a function represented by a power of a variable, this conception has, under the pressure of the needs of expanding mathematical theories, gradually attained the completeness of generality which it possesses at the present time. The opinion appears to be gaining ground that this very general conception of functionality, born on mathematical ground, is destined to supersede the narrower notion of causation, traditional in connection with the natural sciences. As an abstract formulation of the idea of determination in its most general sense, the notion of functionality includes and transcends the more special notion of causation as a one-sided determination of future phenomena by means of present conditions; it can be used to express the fact of the subsumption under a general law of past, present, and future alike, in a sequence of phenomena. From this point of view the remark of Huxley that Mathematics "knows nothing of causation" could only be taken to express the whole truth, if by the term "causation" is understood "efficient causation." The latter notion has, however, in recent times been to an increasing extent regarded as just as irrelevant in the natural sciences as it is in Mathematics; the idea of thorough-going determinancy, in accordance with formal law, being thought to be alone significant in either domain.

The observations I have made in the present address have, in the main, had reference to Mathematics as a living and growing science related to and permeating other great departments of knowledge. The small remaining space at my disposal I propose to devote to a few words about some matters connected with the teaching of the more elementary parts of Mathematics. Of late years a new spirit has come over the mathematical teaching in many of our institutions, due in no small measure to the reforming zeal of our General Treasurer, Prof. John Perry. The changes that have been made followed a recognition of the fact that the abstract mode of treatment of the subject that had been traditional was not only wholly unsuitable as a training for physicists and engineers, but was also to a large extent a failure in relation to general education, because it neglected to bring out clearly the bearing of the subject on the concrete side of things. With the general principle that a much less abstract mode of treatment than was

[1] See the "Revue du Mois," 1908.

formerly customary is desirable for a variety of reasons, I am in complete accord. It is a sound educational principle that instruction should begin with the concrete side, and should only gradually introduce the more general and abstract aspects of the subject; an abstract treatment on a purely logical basis being reserved only for that highest and latest stage which will be reached only by a small minority of students. At the same time I think there are some serious dangers connected with the movement towards making the teaching of Mathematics more practical than formerly, and I do not think that, in making the recent changes in the modes of teaching, these dangers have always been successfully avoided.

Geometry and mechanics are both subjects with two sides: on the one side, the observational, they are physical sciences; on the other side, the abstract and deductive, they are branches of Pure Mathematics. The older traditional treatment of these subjects has been of a mixed character, in which deduction and induction occurred side by side throughout, but far too much stress was laid upon the deductive side, especially in the earlier stages of instruction. It is the proportion of the two elements in the mixture that has been altered by the changed methods of instruction of the newer school of teachers. In the earliest teaching of the subjects they should, I believe, be treated wholly as observational studies. At a later stage a mixed treatment must be employed, observation and deduction going hand in hand, more stress being, however, laid on the observational side than was formerly customary. This mixed treatment leaves much opening for variety of method; its character must depend to a large extent on the age and general mental development of the pupils; it should allow free scope for the individual methods of various teachers as suggested to those teachers by experience. Attempts to fix too rigidly any particular order of treatment of these subjects are much to be deprecated, and, unfortunately, such attempts are now being made. To have escaped from the thraldom of Euclid will avail little if the study of geometry in all the schools is to fall under the domination of some other rigidly prescribed scheme.

There are at the present time some signs of reaction against the recent movement of reform in the teaching of geometry. It is found that the lack of a regular order in the sequence of propositions increases the difficulty of the examiner in appraising the performance of the candidates, and in standardising the results of examinations. That this is true may well be believed, and it was indeed foreseen by many of those who took part in bringing about the dethronement of Euclid as a text-book. From the point of view of the examiner it is without doubt an enormous simplification if all the students have learned the subject in the same order, and have studied the same text-book. but, admitting this fact, ought decisive weight to be allowed to it? I am decidedly of opinion that it ought not. I think the convenience of the examiner, and even precision in the results of examinations, ought unhesitatingly to be sacrificed when they are in conflict—as I believe they are in this case—with the vastly more important interests of education. Of the many evils which our examination system has inflicted upon us, the central one has consisted in forcing our school and university teaching into moulds determined not by the true interests of education, but by the mechanical exigencies of the examination syllabus. The examiner has thus exercised a potent influence in discouraging initiative and individuality of method on the part of the teacher; he has robbed the teacher of that freedom which is essential for any high degree of efficiency. An objection of a different character to the newer modes of teaching geometry has been frequently made of late. It is said that the students are induced to accept and reproduce, as proofs of theorems, arguments which are not really proofs, and thus that the logical training which should be imparted by a study of geometry is vitiated. If this objection really implies a demand for a purely deductive treatment of the subject, I think some of those who raise it hardly realise all that would be involved in the complete satisfaction of their requirement. I have already remarked that Euclid's treatment of the subject is not rigorous as regards logic. Owing to the recent exploration of the foundations of geometry we possess at the present time tolerably satisfactory methods of purely deductive treatment of the subject; in regard to mechanics, notwithstanding the valuable work of Mach, Herz, and others, this is not yet the case. But, in the schemes of purely deductive geometry, the systems of axioms and postulates are far from being of a very simple character; their real nature, and the necessity for many of them, can only be appreciated at a much later stage in mathematical education than the one of which I am speaking. A purely logical treatment is the highest stage in the training of the mathematician, and is wholly unsuitable—and, indeed, quite impossible—in those stages beyond which the great majority of students never pass. It can then, in the case of all students, except a few advanced ones in the universities, only be a question of degree how far the purely logical factor in the proofs of propositions shall be modified by the introduction of elements derived from observation or spatial intuition. If the freedom of teaching which I have advocated be allowed, it will be open to those teachers who find it advisable in the interests of their students to emphasise the logical side of their teaching to do so; and it is certainly of value in all cases to direct the attention of students to those points in a proof where the intuitional element enters. I draw, then, the conclusion that a mixed treatment of geometry, as of mechanics, must prevail in the future, as it has done in the past, but that the proportion of the observational or intuitional factor to the logical one must vary in accordance with the needs and intellectual attainments of the students, and that a large measure of freedom of judgment in this regard should be left to the teacher.

The great and increasing importance of a knowledge of the differential and integral calculus for students of engineering and other branches of physical science has led to the publication during the last few years of a considerable number of text-books on this subject intended for the use of such students. Some of these text-books are excellent, and their authors, by a skilful insistence on the principles of the subject, have done their utmost to guard against the very real dangers which attend attempts to adapt such a subject to the practical needs of engineers and others. It is quite true that a great mass of detail which has gradually come to form part—often much too large a part—of the material of the student of Mathematics, may with great advantage be ignored by those whose main study is to be engineering science or physics. Yet it cannot be too strongly insisted on that a firm grasp of the principles, as distinct from the mere processes of calculation, is essential if Mathematics is to be a tool really useful to the engineer and the physicist. There is a danger, which experience has shown to be only too real, that such students may learn to regard Mathematics as consisting merely of formulæ and of rules which provide the means of performing the numerical computations necessary for solving certain categories of problems which occur in the practical sciences. Apart from the deplorable effect, on the educational side, of degrading Mathematics to this level, the practical effect of reducing it to a number of rule-of-thumb processes can only be to make those who learn it in so unintelligent a manner incapable of applying mathematical methods to any practical problem in which the data differ even slightly from those in the model problems which they have studied. Only a firm grasp of the principles will give the necessary freedom in handling the methods of Mathematics required for the various practical problems in the solution of which they are essential.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A MERCHANT VENTURERS' research scholarship of the value of 50*l*., tenable for one year in the faculty of engineering of the University of Bristol, which is provided and maintained in the Merchant Venturers' Technical College, has been awarded to Mr. Harold Heaton Emsley.

The Child, a new monthly journal devoted to child welfare, will appear in the early autumn, under the general editorship of Dr. T. N. Kelynack. The journal will be suited to the requirements of all engaged in child study or working for the betterment of child life. The publishers will be Messrs. John Bale, Sons and Danielsson, Ltd., 83–91 Great Titchfield Street, Oxford Street, London, W.

THE governing body of the Battersea Polytechnic is arranging considerable developments for next session in the work of the Domestic Economy Department of the Battersea Polytechnic. An entirely new third-year course will be introduced. This course will carry forward greatly the application of science to housecraft. It will consist, in the main, of much more elaborate work both on the theoretical and practical sides in the subjects of physiology, hygiene, chemistry, physics, and biology. It is intended that special attention shall be given to the carrying forward on the scientific side of the processes which underlie the arts of cookery, laundrywork, and housewifery. It is intended, too, that students shall spend some of their time in practical research work upon the various biological and chemical processes in which so much of their work will be done.

THE report of the Hebdomadal Council of Oxford University, entitled "Principles and Methods of University Reform," has been published by the Clarendon Press. Lord Curzon of Kedleston, Chancellor of the University, contributes an introduction on behalf of the council. We hope later to deal with the important proposals contained in the report, but attention may here be directed to the question of compulsory Greek and the suggested entrance examination. The council proposes that Greek shall be no longer a compulsory subject, but that every candidate must, in order to pass Responsions, satisfy the masters of the schools in Latin and in elementary mathematics, and also either in (*a*) Greek or in (*b*) two other subjects, one, and only one, of which must be a modern language. The optional subjects include, besides modern languages, English history, elementary politics, elementary trigonometry, statics and dynamics, elementary physics and chemistry, and the general principles of geography and the geography of the British Isles and Empire. The proposal to make Greek an optional subject is, says Lord Curzon in his introduction, based "mainly on the fact that the non-Greek curriculum is now firmly established, not only in the secondary schools receiving grants from Government, but also, as an alternative course taken by many boys, in the older public schools, which supply a large proportion of the students of the University." The question of compulsory Greek has been purposely separated from that of an entrance examination. The scheme for an entrance examination framed by the council is as follows:—There will be, in substitution for Responsions, an entrance examination, conducted on behalf of the University by the Delegates for the Inspection and Examination of Schools. This examination will include three necessary subjects and optional subjects. In order to pass, a candidate must qualify in the three necessary subjects at one and the same time, and must also pass in two of the optional subjects, either when he passes in the necessary subjects or at some other time. The necessary subjects will be English, to be tested by an essay or a composition on materials supplied, *e.g.* précis or reproduction of a passage read aloud; Latin or Greek; elementary mathematics; two papers, (*a*) arithmetic and algebra, (*b*) geometry. The optional subjects will be practically the same as those suggested for Responsions. Referring to the entrance examination, Lord Curzon points out that, in adopting the view that school studies should be excluded from the curriculum of the University, and that all matriculated students should be required to have received a minimum standard of general education, the council believes the University will be acting in its best interests by helping to maintain a proper standard in the schools which prepare for it.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 22.—M. Emile Picard in the chair.—The president announced the death of M. Eugène Rouché.—Paul **Sabatier** and A. **Mailhe**: The catalytic preparation of the phenolic oxides and the diphenylenic oxides. The authors have applied the catalytic properties of thoria to the preparation of phenyl ether and its homologues. The thoria is maintained at a temperature of between 390° C. and 450° C., and the vapour of the phenol passed over it. The yield is good; but if the temperature is raised another reaction, characterised by the elimination of hydrogen, takes place, the oxide of diphenylene being formed. The reaction applies to the cresols and xylenols.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the second quarter of 1910. Observations were possible on fifty-four days, and the results are recorded in tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—M. **Schaumasse**: Observations of the Metcalf comet made at the Observatory of Nice with the bent equatorial of 40-cm. aperture. The comet appears as a nebulosity of the tenth magnitude, with a well-marked condensation.—Michel **Fekete**: A theorem of M. Landau.—C. **Maltézos**: The real image of Purkinje.—L. **Fondard** and F. **Gauthié**: The composition of carnations with flexible stems and rigid stems. Three American varieties of carnation with rigid stems, and one French variety with flexible stems, have been analysed, and the differences in the stiffness of the stems found to be accompanied with distinct differences in composition.—Ed. **Hesse**: *Trypanoplasma vaginalis*, a new species found as a parasite in the vagina of the leech.—E. **Roubaud**: A Bombex preying on the Glossina of Dahomey. This wasp is one of the very small number of species known to capture the mosquito.

CALCUTTA.

Asiatic Society of Bengal, August 3.—Manindra Nath **Banerjee**: A system of Indian scientific vocabulary. This paper attempts to give Sanskrit equivalents for a number of European scientific terms, mostly on the basis of phonetic resemblance. With the help of dictionaries and grammars, the Sanskrit words are made to yield the meanings warranted by their European originals.—Panchanan **Neogi** and Birendra Bhusan **Adhikary**: The preparation of phenyl-nitro-methane by the interaction of mercurous nitrite and benzyl chloride. The present work is in continuation of Rây and Neogi's work on the preparation of aliphatic nitro-compounds by the interaction of mercurous nitrite and alkyliodides. The authors have prepared phenyl nitrite and alkyliodides.—D. **Hooper**: Materia Medica Animalium Indica. A classified list of substances of the animal kingdom used in Indian medicine, with notes on their origin, history, uses, and chemical composition. The list is compiled from several works on Indian materia medica, with original observations of the author.

CONTENTS.

	PAGE
Colour-vision	263
A History of Biological Theories	263
Science in School	264
Classic Wall-painting. By **A. H. C.**	265
Our Book Shelf	265
Letters to the Editor:—	
Separating Power of a Telescope. **J. W. Scholes**; **T. Lewis**	266
Colour-vision.—**R. M. Deeley**	267
Lake Edward, Ruwenzori, and the Uganda-Congo Frontier. By **E. H. H.**	267
William James	268
Dr. Louis Olivier	269
Notes	269
Our Astronomical Column:—	
Astronomical Occurrences in September	272
The Paris Observatory	272
Observations of Comet 1910*a*	272
The Sun's Velocity through Space	272
Parallax of Fourth-type Stars	273
The Maximum of Mira in 1909	273
The Study of Double Stars for Amateurs	273
Metcalf's Comet, 1910*b*	273
The Royal Photographic Society's Exhibition	273
The British Association at Sheffield	274
Inaugural Address by the Rev. **Prof. T. G. Bonney**, Sc.D., LL.D., F.R.S., President of the Association	274
Section A.—Mathematical and Physical Science.—Opening Address by **Prof. E. W. Hobson**, Sc.D., F.R.S., President of the Section	284
University and Educational Intelligence	291
Societies and Academies	292

THURSDAY, SEPTEMBER 8, 1910.

ORE DEPOSITS.

(1) *The Ore Deposits of South Africa.* By J. P. Johnson. Part ii., The Witwatersrand and Pilgrims' Rest Goldfields and Similar Occurrences. Pp. vi + 51. (London: Crosby Lockwood and Son, 1909.) Price 5*s.* net.

(2) *The Geology of Ore Deposits.* By H. H. Thomas and D. A. MacAlister. Pp. xi + 416. (London: E. Arnold, 1909.) Price 7*s.* 6*d.* net.

(1) THE second part of Mr. Johnson's "Ore Deposits of South Africa," of which the first part was reviewed in NATURE, June 3, 1909, vol. lxxx., p. 395, deals with the goldfields of the Transvaal. The book is intended for the use of prospectors and students, and consists of brief descriptions of each mining field and of short discussions of the genesis of the ores. It is illustrated with sections of the mines, and outline maps of which the shading is not always clearly explained. The author gives an excellent summary of the arguments for the placer and impregnation theories of the origin of the Rand ores, and says that "judging them on their own evidence the writer would unhesitatingly class them as detrital ore deposits" (p. 17). He suspends judgment, however, from the consideration that the gold at Pilgrims' Rest is due to impregnation. The ores at Pilgrims' Rest are quartz stringers in dolomite and altered dolomite; and they are doubtless of the same origin as those in the dolomites of South Dakota, which are strikingly different in all essential characters from the banket of the Rand. Mr. Johnson's remark that the analogy between the ores of Pilgrims' Rest and of the Rand is the strongest argument in favour of the impregnation theory for the banket is not complimentary to the other arguments. The most useful parts of the book are the chapters on the less-known secondary goldfields of the Transvaal.

(2) Messrs. Thomas and MacAlister's "Geology of Ore Deposits" agrees with Mr. Johnson's book in the conciseness with which it summarises the structures of various mining fields. It is, however, world-wide in its range. It should prove of great service as a text-book to students of economic geology who desire a clear statement of current theories. As the authors, in 416 small pages, state the principles of ore formation and explain them by reference to occurrences in nearly every mining country, the work necessarily suffers by extreme compression. There are no references to authorities, and, owing to their absence, the reader is sometimes left in doubt whether evidence opposed to the authors' conclusions has been weighed and rejected or has escaped their diligent search. An omission that might have been avoided is an index of localities. The same mining field may be referred to in different chapters, and so many mining localities are mentioned that a geographical index would have added greatly to the usefulness of the book as a work of preliminary reference. Some statistics of ore yields would also have been an advantage as showing the relative importance of the different processes of mineral deposition; the authors mention some insignificant ore occurrences which are of no economic importance, and some of which have not been worked, and inferences drawn from them as to the origin of the larger ore masses may be invalid. Owing to the wide range of the book it is not surprising that it contains small mistakes, both geological and geographical, in reference to foreign mining fields.

The classification of ores adopted by the authorities is based solely on genetic grounds. They describe first the ores due to the segregation of metals in igneous rocks, a process to which the authors perhaps attach undue importance, judged by the economic value of the ores thus produced. In succeeding chapters they describe ores due to pneumatolysis, to the action of heated solutions resulting from igneous intrusions, to metasomatic replacement, to metamorphism, to precipitation, and to the deposition of detritus. A special chapter describes the changes in ore deposits apart from those included under metamorphism. The authors show remarkably wide acquaintance with the literature of ore deposits and a sound and cautious judgment. They accept the detrital origin of the gold in the Rand Banket, and reject the view that nuggets are formed by deposition from solution in the drifts wherein they are found. The accounts of the British and especially of the Cornish ores are the best in the book, many of the references to the foreign fields being too brief to do more than show the place assigned to the ores in the authors' classification.

One significant and interesting feature in this book is the complete abandonment in a British text-book of that morphological classification of ores which was for so long dominant in this country that it has been described as "*the* British classification."

J. W. G.

OBSERVATIONAL METEOROLOGY.

Meteorology, Practical and Applied. By Sir John Moore. Second revised and enlarged edition. Pp. xxvii + 492. (London: Rebman, Ltd., 1910.) Price 10*s.* 6*d.* net.

DURING the last fifteen years much progress has been made in the study of meteorology, as a comparison between the first and second editions of Sir John Moore's treatise amply demonstrates. Expansion in some directions necessitating curtailment in others has changed and improved the work. As an example of addition we may instance the account of the investigation of the upper atmosphere with the information acquired of the isothermal layer and the behaviour of air currents. This inquiry, practically limited to the interval between the appearance of the two editions, has reacted, in various ways, traces of which will be found in the book. It has given a strong impulse to the work of designing accurate self-recording instruments, necessitating a considerable increase in the chapters devoted to the methods of measurement and registration of climatic factors. Through the increased attention attracted to meteorology and the firmer scientific foundation thus acquired, there has arisen the necessity for a broader, more general view of the factors of operation, in which world-wide areas and cosmical influences are substituted for limited districts and local circumstances. This more philosophic view the author has not discussed with the fulness its importance deserves. Perhaps, it hardly comes within the scheme, but the omission indicates the position the book occupies among treatises on meteorology. It deals with the mechanical processes employed in observation and the discussion of the results obtained, rather than with the problems of general circulation affecting the atmosphere as a whole. It is an admirable treatise on the methods of observation, it demonstrates very satisfactorily what can be accomplished by instrumental means, and what are the objects and advantages to be gained by the systematic collection of details. The principles underlying this aspect of practical meteorology are well illustrated by the description of the official weather service at home, in the United States, and in Canada. This information is thoroughly modern, trustworthy, and interesting. One section is devoted to the consideration of climate as deduced from the records supplied by instrumental means and one to the influence of season and of weather on disease. Perhaps the last is a larger subject than can be discussed adequately in the space allotted to it, but it is a subject on which the writer is an authority, and constitutes an important branch of meteorological science.

ABSTRACT AND OTHER PHILOSOPHY.

(1) *Gustav Freytags Kultur- und Geschichtspsychologie: Ein Beitrag zur Geschichte der Geschichtsphilosophie.* By Dr. Georg Schridde. Pp. ix+95. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1910.) Price 3 marks.

(2) *Lessings Briefwechsel mit Mendelssohn und Nicolai über das Trauerspiel.* By Prof. Dr. Robert Petsch. Pp. lv+144. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1910.) Price 3 marks.

(3) *Hegels Ästhetik im Verhältnis zu Schiller.* By A. Lewkowitz. Pp. 76. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1910.) Price 1.80 marks.

(4) *Über Christian Wolff's Ontologie.* By Hans Pichler. Pp. 91. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1910.) Price 2 marks.

(5) *Zwei Vorträge zur Naturphilosophie.* By Hans Driesch. Pp. iv+38. (Leipzig: Wilhelm Engelmann.) Price 80 pfennigs.

(1) GUSTAV FREYTAG is best known in England as a novelist, and chiefly as the writer of that charming story of German commercial life, "Soll und Haben," which has been translated and published in English as "Debit and Credit." But Freytag was more than novelist. He was also poet, dramatist, and thinker. Born in 1816, and living until 1895, his life—as Dr. Schridde remarks—shows us the very heart-beat of the century, a century of tremendous importance in the history of his country. Politically he was strongly for Bismarckian unification, with Prussian supremacy; philosophically he may roughly be classed as Hegelian, though less abstract, and thus he is also religious, for his "metaphysic transfigures the desiderated calmness, the white light of Reason, into religious faith." Dr. Schridde gives a good account of the influence upon Freytag of Kant, Fichte, Humboldt, Schelling, and Hegel, and is thoroughly in sympathy with his subject, though not refraining from criticism of weak places.

(2) This is a collection of letters exchanged by Lessing, Moses Mendelssohn, and Nicolai, on the subject of the correct principles of tragedy. The proper mixture of sympathy and fear—the two chief emotions to be aroused—is discussed, and the distribution of sorrows among the characters. The hero must be the most severely handled by Fate; as to whether the end shall see virtue rewarded or not, this may be left to the dramatist's discretion. There is much discussion of Corneille, Cibber, and the Greek playwrights, but very little mention of Shakespeare, who was discovered for Germany by Schlegel and Goethe.

(3) This is supposed to be a comparison of the æsthetic of Hegel and Schiller, but as a matter of fact it is mainly concerned with the former. The scheme of the booklet may be guessed by the section titles:—"Idea of the Absolute Spirit," "Idea of the Beautiful," "the Beautiful and the Development of the World Spirit," "Art and Metaphysic," &c. Hegel is good for the metaphysically inclined reader who wants "something craggy to break his mind upon," but to many readers the time spent in wrestling with him seems wasted.

(4) Another typically German pamphlet. Our Teutonic cousins still retain their interest in abstract thought and—in spite of Kant—in the "ontological proof" which, since Comte and Spencer, has become almost extinct in France and England. Herr Pichler gives an amusing parody of the ontological axiom (that as every something must be grounded in either something or nothing, and as nothing can come out of nothing, every something must be grounded in something real) by suggesting that every man has stolen either something or nothing. To take away from nothing is no theft, therefore every man has stolen something. The reader may be left to worry out the fallacy for himself, with a hint to remember "ambiguous middle term."

(5) These two lectures, as we are informed in the foreword, are connected by the chronology of their delivery rather than by their contents. But Dr. Driesch—who, by the way, was Gifford lecturer at Aberdeen two years ago—always has something to say, and no reader will complain of discontinuity in this pamphlet, even if it exists.

Dr. Driesch is a biologist; and, in opposition to the school which has for some time been dominant, he is a vitalist. He holds that life has its own laws; that biology is not merely applied chemistry-physics, but is a thing for itself; that the materialistic or mechanical view of living substance is false. His philosophic position approximates to that of Sir Oliver Lodge in England, and his arguments in support of his opinions are most weighty and—the present reviewer ventures to say—convincing.

COLOUR CHEMISTRY.

A Manual of Dyeing: for the Use of Practical Dyers, Manufacturers, Students, and all Interested in the Art of Dyeing. By Prof. E. Knecht, C. Rawson, and Dr. R. Loewenthal. Second edition. Vol. i., pp. xii+371. Vol. ii., pp. 372–902. (London: C. Griffin and Co., Ltd., 1910.) Price 45s., two vols.

THE first edition of this work was reviewed in NATURE on June 22, 1893, and in the seventeen years which have elapsed since its publication, such rapid developments have taken place in colour chemistry that certain sections of the book have for some time been out of date, and the whole work has for several years been out of print. The issue of the present edition has, therefore, involved a very complete and laborious revision, and this no doubt accounts for the somewhat protracted delay in its issue.

This raises the question whether, for the sake both of authors and purchasers, some scheme could not be devised for arranging and binding a book of this type in such a manner that sections could be re-written and issued separately.

The general scheme of the book has not been materially altered, but vol. iii. of the first edition, which consisted of illustrative dyed patterns, has not been reproduced, and in this the authors have been well advised.

The section dealing with the theory of dyeing processes has been extended to three times its original length, but any general agreement with regard to the theory of dyeing does not at present appear possible, nor have theoretical considerations in the past been of much service in connection with the practical application of colouring matters. It is to be hoped that further investigation will lead to such a unification of ideas that theory may fulfil its proper function of a sign-post for those seeking new fields of practical application.

In the section dealing with textile fibres, five excellent plates replace the older diagrammatic illustrations. While the ordinary fibres are adequately described, the treatment of artificial silk seems hardly to have received that attention to which its present great commercial importance entitles it. There is, for instance, no reference to Thiele silk, one of the chief products now used.

Part vi. comprises a description of the natural colouring matters, and in this section it has been found possible to condense the matter originally published, this being in agreement with the diminished importance of these dye-stuffs from the practical point of view. The recent work of A. G. Perkin, v. Kostanecki, Schmidt, and others, on the constitution of the colouring matters of the natural dye-stuffs, is duly referred to.

The most extensive section of the book is, of course, that dealing with the artificial dye-stuffs, and this has required the greatest amount of revision. Certain entirely new groups of dyes, such as the artificial vat colours, have been introduced since the publication of the first edition, and other groups, such as the sulphide dyes, have been greatly enlarged. Some mention of Tyrian purple might well have been included in view of P. Friedlaender's discovery that it is a dibromindigotin.

A section of the work to which great importance has always been attached is that dealing with the analysis and valuation of materials used in dyeing, and this has received a very thorough revision.

The book in its new edition will again take its place as one of the most important works published on colouring matters and their application.

OUR BOOK SHELF.

La Métallographie Microscopique. By Louis Révillon. Pp. 176. (Paris: Gauthier-Villars, n.d.) Price 3 francs.

THIS is another volume of the small Aide-Mémoire series by the author of the work on "Special Steels," which was reviewed some time ago. Considering the size and price of the book, a good account of the subject is given, though, in common with many other enthusiasts, the author is inclined to claim too much for his subject, p. 7, "et de résoudre tous les problèmes . . .," and in describing the preparation of the polished face of the section for examination, is too severe in his conditions, namely, "perfectly polished so that there remains no scratch visible at the highest power of the microscope." Much time has been wasted in the past in striving after this ideal. It is not necessary, unless when looking for the finest cracks, and, combined with a somewhat elaborate series of precautions, is apt to discourage the reader from beginning practical work. Advice such as that given on pp. 69 and 70 has always been impressed on beginners by the writer, namely, that the section is prepared for observation and study, not merely for photographing, and that the polished section should always be examined carefully before etching in any way, as then small holes, oxides, scoriæ, and sulphides are generally much more easily seen against the polished metallic surface than after etching.

With many of the opinions expressed one cannot agree. The Martensitic interlacing needles do not represent the structure of properly hardened carbon steels, and many practical points might also be controverted, but the work as a whole gives a very fair introduction to a study of the subject from the point of view of a portion of the French school. Osmondite is given, although M. Osmond has specifically repudiated it in *Revue de Métallurgie*. Separate chapters are devoted to special steels, the alloys of copper, other industrial alloys, and the final chapter to the interesting "Macrographie." A. McWILLIAM.

Die Kraftmaschinen. By C. Schütze. Pp. vi+235. (Leipzig: Quelle and Meyer, 1909.) Price 1.80 marks.

THIS little volume is devoted to a non-mathematical description of the various types of motors now employed for power purposes, and of the more important details of each class; windmills, waterwheels, and turbines, steam, gas, and petrol engines, and dynamos and electric motors are all in turn discussed and described. The text is illustrated by a large number of figures, mostly line illustrations, and, as all minute details are omitted, these illustrations will be easily understood and followed by the non-technical reader. The whole volume is, in fact, intended for those who are not experts in this branch of engineering. It will appeal, however, to many who use motors for business or pleasure, and desire to have some knowledge of the principles underlying the design and working of the particular machines they employ. The steam turbine has been rather inadequately treated in comparison with the reciprocating steam engine, but perhaps this was inevitable in a book of this nature, as the latter is still practically unchallenged by its younger rival in many branches of work in which motive power is required.

This is a book which will probably stimulate many of its readers to widen their knowledge of the problems concerned with the generation of energy, and to devote themselves to a systematic study of the subject, and, if it fulfils this, it will have done useful work. T. H. B.

Photomicrographs of Botanical Studies. Pp. 62. (Manchester: Flatters, Milborne and McKechnie, Ltd., n.d.) Price 2s. net.

This booklet contains about a hundred plates, which are photographic reproductions from the microscopical slides offered by the firm above-mentioned for the use of botanical students. The chief impression conveyed by the figures is the limitation imposed upon good microscopical preparations when referred to one focal plane as necessitated by photography. While the value of good slides for demonstration and examination by students is appreciable, one cannot attach much importance to figures which are primarily indices and convey in many cases only a portion of the information that can be derived from the preparations.

Illustrated Guide to the Museum of the Royal College of Surgeons, England. Pp. vi+132. By Prof. Arthur Keith. (London: Issued by order of the Council of the College, and sold by Taylor and Francis, 1910.) Price 6*d*.

Few even of those who constantly make use of the College of Surgeons' Museum can be aware of the vast wealth of material stored there. For it contains not only the greatest anatomical collection in existence, representative of everything included under the term "anatomy" in its widest sense; but it also includes a unique pathological museum, and collections illustrating anthropology, teratology, odontology, and the anatomy of animals and plants, each of which, if standing alone, would make a famous museum. Nor does this exhaust its claims on our interest, for in it is housed the famous collection made by John Hunter, innumerable anatomical and pathological preparations that have served as material for the master-builders of the sciences of anatomy and pathology, and specimens illustrating the history of all that relates to the preservation of dead bodies (starting from the earliest known mummy), the evolution of surgical and dental instruments, and the manifold curiosities of medical science which at various times engaged the attention of the ever-inquisitive Hunter.

The council of the college has earned the gratitude of a very wide circle of students in issuing this "guide," which admirably serves its purpose of indicating what the museum contains and where the various specimens are to be found, and Prof. Keith deserves our heartiest congratulations on the manner in which he has accomplished his task. For he has done something more than merely direct the reader in his wanderings through the vast storehouse of treasures in his charge; out of the abundance of his knowledge and erudition he has crammed a vast amount of interesting and suggestive information into this small volume.

This is only one, and by no means the least, of the many great services which have already marked Dr. Keith's conservatorship of the college museum.

The Photographic Annual, 1910–11, Incorporating the Figures, Facts, and Formulae of Photography. A Guide to their Practical Use. Edited by E. J. Wall. Sixth edition; extended, largely re-written, and revised. Pp. viii+287. (London: G. Routledge and Sons, Ltd.; Dawbarn and Ward, Ltd.; New York: Tennant and Ward; Melbourne: Baker and Rouse Proprietary, Ltd., 1910.) Price 1*s*. net.

Every photographer knows the value and utility of this annual issue, and that this is the sixth issue is sufficient testimony to its merits. There is no doubt that, in preparing such a work as this, and to keep the volume within a reasonable size, great difficulty must be experienced in determining what information to include or omit. The editor has used his discretion wisely, with the result that the present issue should meet with general approval among photographers.

The importance and recent advances made in screen-plate colour-photography is sufficient reason for the first forty pages being devoted to this subject, and here the reader will find a capital *résumé* of the state of affairs up to the present time. Stereoscopic work is next dealt with, and in the twenty-seven pages in which this subject is treated many useful hints will be found. Nearly the same amount of space is confined to some useful notes on development, including time, tank, and thermo methods. Practically the remainder of the book is taken up by the figures, facts, and formulæ, which always form the chief feature of this book.

Being well up-to-date and in a handy form the book should continue its useful career.

LETTERS TO THE EDITOR.

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

The Ratio between Uranium and Radium in Minerals.

In his interesting letter (Nature, August 25) Mr. A. S. Russell describes the result of a determination of the amount of radium in a specimen of autunite from Autun, France, made by him in Prof. Marckwald's laboratory, which he found to be only 27 per cent. of the equilibrium amount. The ratio found by Mlle. Gleditsch in Mme. Curie's laboratory for the same mineral was 80 per cent., while Miss Pirret and I recently, for an autunite from Guarda, Portugal, found 44 per cent. Some results I have obtained since the paper with Miss Pirret was published appear to put a new complexion on the matter. Dual measurements of the radium ratio and of the helium content of several specimens of Portuguese autunite have shown that both vary considerably for different specimens of the same mineral. Prof. Piutti ("Helium in Recent Minerals," *Le Radium*, 1910, vii., 178) found that autunite was the only radio-active mineral in which helium could not be detected.

With a very delicate method, similar to that described for the detection of the helium produced from uranium and thorium (*Phil. Mag.*, August, 1908), I have only failed to find helium in one specimen of autunite, while in another the amount was such that Prof. Piutti would have detected it easily. The latter case refers to the specimen for which Miss Pirret and I found 44 per cent. for the radium ratio. The amount of helium was 3·3 cu. mm. per gram of uranium. On the assumptions, which certainly are not true but may not lead to an entirely false result, that the uranium was initially free from all products, and these have been all retained by the mineral, the age of the mineral would be 77,000 years and the period of average life of the parent of radium 132,000 years. The material was, however, not a single piece, a batch of specimens containing 40 per cent. of autunite, obtained direct from the mining syndicate, having been ground up together. From a fresh batch, obtained through a dealer, two single pieces were picked out, the first being an almost pure crystal weighing 2·3 grams, and of so fresh and new appearance that it looked as if it had been withdrawn from its mother-liquor but yesterday, and the second an obviously older looking, greener, and much larger mass containing 46 per cent. of matrix. The first gave a radium ratio of 70 per cent., and in it helium could not be detected. The quantity was not greater than 0·002 cu. mm. per gram U. This quantity would form in about thirty years! For the second, the radium ratio was 44 per cent. and the helium 0·035 cu. mm. per gram U, which would be produced in about 600 years. Lastly, Mr. Russell very kindly gave me the remains of the specimen for which he found 27 per cent. for the radium ratio. It weighed less than 0·5 gram, but the helium was easily detectable. It amounted to more than 0·15 cu. mm. per gram U, some being lost.

If these results are representative, the radium ratio decreases to a minimum and then rises more slowly as the helium content increases. If the latter is taken as a measure of the age of the mineral, the minimum appears to be reached after a few thousand years. This, of course, is exactly what would occur if, when the autunite was formed, the radium (but not its parent) associated with the uranium in its former condition separated with the latter. This in itself is not only possible, but probable, owing to the isomorphism of radium and calcium. But it is a somewhat startling result if initial radium can have any influence on the amount present in a mineral to-day, for this necessitates that the ages indicated by the helium content are not altogether below the truth, and that these beautiful crystals are actually even now in full process of formation.

Frederick Soddy.

Physical Chemistry Laboratory, University of Glasgow.

Stagnant Glaciers

In the notice of the Professional Papers of the U.S. Geological Survey on the "Glaciers, Goldfields, and Landslides of North America," published in Nature of July 21, attention is directed to the peculiar stagnant condition of some glaciers, and to the fact that certain glaciers, after being stagnant for long intervals, suddenly commence to move.

Although the movement of glaciers is such as would take place if they were viscous bodies, there is reason to believe that they have not all the same viscosity. I pointed out in a paper communicated to the Royal Society (Proc. Roy. Soc., 1908, p. 250) that the calculated viscosities of several Swiss glaciers varied from $292{\cdot}2 \times 10^{12}$ to $3{\cdot}17 \times 10^{12}$ C.G.S. units. Although some of the data upon which these figures were based were only estimated ones, I do not think that the different viscosities found are due wholly to errors in the data. In other words, that the viscosity of glacier ice is not a constant, as in the case of water, &c., but varies with variations in the granular structure of the ice, or that there is a limiting stress below which distortion does not take place as with plastic bodies.

So far as I am aware, no glaciers have been proved actually to be stagnant by careful measurement. Generally speaking, the conclusion that a glacier is dead is formed owing to the absence of certain features which are generally associated with glacier movement.

It is very desirable that such statements should be based upon actual measurements only, and also that the actual granular structure of the ice should be given, for there is every reason to believe that the viscosity of glacier ice varies with the size of the glacier grains. Were it not for the fact that the glacier grains are actually broken up by shear planes in the ice, they would gradually become larger and larger until they became so large, and the viscosity became so great, that the ice would scarcely move at all on small slopes. In such a case an earthquake might give rise to fractures in the ice, and by temporarily decreasing the viscosity increase the rate of flow.

R. M. Deeley.

Melbourne House, Osmaston Road, Derby, July 23.

It chanced, strangely enough, that Mr. Deeley's interesting letter reached me at a Norwegian port during the return journey of the Geological Congress party from Spitsbergen, on which Prof. R. S. Tarr, whose work has given rise to the letter, is a fellow-traveller with me. I have therefore taken advantage of the opportunity to discuss the subject with Prof. Tarr and other glacialists of our party.

Mr. Deeley is right in his supposition that the stagnant condition of the "dead ice" in Alaska has been inferred from surface indications, and has not yet been tested by actual measurement. It is, indeed, not likely that the ice of the areas described as "stagnant" is absolutely motionless, nor do I think that this has been implied in the descriptions. Such motion as it may have must however be very small, since it seems that the trees covering parts of the surface-moraines in the "dead" areas show no sign of disturbance.

As hinted in my review, it is evident that rapid advances of glaciers, comparable to those observed in Alaska, have taken place in regions where some other cause than an earthquake must be sought. During our recent journey in Spitsbergen, of which I hope shortly to give some account in these pages, we have been shown by our leader, Prof. G. de Geer, several cases of this kind which he has studied. It may be that Mr. Deeley's explanation of ice-structure will explain these rapid spasmodic movements, but I shall not venture upon a discussion of this difficult physical question. Mr. Deeley has at any rate suggested a line of research which ought to be followed up and experimentally tested in the field.

Stockholm, August 19. G. W. Lamplugh.

The Leaning Tower of Pisa.

The photograph of the "Leaning" Tower of Pisa in Nature of August 4 shows clearly that the top tier is not square with the rest. From a rough alignment with the edge of a postcard, the photograph appears as if the tower was of the order of 25 mm./metre out of plumb when the top tier was put on presumably plumb.

Exact measures of this and of other parts of the tower might afford interesting data as to the epochs of the construction of the tower and of the progress of its "leaning."

Edward G. Brown.

This famous tower will doubtless always be a question, like the man in the iron mask and other historical mysteries. Most architects, however, will be very slow to believe that it would have been built intentionally leaning on the general grounds that, however adventurous the architect, the clients would not have stood it. The analogy of the leaning towers of Bologna is hardly a sound one, as these plain shafts of brickwork, much like tall chimneys, can hardly be other than cases of settlement due to indifferent foundations. It should be remembered that construction was not a strong point with the Italians in the Middle and Renaissance Ages. In the case of the Tower of Pisa, Taylor particularly remarks on the wedge-shaped courses, which show an attempt to straighten the shaft. The best explanation appears to be that the tower was commenced, settled on its marshy bed, and that when the building was continued after a long interval it was considered safe to continue the work up to the limit of stability which could be calculated by the mathematicians of the epoch. The overhang is given by Taylor as 13 feet.

It is rather a pity that so much attention is concentrated by visitors on the tower, whereas the cathedral, Campo Santo, and particularly the Baptistery, are monuments of greater architectural importance. The design of the Baptistery is extremely interesting, and is perhaps the nearest expression of a Gothic dome.

The construction in this case is highly interesting, because the outer dome is supported by a cone, as at St. Paul's, London, but without an inner dome. As, however, the cone is not illuminated from the inside, it has a domical effect. The top of the cone shows externally, to the detriment of the general outline, not being cut off to carry a lantern as at St. Paul's.

Sir Christopher Wren may have known from travellers or by converse with foreign men of science of this example, but it is not necessary to jump to that conclusion, as an ordinary brick kiln or oast house would give the idea, aided by Wren's mathematical analysis of cones as units of high carrying power.

Taylor and Cresy's drawings of the Pisan monuments have every appearance of being most trustworthy, and should be consulted by your correspondent. I had the plates with me when visiting Pisa in 1890, and I had the opportunity to go up the tower and round its galleries. Ruskin has a passage on the setting out of the lower part of the western façade of the cathedral, but I remember the impression produced by my examination was not favourable to his argument.

ARTHUR T. BOLTON.

Victoria Mansions, 28 Victoria Street, Westminster, S.W.

The Origin of the Domestic "Blotched" Tabby Cat.

THE question of the origin of the two types of our domestic cats has been the subject of much controversy, and it is therefore with diffidence that the views here expressed are now put forward. It is, of course, well known that any domestic "tabby" can, at a glance, be assigned to one of the two colour patterns, "striped" or "blotched."

In a recent paper (Proc. Zool. Soc., 1907, pp. 143–66) Mr. R. I. Pocock comes to the conclusion that the origin of *F. catus* (blotched tabby) is "at present quite unknown," and suggests that it is "the survivor of some extinct, probably Pleistocene, cat of Western Europe" (*ibid.*, p. 160); in effect, he regards *catus* as a good species. It seems to have been pretty clearly shown by the same writer that the *torquata* breed (striped tabby) is either the direct descendant of *F. sylvestris* or is the result of a cross between that species and *F. ocreata* (Proc. Zool. Soc., 1907, p. 947, and NATURE, vol. lxxvii., p. 414), which latter is, no doubt, merely a geographical race of *sylvestris*.

In his previous paper (Proc. Zool. Soc., 1907, p. 160) Mr. Pocock remarks that "when two distinct species cross the hybrid sometimes reverts in some respects to the characters of a [supposed] common ancestor of both"; this cannot be denied, but such a cross more commonly results in a form intermediate between the two parents, usually designated as a mongrel. After much diligent search, I have been unable to find a single instance in which complete segregation has taken place in respect of all specific characters *when two well-defined species are crossed*.

The two "types" of tabby, when crossed, always produce individuals which are at once referable to one or the other variety; in short, we get complete (Mendelian) segregation in respect of this character.

It therefore seems to me to be incompatible with the above observed facts, that *F. catus* is the survivor of some extinct cat of Western Europe, for if *catus* were a good species, when crossed with *torquata* we would most certainly have some form of intermediate produced. This, as we know from everyday experience, is contrary to the expressed results of such a cross. From these facts it is suggested as a possible explanation that *F. catus* arose *per saltum* from *F. sylvestris*. In short, I believe that *F. catus* has arisen from *F. sylvestris* as a "sport," and when crossed with its parent species or *inter se* follows the Mendelian law of segregation, as many such discontinuous variations have now been proved to do. At the same time (from evidence which cannot be here brought forward), it would appear that only in extremely rare cases, if at all, can Mendelian action be accountable for the evolution of a species *in nature*.

In opposition to such an origin, Mr. Pocock urges (Proc. Zool. Soc., 1907, p. 160) "the complete absence of evidence that species of Felis are ever dimorphic in pattern, and the ascertained fact that they breed true to their specific and sub-specific type." The objection, of course, is a purely negative one, and there is some evidence to show that animals under domestication are more subject to pronounced variation than in a state of nature.

In the leopard (*F. pardus*) we have a species of *felis* which can most certainly be regarded as dimorphic, in that it produces a black form, and (so far as the somewhat meagre information on the subject goes) in its gametic behaviour is exactly comparable to the case of the "blotched" and "striped" tabby. There are, so far as I know, no data in the case to show which is the "dominant" form, but, from analogy, it is almost certain the black would be dominant over the spotted. It is the hope of obtaining such information in the case of our common cats which has induced me to approach the subject. Finally, it may be said that, although no *direct* proof can be brought forward in support of such a suggestion, I am convinced that a properly conducted series of experiments with the two types would bring to light much evidence in favour of such a view.

Unfortunately, the writer is at present unable to carry out such a series of experiments, and it is hoped that others may hereby be induced to do so.

H. M. VICKERS.

81A Princes Street, Edinburgh, August 20.

I AM glad Mr. Vickers has directed the attention of Mendelians to the question of our two types of "tabby" cat. With the same purpose in view, and in the hope of inducing someone with time and facilities at his disposal to carry out breeding experiments with these animals, I recently communicated to the Mendel Society a paper on this subject, which will appear in the forthcoming issue of the journal. The results of such experiments are sure to be interesting, but whether or not they will settle the origin of the "blotched" tabby is another matter. They may turn the balance of the evidence in favour of this or that theory, but it is doubtful if they will result in more than a hypothetical conclusion. For myself I have quite an open mind on the point. As stated in my original paper on English cats, the "blotched" tabby may be regarded provisionally either as a survivor of some extinct cat that formerly inhabited Europe or as a "mutation" of the "striped" tabby. I reserved the names "*catus*" and "*torquata*" for these two types as a convenient means of designating them, following Linnæus's method, which is still in vogue, of assigning a specific epithet to our domesticated animals, like *Ovis aries*, *Canis familiaris*, and others, when their origin is uncertain or unknown.

I think Mr. Vickers a little overstates the case when he says there has been much controversy on the subject of the origin of these cats, and speaks of their existence as well known. It was the fact that the remarkable differences between them had been practically ignored or unappreciated by zoologists that induced me to discuss the question at some length three years ago. Nor do I think Mr. Vickers himself quite appreciates the distinction I emphasised between dimorphism in pattern and dimorphism in colour. Experience with wild animals shows that pattern is far more stable than colour. Pattern is wonderfully persistent; colour is not. No one would be greatly surprised at finding a black or white example in a litter of spotted hyænas, but it would be admittedly an extremely remarkable thing if a specimen resembling a striped hyæna in pattern occurred amongst them. Such a "mutation" would be comparable to the "mutation," if mutation it be, of the "blotched" from the "striped" tabby cat. Such a mutation in pattern as that supposed in the case of the hyæna may, of course, be produced to-morrow; but, so far as I am aware, no such variation has as yet been recorded, and I write this with full recollection of the curious variations in pattern that have been recorded of the common leopard.

Finally, may I demur to one more statement made by Mr. Vickers, namely, that animals under domestication are more subject to pronounced variation than those in a state of nature? I do not dispute this common assumption, but I am not satisfied that the evidence in its favour amounts to very much.

The questions raised by Mr. Vickers are, however, full of interest; and all that I have said is in justification of the agnostic attitude that I think should be, for the present, preserved towards the origin of the "blotched" tabby cat.

R. I. POCOCK.

Zoological Gardens, August 24.

LAKE BALATON.[1]

LAKE BALATON, or Platten See, is the largest lake in Austro-Hungary, and, in fact, in south-eastern Europe. It is fifty miles long, and is shallow in proportion to its size. It lies in a depression on the Hungarian plain at the foot of the hills of the Bakony Wald. The Hungarian Geographical Society organised a commission, under the presidency of Prof. Ludwig von Loczy, to subject this lake to a thorough investigation. The results are being published in three volumes, of which the first is devoted to geography, geology, palæontology, hydrography, physics, and chemistry; the second to biology; the third to the social and ethnographical geography, including accounts of the watering-places and hot springs, and a bibliography. Four further sections of this work have now been received, and one of them completes the second volume. As the parts are issued in the order of their completion, it is not easy to form from these disconnected fragments a clear impression of the work as a whole. Thus the only contribution yet issued to the introduction, which is to be a geographical memoir on the lake and its district, is a geo-physical appendix, dealing with the determination of gravity by R. von Sterneck, with the influence of variations in gravity on the level of the lake surface by Baron Lorand Eötvös, and a report on the magnetic observations by Dr. L. Steiner. Dr. von Sterneck's results show that gravity is normal over part of the middle of the lake, while it is above normal along a belt of the hills to the north, and it is below normal in a band still further to the north.

Baron Eötvös has determined the relations of the variations in gravity to the level of the lake surface by measurements made on the ice during the winter. His observations were interrupted by the mild winter of 1902, when the lake was inadequately frozen. His results show that Lake Balaton occurs along a tectonic line, and he recognises variations in level due to gravity, similar to those in India, but on a smaller scale. Dr. Steiner has determined the various magnetic elements for the area of the lake, and has investigated the magnetic properties of the rocks.

No other locality in Europe is so convenient for the study of the formation of wide ice-sheets on an inland sea as Lake Balaton, for, in spite of the comparative saltness of the water, its surface is more completely frozen than the Swiss lakes, which being much deeper, therefore cool more slowly. In ordinary winters the whole of Lake Balaton is covered over with a firm ice-sheet. Dr. von Cholnoky has made a detailed study of the ice in all stages of its formation and decay, illustrated by numerous excellent photographs. The ice-sheet is broken into separate floes separated by narrow leads, which are locally known as rianas, and the wind, driving the ice-fields together or against the shore, piles it into ice-hummocks, which on Lake Balaton are known as turolas. Many of the features of the Arctic ice-sheets are found repeated in southern Europe. Dr. Cholnoky, following Buckley and van Hise, draws an interesting comparison between the movements of the ice-sheet and the earth's crust. Blocks of the ice founder, forming areas of subsidence, and long strips sink between parallel faults forming rift valleys separated by horsts, while various overthrust faults are found in the pressure ridges.

Fig. 1.—Hummock formed from fresh ice on Lake Balaton, January 23, 1903.

The volume on the biology of Lake Balaton is now completed by a memoir on the attempts to acclimatise various tropical water-lilies in the Hévizsee, a well-known bathing resort near Keszthely, to the north of the western end of Lake Balaton. This lake is about three hundred yards across, and is fed by hot

[1] "Resultate der Wissenschaftlichen Untersuchungen des Balaton." Vol. i., Physische Geographie des Balatonsees und seiner Umgebung: Part i., Die Geomorphologie des Balatonsees und seiner Umgebung, Section iii., Geophysikalischer Anhang i. (I.) R. v. Sterneck, Untersuchungen über die Schwerkraft, pp. 31, 1 map; (II.) Baron L. Eötvös, Die Niveaufläche des Balatonsees und die Veränderungen der Schwerkraft auf diesem, pp. 61, 27 figs.; (III.) L. Steiner, Erdmagnetische Messungen in Sommer 1901, pp. 30, 6 figs. Price 6 kroner. Part v., Die Physikalischen Verhältnisse des Wassers des Balatonsees: Section iv., E. v. Cholnoky, Das Eis Balatonsees, pp. 114, xxi. plates, 122 figs. Price 10 kroner. Vol. ii., Die Biologie des Balatonsees und seiner Umgebung: Part ii., Die Flora, Section ii., Die Pflanzengeographischen Verhältnisse der Balatonsee-gegend, appendix: A. Lovassy, Die Tropischen Nymphæen des Hévizsees bei Keszthely, pp. 100, iv. plates, 25 figs. Price 10 kroner. Vol. iii., Soziologische und Anthropologische Geographie der Umgebung des Balaton: Part i., Geschichte der Umgebung des Balaton, Division iii., R. Békefi, Kirchen und Burgen in der Umgebung des Balaton im Mittelalter, pp. 363, 1 map, 142 illustrations. Price 20 kroner.) Vienna: Ed. Hölzel, 1907-9.)

springs, so that the temperature of the water is from 32° to 38° C. in summer, and from 26° to 30° C. in winter. A chapter on the composition of the lake water, by G. v. Weszelszky, shows that it contains 0·531 part per thousand of salts, of which the chief are magnesium chloride, bicarbonate of lime, and sodium sulphate. The shape of the lake basin has been carefully determined by Dr. Jordan.

Dr. Lovassy has attempted to acclimatise tropical water-lilies in this pond. He points out the interesting fact that the Nile lotus (*Nymphaea lotus*) is still living in the warm waters of Nagyvared, and a flower stem referred to this plant was discovered in Upper Pliocene calcareous tufa at Ganocz, in Szepes, by Prof. Pax, of Breslau, in 1904. Dr. Lovassy, therefore, holds that the Nile lotus still lives in Hungary as a relic from its former wide extension over southern Europe. He insists that the plant was neither introduced by man nor birds, and that Nagyvared is a natural subtropical oasis. Earlier attempts to plant tropical water-lilies in the Hévizsee were made between 1826 and 1842. Dr. Lovassy's experiments lasted from 1898 to 1906, and were tried on many distinct species; and in connection with the work he has compiled a synopsis of the Nymphaceæ; some species failed altogether, others lived, but would not produce seeds, and only a variety of the Indian *Nymphaea rubra*, for which he founds a new subspecies, *longiflora*, has been successfully acclimatised.

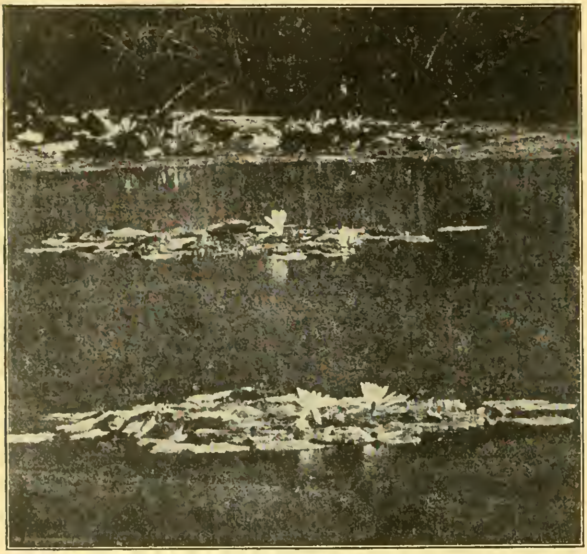


FIG 2.—Water-lilies in the Hévizsee. In foreground some specimens of *Nymphaea lotus*, L., and in background *Nymphaea rubra longiflora*, nov. subsp.

The longest of the four contributions recently received is a memoir by Dr. Békefi on the mediæval churches and castles in the neighbourhood of Lake Balaton. It consists of a detailed account illustrated by plans and photographs, both of the buildings still occupied and those represented by numerous picturesque ruins.

J. W. G.

THE BRITISH ASSOCIATION AT SHEFFIELD.

FROM the point of view of numbers, this year's meeting of the British Association, with a total membership of about 1400, does not take a very high place among the great meetings of recent years; nevertheless, there is only one opinion as to its success. The arrangements have been admirably made, and everyone agrees that no more perfect and convenient place for the reception-room and accessory writing and other rooms could have been provided than has been furnished at the Cutlers' Hall. The local committee, under the chairmanship of Prof. W. M. Hicks, is to be congratulated upon the businesslike way in which it has organised the many and various general affairs of the meeting. The scientific proceedings of the sections have been full of interest, but here no further reference need be made to them, as accounts of the work of the sections will appear in later issues.

The annual report of the council of the association was presented at the meeting of the general committee on August 31. The council presented an address to the King upon his accession to the throne, and in a further letter expressed the hope that he would follow his august father in the patronage of the association. This the King has consented to do.

At the Winnipeg meeting last year a resolution was formulated by the Anthropological Section, relating to inquiries into Canadian ethnology, was supported by the general committee, and referred to the council. This resolution, which was forwarded to the Dominion Government by the council was as follows :—

I. (1) "That it is essential to scientific knowledge of the early history of Canada that full and accurate records should be obtained of the physical character, geographical distribution and migrations, languages, social and political institutions, native arts, industries, and economic systems of the aboriginal peoples of the country.

(2) "That scientific knowledge of the principles of native design and handicraft is an essential preliminary to any development of native industries such as has already been found practicable, especially in the United States, in Mexico, and in India, and that such knowledge has also proved to be of material assistance in the creation of national schools of design among the white population.

(3) "That, in the rapid development of the country, the native population is inevitably losing its separate existence and characteristics.

(4) "That it is therefore of urgent importance to initiate, without delay, systematic observations and records of native physical types, languages, beliefs, and customs; and to provide for the preservation of a complete collection of examples of native arts and industries in some central institution, and for public guardianship of prehistoric monuments such as village sites, burial grounds, mounds, and rock carvings.

(5) "That the organisation necessary to secure these objects, and to render the results of these inquiries accessible to students and to the public, is such as might easily be provided in connection with the National Museum at Ottawa, which already includes many fine examples of aboriginal arts and manufactures, and might be made a

centre for the scientific study of the physical types, languages, beliefs, and customs of the aboriginal peoples."

II. To recommend the council to urge the Dominion Government to include in the schedules of the next Canadian census full inquiries as to precise place of origin, native language, previous status and occupation, year of immigration, and such other information as may be deemed of scientific value for the study of the effects of the Canadian environment upon immigrants of European origin.

The resolution was referred to the Canadian Geological Survey by the Privy Council, and in the course of a reply the director of the survey, Mr. R. W. Brock, stated that the Government had shown appreciation of the value of the work by enabling the survey three years ago to make a beginning in the direction indicated. An ethnologist is at present living with the Eskimo in the Arctic, and a preliminary report on his observations appeared in the Geological Survey summary report for 1908. With the assistance of the Canadian archæological societies and the support which the British Association gave in its resolution, the director expressed strong hopes that something worth while may be accomplished along these lines.

It was subsequently reported to the council by the general officers that information had reached them that the Dominion Government of Canada had authorised the payment of the salary of an ethnologist for the Dominion, and also a grant for the collection of ethnological material. This may be regarded as a direct outcome of the representations made by the British Association.

The important question of the relationship of the sections generally, and the possible desirability of a new subdivision and the incorporation of new subjects was referred to the council by the general committee at Winnipeg. A committee was appointed by the council to consider the matter, and among its recommendations were (1) that the title of Section A be changed to "Mathematics, Physics, and Astronomy (including Cosmical Physics)"; (2) that the question of the combination of geology and geography into one section of two departments should receive further consideration; (3) that there should be a permanent subsection of agriculture, attached to a particular section annually, such as chemistry, economic science, and botany. The proposed changes did not, however, meet with the approval of the general committee. It was resolved at the meeting of this committee on September 2 that the present title of Section A should remain unaltered, that Sections C and E should not be combined, and that the question of the sub-section of agriculture should be referred back to the council.

Sir William Ramsay was nominated by the council to fill the office of president of the association for next year's meeting at Portsmouth, and his nomination was confirmed by the general committee. At the meeting of this committee on September 2 an invitation from Dundee to visit that city in 1912 was unaimously accepted. An invitation to meet in the capital cities of Australia was conveyed by Sir George Reid, High Commissioner of the Commonwealth, and Prof. Orme Masson. The proposal was that the association should spend a few days each in Adelaide, Melbourne, Sydney, and Brisbane. The general committee was informed that the Commonwealth Government has voted 10,000*l*., which is earmarked for oversea expenses, and that the contributions of the several States will include free railway travelling. The minimum time needed for the visit, including the journey out and home, will be about three months. After discussion, it was proposed by Sir William Ramsay that the invitation should be accepted for 1914. The resolution was seconded by Prof. H. B. Dixon and carried by the general committee.

On Tuesday afternoon a special degree congregation was held at the University, when the Duke of Norfolk, as Chancellor of the University, conferred honorary degrees upon the following distinguished visitors and two leading Sheffield men—the Lord Mayor (Earl Fitzwilliam) and Sir Joseph Jonas:—LL.D.: The Right Hon. the Lord Mayor of Sheffield (Earl Fitzwilliam). D.Sc.: Mr. W. Bateson, F.R.S., Prof. T. G. Bonney, F.R.S., Sir William Crookes, F.R.S., Mr. Francis Darwin, F.R.S., Prof. T. W. Rhys Davids, Sir Archibald Geikie, K.C.B., F.R.S., Prof. E. W. Hobson, F.R.S., Sir Oliver Lodge, F.R.S., Sir Norman Lockyer, K.C.B., F.R.S., Dr. H. A. Miers, F.R.S., Sir William Ramsay, K.C.B., F.R.S., Prof. C. S. Sherrington, F.R.S., Sir J. J. Thomson, F.R.S. D.Eng.: Sir Joseph Jonas, J.P., Sir W. H. White, K.C.B., F.R.S. D.Met.: Mr. J. E. Stead, F.R.S.

Subjoined is a synopsis of grants of money appropriated for scientific purposes at the Sheffield meeting:

	£
Section A.—Mathematical and Physical Science.	
Turner, Prof. H. H.—Seismological Observations	60
Shaw, Dr. W. N.—Upper Atmosphere	25
Preece, Sir W. H.—Magnetic Observations at Falmouth	25
Gill, Sir David.—Establishing a Solar Observatory in Australia	50
Gill, Sir David.—Grant to the International Commission on Physical and Chemical Constants	30
Section B.—Chemistry.	
Divers, Prof. E.—Study of Hydro-aromatic Substances	20
Armstrong, Prof. H. E.—Dynamic Isomerism	25
Kipping, Prof. F. S.—Transformation of Aromatic Nitroamines	15
Kipping, Prof. F. S.—Electro-analysis	15
Arnold, Prof. J. O.—Influence of Carbon, &c., on Corrosion of Steel	15
Section C.—Geology.	
Harker, Dr. A.—Crystalline Rocks of Anglesey	2
Tiddeman, R. H.—Erratic Blocks	10
Lapworth, Prof. C.—Palæozoic Rocks	10
Watts, Prof. W. W.—Composition of Charnwood Rocks	2
Watts, Prof. W. W.—Igneous and Associated Sedimentary Rocks of Glensaul	15
Bourne, Prof. G. C.—Mammalian Fauna in Miocene Deposits, Bugti Hills, Baluchistan	45
Section D.—Zoology.	
Woodward, Dr. H.—Index Animalium	75
Hickson, Prof. S. J.—Table at the Zoological Station at Naples	75
Shipley, Dr. A. E.—Feeding Habits of British Birds	5
Shipley, Dr. A. E.—Belmullet Whaling Station	30
Bourne, Prof. G. C.—Mammalian Fauna in Miocene Deposits, Bugti Hills, Baluchistan	30
Section E.—Geography.	
Chisholm, G. G.—Map of Prince Charles Foreland	30
Herbertson, Prof. A. J.—Equal Area Maps	20
Section F.—Economic Science and Statistics.	
Cannan, Prof. E.—Amount and Distribution of Income	5
Section G.—Engineering.	
Preece, Sir W. H.—Gaseous Explosions	90
Section H.—Anthropology.	
Munro, Dr. R.—Glastonbury Lake Village	5
Myres, Prof. J. L.—Excavations on Roman Sites in Britain	10
Read, C. H.—Age of Stone Circles	30
Read, C. H.—Anthropological Notes and Queries	40
Munro, Dr. R.—Artificial Islands in Highland Lochs	10
Section I.—Physiology.	
Schäfer, Prof. E. A.—The Ductless Glands	40
Sherrington, Prof. C. S.—Body Metabolism in Cancer	6

	£
Hickson, Prof. S. J.—Table at the Zoological Station at Naples	25
Waller, Prof. A. D.—Electromotive Phenomena in Plants	10
Waller, Prof. A. D.—Anæsthetics	20
Sherrington, Prof. C. S.—Mental and Muscular Fatigue	25
Starling, Prof. E. H.—Dissociation of Oxy-hæmoglobin	25
Section K.—Botany.	
Scott, Dr. D. H.—Structure of Fossil Plants	15
Darwin, Dr. F.—Experimental Study of Heredity	45
Johnson, Prof. T.—Survey of Clare Island	20
Oliver, Prof. F. W.—Registration of Botanical Photographs	10
Section L.—Education.	
Findlay, Prof. J. J.—Mental and Physical Factors	10
Corresponding Societies Committee.	
Whitaker, W.—For Preparation of Report	20
Total	1090

SECTION B.

CHEMISTRY.

Opening Address by J. E. Stead, F.R.S., F.I.C., F.C.S., President of the Section.

It was with considerable diffidence that I accepted the position of President of this section. The long list of illustrious and eminent chemists who have occupied the chair in the past, men of science of the highest attainments, and usually professors of our educational institutions, is indicative of the very high standard to be followed. As, however, it was urged that a President with experience in the metallurgy of iron and steel was desired, I bowed to the decision of the Council, concluding that even as a mere layman I might, in this address, discuss one or more subjects to which prominent metallurgists have for the past thirty years directed their earnest attention, both in Europe and America. I refer to some of the underlying phenomena connected with the effect of sulphur and silicon on the carbon condition of commercial cast iron.

The effect of sulphur and silicon on cast iron has received the attention of Karsten, Percy, Weston, Howe, Keep, West, Dillner, Bachman, Summershach, Wüst, Johnson, Stoughton, Hailstone, Longmuir, Adamson, Turner and Schuler, Levy, and many others. They all agree in concluding that sulphur tends to make iron white by retaining the carbon in the combined state, and that silicon tends in the opposite direction. Prof. Howe and Dr. Wüst have endeavoured to arrive at the exact quantitative effect of sulphur and silicon in preventing or facilitating the decomposition of the carbides.

Howe recognised that the data available are insufficient on which to make any final conclusion.

Wüst found, by a series of trials, that in pigs containing 3·15 per cent. carbon and about 1 per cent. silicon, on an average 0·01 per cent. sulphur prevented the separation of 0·02 per cent. graphite, but that with 2 per cent. silicon its effect was much less.

It is the general experience, that the effect of sulphur depends on the proportion, not only of silicon, but of the total carbon and manganese, and of the temperature at which the iron is cast, and the size and temperature of the mould into which the metal is run. Under some critical conditions 0·1 per cent. sulphur may prevent the separation of 3 per cent. graphite.

Howe's discovery—that the tendency of silicon, in increasing the decomposition of the carbides, is rapid at first, especially as the silicon rises from zero to 0·75 per cent., and then slower and slower with each further increase—is very important; so also is the generalisation of Messrs. Charpy and Grenet—that the separation of graphite on annealing iron which is initially white, containing the whole of the carbon in the combined condition, begins at a temperature which is the lower the greater the percentage of the associated silicon, and that the separation of graphite, once begun, continues at even lower temperatures than that at which it started.

The evidence advanced by Phillips, Prost, Campredon, Schulte, and others—that, on dissolving sulphurous irons in hydrochloric acid, all the sulphur is not given off as H_2S, and that a part either passes off as $S(CH_3)_2$ or remains behind with the solution as some organic product—was tentatively believed as indicative that the sulphur is chemically associated with the carbon and the iron.

Levy,[1] who has done much good work in the endeavour to determine the relations which exist between iron, carbon, and sulphur, in the alloys of these elements, states, as the result of his research, that there is no conclusive evidence of any chemical union.

In his tabulated results showing the amount of sulphur evolved presumably as $S(CH_3)_2$ on dissolving iron, carbon and sulphur alloys, the maximum is 0·06 per cent., but the average is very much less.

Schulte, on the other hand, had found that from 1 per cent. to 12 per cent. of the total sulphur is evolved as an organic sulphur compound; and Bischoff found an even greater quantity.

The results are apparently conflicting, and it is evidently obvious that more research is required in this direction.

It has been shown by Arnold and McWilliam, and confirmed by others, that carbide of iron does not decompose into graphite and iron during the annealing of steel until it segregates into relatively large masses. Taking this as a basis, Mr. Levy has advanced an explanatory hypothesis as to how it is that sulphide of iron prevents the decomposition of carbides in white irons. He had found that during the solidification of irons free from silicon and manganese, but rich in sulphur, "the sulphide separates at a temperature in the neighbourhood of 1130° C., together with, and as a component of, the austenite-cementite eutectic, forming a triple austenite-cementite-sulphide eutectic, the cementite component of which is interstratified with a jointed pearlite (by decomposition of austenite) sulphide one." He stated that "The presence of iron sulphide in the eutectic introduces intervening layers, which may partly ball up on annealing, but even then leave sulphide films between the cementite crystals; these act almost as emulsifiers, preventing the coalescence of the cementite portion, which is apparently a necessary preliminary to its decomposition into free carbon and iron. These layers and films are so persistent, even on slow cooling, as to retain their position between the cementite crystals, until the metal has cooled well below the temperature of decomposition, so that an iron which might otherwise become grey is retained, even on very protracted cooling, in the white form, by sulphur as sulphide; 0·25 per cent. sulphur being sufficient for this purpose under the moderately protracted cooling conditions of the research. It is not improbable that the mechanical force exerted by sulphide, on separation and cooling, may also prevent the physical conditions necessary for carbide decomposition, which, as is well known, is accompanied by considerable expansion."

It is to be noted that Mr. Levy's argument is based on the effect of the sulphide films in the eutectic, preventing the segregation of the cementite into relatively large masses, which, as he expresses it, "is apparently a necessary preliminary to its decomposition."

His conclusions were based on the examination of hypo-eutectic alloys containing not more than 2·75 per cent. carbon and free from massive plates of cementite.

Whilst admitting that his conclusions may be correct, as applied to the eutectic, some other explanation would be necessary if decomposition did not occur when a considerable quantity of massive cementite initially were to form in the alloy.

That stable massive cementite can be so obtained in iron sulphide alloys I shall presently show.

If it could be shown that sulphur in some form of combination with the iron and carbon does crystallise with the carbides, and that such mixture or solid solution is stable and not readily decomposed, it would be reasonable to conclude that the sulphur is responsible for the stability.

It has been suggested that silicon in iron decomposes the carbides according to the following chemical reaction: $3Si - {}^2Fe_3C = {}^3Fe_2Si - 2C$. The only objection to this explanation is that the silicon is not free in cast iron, as was

[1] "Journal of the Iron and Steel Institute." No. 2, 1908.

proved by Turner, and, moreover, as will be shown presently, it is combined with iron in solid solution before the carbide is decomposed.

Gontermann[1] found that on adding pure silicon to molten iron, the iron and silicon combined with considerable rise in temperature, and I have noticed the same thing even when adding it to carburised iron.

The same authority, who has made a most careful study of the ternary alloys of the iron-carbon-silicon series, has shown that the eutectic freezing-point rises with the silicon from 1130° when silicon is absent, to about 1150° when it reaches 10 per cent., and to 1175° when it is about 17 per cent., and that the carbon in the eutectic of the alloys containing between 0 per cent. and 10 per cent. silicon, falls as the silicon rises by about 0·3 per cent. for each unit of silicon.

The same author proved that the pearlite reversion point in these alloys rises with the silicon on an average of about 30° C. for each unit of silicon in the alloys containing between 0° and 6 per cent. silicon. He concluded, but did not actually prove, that in the region of the curve of unvarying equilibrium two cementites crystallise; one a solid solution of the carbide and silicide of iron; and a second, a mixture of this with another ternary iron-silicon-carbon solid solution.

If the composition of the alloy lies between the curve of saturated silico-austenite and the curve of non-varying equilibrium, saturated silico-austenite primarily forms; and following this a secondary crystallisation of a binary eutectic consisting of this saturated austenite and silico-cementite.

In the year 1901 I described certain unique idiomorphic crystals which had been found in the hearth of a disused blast furnace at Blaina. The crystals were more or less oxidised on their exterior surfaces.

The analysis was as follows :—

	After deducting the Oxygen, &c. Per cent.
Manganese	54·56
Iron	37·71
Carbon	3·91
Silicon	3·82
	100·00

A micro-examination proved the crystals to be quite homogeneous mixtures, or solid solutions. It was difficult to assign to them any definite chemical constitution. They may be considered as silico-carbides of manganese and iron, and, as will be shown presently, bear a close relation to similar crystals which primarily form during the freezing of iron-carbon-silicon alloys.

Having briefly referred to the work of a number of authorities, I now propose to describe my attempts to supplement our knowledge in this direction by a purely micro-chemical research.

In order to understand the remarks which follow, it is necessary briefly to describe the changes which occur when pure iron-iron carbide alloys pass from the liquid to the solid state as are indicated by the researcehs of Osmond, Roberts-Austen, Stansfield, and of Carpenter and Keeling.

In the iron alloys containing less than the eutectic proportion of 4·3 per cent. carbon, described as hypo-eutectic alloys, austenite octohedral crystallites of the fir-tree type first fall out of solution, and these continue to grow until the liquid is so impoverished of iron and enriched in carbon that when the eutectic proportion of 4·3 per cent. carbon is reached, the liquid solidifies and breaks up into carbide of iron and austenite.

The hypereutectic alloys, containing more than the eutectic proportion of carbon, on cooling, first yield carbide of iron crystals, and these continue to grow until, by removal of the excess carbon, the eutectic proportions of iron and carbon are reached. The eutectic in its turn then freezes.

For the purpose of my research it was necessary to select pig metals, grey and high in silicon and white with high sulphur. These were kindly supplied by Messrs. Wilson, Pease and Co. and Messrs. Cochrane and Co., Middlesbrough. They were made from Cleveland ironstone and contained :—

	White	Grey Glazed Iron No. 1	Grey Glazed Iron No. 2
	Per cent.	Per cent.	Per cent.
Combined carbon ...	2·98	nil	trace
Graphite	traces	2·65	3·300
Manganese	0·29	0·72	0·676
Silicon	1·89	5·21	4·321
Sulphur	0·27	0·03	0·025
Phosphorus	1·62	1·56	1·660

It may be accepted that the sulphur in the white iron undoubtedly is the cause of the whiteness of the iron, whilst the excessively high silicon and low sulphur are equally responsible for the graphitic condition of the carbon in the grey irons.

The micro-structure of the high silicon metal was characteristic of all phosphoretic, high-silicon, carbon alloys. Curved plates of graphite cut the mass in many directions, whilst the binary eutectic of phosphorus and iron remained in irregular patches, generally midway between the graphite plates. The ground mass occupying the space between the eutectic and graphite plates consisted of silico-ferrite.

The interesting feature about the structure of the white iron is that there was no iron-iron-carbide eutectic. This had been replaced by the ternary eutectic of iron-phosphorus and carbon, which, according to Dr. Wüst, contains about :—

	Per cent.
Iron	91
Phosphorus	7
Carbon	2
	100

There was evidence that the primary crystals of austenite of the octohedral skeleton type had been the first to fall out of solution, that the second crystal to form consisted of short plates of carbide of iron (cementite); whilst the ternary eutectic of phosphorus, carbon, and iron was the last to freeze and occupied spaces between the cementite plates and the primary crystals.

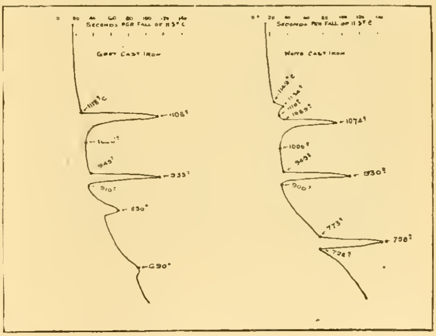


Diagram showing arrest in cooling; grey iron No. 2 on left, white iron on right.

Dr. Carpenter and his assistant, Mr. Edwards, of Victoria University, Manchester, kindly obtained, for the purpose of this address, the cooling curves of these two typical metals. These were as follows :—

Grey Iron.

The long arrest at 1118° indicates a change of state, but is also coincident with important chemical changes. The second long arrest at 945° is due to freezing of the iron phosphorus carbon eutectic. The arrest at 850° indicates the formation of pearlite, and corresponds closely with the arrest in a similar alloy examined by Gontermann. The arrest at 690° is probably due to the formation of pearlite in the eutectic of iron and phosphorus, and is of great interest, for it points to the conclusion that silicon is not a constituent of the austenite of the ternary eutectic.

[1] "Anorganische Chemie, Bd. 59, 1908.

White Iron.

The micro-structure and analysis help more fully to explain the arrests on cooling this alloy.

The first arrest, at 1149° C., is where the primary austenite crystallises with the silicon, as will be shown presently.

The second arrest is where the primary cementite plates freeze.

The third arrest, at 945°, is the freezing point of the ternary eutectic, and is identical with that of the corresponding long arrest of the grey iron.

The fourth arrest, at 77°, is coincident with the formation of pearlite.

Bearing in mind that the manganese in the white iron was insufficient to combine with the whole of the sulphur present to form manganese sulphide, it is obvious that some other compound or compounds of sulphur existed. The microscope clearly revealed the presence of manganese sulphide and traces of free iron sulphide.

The carbide plates were quite free from striations of sulphide, such as had been noticed by Mr. Levy in the eutectic of high sulphur irons.

But for the sulphur present, the silicon would have been sufficient to effect a decomposition of the carbides, and the metal in absence of the sulphur would have given a grey instead of a white fracture. In view of this conclusion, it appeared to be probable that if manganese were to be melted with the metal, it would combine with the sulphur associated with iron, &c., and crystallise as MnS, previous to the solidification of the carbide, or independently, and that the metal would then become grey on cooling.

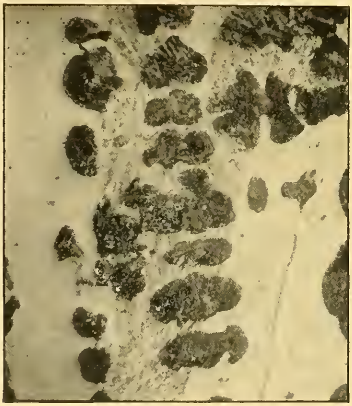


FIG. 1.—Cleveland White Iron.
White = massive plates of Fe_3C.
Dark = pearlite, the decomposed austenite.
White and half-tone = ternary Fe—C—P eutectic.

In order to test this, a portion of the metal was melted in a clay pot with a little pure manganese, free from carbon—sufficient to give 1 per cent. of manganese, which was more than sufficient to combine with the whole of the sulphur. As soon as the mass was melted it was at once poured into a sand mould and allowed to set. When cold, it broke with a grey fracture corresponding to what is known as hard forge, and the combined carbon, instead of being about 3 per cent., was reduced to 0·6 per cent., a result proving the correctness of the hypothesis.

It is well known that when manganese or chromium and some other metals are present in large quantities in pig irons, these metals, as carbides, crystallise with the carbide of iron, forming double carbides, and these are much more stable than the massive pure iron carbide. It appeared reasonable to believe that if sulphide of iron, or some iron-sulpho-carbon compound, were to crystallise with the carbides it would have a similar effect.

Remembering that the conclusions on this question, as to whether sulphur does or does not crystallise with the carbides, are conflicting, it is evident that the only possible way to find out whether sulphur does so crystallise is to separate the carbide from the iron and test it for sulphur. With this object, a considerable quantity of the original Cleveland white metal was crushed to the very finest powder. It was then treated with a 10 per cent. solution of hydrochloric acid in water in large excess, and the action of the acid was allowed to continue until evolution of gas ceased. The insoluble matters, consisting mainly of carbides and phosphides, were filtered off, washed and dried, and were ground down in an agate mortar to a still finer powder, so as to liberate any mechanically entangled sulphides. The powder so dealt with was again treated with acid as before, after which the residue was filtered off, thoroughly washed with water, was transferred to a separate vessel, and was boiled with strong caustic-potash to dissolve any decomposition products.

The residue was again filtered off, was washed and dried, and submitted to analysis. The residue when dried weighed about 45 per cent. of the original metal, and contained as follows:—

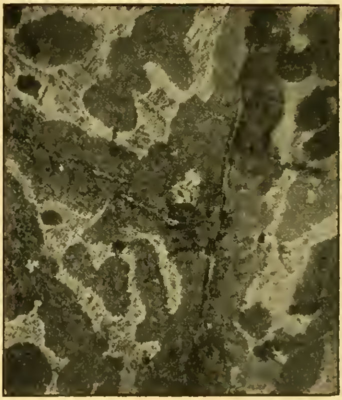


FIG. 2.—Cleveland Glazed Iron.
Ground mass = silico-ferrite.
White complex = iron—iron phosphide eutectic.
Straight dark lines = graphite.

	Per cent.
Iron	92·43
Carbon	6·06
Silicon	0·12
Sulphur	0·12
Phosphorus	0·97 (6·2 per cent. phosphide of iron)
Water, &c.	0·30
	100·00

A second trial was made with the same metal; but, in this case, repounding and acid treatment were repeated three times, so as to eliminate the possibility of mechanical inclusion of sulphide or iron. The sulphur found in the remaining carbides was 0·1 per cent.

As the manganese in this metal was not sufficient to form manganese sulphide with the sulphur, it seemed desirable to determine whether or not, when the manganese is in sufficient quantity, sulphur would crystallise with the carbide. For this purpose the white chilled part of a crushing roll was experimented upon. The centre part was open grey iron, and contained 3·1 per cent. of the carbon as graphite.

The white chilled portion contained:—

	Per cent.
Combined carbon	3·75
Graphitic carbon...	Trace
Manganese	0·65
Silicon	0·70
Sulphur	0·10
Phosphorus	0·23

It was crushed to powder and treated exactly in the same way as previously described for the separation of carbide. The residue contained by analysis:—

	Per cent.
Silicon	0·028
Sulphur	0·016

a result showing that only a minute quantity of sulphur was crystallised with the carbide. Whether a different result would follow if both sulphur and manganese were greatly increased has yet to be determined.

Having proved that sulphur in some undetermined state of chemical combination does crystallise with carbide of iron, an attempt was made to determine the maximum amount of that element the carbide will retain under the most favourable conditions. With this object in view, a considerable quantity of very pure white iron, containing only traces of silicon, sulphur, and phosphorus, and 3·5 per cent. of carbon, was melted in a plumbago crucible, and when in a molten condition sticks of roll sulphur were forced under the surface of the metal, and afterwards the mixture was briskly shaken up with the sulphur which had liquefied on the surface.

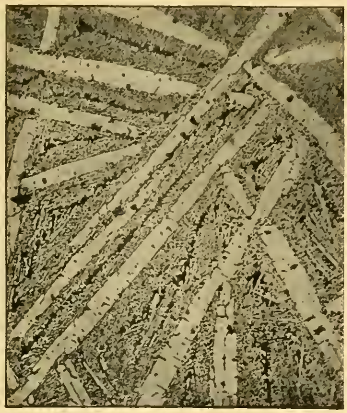


Fig. 3.—Iron-Carbon-Sulphur Alloy (4·37 per cent. Carbon).
White thick bands = massive carbide of iron.
Complex structure = iron—iron-carbide-sulphide-pearlite eutectic.

Precisely the same result was obtained as described by Karsten, who had made a similar experiment. A metal was produced having a white fracture and large cleavage faces. The micro-structure was similar to that of hyper-eutectic iron carbon alloys. Large plates of carbide cut the metal in many directions, whilst between the carbide plates was located the triple carbide-sulphide-pearlite eutectic, so accurately described by Mr. Donald Levy.

The carbide plates themselves were peculiar in having circular prismatic inclusions of sulphide of iron symmetrically arranged at right angles to the sides of the plates. In horizontal sections of these plates they appeared as circular dots, sometimes arranged in continuous lines, suggesting that the sulphide had been actually in solution with the carbide when the metal was liquid, that they fell out of solution together, the sulphide separating and segregating along the cleavages of the carbide.

A portion of this sulphurous material was remelted and treated with a second quantity of sulphur. This time, in addition to sulphide of iron, a considerable quantity of the soot-like substance described by Karsten floated to the surface, and free graphite separated and stuck to the sides of the crucible.

The analyses of these metals are as follows:—

	After the first addition of Sulphur Per cent.	After the second treatment with Sulphur Per cent.
Carbon	4·37	4·39
Sulphur ...	about 1·00	1·00
Silicon	0·03	0·05

From which we may conclude that the maximum degree to which the carbon can be concentrated by this method is about 4·4 per cent. In these trials the carbide certainly had sufficient opportunity to become saturated with sulphur in each case. Both of the metals were crushed to exceedingly fine powder, and were treated with acid to decompose the free sulphides. The residues were repounded and treated with acid a second time, and afterwards with strong potash solution. After this treatment, analyses of the insoluble residues indicated in one case 0·09 per cent. sulphur, and in the other 0·08 per cent. *From this it would appear that carbides will not carry in solid solution more than about 0·1 per cent. of sulphur.*

Fig. 4.—Same as Fig. 2, heat-tinted and more highly magnified.
Broad bands = massive carbide of iron with inclusion of sulphide of iron.
Complex structure = jointed eutectic of Fe—Fe_3C—FeS.
The white specks are all FeS.

The metal containing 4·37 per cent. carbon and 1 per cent. sulphur, even on prolonged annealing, did not become graphite, a proof that the massive carbides present were quite stable.

The microscope reveals the fact that in almost all commercial white irons containing much sulphur the greater part of the sulphur is combined with either manganese or iron, and that the sulphides mainly exist as independent inclusions. It appears reasonable to assume that the manganese sulphide is without influence on the carbon condition, and that, although iron sulphide may have some influence, in the way suggested by Mr. Levy, on the eutectic, *it is the sulphur that crystallises with the carbide which is mainly responsible in preventing the separation of graphite by making the carbide more stable.*

If it is assumed that the stability of the carbide depends on the quantity of sulphur which crystallises with it, and not on the total amount present in the metal carrying the carbides, it is clear that a great field of research is now open, the borders of which I have barely touched to corelate their stability and sulphur contents.

The microscope does not show in what constituent the silicon crystallises. It is known that in grey irons it is associated with the ferrite and pearlite; but grey iron is the final result of the decomposition of carbide of iron and possibly silico-carbides, which primarily form during solidification, and although the silicon in the decomposed product may be entirely associated with the iron, it is no proof that initially some of it may not have crystallised with the carbides.

In the white Cleveland iron, previously referred to, it is probable that the several constituents are present in the following proportions:—

	Per cent.
Silico-pearlite, the residue of the original austenite octahedral crystallites	42·50
Iron carbide in plates	33·66
Iron, phospho-carbide eutectic	23·10
Manganese sulphide	0·38
Iron sulphide	0·36
	100·00

When fractionally dissolving the powdered metal in acid, it was the iron and associated silicon of the pearlite which passed into solution, and the carbide and phosphide which remained insoluble, and as these contained only 0·12 per cent. silicon, or about 0·06 per cent. on 100 parts

FIG. 5.—Same as Fig. 4. Section cut parallel to the surface of a massive carbide plate.
The ground mass is carbide of iron.
The white dots are sulphide of iron.

of the original metal, it is evident that the pearlite must have contained $1·89 - 0·06 = 1·83$ per cent. of the silicon, or on 100 parts of it $\frac{100 \times 1·83}{42·5} = 4·3$ per cent., and that about 97 per cent. of the total silicon had crystallised with the austenite.

A little reflection will lead to the conclusion that if the carbon in the Cleveland white iron were to be gradually increased, the proportion of primary austenite crystallites would decrease; there would be less and less of them to carry the silicon, and this element would be concentrated in the diminishing solid austenite. It also follows that if the carbon were to be so increased that no primary austenite would form, the silicon would have to crystallise in some other constituent.

In the example, referred to above, of the chilled casting, the carbides contained only 0·028 per cent. silicon, or 0·016 per cent. on the original metal. In this case, therefore, about 98 per cent. had crystallised with the primary austenite.

The question as to what amount of silicon will crystallise with the austenite so as to saturate it is probably variable with other variables. To determine this by chemical analysis would involve an exceedingly tedious research.

It is probable that as it increases, and as the austenite approaches more and more nearly to the saturation point, a gradually increasing proportion of the silicon will crystallise with the carbides.

It is well known that molten low silicon grey irons, in the absence of any appreciable quantity of sulphur, gives a white fracture when slightly chilled. Irons with above 5 per cent. silicon, when similarly treated, are supposed not to behave in the same manner, and this is quite true when any ordinary method of chilling is adopted. For instance, when the liquid silicious glazed metal No. 1 was run into water, the chilled iron contained graphite; but when a large drop was suddenly pressed into a sheet as thin as paper between cold plates of iron, the chilled metal was quite white, and no graphite could be detected on dissolving it in nitric acid. The metal so chilled was difficult to dissolve in acid, and the silica produced, instead of forming a gelatinous bulky residue, remained in a close, dense condition—indeed, the thin chilled sheet, after all soluble matter had been removed, remained a rigid sheet of dense coherent silica, whereas the same metal allowed to cool slowly from the liquid state in a sand mould yielded to acid gelatinous silica.

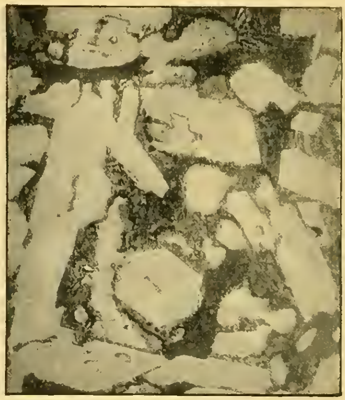


FIG. 6.—Glazed Cleveland Iron after melting with a little Sulphide of Iron.
White crystals = primary carbo-silicide of iron.
Dark = the second cementite.
Complex structure = iron-carbon-phosphorus eutectic.

The different behaviour to acid treatment of the chilled as contrasted with that of the slowly cooled metal indicates that the condition of the silicon in rapidly chilled metal is different from its condition in the same metal slowly cooled.

In 1895 Mr. T. W. Hogg, of Newburn Steel Works, published an account of a very interesting observation, in which he showed the difference in the silicon solubility in different parts of the same pig iron, a portion of which was white and a portion grey. The iron referred to contained:—

	White part Per cent.		Grey part Per cent.	
Combined carbon	3·88	4·33	0·98	4·66
Graphitic carbon	0·45		3·68	
Silicon	0·65		0·85	
Manganese	1·63		1·60	

He determined the solubility in dilute acid of the silicon in each portion, and found that the silicon soluble in hydrochloric acid was, in the grey part = about 81 per cent. and in the white part = about 48 per cent.

He found also that the silica left on treating the two varieties of metal in acid differed in character—that from the white portion was dense, whilst that from the grey metal was much more voluminous. The white metal contained the eutectic proportion of carbon, and therefore it could not contain any austenite crystallites; indeed, with the silicon 0·60 per cent. also present, it must be regarded as a hypereutectic alloy, and on that account we are forced to conclude that the silicon must have crystallised with the carbide.

It has long been known that on dissolving grey ferrosilicon containing even 6 per cent. silicon the silica gelatinises, whereas when the silicon approaches 10 per cent. much of the silica remains in a dense form. It is almost certain that during the solidification of the grey part of Mr. Hogg's pig iron a rich silicon cementite must have primarily formed, for the high carbon would not allow the formation of any primary silico-austenite; when this cementite decomposed the silicide part of it would become diluted with the iron of the decomposed carbide. It was, no doubt, this diluted solid solution in the cold grey metal which yielded the gelatinous silica.

That silicon does diffuse into iron, even at relatively low temperature, was proved by Lebeau. He found that free silicon and iron, when heated together *in vacuo* at 960° C., chemically combine, a fact I have fully confirmed, although it is impossible to get silicon to combine with iron on heating them together in a cementation furnace where oxidising gases have access to the silicon.

FIG. 7.—An Iron-Carbon-Silicon Alloy, free from Phosphorus, made more stable by Sulphur.
Broken-up structure in the centre=the eutectic of two cementites, silico-carbide and carbide.
Half-tone=the carbide cementite.
Dark area=decomposed eutectic.
Light portion at right lower corner=crystallite of silico-pearlite.

To determine whether silicide of iron would diffuse into and precipitate the graphite in white iron, a sample of crushed white iron free from impurities, containing 3·5 per cent. of carbon, was mixed with 10 per cent. by weight of a silicon alloy containing 20 per cent. of silicon ($=Fe_2Si$), also in powder. The mixture, after compression in a short piece of iron tube, was heated for two hours at 1000° C. in an atmosphere of hydrogen gas, and was then removed and cooled in air.

For comparison, a portion of the crushed white iron was treated in the same way.

The combined carbon in the metals before and after heating were as follows:—

	Before Per cent.	After Per cent.
In while metal alone	3·5	3·44
,, ,, and silicide	3·20	0·60

Not only does this trial prove that silicide does diffuse into carbide of iron and precipitate graphite, it has also an important bearing on the question as to why silicon in pig iron, even in small quantities, causes the carbide to be decomposed. In the experiments with the chilled part of a casting containing only 0·7 per cent. silicon and 3·75 per cent. carbon, it was shown that the carbide contained only 0·028 per cent. silicon, and that 98 per cent. of the total silicon was concentrated in the pearlite; yet this white iron, on heating to 1000° C., became quite grey. *Are we not justified in concluding that it was the diffusion of silicide of iron from the silico-austenite into the carbides which caused the separation of graphite?*

As I had proved, first that sulphur crystallises with and makes the carbide of iron more stable, and second that in the presence of a fusible mother liquor rich in phosphorus, after the austenite crystallisation is complete, the carbide crystallises out in plates and not as iron carbide eutectic, it appeared probable that if, as Gontermann premised, two kinds of cementite actually form during the solidification of iron-carbide-silicon alloys, it might be possible to obtain them in a separate state by melting the rich silicon alloys with a little sulphur.

In order to test this, a portion of the No. 1 grey glazed metal was melted, and when fluid a little sulphide of iron was mixed with it. The mixture was then cast in sand.

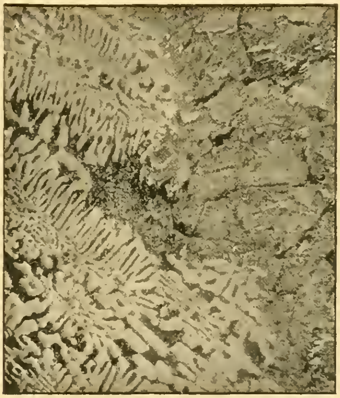


FIG. 8.—Pure Iron-Iron Carbide Eutectic, the cooling of which was arrested before the complete decomposition of the Carbides into Austenite and Graphite.
White=carbide of iron. Black lines=graphite.
Half-tone=pearlite.

Owing to the rapidity of the melting, some of the graphite escaped and floated on the surface of the metal.

When cold it was found that the lower part of the small casting gave a white fractured surface, whilst the upper part was close grey.

The analyses were as follows:—

	White part Per cent.	Grey part Per cent.
Combined carbon	2·06	0·60
Graphite	trace	1·46
Manganese	0·03	0·03
Silicon	5·41	5·40
Sulphur	0·88	0·91
Phosphorus	1·50	1·50

The grey part, although slowly attacked by cold acid, did dissolve, yielding much voluminous silica. The white part was almost inert, and only dissolved in strong hydrochloric acid with difficulty, and when the iron was dissolved out the remaining silica was of the dense variety, from which it would appear that the effect of the sulphide is akin to that of sudden quenching.

It was the micro-structure of the white portion, however, which was of unique interest. On "heat-tinting" two kinds of hard crystals appeared, one more readily coloured by heating than the other. The more resistant crystals were idiomorphic, and were furnished with their terminal angles, but as they were embedded in the surrounding metal it was impossible to form any exact idea of the crystalline system to which they belonged.

The second order of crystals had evidently solidified at a later period, as their forms were interfered with by those of the idiomorphic type; they were much like ordinary plates of carbide of iron. The ground mass contained indications of octahedral on fir-tree crystallites and a well-developed phosphorus iron eutectic of the honeycomb type. This eutectic was the last to freeze, as it filled the spaces between the plates of the hard crystals. There was no pearlite excepting in the eutectic of phosphorus and iron. We can only tentatively conclude that, of the two cementites, the idiomorphic crystals contained the greater part of the silicon, because of their greater resistance to oxidation, and probably consisted of carbo-silicide of iron, with sufficient sulphur in them to make them stable; also that the second crystals were carbide of iron, possibly containing a lesser quantity or no silicide in solid solution.

A further series of experiments was made on a portion of the same metal. In this case the molten iron was mixed and agitated with free sulphur instead of sulphide of iron, and the metal was at once poured into a sand mould in a thin layer. When cold it was quite white in fracture, and had large, brilliant cleavage faces.

It had the following composition:—

	Per cent.
Combined carbon	2·60
Manganese	Trace
Silicon	6·65
Sulphur	0·93
Phosphorus	2·08

The sulphur had evidently effected concentration of the silicon, phosphorus, and carbon by removing some of the iron, as sulphide of iron was actually formed and floated on the surface of the iron. It was fractionally dissolved as described in previous cases, and the residue (72 per cent. of the weight of the original metal) was tested and found to contain:—

	Per cent.
Carbon	2·92
Manganese...	Trace
Silicon	6·70
Sulphur	0·062
Phosphorus	1·410

This insoluble fraction evidently consisted of both classes of crystals, together with some phosphide of iron. Efforts were made to separate the crystals by chemical means, but without success.

On the long and continued action of strong hydrochloric acid a residue was obtained containing a little less carbon and more silicon than were present in the mixture, an indication that the less soluble portion is different from that more soluble.

The micro-structure was similar to that of the metals of the previous trial, but as the carbon and silicon were higher the carbo-silicide was in greater quantity. It crystallised in long flat plates, and not in relatively short idiomorphic crystals.

It is probable exception may be taken, with some justification, that the sulphur does not simply arrest the decomposition of the cementites, which I have premised primarily form, but may act in some other unknown way. An attempt was therefore made to find out whether they could be obtained by some other method without the aid of sulphur. As it is known that the ternary eutectic of iron, phosphorus, and carbon melts at about 945° C., it appeared probable that if silicon in small quantity were to be melted with an iron-carbon-phosphorus alloy very rich in phosphorus, the two kinds of cementites would fall out of solution at a lower temperature, and would probably not decompose into graphite and silico-austenite in cooling down after their formation. To ascertain whether or not this would be the case, a fusible iron-phosphorus-carbon alloy containing more than the eutectic proportion of carbon was made. It had the following composition:—

	Per cent.
Iron	91·89
Phosphorus...	5·37
Carbon	2·62
Silicon, &c.	0·10
Sulphur	0·02
	100·00

Four hundred grams were melted with sufficient silicon alloy to yield in the mixture:—

	Per cent.
Carbon	2·4
Phosphorus	5·0
Silicon	2·90
Sulphur	0·02

When melted, a portion of it was cast in a sand mould; the remainder was allowed to cool in the crucible.

When cold, that cooled in the crucible was quite grey, whilst the portion cooled in sand was white at the lower part and grey on the top part of the casting, results which proved that the alloy was very unstable, and that decomposition of the lower part of the casting was arrested by the slight chilling effect of the cold sand.

On microscopic examination of the white portion, the ground mass was found to consist of the binary phosphorus iron eutectic, whilst two different cementites were embedded in it; one much more rapidly coloured on "heat-tinting" than the other. The colours of the constituents of the properly heated and polished metal were as follows:—

Cementite (*a*)	White
,, (*b*)	Red
Phosphide of iron	Purple
Iron pearlite crystallites	Grey

The part which broke with a grey fracture consisted of octahedral crystallites of silico-pearlite, the binary phosphorus iron eutectic, and undecomposed (red) cementite crystals, but there was a complete absence of the (white) cementite crystals. Graphite was also present in exceedingly fine plates, resembling what is known as temper graphite.

The evidence here is conclusive that even in the absence of sulphur:—

1st. Two cementites had formed.

2nd. That one cementite is much more unstable than the other variety, and decomposes in advance into silico-austenite and graphite.

Having proved that two different kinds of cementite do actually form and crystallise in the phosphorus eutectic, it remained to ascertain in what way these crystallise in the absence of the phosphorus eutectic.

For this purpose two hypo-eutectic alloys were prepared without any phosphorus, but with sufficient sulphide of iron to check the decomposition of the carbides.

They contained:—

	1 Per cent.	2 Per cent.
Carbon	2·40	2·10
Silicon...	3·17	7·10
Sulphur	1·21	0·82
Phosphorus	0·02	0·02

These when cold, after casting in sand, broke with white fractures.

The carbides separated in the manner previously described contained:—

	1 Per cent.	2 Per cent.
Carbon	6·16	3·00
Sulphur	0·09	0·08
Silicon	0·97	7·93
Percentage of carbides insoluble in acid	27·5	50·00

The repeated acid treatment in this, as in all previous cases, no doubt dissolved a portion of the carbides, and what was actually weighed represented only a part of those actually present in the alloys.

In No. 2 alloy, after polishing and "heat-tinting," the microscope proved the presence of a few fir-tree crystallites embedded in a ground mass of cementite and a eutectic containing the two kinds of cementite, the No. 1 specimen containing a much smaller proportion of the cementite rich in silicon than No. 2.

As the metals had been somewhat rapidly cooled, the alloy No. 2 was remelted, and was then allowed to cool in the crucible, so as to obtain a more coarsely crystallised eutectic. When cold, on polishing and "heat-tinting," the eutectic was clearly seen. There were the remains of large primary silico-austenite crystallites, plates of the red-coloured cementite, and a well-developed eutectic consisting of the (red) coloured and (white) cementites.

The cooling having been slow, this compound constituent had suffered partial decomposition in isolated patches into graphite and silico-ferrite, whilst the cementite coloured red remained intact.

There can be little doubt that the residue left insoluble in acid consisted of the two cementites, but in what proportion it is impossible to tell, as a method for isolating them has yet to be found.

Had the alloy contained a greater proportion of carbon, the amount of cementite rich in silicon would have been in much greater proportion.

The trials, incomplete and necessarily imperfect as they are, go far to prove, just as Gontermann premised, that during the solidification of high silicon pig irons two cementites fall out of solution together as a eutectic mixture.

They also have proved that the carbo-silicides are exceedingly unstable, breaking up into silico-austenite almost as soon as formed. *It is the instability of these silico-carbides which is mainly responsible for the graphitic character of grey irons rich in silicon and low in sulphur.*

Summary and Conclusions.

(1) The experimental results advanced show proof that carbide of iron in presence of iron sulphide crystallises with a minute quantity of sulphur not exceeding about one-thousandth part of the weight of the carbide, but the nature of the iron-carbon-sulphur compound has not yet been determined.

(2) It seems almost, if not absolutely, certain that it is the sulphur crystallised with the carbide which makes the latter stable.

(3) The evidence appears to support the view, long held by some, and more recently accepted by others, that during the freezing of iron-carbon-hypo-eutectic alloys after the crystallisation of the primary austenite, and in the eutectic and hypereutectic alloys, it is the carbide, and not graphite, which primarily forms, and that the carbide afterwards decomposes into graphite and austenite.

(4) It has been proved by chemical methods that when the hypo-eutectic alloys, low in silicon, freeze, nearly all the silicon crystallises out with the primary austenite; and it follows that on gradually increasing the carbon so as to reduce the quantity of primary austenite, the silicon remaining constant, the austenite which does form must be as gradually enriched in silicon up to saturation point, and, when that point is reached, the excess silicon crystallises out with a portion of the carbide of iron to form carbo-silicide of iron. Other elements remaining constant, the same result must follow on gradually increasing the silicon.

(5) In the alloys of eutectic proportion and in the hyper-eutectic alloys, as no primary austenite can form, the silicon crystallises primarily with the carbide.

(6) In Cleveland pig iron containing about 1·5 per cent. phosphorus, a ternary eutectic of iron-carbon-phosphorus takes the place of the iron-iron-carbide eutectic. In white irons containing 3 per cent. carbon and under 2 per cent. silicon, after the primary austenite has fallen out of solution, carrying practically all the silicon, it is not iron-iron-carbide which forms, but independent plates of cementite, or carbide of iron, and after these have crystallised and the residual mother liquor has arrived at the composition of the ternary iron-carbon-phosphorus eutectic, the latter solidifies at 945° C.

(7) In Cleveland irons which become grey on cooling, and in which there is no primary austenite, the same iron-carbon-phosphorus eutectic is the only eutectic to form during cooling, and, instead of a ternary iron-carbon-silicon eutectic, two independent cementites crystallise—one a silico-carbide and the other carbide of iron, possibly containing a little silicide in solid solution. The micro-examination of the cold alloys, to which a little sulphur had previously been added when the metals were melted, led to the conclusion that it is the carbo-silico-cementite which primarily crystallises.

(8) There is evidence that the primary carbo-silicides are exceedingly unstable, and are the first to decompose into graphite and silico-austenite.

(9) In the absence of any sensible quantity of phosphorus, two cementites form—one the silico-carbide cementite, the other the carbide cementite—and these crystallise together as a eutectic mixture.

(10) The exact composition of the two cementites has not yet been determined, as no chemical method has been found for their isolation.

(11) It is evident that it is the exceedingly unstable character of the silico-carbides which is responsible for the greyness of commercial metals rich in silicon and low in sulphur.

(12) Silicide of iron when heated at 1000° C. with pure white iron free from silicon effects the decomposition of the carbide of the white iron. Based on this observation, the hypothesis seems justifiable, in cases where all the silicon present in hypo-eutectic alloys crystallises out with the primary austenite, that after the carbide has solidified diffusion of the silicide follows, and this leads to the decomposition of the carbide of iron into graphite of iron.

(13) Many of the results arrived at by chemical analysis support the hypothetical conclusions of Gontermann, who depended mainly on data obtained by thermal methods of treatment.

In conclusion, it will be clear from what I have stated that there are many gaps yet to be filled. I hope that the knowledge of this fact will lead others to follow up the research, which, in its present stage, is far from complete.

SUB-SECTION OF B.

AGRICULTURAL SUB-SECTION.

Opening Address by A. D. Hall, M.A., F.R.S., Chairman of the Sub-section.

I believe it is customary for anyone who has the honour of presiding over a section of the British Association to provide in his presidential address either a review of the current progress of his subject or an account of some large piece of investigation by which he himself has illuminated it. I wish I had anything of the latter kind which I could consider worthy to occupy your attention for the time at my disposal; and as to a review of the subject, I am not without hopes that the sectional meetings themselves will provide all that is necessary in the way of a general review of what is going forward in our department of science. I have, therefore, chosen instead to deal from an historic point of view with the opinions which have prevailed about one central fact, and I propose to set before you this morning an account of the ebb and flow of ideas as to the causes of the fertility of the soil, a question which has naturally occupied the attention of everyone who has exercised his reason upon matters connected with agriculture. The fertility of the soil is perhaps a vague title, but by it I intend to signify the greater or less power which a piece of land possesses of producing crops under cultivation, or, again, the causes which make one piece of land yield large crops when another piece alongside only yields small ones, differences which are so real that a farmer will pay three or even four pounds an acre rent for some land, whereas he will regard other as dear at ten shillings an acre.

If we go back to the seventeenth century, which we may take as the beginning of organised science, we shall find that men were concerned with two aspects of the question—how the plant itself gains its increase in size, and, secondly, what the soil does towards supplying the material constituting the plant. The first experiment we have recorded is that of Van Helmont, who placed 200 lb. of dried earth in a tub, and planted therein a willow tree weighing 5 lb. After five years the willow tree weighed

169 lb. 3 oz., whereas the soil, when redried, had lost but 2 oz., though the surface had been carefully protected meantime with a cover of tin. Van Helmont concluded that he had demonstrated a transformation of water into the material of the tree. Boyle repeated these experiments, growing pumpkins and cucumbers in weighed earth, and obtaining similar results, except when his gardener lost the figures, an experience that has been repeated. Boyle also distilled his pumpkins, &c., and obtained therefrom various tars and oils, charcoal and ash, from which he concluded that a real transmutation had been effected, "that salt, spirit, earth, and even oil (though that be thought of all bodies the most opposite to water) may be produced out of water."

There were not, however, wanting among Boyle's contemporaries men who pointed out that spring water used for the growing plants in these experiments contained abundance of dissolved material, but in the then state of chemistry the discussion as to the origin of the carbonaceous material in the plant could only be verbal. Boyle himself does not appear to have given any consideration to the part played by the soil in the nutrition of plants, but among his contemporaries experiment was not lacking. Some instinct seems to have led them to regard nitre as one of the sources of fertility, and we find that Sir Kenelm Digby, at Gresham College in 1660, at a meeting of the Society for Promoting Philosophical Knowledge by Experiment, in a lecture on the vegetation of plants, describes an experiment in which he watered young barley plants with a weak solution of nitre, and found how their growth was promoted thereby; and John Mayow, that brilliant Oxford man whose early death cost so much to the young science of chemistry, went even further, for, after discussing the growth of nitre in soils, he pointed out that it must be this salt which feeds the plant, because none is to be extracted from soils in which plants are growing. So general has this association of nitre with the fertility of soils become, that in 1675 John Evelyn writes: "I firmly believe that where saltpetre can be obtained in plenty we should not need to find other composts to ameliorate our ground"; and Henshaw, of University College, one of the first members of the Royal Society, also writes about saltpetre: "I am convinced, indeed, that the salt which is found in vegetables and animals is but the nitre which is so universally diffused through all the elements (and must therefore make the chief ingredient in their nutriment, and by consequence all their generation), a little altered from its first complexion."

But these promising beginnings of the theory of plant nutrition came to no fruition; the Oxford movement in the seventeenth century was but the false dawn of science. At its close the human mind, which had looked out of doors for some relief from the fierce religious controversy with which it had been so long engrossed, turned indoors again and went to sleep for another century. Mayow's work was forgotten, and it was not until Priestly and Lavoisier, De Saussure, and others, about the beginning of the nineteenth century, arrived at a sound idea of what the air is and does that it became possible to build afresh a sound theory of the nutrition of the plant. At this time the attention of those who thought about the soil was chiefly fixed upon the humus. It was obvious that any rich soils, such as old gardens and the valuable alluvial lands, contained large quantities of organic matter, and it became somewhat natural to associate the excellence of these fat, unctuous soils with the organic matter they contained. It was recognised that the main part of a plant consisted of carbon, so that the deduction seemed obvious that the soils rich in carbon yielded those fatty, oily substances which we now call humus to the plant, and that their richness depended upon how much of such material they had at their disposal. But by about 1840 it had been definitely settled what the plant is composed of and whence it derives its nutriment—the carbon compounds which constitute nine-tenths of the dry weight from the air, the nitrogen, and the ash from the soil. Little as he had contributed to the discovery, Liebig's brilliant expositions and the weight of his authority had driven this broad theory of plant nutrition home to men's minds; a science of agricultural chemistry had been founded, and such questions as the function of the soil with regard to the plant could be studied with some prospect of success. By this time, also, methods of analysis had been so far improved that some quantitative idea could be obtained as to what is present in soil and plant, and, naturally enough, the first theory to be framed was that the soil's fertility was determined by its content of those materials which are taken from it by the crop. As the supply of air from which the plant derives its carbonaceous substance is unlimited, the extent of growth would seem to depend upon the supply available of the other constituents which have to be provided by the soil. It was Daubeny, Professor of Botany and Rural Economy at Oxford, and the real founder of a science of agriculture in this country, who first pointed out the enormous difference between the amount of plant food in the soil and that taken out by the crop. In a paper published in the Philosophical Transactions in 1845, being the Bakerian Lecture for that year, Daubeny described a long series of experiments that he had carried out in the Botanic Garden, wherein he cultivated various plants, some grown continuously on the same plot and others in a rotation. Afterwards he compared the amount of plant food removed by the crops with that remaining in the soil. Daubeny obtained the results with which we are now familiar, that any normal soil contains the material for from fifty to a hundred field crops. If, then, the growth of the plant depends upon the amount of this material it can get from the soil, why is that growth so limited, and why should it be increased by the supply of manure, which only adds a trifle to the vast stores of plant food already in the soil? For example, a turnip crop will only take away about 30 lb. per acre of phosphoric acid from a soil which may contain about 3000 lb. an acre; yet, unless to the soil about 50 lb. of phosphoric acid in the shape of manure is added, hardly any turnips at all will be grown. Daubeny then arrived at the idea of a distinction between the active and dormant plant food in the soil. The chief stock of these materials, he concluded, was combined in the soil in some form that kept it from the plant, and only a small proportion from time to time became soluble and available for food. He took a further step, and attempted to determine the proportion of the plant food which can be regarded as active. He argued that since plants only take in materials in a dissolved form, and as the great natural solvent is water percolating through the soil more or less charged with carbon dioxide, therefore in water charged with carbon dioxide he would find a solvent which would extract out of a soil just that material which can be regarded as active and available for the plant. In this way he attacked his Botanic Garden soils, and compared the materials so dissolved with the amount taken away by his crops. The results, however, were inconclusive, and did not hold out much hope that the fertility of the soil can be measured by the amount of available plant food so determined. Daubeny's paper was forgotten; but exactly the same line of argument was revived again about twenty years ago, and all over the world investigators began to try to measure the fertility of the soil by determining as "available" plant food the phosphoric acid and potash that could be extracted by some weak acid. A large number of different acids were tried, and although a dilute solution of citric acid is at present the most generally accepted solvent, I am still of opinion that we shall come back to the water charged with carbon dioxide as the only solvent of its kind for which any justification can be found. Whatever solvent, however, is employed to extract from the soil its available plant food, the results fail to determine the fertility of the soil, because we are measuring but one of the factors in plant production, and that often a comparatively minor one. In fact, some investigators—Whitney and his colleagues in the American Department of Agriculture—have gone so far as to suppose that the actual amount of plant food in the soil is a matter of indifference. They argue that as a plant feeds upon the soil water, and as that soil water must be equally saturated with, say, phosphoric acid, whether the soil contains 1000 or 3000 lb. per acre of the comparatively insoluble calcium and iron salts of phosphoric acid which occur in the soil, the plant must be under equal conditions as regards phosphoric acid, whatever the soil in which it may be grown. This argument is, however, a little more suited to controversy than to real life; it is too fiercely logical for the things themselves, and depends upon various assumptions holding rigorously, whereas we have more reason to believe that they are only imperfect approximations to the truth. Still, this view does merit our careful attention, because it insists that the chief factor in plant production must be the supply of water to the plant, and that soils differ from one another far more in their ability to maintain a good supply of water than in the amount of plant food they contain. Even in a climate like our own, which the text-books describe as "humid" and we are apt to call "wet," the magnitude of our crops is more often limited by want of water than by any other single factor. The same American investigators have more recently engrafted on to their theory another supposition, that the fertility of soil is often determined by excretions from the plants themselves, which thereby poison the land for a renewed growth of the same crop, though the toxin may be harmless to a different plant which follows it in the rotation. This theory had also been examined by Daubeny, and the arguments he advanced against it in 1845 are valid to this day. Schreiner has, indeed, isolated a number of organic substances from soils—di-hydroxystearic acid and picoline-carboxylic acid were the first examples—which he claims to be the products of plant growth and toxic to the further growth of the same plants. The evidence of toxicity as determined by water-cultures requires, however, the greatest care in interpretation, and it is very doubtful how far it can be applied to soils with their great power of precipitating or otherwise putting out of action soluble substances with which they may be supplied. Moreover, there are as yet no data to show whether these so-called toxic substances are not normal products of bacterial action upon organic residues in the soil, and as such just as abundant in fertile soils rich in organic matter as in the supposed sterile soils from which they were extracted.

As, then, we have failed to base a theory of fertility on the plant food that we can trace in the soil by analysis, let us come back to Mayow and Digby, and consider again the nitre in the soil—how it is formed and how renewed. Their views of the value of nitrates to the plant were justified when the systematic study of plant-nutrition began, and demonstrated that plants can only obtain their supply of the indispensable element nitrogen when it is presented in the form of a nitrate; but it was not until within the last thirty years that we obained an idea as to how the nitre came to be found. The oxidation of ammonia and other organic compounds of nitrogen to the state of nitrate was one of the first actions in the soil which was proved to be brought about by bacteria, and by the work of Schloesing and Müntz, Warington and Winogradsky, we learnt that in all cultivated soils two groups of bacteria exist which successively oxidise ammonia to nitrites and nitrates, in which latter state the nitrogen is available for the plant. These same investigators showed that the rate at which nitrification takes place is largely dependent upon operations under the control of the farmer; the more thorough the cultivation, the better the drainage and aëration, and the higher the temperature of the soil, the more rapidly will the nitrates be produced. As it was then considered that the plant could only assimilate nitrogen in the form of nitrates, and as nitrogen is the prime element necessary to nutrition, it was then an easy step to regard the fertility of the soil as determined by the rate at which it would give rise to nitrates. Thus the bacteria of nitrification became regarded as a factor, and a very large factor, in fertility. This new view of the importance of the living organisms contained in the soil further explained the value of the surface soil, and demolished the fallacy which leads people instinctively to regard the good soil as lying deep and requiring to be brought to the surface by the labour of the cultivator. This confusion between mining and agriculture probably originated in the quasi-moral idea that the more work you do the better the result will be; but its application to practice with the aid of a steam plough in the days before bacteria were thought of ruined many of the clay soils of the Midlands for the next half-century. Not only is the subsoil deficient in humus, which is the accumulated débris of previous applications of manure and vegetation, but the humus is the home of the bacteria which have so much to do with fertility.

The discovery of nitrification was only the first step in the elucidation of many actions in the soil depending upon bacteria—for example, the fixation of nitrogen itself. A supply of combined nitrogen in some form or other is absolutely indispensable to plants and, in their turn, to animals; yet, though we live in contact with a vast reservoir of free nitrogen gas in the shape of the atmosphere, until comparatively recently we knew of no natural process except the lightning flash which would bring such nitrogen into combination. Plants take combined nitrogen from the soil, and either give it back again or pass it on to animals. The process, however, is only a cyclic one, and neither plants nor animals are able to bring in fresh material into the account. As the world must have started with all its nitrogen in the form of gas, it was difficult to see how the initial stock of combined nitrogen could have arisen; for that reason many of the earlier investigators laboured to demonstrate that plants themselves were capable of fixing and bringing into combination the free gas in the atmosphere. In this demonstration they failed, though they brought to light a number of facts which were impossible to explain, and only became cleared up when, in 1886, Hellreigel and Wilfarth showed that certain bacteria, which exist upon the roots of leguminous plants, like clover and beans, are capable of drawing nitrogen from the atmosphere. Thus they not only feed the plant on which they live, but they actually enrich the soil for future crops by the nitrogen they leave behind in the roots and stubble of the leguminous crop. Long before this discovery experience had taught farmers the very special value of these leguminous crops; the Roman farmer was well aware of their enriching action, which is enshrined in the well-known words in the Georgics beginning, "Aut ibi flava seres," where Virgil says that the wheat grows best where before the bean, the slender vetch, or the bitter lupin had been most luxuriant. Since the discovery of the nitrogen-fixing organisms associated with leguminous plants, other species have been found resident in the soil which are capable of gathering combined nitrogen without the assistance of any host plant, provided only they are supplied with carbonaceous material as a source of energy whereby to effect the combination of the nitrogen. To one of these organisms we may with some confidence attribute the accumulation of the vast stores of combined nitrogen contained in the black virgin soils of places like Manitoba and the Russian steppes. At Rothamsted we have found that the plot on the permanent wheat field which never receives any manure has been losing nitrogen at a rate which almost exactly represents the differences between the annual removal of the crop and the receipts of combined nitrogen in the rain. We can further postulate only a very small fixation of nitrogen to balance the other comparatively small losses in the drainage water or in the weeds that are removed; but on a neighbouring plot, which has been left waste for the last quarter of a century, so that the annual vegetation of grass and other herbage falls back to the soil, there has been an accumulation of nitrogen representing the annual fixation of nearly a hundred pounds per acre. The fixation has been possible by the *azotobacter* on this plot, because there alone does the soil receive a supply of carbohydrate, by the combustion in which the *azotobacter* obtained the energy necessary to bring the nitrogen into combination. On the unmanured plot the crop is so largely removed that the little root and stubble remaining does not provide material for much fixation.

Though numerous attempts have been made to correlate the fertility of the soil with the numbers of this or that bacterium existing therein, no general success has been attained, because probably we measure a factor which is only on occasion the determining factor in the production of the crop. Meantime, our sense of the complexity of the actions going on in the soil has been sharpened by the discovery of another factor, affecting in the first place the bacterial flora in the soil, and, as a consequence, its fertility. Ever since the existence of bacteria has been recognised, attempts have been made to obtain soils in a sterile condition, and observations have been from time to time recorded to the effect that soil which has been heated to the temperature of boiling water, in order to destroy any bacteria it may contain, had thereby gained greatly in fertility, as though some large addition of fertiliser had been made to it. Though these observations have been repeated in various times and places, they were generally ignored, because of the difficulty of forming any explanation: a fact is not a fact until it fits into a theory. Not only is sterilisation by heating thus effective, but other antiseptics, like chloroform and carbon bisulphide vapour, give rise to a similar result. For example, you will remember how the vineyards of Europe were devastated some thirty years ago by the attacks of phylloxera, and though in a general way the disease has been conquered by the introduction of a hardy American vine stock which resists the attack of the insect, in many of the finest vineyards the owners have feared to risk any possible change in the quality of the grape through the introduction of the new stock, and have resorted instead to a system of killing the parasite by injecting carbon bisulphide into the soil. An Alsatian vine-grower who had treated his vineyards by this method observed that an increase of crop followed the treatment even in cases where no attack of phylloxera was in question. Other observations of a similar character were also reported, and within the last five years the subject has received some considerable attention, until the facts became established beyond question. Approximately the crop becomes doubled if the soil has first been heated to a temperature of 70° to 100° for two hours, while treatment for forty-eight hours with the vapour of toluene, chloroform, &c., followed by a complete volatilisation of the antiseptic, brings about an increase of 30 per cent. or so. Moreover, when the material so grown is analysed, the plants are found to have taken very much larger quantities of nitrogen and other plant foods from the treated soil; hence the increase of growth must be due to larger nutriment and not to mere stimulus. The explanation, however, remained in doubt until it has been recently cleared up by Drs. Russell and Hutchinson, working in the Rothamsted laboratory. In the first place, they found that the soil which had been put through the treatment was chemically characterised by an exceptional accumulation of ammonia, to an extent that would account for the increased fertility. At the same time, it was found that the treatment did not effect complete sterilisation of the soil, though it caused at the outset a great reduction in the numbers of bacteria present. This reduction was only temporary, for as soon as the soil was watered and left to itself the bacteria increased to a degree that is never attained under normal conditions. For example, one of the Rothamsted soils employed contains normally about seven million bacteria per gram—a number which remains comparatively constant under ordinary conditions. Heating reduced the numbers to 400 per gram, but four days later they had risen to six million, after which they increased to more than forty million per gram. When the soil was treated with toluene a similar variation in the number of bacteria was observed. The accumulation of ammonia in the treated soils was accounted for by this increase in the number of bacteria, because the two processes went on at about the same rate. Some rearrangements were effected also in the nature of the bacterial flora; for example, the group causing nitrification was eliminated, though no substantial change was effected in the distribution of the other types. The bacteria which remained were chiefly of the class which split up organic nitrogen compounds into ammonia, and as the nitrate-making organisms which normally transform ammonia in the soil as fast as it is produced had been killed off by the treatment, it was possible for the ammonia to accumulate. The question now remaining was, What had given this tremendous stimulus to the multiplication of the ammonia-making bacteria? and by various steps, which need not here be enumerated, the two investigators reached the conclusion that the cause was not to be sought in any stimulus supplied by the heating process, but that the normal soil contained some negative factor which limited the multiplication of the bacteria therein. Examination along these lines then showed that all soils contain unsuspected groups of large organisms of the protozoa class, which feed upon living bacteria. These are killed off by heating or treatment by antiseptics, and on their removal the bacteria, which partially escape the treatment, and are now relieved from attack, increase to the enormous degree that we have specified. According to this theory, the fertility of a soil containing a given store of nitrogen compounds is limited by the rate at which these nitrogen compounds can be converted into ammonia, which, in its turn, depends upon the number of bacteria present effecting the change, and these numbers are kept down by the larger organisms preying upon the bacteria. The larger organisms can be removed by suitable treatment, whereupon a new level of ammonia production, and therefore of fertility, is rapidly attained. Curiously enough, one of the most striking of the larger organisms is an amœba akin to the white corpuscles of the blood—the phagocytes, which, according to Metchnikoff's theory, preserve us from fever and inflammation by devouring such intrusive bacteria as find entrance in the blood. The two cases are, however, reversed: in the blood the bacteria are deadly, and the amœba therefore beneficial, whereas in the soil the bacteria are indispensable, and the amœba become noxious beasts of prey.

Since the publication of these views of the functions of protozoa in the soil, confirmatory evidence has been derived from various sources. For example, men who grow cucumbers, tomatoes, and other plants under glass are accustomed to make up extremely rich soils for the intensive culture they practise, but, despite the enormous amount of manure they employ, they find it impossible to use the same soil for more than two years. Then they are compelled to introduce soil newly taken from a field and enriched with fresh manure. Several of these growers here have observed that a good baking of this used soil restores its value again; in fact, it becomes too rich, and begins to supply the plant with an excessive amount of nitrogen. It has also been pointed out that it was the custom of certain of the Bombay tribes to burn vegetable rubbish mixed, as far as possible, with the surface soil before sowing their crop, and the value of this practice in European agriculture, though forgotten, is still on record in the books on Roman agriculture. We can go back to the Georgics again, and there find an account of a method of heating the soil before sowing, which has only received its explanation within the last year, but which in some form or other has got to find its way back again into the routine of agriculture. Indeed, I am informed that one of the early mysteries, many of which we know to be bound up with the practices of agriculture, culminated in a process of firing the soil preparatory to sowing the crop.

My time has run out, and I fear that the longer I go on the less you will feel that I am presenting you with any solution of the problem with which we set out—"What is the cause of the fertility of the soil?" Evidently there is no simple solution; there is no single factor to which we can point as *the* cause; instead, we have indicated a number of factors any one of which may at a given time become a limiting factor and determine the growth of the plant. All that science can do as yet is to ascertain the existence of these factors one by one and bring them successively under control; but, though we have been able to increase production in various directions, we are still far from being able to disentangle all the interacting forces the resultant of which is represented by the crop.

One other point, I trust, my sketch may have suggested to you: when science, a child of barely a century's growth, comes to deal with a fundamental art like agriculture, which goes back to the dawn of the race, it should begin humbly by accepting and trying to interpret the long chain of tradition. It is unsafe for science to be dogmatic; the principles upon which it relies for its conclusions are often no more than first approximations to the truth, and the want of parallelism, which can be neglected in the laboratory, gives rise to wide divergencies when produced into the regions of practice. The method of science is, after all, only an extension of experience. What I have endeavoured to show in my discourse is the continuous thread which links the traditional practices of agriculture with the most modern developments of science.

NOTES.

MADAME CURIE and M. Debierne have presented a joint memoir to the Paris Academy of Sciences announcing that they have succeeded in isolating pure radium. The metallic radium obtained is reported to be of a brilliant white colour, which blackens when exposed to the air. It burns paper, rapidly decomposes water, and adheres to iron.

THE chief chemist of the Barrow works of Messrs. Vickers, Sons and Maxim announces the discovery of an alloy which is believed to be superior to anything of its kind hitherto manufactured, and is to be known as duralumin. While being slightly heavier than pure aluminium, it is reported to be as strong as steel, and it can be rolled, drawn, stamped, extended, or forged at suitable temperatures. It is less corrodable than other high aluminium alloys under all the usual corrosive tests, and possesses many valuable properties. It is only one-third the weight of brass.

ACCORDING to *Science*, Dr. Charles Fahlberg, who was associated with Prof. Ira Remsen in the discovery of saccharine, died at Bad Nassau on August 15.

THE *Times* announces the death, at Cintra, of Prof. Pedroso, president of the Geographical Society of Lisbon.

THE centenary of the death of the famous Italian naturalist Filippo Cavolini will be commemorated by a series of meetings to be held in Naples on September 12–14. The arrangements are in the hands of a committee, the presidents of which are Profs. Monticelli and Cavara, professors of zoology and botany in the Royal University of Naples, and the inaugural meeting will be held in the Great Hall of that University on September 12 at 10 a.m.

THE following are the arrangements for the opening of the winter session of the London medical schools:—St. George's Hospital, King's College Hospital, and London Hospital will open on October 1. At the first-named Dr. S. Squire Sprigge will deliver an oration "On Prizes." St. Bartholomew's Hospital, Charing Cross Hospital (at which Dr. F. W. Mott, F.R.S., will deliver the eighth Huxley lecture, on "The Hereditary Aspect of Nervous and Mental Diseases"), Guy's Hospital, London (Royal Free Hospital) School of Medicine for Women (at which an address on "Women's Sphere in Medicine" will be given by Dr. E. W. Roughton), Middlesex Hospital, St. Mary's Hospital, University College Hospital, and Westminster Hospital will reopen on October 3. The opening day for St. Thomas's Hospital is October 4, and that of the London School of Tropical Medicine is October 14, when Dr. H. A. Miers, F.R.S., will give an address. At the opening of the medical school of the Victoria University of Manchester, on October 3, Prof. W. Thorburn will speak on "The Evolution of Surgery."

THE second International Congress for the Preservation of Game was opened at Vienna on Monday last. At one of the sections a message from King George to Mr. F. C. Selous, urging the desirability of making international provision for the preservation of migratory game birds, especially woodcock and quail, was read. A resolution in the sense of the King's message was adopted by the section. The next congress, which will meet in three years' time, is to be devoted chiefly to the preservation of game outside Europe.

SPEAKING as president of the twenty-fifth Congress of the Royal Sanitary Institute (now in session at Brighton), Sir John Cockburn said the history of the growth of sanitary science is epitomised in that of the Royal Sanitary Institute, which during the last quarter of a century has exercised a continually increasing influence for good on the health of the nation. Cleanliness, fresh air, pure food, and prevention of infection are the key-notes of modern medicine. In every city ample provision for baths should be made available for the masses. But cleanliness should not be confined to external appearance. Clean air is required. It is true that recent years have witnessed some improvements in this respect. The ventilation of our theatres also is not so bad as it was. It is perhaps in railway travelling that those who love to keep their bodies pure suffer most. There are smoking carriages for those who affect the weed; why not fresh-air carriages also, in which any occupant could demand that one at least of the windows shall be kept open? The objectors generally express the fear of catching cold. It is high time that this fallacy were exploded. What is called a cold in the head is an infectious disease, and is caught nowhere so readily as in close compartments. Fresh air, far from being the cause, is the best preventive.

THE treaty by which the Sovereign rights of the Korean Emperor are transferred to the Emperor of Japan came into effect on Monday, August 29, when it was promulgated in Seoul and Tokyo. The Korean peninsula, about equal in size to Great Britain, has thus become an integral part of Japanese territory. The Japanese Embassy has issued the following announcement, received from the Foreign Office at Tokyo, referring to the annexation:—(1) Korea shall hereafter be named "Chosen"; (2) the Government-General shall be established in Chosen; (3) the Residency-General and its accessory offices will be in existence for the present, and the Resident-General will exercise the functions of the Governor-General; (4) the issue of special passports for the people of Chosen is abolished, and hereafter the Chosens will be treated on an equal footing as the Japanese in the matter.

IT being possible to allot space in the Chemical Court of the reconstituted British Section of the Brussels Exhibition only to little more than half of the original exhibitors, a letter has been addressed by Sir Boverton Redwood, chairman of the Chemical Industries Committee, to the remaining firms asking them to funish a descriptive account of their exhibits, with photographs if possible, for display on a wall space which has been appropriated for the purpose. It is suggested that a convenient size for the framed account would be 4 feet by 3 feet, but in exceptional circumstances it is hoped that room may be found for a larger frame. Frames will be supplied free of cost by the Exhibition Branch of the Board of Trade, to whom photographs should be sent at the earliest possible date, as the new British Section of the exhibition is to be formally opened on September 15.

THE twenty-first annual general meeting of the Institution of Mining Engineers is to be held at Nottingham on Wednesday, September 14, when the following papers will be presented:—The mining school at Bochum, Prof. H. Louis; progress in the use of exhaust-steam power, Mr. J. Burns; the Elliott-Jones vertical coke-oven, Mr. T. C. Futers. In addition, the undermentioned communications, which have already appeared in the Transactions of the institution, will be open for discussion:—A storage-battery extension to a three-phase colliery power-plant, Mr. W. Maurice; measurements of the increase of temperature in bore-holes, with the depth, the technics, and practical importance of the same for geological prognosis, with reference to new measurements in Mexico, Borneo, and in Central Europe, Drs. J. Kœnigsberger and M. Mühlberg; experiments illustrative of the inflammability of mixtures of coal-dust and air, Prof. P. Phillips Bedson; some memoranda concerning coal-dust and the essential principles of the coal-dust theory, Mr. H. W. G. Halbaum; the use of concrete for mine support, Prof. W. R. Crane; fire-damp caps and the detection of fire-damp in mines by means of safety-lamps, Messrs. E. B. Whalley and W. M. Tweedie; equipment for the study of flame-caps and for miscellaneous experiments on safety-lamps, Prof. G. R. Thompson.

The second International Conference for the Study of Cancer is to be held in Paris on October 1–5 under the presidency of Prof. Czerny. French, English, and German are to be the official languages of the conference. Intending members should give notice to the treasurer, Dr. A. de Rothschild, 6 rue Saint-Philippe de Roule, Paris VIIIe.

The ninth International Conference on Tuberculosis will take place at Brussels on October 5–8. Among the subjects likely to be brought under consideration are:—Hereditary tuberculosis contagion; the pre-disposition to the disease; the protection of children against tuberculosis; tuberculosis and the school; the part of women in the campaign against tuberculosis. Reports on the progress of the war against tuberculosis in different countries, milk supply, solar radiation, international statistics, and international marks indicating the condition of the lungs will be presented, and a paper will be read by Dr. Nathan Raw on the general measures recommended by the International Conference to the public authorities for the prevention of the spread of tuberculosis in different countries. The address of the Secretariat of the conference is Avenue Van Volxem, 253, Forest-Brussels.

In connection with the Turin International Exhibition to be held in 1911, there is to be a competition in the transmission and reception of messages with Morse, Hughes, and Baudot apparatus. According to the *Electrician*, the tests will begin on August 22, and will be open to members of either sex of the staffs of telegraph administrations and army or navy telegraphists. The tests will include twenty minutes' transmission and thirty minutes' reception of messages by the Morse apparatus, the receiving being done with either the sounder or the writing instrument; and one hour of transmission by Hughes apparatus, mechanical or electrical, and with either E or W key; and one hour of transmission by Baudot quadruple apparatus. The text will be in languages suitable to the operators, will be printed on sheets containing fifty words each, and will consist of words, groups of letters, and figures. The text will be different for each system, but the same for competitors in the same system. A special test for reception by sounder and the writing of the text by a writing machine (the writing machine being provided by the competitor) will also be held, if not less than ten competitors belonging to three different administrations apply by June 15, 1911. The transmission will be effected in accordance with the International Telegraph Regulations. There will be a championship cup, which will remain the property of the successful competitor, and be competed for by competitors who gain a prize in each of the three systems (Morse, Hughes, and Baudot). There will also be an international representation prize cup to be competed for by groups of three competitors who all represent one State, and have between them won prizes in all the three sections. There will also be individual prizes—ten for the Morse, eight for the Hughes, and eight for the Baudot tests. Applications must be sent by June 15 next to the Secretariat General, Bureau du Concours International de Telegraphie, Rome.

In *Man* for August Mr. C. M. Woodford describes a remarkable stone-headed axe from Rennell Island which he has been fortunate enough to acquire. He shows that this weapon is in type quite different from the examples with which it has been compared found in Malaita, in which a nodule of iron pyrites is attached to a handle ornamented with nautilus or pearl shell. In the Rennell Island example, the head, formed apparently of a basaltic stone, is star-shaped with eight projections, and is attached to a plain handle made of a hard, dark wood, probably *Afzelia bijuga*. The union is effected by an ingenious system of rattan lashings, which pass through holes in the handle.

Mr. T. Sheppard, the energetic curator of the Hull Museum, in his annual report for 1909 records important accessions to the valuable collections in his charge. On the antiquarian side, the most important addition is the famous Brigg boat, constructed from a single trunk of oak, 50 feet long and 6 feet broad. From the caulking Mr. Slater has been able to identify a good list of mosses and hepatics, these being the earliest records of the kind for the county. This boat has formed the subject of no fewer than forty monographs prepared by members of various learned societies, and Mr. Sheppard has in hand a descriptive handbook of this important object. A grey ware jar from North Lincolnshire has also been received, containing coins of the Emperors Valens, Julian II., Gratianus, Valentinianus, and Constantinus II., all of the fourth century A.D., with a curious ring bearing an image of the dove and olive branch, probably of Christian origin, and dating from the fifth century. The museum has also been fortunate in acquiring two important collections of birds, one that of Mr. Fertune, of Yorkshire birds, occupying forty cases; the second that of Sir H. Boynton, from Burton Agnes Hall, in 200 large cases. Both these important collections are now being catalogued and arranged for exhibition.

Mr. W. C. Farabee reprints from the Proceedings of the American Antiquarian Society for October, 1909, an account of the strange race known as the Machyengas, who inhabit the region lying between the base of the Cordillera and the Upper Ucayaali and Urubamba rivers in eastern Peru. The most remarkable fact about them is that they have no fear of the dead, and do not hesitate to touch the corpse and dispose of it without any ceremony, simply flinging it into the river to be eaten by fish. This results from the absence of any belief in the return of the soul, which after death enters the red deer. This animal, though not regarded as sacred, is not used for food. When asked what becomes of the spirit, they reply, "Nothing; that is the end of it when it enters the deer." Their deity Idioci, "the big man of the sky," is otiose, and has little concern with the world except that he thunders and sends rain. He is treated with indifference, receiving no prayers, offerings, or dances; they have no charms or fetishes, and are controlled by no power or influence outside themselves. This is a remarkable picture of a tribe bound by no conventions or restraints of religion or custom.

The Bulletin of the Sleeping Sickness Bureau (No. 19, July 26) contains a progress report on the Uganda sleeping-sickness camps from December, 1906, to November, 1909, by Dr. A. P. Hodges, principal medical officer. It deals particularly with the treatment of the disease. The conclusions are that the prospect of curing sleeping sickness by medicinal treatment has not materially increased, that the percentage of apparent cures is practically negligible from the point of view of stamping out the disease, that the percentage of apparent cures continues to diminish with lapse of time after treatment, while the death-rate continues to increase, and that there is no decided superiority of one mode of treatment over another of those known to be of benefit.

The July number of the monthly *Folia Neuro-biologica* thoroughly maintains the reputation of that magazine for usefulness as a bibliographical review of neurology. Of the three original articles contained in this number, perhaps the most interesting is a paper by Dr. Ferruccio Rossi on the cutaneous innervation of the lumbo-sacral region in the dog. The author concludes (1) that spinal transection at various levels in this region reveals very precise limits between cutaneous sensibility and insensibility; (2) that these limits are constant and characteristic for each segmental level; (3) that transection between the 13th dorsal and 1st lumbar, between the 1st and 2nd, 2nd and 3rd, or 3rd and 4th lumbar segments involves only a single *dermatom*, while yet more distal transections involve more than a single *dermatom*; (4) that the results obtained are of value for the study of the dorsal and ventral axile lines of the extremities, and for the topical diagnosis of spinal lesions.

To the Bulletin of the Royal Academy of Belgium, Classe des Sciences, 1910, No. 5, Mr. A. Rutot contributes an article on the existence in Belgian caverns of layers containing remains of Arctic rodents. Such layers have been already identified in Swiss and German caves in association with those containing the so-called mammoth-fauna, which indicates a moderately cold climate, and includes the Aurignacien and Solutreën stages. One of these rodent zones—the Middle Magdalenien—contains a fauna comparable to that of the European and Asiatic steppes, while a second includes one of the type of the Siberian tundra. Both these layers belong to the reindeer epoch; but the tundra-like fauna alone indicates absolutely Arctic conditions, *Myodes torquatus*, *Arvicola gregalis*, and *Lagomys pusillus* representing the Arctic type of rodents. The researches of the author reveal the interesting fact that almost precisely identical faunistic, and therefore climatic, conditions obtain in the caverns of the Meuse valley and other districts in Belgium, where, however, the Solutreën stage is practically unrepresented.

According to the *Field* of August 3, no fewer than nine "schools" of caa'ing whales, *Globicephalus melas*, were observed out at sea by some men occupied in capturing sea-fowl on the bird-rocks at Vagö, in the Færöes. Of these, 250 were surrounded by the boats and driven into Midvag, and killed the same evening. The next morning, when the take was being distributed, news came that another very large school had made its appearance at Sand, some twelve miles distant, but that no attempt at driving them towards the land had been made, the number of boats present being inadequate for the purpose. Many of the Midvag people at once started for the spot, and as a result of the combined attack which ensued 400 more whales were secured. The value of the products of a whale of this species is about 3*l.* 7*s.* 6*d.*

The *Emu* for July contains an excellent coloured plate of the white-fronted fantail (*Rhipidura phasiana*), a species first described by Mr. de Vis in 1884, on the evidence of a specimen collected near the mouth of the Norman River. In addition to a portrait of the late Dr. Sharpe, this issue also includes various papers on Australian bird-life, chiefly of local interest.

In part i. of vol. xl. of the Memoirs of the Museum of Comparative Zoology at Harvard College, Mr. Glover M. Allen gives coloured figures of living specimens of that rare insectivorous mammal *Solenodon paradoxus* of San Domingo, based on living specimens recently received by that institution. These show that the general colour is some shade of tawny or rufous, with a variable amount of black on the back and throat, and a pale nuchal spot. They further indicate that the well-known figure of the other species of the genus, *S. cubanus*, given by Peters is incorrect in showing the tail bent laterally, this appendage being incapable of such lateral movement except near the tip. The two species were formerly believed to be distinguished merely by colour, but it is now ascertained that there is a difference in the number of the vertebræ. Much information with regard to the skeleton, muscles, and viscera is given in Mr. Allen's memoir.

A study of the distribution of the Mollusca in connection with an ecological survey of a marsh area on the Chicago River is discussed by Mr. F. C. Baker in a Bulletin (vol. viii., art. 4) of the Illinois State Laboratory of Natural History. The author is especially concerned with showing how ecological observations may throw light on the taxonomic relation of species.

Mr. S. T. Dunn places on record in the *Kew Bulletin* (No. 6) a historical account of the Hong Kong herbarium, in which he duly acknowledges the valuable services of Mr. C. Ford, who was for thirty years curator, and of Sir Joseph Hooker, whose latest assistance has been rendered in the form of a personal revision of the balsams. The miscellaneous notes in the same number of the journal contain several interesting items, including a letter from Mr. H. N. Ridley describing the botanical features observed on a journey to the north-west of the Malayan peninsula, where he traced the change from a Malayan to a Siamese flora about Gunong Terai; a collation of data concerning the germination of the rubber-yielding species *Manihot dichotoma*, *M. piauhyensis*, and *Funtumia elastica*; also a communication regarding the Guayule industry in Mexico.

An article on the genus Citrus, contributed by Mr. A. W. Lushington to the *Indian Forester* (June), claims attention both as a systematic revision of a difficult genus of cultivated plants, and because the author attempts to identify the plants yielding the numerous Indian varieties of citrus fruit. Four classes or subgenera are defined. Firstly, there is *Citrus trifoliata*, regarded as the most primitive. Then there are the species bearing four-petalled flowers, and presenting other typical characters, represented by the caffre, sour and sweet limes. A third class is characterised by five-petalled flowers, usually white, and a fruit with a loose skin, of which the mandarin is an example; while the fourth class includes the pomelo, lemons, Seville orange, and citron, which agree in the production of a fruit with a firmly adherent skin and flowers normally five-petalled.

A correspondent informs us that he recently found growing on the cliffs near Osmington, Weymouth, among a large quantity of ordinary blue chicory, several plants which bore white flowers corresponding in every respect with the ordinary chicury except in colour. Though this is an uncommon occurrence, the white variety of the common chicory has been recorded before. Syme in "English Botany" (v., p. 123) gives the colour as "pale bright-blue varying to white," and Hooker, "Students' Flora" (p. 210), says flowers "bright blue, rarely white."

THE summary of the weather issued by the Meteorological Office for the summer season comprised by the thirteen weeks from June 25 to September 3 shows that the mean temperature was rather below the average except in the north and west of Scotland, but the difference from the normal was nowhere large. The absolute maximum temperatures ranged from 80° to 83° in all the districts of the United Kingdom with the exception of the north and south of Ireland and the Channel Islands, where the highest temperature was in each case 79°. The lowest shade temperatures ranged from 30° in the east of Scotland and 34° in the north of Scotland and the south-west of England to 40° in the Midland counties, 41° in the south of Ireland, and 47° in the Channel Islands. The largest aggregate rainfall was 13·71 inches, in the west of Scotland, and the lowest 6·81 inches, in the east of England. There was an excess of rain over the entire kingdom except in the north of Scotland, the greatest excess being 2·77 inches, in the south-west of England. The number of rainy days ranged from eleven more than the average in the south of Ireland to five less than the average in the north of Scotland. The largest number of rainy days in any district was sixty, in the south of Ireland, and the least forty-four, in the south-east of England. There was a deficiency of bright sunshine for the thirteen weeks in all districts except in the north of Scotland and the north of Ireland. The greatest deficiency was 135 hours in the Channel Islands, 126 hours in the south-east of England, and 113 hours in the north-east of England. At Greenwich the mean temperature for the three summer months this year was 1° below the average, the mean being 61°. The absolute maximum temperature was 82·3°, which is decidedly low in comparison with former summers, and there were forty-three days with a temperature of 70° or above, which is a rather larger number of warm days than some recent summers. The aggregate rainfall was 8·10 inches, which is 1·32 inches more than the average, but is less than in the summer of either 1908 or 1909. The deficiency of bright sunshine at Greenwich for the three months was 170 hours.

THE meteorological chart of the North Atlantic and Mediterranean for September (first weekly issue, August 18), published by the Meteorological Committee, gives an interesting account, with daily synoptic charts, of the weather over the Atlantic for a week ending August 17, and throws considerable light on the cause of the changeable weather over the British Islands during that period. Between August 11 and 14 a barometric depression passed slowly from about 55° N., 30° W., to the neighbourhood of our western coasts, causing showery weather generally over western Europe, and thunderstorms in many parts of the United Kingdom on the night of August 14. During the latter half of the period another depression developed over eastern Canada, and furnished a good example of such disturbances crossing the whole of the North Atlantic. It arrived off the west of Scotland by the morning of August 17; changeable weather therefore again set in, and south and south-west winds became strong on parts of our western and southern coasts.

THE director-general of Indian observatories has issued a memorandum, dated August 6, on the monsoon conditions prevailing during June and July, with anticipations for August and September. The combined distribution of rainfall in June and July was rather irregular, being considerably in excess in some provinces and in defect in others. In July the monsoon conditions were weak over a large area, and an almost complete break in the rains occurred in the second and third weeks. From information obtained as to the conditions over a large part of the earth's surface since the date of the memorandum of June 9 (see NATURE, July 28), the director-general concludes, *inter alia*, that the general outlook appears more uncertain than usual, but there is no reason for expecting a large defect in the total amount of rainfall during August and September.

THE *Annuario* of the Rio de Janeiro Observatory, 1909–10, contains, in addition to ephemerides and astronomical data for the two years stated, a large number of tables relating to the physics of the globe. The tables usually employed in the reduction of astronomical and meteorological observations, and the values of the various units are very complete and handy for reference. The compilation extends to 405 octavo pages, but contains no original scientific discussions.

Le Radium for July devotes seven pages to tables of constants of ionisation and of radio-activity compiled by Prof. T. H. Laby. The following constants are tabulated:—Rates of re-combination of ions, their mobilities, the electric charges they carry, the quotients of the charges by the masses, path and velocity of α rays, number of α particles emitted by radium, heat developed by radio-active substances, and a number of other radio-active and atomic constants which may be calculated from these. In the same number M. W. Duane, of Madame Curie's laboratory, gives a description of an arrangement for registering photographically the number of α particles emitted by a radio-active substance, founded, like the counting method of Prof. Rutherford and Dr. Geiger, on the augmentation of the ionisation of a rarefied gas within a closed vessel by the collision of the α particles with the molecules. The vessel, of small capacity, is of ebonite, closed below by a brass plate having a small window in it covered with a thin sheet of mica. The radio-active substance is placed below the window, and the brass plate is raised to an electrical potential nearly sufficient to cause a discharge to take place between it and a wire electrode at the top of the vessel, which is connected to a gold-leaf electroscope. An image of the gold leaf is formed on a photographic film moving behind a slit. The gold leaf is brought back to the normal position after each displacement by means of a leak produced by polonium outside the electroscope. Several reproductions of photographs obtained are given, which show the displacements produced by the α particles, but the author gives a further photograph showing displacements obtained without α particles, the explanation of which he is not yet in a position to give.

THE current number of the *Zeitschrift fur physikalische Chemie* contains another contribution from the van 't Hoff Laboratory at Utrecht on the allotropy of the elements, the alleged allotropy of lead having been examined by E. Cohen and K. Inouye. During the electrolysis of solutions of lead salts, it was shown by O. Lehmann that two kinds of crystals can be formed according to the conditions, one crystallising in the regular and the other in the monosymmetric system. It has now been found that cells set up with these different crystals show no difference of electromotive force, from which it is concluded that these two crystalline forms are not really allotropic modifications.

THE July issue of the Journal of the Association of Teachers in Technical Institutions has reached us. Its leading contents include the address of the president of the association, Mr. J. Wilson, in Birmingham last June, and an address delivered by Dr. Robert Pohl to the west Yorkshire branch of the association last April. Both these discourses have already been dealt with in these columns.

THE Cambridge University Press gives notice that it has taken over the copyright and control of the "Encyclopædia Britannica," and that it will publish the new and complete edition (the eleventh) about the end of the present year. The work entirely supersedes all previous editions, and brings its survey down to the summer of 1910. The whole of the twenty-eight volumes will be issued at one time, in two forms, an ordinary paper impression and one on India paper. To many readers the thin paper edition will come as a great boon.

THE Geologists' Association announces that its jubilee volume, "Geology in the Field," is now completed, and that an index to it is in preparation, and will be issued shortly.

OUR ASTRONOMICAL COLUMN.

REDISCOVERY OF D'ARREST'S COMET (1910c).—A telegram from the Kiel Centralstelle announces the rediscovery of D'Arrest's comet, by M. Gonnessiat, on August 26. The comet is of the fourteenth magnitude, and its position at 9h. 32·6m. (Algiers M.T.) on the day of discovery was R.A. = 16h. 48m. 25·3s., dec. = 9° 42′ 50″ south; this position lies in Ophiuchus about 5° E. of ζ Ophiuchi.

This comet was discovered by D'Arrest in 1851, and has a period of about 6·5 years. In 1903 it escaped observation, but was observed, after passing perihelion on May 21, in the summer of 1897.

An ephemeris for the comet is published in No. 4437 of the *Astronomische Nachrichten* (p. 344). The observations indicate that corrections of −1m. 17s., +5·1′, should be applied to M. Leveau's ephemeris (*Bulletin astronomique*, vol. xxvii., p. 81), and the following places result:—

Ephemeris 0h. M.T. Paris.

1910			α (h. m.)		δ (° ′)
September	9	...	17 28·8	...	−16 53·4
,,	11	...	17 35·4	...	−17 53·3
,,	13	...	17 42·3	...	−18 52·0
,,	15	...	17 49·4	...	−19 49·2

Owing to the low declination and the fact that the magnitude is only 14, observations in these latitudes are not very promising.

THE RECENT OCCULTATION OF η GEMINORUM BY VENUS.—Observations of the occultation of η Geminorum by Venus on July 26, made at several observatories, are reported in No. 4435 of the *Astronomische Nachrichten*. MM. Baldet, Quénisset, and Antoniadi found, at Juvisy, that the times of immersion and emersion were 15h. 2m. 9s. ± 2s. and 15h. 5m. 39s. ± 0·5s. (M.T. Paris) respectively, the duration of the occultation being 3m. 30s. ± 2·5s. A notable feature of the emersion under good conditions was the suddenness with which it took place; within 1½ or 2 seconds from the first suggestion of reappearance, the star regained its normal brightness. Apparently the rays were not deviated more than 0·3″, and there was no change in the colour of the star. From the fact that the augmentation of the star's light extended over 1½ or 2 seconds, the observers deduce that the height of the planet's atmosphere, producing the absorption, is about 80 to 110 km.

SEARCH-EPHEMERIDES FOR COMETS 1889 V. (BROOKS) AND 1890 VII. (SPITALER).—A set of elements and a search-ephemeris for Brooks's comet, 1889 V., are published in No. 4437 of the *Astronomische Nachrichten* by Dr. Bauschinger. The probable time of perihelion passage is 1911 January 8, and the ephemeris covers the period August 4, 1910, to February 20, 1911. This comet is of special interest owing to its having thrown off four fragments, one of which became brighter than the parent body, in 1889. Seen in 1903, it was single and of the fourteenth magnitude, so that its detection at the coming approach is doubtful. According to the ephemeris, the comet was at its nearest to the earth at the beginning of August, and its present position (September 9) is in Sagittarius at α = 19h. 37·4m., δ = −29° 55·2′ south.

The rediscovery of Spitaler's comet is still more doubtful. Discovered in 1890, its period was found to be about 6½ years, but it was not seen in 1897 or 1903. However, Herr F. Hopfner has calculated elements for the present approach, and publishes them, with nine four-day search ephemerides, in No. 4437 of the *Astronomische Nachrichten*. The different ephemerides are calculated for different dates of perihelion passage covering the period September 12 to November 15 in eight-day intervals.

THE SUN-SPOTS OF 1909.—A statistical summary of sun-spots, as observed at the Royal Observatory of Capodimonte during 1909, is published by Dr. E. Guerrieri in No. 6, vol. iv., of the *Rivista di Astronomia* (Turin). In it are given numerous tables showing analyses, in different forms, of the frequencies, areas and numbers of spots, faculæ, &c., which should prove useful to anyone discussing solar phenomena. The mean diurnal frequency of spot groups for the year was 3·6, 1·7 less than that for 1908; the mean diurnal number of spots was the same, 30·5 in each year.

WATER VAPOUR ON MARS.—The conditions obtaining on Mount Whitney during the Lick Observatory expedition researches in September, 1909, are discussed by Prof. Campbell in No. 3, vol. iv., of the Journal of the Royal Astronomical Society of Canada (p. 212). Prof. Campbell combats the idea that they were unfavourable, and says that on September 1 and 2, when the photographs were taken, the nights were as perfect for the purpose as could be wished. He also points out that with a nearly evanescent *a* band, the more water vapour one attributes to the terrestrial atmosphere, the less remains attributable to that of Mars.

MEASURES OF DOUBLE STARS.—Dr. Lau's tenth list of double-star measures appears in No. 4436 of the *Astronomische Nachrichten*. It contains the places, recent measures, and the colours of 122 Σ and 6 OΣ stars, and in some cases the formula giving the nature of the variation in distance and position-angle. It is not without significance, perhaps, in the discussion of the colours of double stars, that, in the majority of cases, where both stars have the same colour the colour is given as "white"; where they differ, the colours are most often complementary.

THE PERMANENT INTERNATIONAL COMMITTEE FOR THE "CARTE DU CIEL."—We have now received the volume giving an account of the meeting of the permanent committee for the execution of the *Carte photographique du Ciel*, which took place in Paris in April, 1909. The volume gives a list of those who attended, and a detailed account of the discussions and resolutions; but as the meeting was reported at length in our issue of June 10, 1909, there is no need to refer further to its proceedings.

METEORS AND BOLIDES.—No. 1, vol. iv., of *Palaestra*, a monthly journal issued at Asti, Italy, contains an interesting paper by Prof. Guido Cora on meteors and bolides. The paper was suggested by the appearance of a remarkably fine bolide at Casalbordino (Abruzzi) on December 3, 1909, and contains a discussion of the appearance, the frequency, and the general phenomena attending the appearance of meteors.

HISTORY OF NAVIGATION.—An interesting article on the determination of position at sea, written by Prof. Marguet, appears in No. 13 of the *Revue générale des Sciences*. The author discusses the histories of the compass, the log, and astronomical determination, paying particular attention to such matters as the difference between the magnetic and true north, and illustrating his descriptions with cuts of instruments such as the astrolabe and arbalestrille.

Meteoric Fireballs.—The Rev. W. F. A. Ellison, of Fethard Rectory, Waterford, reports that on August 28, at 11h. 29m. G.M.T., he was surprised by a very brilliant flash, which on first thought he supposed to be vivid lightning. Instantly looking upwards, however, he saw a bright meteor-streak extending from $330°+35°$ to $125°+75°$. It was fully half a degree wide, and part of it remained in sight three or four minutes, and drifted several degrees to the west.

Mr. Ellison has been very successful in recent years as an observer of fireballs, and describes this one as an exceptionally grand example. Unfortunately, he did not see the direction of its flight, but the radiant must have been either in Sagittarius or the head of Ursa Major.

The Rev. J. C. W. Herschel, at Wellington College Station, Berks, saw a splendid Perseid on September 2 at 9h. 5m. p.m. It passed from near the Polar Star to θ Draconis, crossing β Herculis, and vanishing in the region of Ophiuchus. The duration was about three seconds, and the meteor projected a streak along the greater part of its course. The probable radiant was near ϵ Persei, and the height of the object from about 72 to 44 miles over Wellingboro' to Yeovil. Its visible trajectory covered 125 miles at a velocity of about 41 miles per second.

Further observations are, however, required of these fine meteors before trustworthy heights and velocities can be computed.

RECENT HITTITE DISCOVERY.

THE object of the lecture is to show in outline how the memory of the Hittites as an imperial people has been recovered and what their place in world-history was. This recovery dates from the finding in 1834–45 of two prehistoric cities at Boghaz Keui and Uyuk in north-western Cappadocia. Their sculptures and inscriptions were ultimately recognised by Sayce as belonging to the same family as certain inscriptions and sculptures which had been found at Hamath and elsewhere in Syria after 1870, and also some other monuments observed in Asia Minor at Ibriz and near Smyrna. These Syrian monuments had been already ascribed to a people which, under the name of *Kheta* or *Khatti*, played a large part in the Syrian relations of Pharaohs of the XVIIIth to the XXth Dynasties, and in those of the Assyrian kings; and this people, it was generally agreed, was identical with the "children of Heth" or Hittites of the Old Testament. If the latter were responsible for the monuments in question in Syria, then, too, in some sense, they were responsible for the monuments in Asia Minor; and, in any case, it was clear that a very peculiar and important civilisation, covering a large area of the Nearer East in the Second Millennium B.C. and the early part of the first, had been forgotten by history.

Scholars and explorers made continual efforts during the next quarter of a century to elucidate this civilisation, and succeeded so far as to place its origin in Asia Minor, and to fill up, more or less, by the discovery of many new monuments, the geographical gaps dividing those first observed. They found that these lay, roughly, along lines of communication leading from north-western Cappadocia to the south and west, and they established in fact that not only northern Syria but west central Asia Minor showed such monuments in almost every part. But fundamental questions—who were the authors of this civilisation? where precisely was its chief focus? and who shared its development?—had still to be left open; and it was not until Boghaz Keui came to be excavated by Winckler and his companions in 1906–7 that they could be answered.

At the last-named site, known for some years to produce cuneiform tablets partly in Babylonian, partly in an unknown tongue, the excavators explored a large megalithic group of ruins in the lower city and fortifications and certain other structures in the upper, besides clearing and re-examining the long-known religious rock-reliefs of Iasily Kaya. Besides several mural sculptures, of which the most interesting shows an armed Amazon, the explorers came on a number of cuneiform tablets, chiefly in the ruins of the earlier portions of the lower megalithic building, which was evidently a palace. These tablets proved to be in the main Foreign Office archives of six generations of kings, who ruled over the Hatti of Boghaz Keui in the fourteenth and thirteenth centuries B.C. They conclusively prove that the Hatti of Cappadocia were the *Kheta* who fought with Egypt at Kadesh, and made the famous treaty with Rameses the Great. The first important reign was that of Subbiluliuma, contemporary of Amenhotep IV.; the last was that of Hattusil II., the "Khetasar" who made the treaty with Rameses. But we know from Babylonian, Assyrian, and Egyptian records that, both before and after these kings, the Hatti were a power in western Asia, and we have to credit them with a history of at least a thousand years. The tablets show that Subbiluliuma extended Cappadocian power over north Syria and even over great part of Mesopotamia, where the Mitanni had formerly been dominant; and that this wide dominion, extending even to the Babylonian frontier, was preserved by his chief successors, Mursil and Mutalla, and not lost until after the reign of Hattusil II., who treated with both Egypt and Babylon as an equal. Startling as this revelation is, we now see that without the existence of such a Hittite power the wide distribution of the Hittite monuments, civilisation, and physical type would have remained inexplicable; and we recognise in Boghaz Keui the natural focus from which these radiated over Asia Minor and Syria. But we recognise also that many of these monuments and much of the Hittite civilisation were work of other peoples than the Cappadocian Hatti—peoples who had learned of the latter and in many cases outlasted them. Other phenomena, too, are explained by the revelations at Boghaz Keui, notably the failure of the Ægean power of Crete to effect a lodgment in Asia Minor, and the long continuance of the Hittite name and fame in Syria. Moreover, they account, as nothing else can, for the Oriental influence which acted on the earliest Hellenic civilisation, especially in Ionian art and religion. For not even the early contact between the Muski-Phrygians and Assyria appears to have resulted in sufficient orientalisation in Phrygia and Lydia to explain the Greek phenomena. The real distributing agency of Orientalism was in Cappadocia, the art and religion of which were of the required type.

It is evident, then, that a great, if forgotten, part has been played in the relations between East and West by the civilisation which occupied so long the whole land bridge between Asia and Europe. The long survival and great extension of Hittite influence in Syria has been illustrated by the excavations at Sinjerli and Sakje Geuzi, and by recent discoveries in the basin of the middle Euphrates on both sides of the river. But an immense field remains to be explored, and other important sites must be thoroughly examined, notably Carchemish, Marash, and Malatia. When even one of these is dug according to the best modern methods a flood of light will be thrown on Hittite archæology; and with the help which the decipherment of the Boghaz Keui tablets not in Babylonian will afford to the decipherment of the Hittite inscriptions, already phonetically interpreted in no small measure by Sayce, the study of the Hittite civilisation will take its place in the field of scientific history.

[1] Discourse delivered at the Sheffield Meeting of the British Association by D. G. Hogarth.

THE INTERNATIONAL ZOOLOGICAL CONGRESS AT GRAZ (AUGUST 15–20, 1910).

THE eighth international congress of zoologists has been a most enjoyable one, even though it has not been marked by any striking pronouncement. No president could have carried out the arduous duties of his office more successfully than Prof. von Graff. To him in a large measure was due the representative character of the meeting. The committee under his presidency worked hard to ensure the comfort of the visitors and the smooth conduct of the meetings. That this was no small task may be judged from the fact that some five hundred members and participants came to Graz on August 14 and 15, and that in the five days of the congress more than 100 papers had to be read. One disadvantage of this abundance of communications was the limitation of discussion, which might have been surmounted had the members exercised the art of compression. As it was, papers were frequently read *in extenso*, and valuable time was thus lost. Some confusion was caused by the carrying over of papers from one day to the next, but the committee must be congratulated on the manner in which they organised the proceedings and surmounted difficulties, which in most cases were caused by the very success of the congress.

For such an international gathering Graz was a fortunately chosen meeting place. This "pearl of Styria" lies in beautiful scenery, and wears a peaceful and picturesque air. The Stadt-Park and the Schloss-berg form convenient shady spots in which the leisurely life of the town can be studied, whilst in the "Hilmteich" woods, the methods for bird-protection are seen in the most modern form. Gatherings at these and other points were arranged during the intervals of congress-business, and were greatly enjoyed, for, with the exception of two evenings, the weather remained fine.

The meetings themselves took place in the large "Stephanien-Saal" in the mornings, and in the university buildings in the afternoons. On the first day (August 15) the congress inspected the university, and more especially the zoological institute, where President von Graff guided the members over the charming building over which he rules. Then followed the official reception and opening of the congress. The only papers read that day were a long discussion by Prof. Delage on the methods and results of experimental parthenogenesis; a kinematographic representation of sea-urchin development (by M. F. Vlés and Mdlle. Chevroton); and a description of the biology of the lower Danube by Dr. Antipa. A pleasant evening was spent at the Hilmteich, where one realised the truly international character of this gathering.

The most important paper given during the second day of the congress was one by Prof. Gaupp, of Freiburg, on the affinities of the mammalia as deduced by the study of the skull. Dr. Gaupp is, of course, a well-known authority on this subject, and he treated it from a broad comparative standpoint. Stress was laid on the primordial or cartilaginous cranium, and the descriptive part of the paper was illustrated by a series of exquisite models made by Ziegler under the supervision of Gaupp and others. Amongst many detailed points of interest was the fact that the gristly skull of the young rabbit presented a closer agreement with that of the lizard than did the skull of Echidna. The relationships of the Mammalia, so far as the primitive skull was concerned, pointed rather to reptilian than to amphibian ancestry. Dr. Gaupp subsequently gave a series of demonstrations of the models used in his lecture.

Another paper of importance was that by the veteran zoologist, Geheimrath F. E. Schultze, on the air-sacs of birds, illustrated by a series of casts of the lungs and air-sacs taken from a number of representative and familiar birds. These models were exhibited during the course of the congress, and formed a triumph of technique. They consisted of metallic castings, and exhibited the relationships of the different sacs by a carefully chosen system of colours. No such clear demonstration of the anatomy of this difficult subject has ever before been carried out.

During the afternoon of each day the congress divided into eleven sections, thus showing the extent to which specialisation has proceeded in zoology. The cytologists and protozoologists constituted the first of these, and the chief subjects of interest in this section were the nature of the cell-elements, particularly the meaning of the chromosomes and their relation to sex. These papers, however, were of a highly technical character, and are difficult to summarise until the printed report appears. Very few papers on Protozoa were communicated, the most interesting being one by Dr. Enriques on the experimental determination of conjugation among Infusoria, and a long discussion by Dr. Hartmann on the nature of the nucleus in Protozoa and the bearing of this subject on general cytology.

In the second section papers were given on the anatomy and physiology of Invertebrata. Prof. Pelseneer led off with an interesting account of the occurrence of hermaphroditism in Lamellibranchs, and traced a relation between this condition and certain bionomical factors. It appears that hermaphrodite forms are much commoner than is generally supposed, especially among bivalves that are either commensal in habit, or that lead a deep-sea life. Another paper of interest was that by Mr. E. Ray Gregory on the water vascular system of one of the cake urchins (Echinarachinus). M. Rousselet exhibited specimens of Trochosphæra, and there were several papers dealing with purely histological topics. In the section devoted to Vertebrate problems, there were several contributions to the anatomy and development of the lymphatic system, including some beautiful demonstrations of the lymphatics in tadpoles by Dr. Hoger, in the cat by Drs. Huntington and McClure. Prof. Lee, of Minneapolis, exhibited a most valuable series of early stages in the development of Rodents peculiar to North America. Prof. Hubrecht described the placenta and early development of that strange Malayan mammal, Galeopithecus. Dr. Franz gave an account of the relation between motor activity and the development of the thalamencephalon in the development of fish; and Principal Jordan a most attractive description of the Bering Sea fur seal.

The most popular sections, however, were those that dealt with experimental and bionomical problems, and the list of papers read before them is so large that only a mere and arbitrary selection can be made. Of these, the paper on colour-physiology by Dr. Paul Kammerer, of Vienna, was the most interesting. For some time past Dr. Kammerer has subjected specimens of various Amphibia (*Salamandra maculosa, S. atra,* Molge, spp., *Rana esculenta, arvalis,* &c.), Reptilia, and Mollusca to the influence of various coloured surroundings, and has also reared the offspring of these animals under certain conditions of light and background. By the aid of coloured lantern slides, the author showed how the colouration both of the under and of the upper surface responded to this treatment, how the question of sex complicated the result, and how the offspring appeared to inherit a tendency to develop colouring similar to that induced in their parents without the influence of similar surroundings. The backgrounds employed were chiefly yellow earth and black earth, and the results were only broadly stated (the paper suffering, as did so many others, from congestion of business). Dr. Gadow, of Cambridge, made an interesting speech on the nature of Amphibian colouring, but further discussion was prohibited by the lateness of the hour. Subsequently Dr. Kammerer showed spirit-specimens of his experimental animals. A somewhat disappointing paper on a closely allied subject—the formation of pigment in birds—was contributed by Dr. Riddle, of Chicago. In this Dr. Riddle stated that "both the kind and quantity of melanic pigment produced by a bird . . . are dependent on nutritive and other local and temporary conditions." The disappointment lay in the fact that no explanation of what these conditions were, was given. The paper was mainly an attack upon the results obtained by Miss Durham on the pigments of guinea-pigs.

Prof. Woltereck contributed a further instalment of his work on Daphnids, and showed how variations in the body were correlated with sexual changes. On this subject Dr. Langhans, of Prague, also spoke, urging the evidence he had obtained as to the inheritance of acquired characters in this group. One of the longest experimental papers was that by Prof. Conklin on the power of regulation in Echinoderm eggs. After centrifuging such eggs for a short time, the cytoplasm of the eggs is drawn away from its initial position, but when the eggs are removed from the centrifuge the regulative power shows itself by causing a symmetrical arrangement of the cells. The diverse behaviour of the two polar cells was very clearly shown, and the influence of the length of time of centrifuging was also explained by a series of lantern slides taken from some two thousand preparations.

In another section, Prof. Crampton gave a well-illustrated account of the distribution of species of Partula, based upon his explorations in south-eastern Polynesia. He pointed out the extremely definitely localised character of the species and the evidence for mutation. In the same section, Prof. Carpenter, of Dublin, described an interesting fossil Isopod from the Irish Devonian. Several other palæontological papers dealt with the problem of extinction, and with certain Annelids, Reptiles, and Insects.

Regarding the congress as a whole, one is struck by its increasing scope. It is attended not only by professional and amateur zoologists, but by anatomists, physiologists, and geologists. The problems it discusses touch upon questions of the greatest interest to pathologists and to sociologists. The experimental treatment of zoology is being increasingly adopted, whilst the older systematic problems are being studied afresh. The present is a time of data-collecting on an enormous scale, but no fresh principles are as yet forthcoming, and there is a marked tendency to confine the treatment of the subject to non-controversial matters. One comes away from Graz impressed by the huge amount of zoological work now being done, by the community of spirit that animates its devotees in all countries, and by the value to the cause of peace which such gatherings represent. These sentiments were emphasised in the speeches at the banquet which closed the congress.

THE THIRD INTERNATIONAL CONGRESS OF SCHOOL HYGIENE AT PARIS, AUGUST 2–7, 1910.

THE comparative abstention of German school-hygienists from the third congress was a regrettable feature, and considerably diminished its value from a scientific point of view. The preponderance of Latin influence led to much rhetoric in the sections, and the records of the congress are those of trends of opinion rather than of work accomplished.

The subjects set down for general discussion on the three working days of the congress were, in order:—(1) Uniformity of method in medical inspection; (2) instruction in sexual hygiene; and (3) the training and appointment of the school doctor. The first of these alone presented any general scientific interest. A problem awaiting solution is how to frame the records of inspection so that trustworthy statistics can be obtained by which the influence of varying environments can be compared and alterations from decade to decade satisfactorily established. The discussion was opened by Dr. James Kerr in a paper the value of which could not be over-estimated. He postulated that the two aims of medical inspection (the remedial and the statistical) must be separately considered, for no medical inspection carried out on *all* children is ever likely to be done at public cost to such an extent that it can be of any great value for scientific purposes; when quantitative estimates or comparisons are made, even between schools in the same town or classes in the same school, the results are often not really worth the paper they are written upon. As the result of long experience, he stated that ultimately one is content with only spending as much time as is absolutely necessary on detailed examination, valuable for scientific purposes, and in only examining in such detail sufficient numbers of children to reduce any errors of experiment within such limits that the results will afford a trustworthy standard; the examination of all children in that way is quite unnecessary. For scientific work, he claimed it is best that each topic be examined as a separate problem on data carefully selected and carefully defined by each investigator, and that general inspection should be carried on merely with a definite practical aim of relief to children who present obvious or gross defects. Without this there is great danger of scientific progress being arrested, and the whole movement becoming a lifeless routine of collecting inaccurate and valueless records. It is to be hoped that Dr. Kerr's opinions as here expressed will receive due attention from the authorities in Whitehall, for it is indubitable that much of the work being done in the country at present is utterly unscientific, and has already become the lifeless routine that Dr. Kerr is desirous of guarding against.

The rest of the work of the congress was split up into thirteen sections and sub-sections. Comparing the discussions with those of the second International Congress of 1907 in London, two branches of general school hygiene stand out in which most activity has taken place during the intervening three years. These are physical education and open-air schools. In Section vi., which dealt chiefly with the latter, carefully collated facts were forthcoming which proved alike the wide extension of the movement and the uniform good results obtained without distinction of climate or race. It was Dr. Neufert, of Charlottenburg, who shadowed forth the future developments arising out of the experience gained in the open-air schools. Why should the advantages of the open-air school be limited to the debilitated and unhealthy? If good for them, it must be good also for the normal. All our schools must in future approximate to the open-air ideal, and more activity must take the place of the sedentariness which is now the rule. In connection with the question of activity, it is interesting to note also how the attention paid to manual training has grown during the past three years. Scarcely mentioned in 1907, its advantages are in 1910 independently pressed in many sections and from many points of view by various workers.

Dr. Mumford, of Manchester, dwelt upon its importance in developing the association centres in the brain, where the various sense organs are organised in relation to the combination and arrangement of the muscles. Herr Schrag, of Berne, pointed out the importance of manual training as a link between the various subjects in the curriculum. Prof. Blazek, of Austrian Poland, brought forward the results of ergographical investigations, demonstrating the effects of manual training in developing certain mental qualities of readiness and concentration, and Dr. Schuyten, of Antwerp, supported this with facts proving the effects in diminishing inattention of satisfying the motor needs of the organism.

In Section iv., on physical training, many communications of importance were read. Dr. Digby Bell, of the British Naval School of Physical Exercises, insisted upon the necessity of rescuing the subject from the taint of quackery which still hangs around it. M. Demeny, of Paris, introduced his new system of physical education founded upon continuous movement in opposition to the alternations of fixed contraction and relaxation of muscles upon which older methods are based; his paper was rendered more valuable by a demonstration upon a pupil, which certainly upon æsthetic, and in the writer's opinion upon physiological grounds, showed his method to be superior even to the Swedish movements, which at present hold pride of place in our systems.

A question of great importance to medical inspectors is the discovery of a trustworthy mathematical formula which shall determine the state of nutrition of a child in relation to physical measurements. Prof. Guttmann, of Vienna, examined various formulæ, and came to the conclusion that the best is that of Bornhardt, viz. $G = BL/240$, where G = body weight, B = chest circumference, L = height, and 240 is a constant representing the mean of a very large number of measurements.

Amongst some valuable papers in Section ix. (teaching methods and syllabuses) was one by Dr. Janale, of Prague, giving the results of extensive investigations on fatigue in the school children of that city by Ebbinghaus's combination method, from which he concluded that a single long morning session *per diem* is superior to two shorter sessions occupying both morning and afternoon. Another was by Prof. Schuyten on "inattention" as measured in school over yearly periods by dynamometrical experiments accompanied by memory tests. In the first place, inattention is a natural and inevitable result of physiological activity. It is increased by defective conditions of sanitation and diminished by wise distribution of subjects in the time-table. The best results appear to be obtained by not mixing up together daily the various subjects in the curriculum, but by grouping together homologous subjects on each particular day. This is in direct opposition, of course, to the usual arrangement in school time-tables at present.

The congress, it will be seen, presented many features of great general interest, and its practical results will undoubtedly be considerable. It was satisfactory to hear from the lips of one of the Secretaries of State of France, at the concluding meeting, a pledge that the Government would carry into effective operation the proposals upon school hygiene already before the Chamber.

VETERINARY RESEARCH IN THE TRANSVAAL.

THE present veterinary bacteriological laboratories of the Transvaal Department of Agriculture are situated eight miles to the north of Pretoria, on a farm comprising altogether some 2000 acres of land. They were ready for occupation on October 1, 1908, but, before this time, research in South Africa had to be conducted under less favourable conditions. In 1898, a three-room building of wood and iron lined with brick formed the laboratory, and the equipment of this was "sadly deficient." Calf vaccine lymph was made here, but the preparation was suspended when the late war broke out in the latter part of 1899. In 1901, the laboratory, after having been used during the war as a stable, had now added to it a rinderpest station for the manufacture of serum, and by 1905 it had grown into a heterogeneous collection of buildings, mostly constructed from old wood and iron, from buildings destroyed during the war. Not only were the buildings unsuitable, but they were also unhealthy, enteric fever constantly occurring among the staff, so that in 1906 it was decided to establish the present laboratories.

It may be of interest to consider the work done in these earlier years.

In 1896, rinderpest devastated S. Africa, thousands of cattle dying, and preventive inoculation was introduced. In 1898, at the old laboratory at Daspoort, calf vaccine lymph was made to vaccinate the Kaffirs when a serious outbreak of small-pox took place among them. In 1901–3, rinderpest serum was made in the Daspoort laboratory. In 1905, experiments were made which eventually resulted in the discovery of a serum for inoculating mules against horse-sickness. In 1902, at the close of the war, the introduction of East Coast fever, a new and devastating disease, took place; the disease was, however, at once studied, and means devised for preventing its spread.

A consideration of this work, then, shows what a practical character there had always been in the research work in the old laboratory, and we shall see that this is equally true of the new ones.

The present building comprises some three dozen different rooms, suitably fitted, each for its own particular object.

In the pathological laboratory, 1362 specimens were reported on in one year, and here is studied the histological pathology of various diseases, especially horse-sickness, East Coast fever, and other piroplasmoses.

In the zoological laboratory, the study of the entozoa of the sheep is a matter of great practical importance to the sheep-farmer. In another room, mallein, tuberculin, quarter-evil vaccine, and pleuro-pneumonia cultures are prepared. Three rooms are reserved exclusively for the preparation of rabies vaccine. In yet another room, the vaccine for blue-tongue and a horse-sickness serum are prepared. Of the former, 200,000 doses, and of the latter 1000 tubes, are sent out annually.

An entirely separate building is used for the preparation of calf lymph; three-quarters of a million tubes have been sent out into all parts of S. Africa during the last two years. The laboratory is evidently splendidly equipped with its centrifugal room, still room, serum store, animal room, operating theatre, post-mortem hall, museums, lecture rooms, &c., but we note one important omission, viz., a library, of which there is no account.

Front View of the Veterinary Bacteriological Laboratories at Onderstepoort, Pretoria.

This, the commemoration publication, besides the historical account of the laboratory which we have abstracted, contains five papers. The first is by Dr. Arnold Theiler, the Government veterinary bacteriologist, and is on the very interesting and important subject of "Immunity in Tropical and Sub-tropical Diseases."

He gives an excellent and concise statement of the whole question. This article is worthy of a place in a commemoration number, but as regards the other papers, while in themselves good pieces of research work, there is no special reason for their appearance here. We miss any general account of the animal diseases of S. Africa, rinderpest, horse-sickness, heart-water, and so on; and we should have welcomed a general account and summary of the piroplasmoses and the mortality due to them. Nor do we find any general account of ticks, and the methods taken to combat them. We should have welcomed also a summary of the state of our knowledge on animal entozoa and their economic importance.

The volume presents evident signs of haste in issue from the press. Some of the papers teem with misprints, some are characterised by an almost complete absence of punctuation, while again, in many instances, the language used and the construction of the sentences are so slip-shod as to render them almost meaningless. The volume has a number of excellent illustrations of the staff of the various departments, but the glazed paper on which the book is printed is very trying to the eyes. We may note, too, that on the title-page and cover the laboratories are called "the Veterinary Bacteriological Laboratories," though in the introductory chapter they are termed the "Veterinary Research Laboratories," a better term, we think, for, as we have seen, the work is by no means confined to bacteriology. The laboratory has, we feel sure, under its distinguished head a great future before it, and we venture to offer our heartiest congratulations on its new career.

HALLEY'S COMET

A LARGE number of publications dealing with observations of Halley's comet have appeared during the last week or two, and from them we extract a few of the more important results.

Prof. Barnard, in No. 4431 of the *Astronomische Nachrichten*, deals with the observations he made during the time when the comet was at its least distance from the earth. The observations in the early morning were greatly interfered with by clouds and smoky skies, but the conditions were better after May 17. Prof. Barnard pays particular attention to the observations made during the early mornings of May 18 and 19, and directs attention to a bright pillar of a luminous character seen near the south-eastern horizon. The main feature was the rather broad beam of light, resembling the beam of a searchlight, which stretched obliquely from the eastern horizon to the Milky Way in Aquila, a length of 107°. Between 2h. and 3h. a.m. this was very conspicuous, and Prof. Barnard describes its dimensions and position with respect to neighbouring stars, showing that it was considerably inclined to the ecliptic. This is evidently the phenomenon referred to generally as the tail, but to the observers at Yerkes there appeared the other mass of luminosity, apparently quite separate from the beam, that extended to the south-eastern horizon. Not having been able to observe the comet regularly prior to August 18, Prof. Barnard hesitates to make a definite proposition, but he suggests that this phenomenon was the main tail, whilst the bright beam was only a separate streamer. It involved the ecliptic, and observations on August 19 showed it to be a real phenomenon connected with the comet; at 2h. 20m. a.m. it showed a more definite upper edge, bounded, roughly, by the stars β and γ Piscium and η and ζ Aquarii, and it joined the brighter beam near γ Pegasi. Observations made earlier in May showed several streamers, of which the long bright beam seen on May 18 may have been one, and they also indicated that on May 18 the breadth of the main tail should have been much greater than the beam actually was. Should Prof. Barnard's surmise prove correct, the evidence for the earth's passage through the tail about May 19 would be greatly strengthened.

Curious sky effects during May 19 were also recorded, and were unusual enough to suggest a connection with the comet. At noon, and for several hours afterwards, a horizontal bar of brilliant prismatic colours, with the red uppermost, was seen in the south at an altitude of about 20°, and around the sun was a prismatic halo of 22° diameter.

After its passage, the comet was a brilliant object at Williams Bay, and to Prof. Barnard "it far exceeded all expectations as a spectacular display." On May 26 the tail could be traced to a distance of 63°, and for 25° of its length was very conspicuous. On May 20 the head was about ½° in diameter, and appeared like a nebulous star with a yellowish colour, but on May 24 it was recorded as bluish-white. On this date, however, there was apparently a double nucleus. To the naked eye and with opera-glasses there appeared a nucleus of sensible diameter and of a beautiful bluish-white colour, whilst in the 5-inch finder this was seen to be but an intense nebulosity surrounding a smaller, well-defined nucleus of eighth or ninth magnitude, and of a decidedly yellow colour. Thus naked-eye and telescopic observations on that date would refer to two different nuclei of opposite colours. For several nights about May 27 the tail appeared to diffuse northwards as high as Jupiter, and on a photograph taken on June 6 it is seen that the comet had discarded its tail, which was drifting away from it, and had formed a new one at a slightly different position-angle.

In the same journal Herr Sykora records an observation of the comet on the solar disc at 20·95h. (M.T. Tashkent) on May 19. A 13-cm. image of the sun was projected, and the comet was seen, like a finger-mark on paper, with a diameter of 1 cm.; during the three minutes that observations were not prevented by clouds, the relative motion of the supposed cometary image was about 0·5 cm.

Dr. Hartmann also contributes a note on the measures of the surface brightness of the comet made at Sonnwendstein. First he suggests that, instead of such indefinite terms as "bright," "faint," &c., a definite scale of standardised surface-brightnesses should be employed, the standard unit being referred to a definite illumination produced by a standard lamp under defined conditions. This unit is called a *phos* (*ph.*), a thousandth part of it a *milliphos* (*mph.*), a millionth part a *microphos* (*mkph.*); for the multiples the prefixes *kilo-* and *mega-* are suggested. Then he describes a method of using the photometer where the image of the object is seen through a hole pierced in a mirror fixed in the focal plane of the objective. By measured variations of the source of illumination, the surface of the mirror is brought to the same brightness as the focal image of the object. Again, by using suitable screens, the different radiations from any object may be directly compared, and for Jupiter Dr. Hartmann finds a range from red to green of 27 to 68 mph. (milliphos).

The results obtained by this method, comparing various parts of the comet on different dates, are very interesting. They are too numerous to give fully here, but one or two examples will serve to illustrate them. May 23, 9h. 2m. (M.E.T.), mean brightness of nucleus and the surrounding area of 22″ diameter: white, 220 mkph., yellow, 180 mkph., green, 410 mkph.; 9h. 27m., nucleus alone: white, 620 mkph., red, 360 mkph., orange, 630 mkph., yellow, 730 mkph., green, 1350 mkph. On May 26 a number of observations, including the nucleus, the area surrounding it, and the tail, were made, and for the tail, at 3m. 42s. in R.A. behind the head, a value of 0·22 mkph. was found. For comparison, Dr. Hartmann found on May 31 that the surface brightness of the Ring Nebula was 1·2 mkph., and for the inner space 0·6 mkph.; a bright area of the Milky Way, in Cygnus, gave a value of 0·05 mkph.

M. Antoniadi suggests that the tail, seen by Prof. Eginitis, turned towards the sun on May 20, was only a minor sheath; his observations, and those of Dr. Hartmann and others, show the tail as a sickle-shaped object with its *convex* side turned sunwards.

That the comet was a fine spectacle at Tokio is shown by a table giving the magnitude, length of tail, &c., as seen by Mr. K. Saotome, of the Tokio Observatory, reproduced in the *Astronomische Nachrichten*.

In No. 4433 of the same journal Drs. Cowell and Crommelin discuss the different elements published by various calculators for the 1910 osculation. These agree fairly well except in the value given for the mean motion (μ), in which there are grave differences. M. Iwanow adopted Pontecoulant's value for 1835, which the Greenwich observers have shown to be 0·05″ in error, and should therefore have arrived at a perihelion date differing from theirs by about one month. That this is not so indicates that some serious error crept into his calculations, and it is suggested that, as the difference is so important from a gravitational point of view, the discordance should not be allowed to remain unproved. Mr. Merfield and Messrs. Crawford and Meyer appear to have deduced their value of μ from the recent observations alone, a procedure which Drs. Cowell and Crommelin deprecate as untrustworthy; and the value obtained by the Berkeley computers is enormously in error. According to the Greenwich calculators, the value for 1910 is $\mu = 46{\cdot}6747''$, but this cannot yet be accepted as definitive.

A number of observations of the comet's brightness, made by Prof. Wendell, Mr. Leon Campbell, and Dr. Holetschek, are also published in the *Astronomische Nachrichten*, and the Harvard observations are plotted with the theoretical curve derived from the formula $1/r^2\Delta^2$; this shows very plainly the physical action produced by the solar rays as the comet got nearer the sun, the magnitudes increasing during this period beyond the rate demanded by the formula.

In No. 1, vol. xxxii., of the *Astrophysical Journal* Mr. Slocum describes the observations of the sun made at the Yerkes Observatory on May 18 and 19. Direct photographs and spectroheliograms are reproduced, and will serve as comparisons for any phenomena that may be attributed to cometary influence; nothing abnormal was noted.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Dr. H. Wren, of Birkbeck College, has been appointed professor of pure and applied chemistry at the Municipal Technical Institute, Belfast.

Mr. J. M. Caie, organiser in Inverness and Ross for the North of Scotland College of Agriculture, has been temporarily appointed lecturer in agricultural education in the college in the place of Mr. R. B. Greig, who has gone to Australia as a member of the Agricultural Commission.

Next session will be the hundred and fifteenth of the Glasgow and West of Scotland Technical College. In 1886 the present college was formed by the amalgamation of several institutions, including Anderson's College, which dated from 1796. The new calendar provides abundant evidence of the flourishing condition of the various departments included in the college. The first section of the new buildings, consisting of five large wings, we notice, was opened in 1905. The second section was opened in 1908, and comprises the main entrance hall, additions to the library and mechanics' laboratories, class-rooms for the decorative trades, and laboratories for dyeing, bleaching, &c. The third section was opened in the following year, and contains additional accommodation for civil engineering, engineering drawing, and other subjects. The fourth section will, it is expected, be ready for the coming session, and within it provision will be made for the department of textile manufacture. The plan of confining each department to one floor has been followed in nearly every case, with the result that the internal arrangements are well adapted to promote efficiency in working. The whole building comprises over seven acres of floor space, and forms one of the largest structures in Great Britain devoted to education.

The sixth annual report of the Education Committee of the County Council of the West Riding of Yorkshire deals, among other matters, with the part the committee has taken in providing university and technical education in the area for which it is responsible. The grants of 4500*l.* to the University of Leeds and 1500*l.* to the University of Sheffield have been continued. In addition to these sums, the University of Leeds has received 775*l.* to provide extension science lectures, instruction in coal mining, and free studentships for disposal by the County Council; and the University of Sheffield 500*l.* for Saturday mining courses and other purposes. So far as technical education is concerned, the greatest difficulties continue to be encountered in the rural portions of the Riding, where the meagreness of population and the prevailing conditions of life and work are less favourable to the successful maintenance of evening schools than in the more populous areas. In the mining districts the difficulty, which has always been a serious one, of maintaining regular attendance, has been accentuated during the session owing to the operation of the Eight Hours' Act rendering it almost impossible for students to change their shifts. The committee has the matter under consideration, and hopes to find a solution of the problem before the opening of the coming session. A satisfactory increase in the proportion of students attending for group courses of instruction is again reported. Practically all the West Riding schools are now organised on this basis, with the result that the educational equipment of the students is much more effective than when attendance for isolated subjects was the general rule.

The issue of *Science* for August 19 last contains an article providing tables giving data in regard to the degrees of doctor of philosophy conferred by the universities of the United States. There were conferred this year 353 degrees, not quite so many as in the three preceding years, when the numbers were 366, 378, and 387. Almost exactly half the degrees conferred last year were in science. The universities, however, differ considerably in the relative importance of their work in science. Chicago appears to be the best balanced; it has conferred just half its degrees in the sciences and half in other subjects. At the Johns Hopkins and Cornell about 60 per cent. of the degrees are in the sciences, whereas the percentage is about 40 at Harvard, Yale, Columbia, and Pennsylvania. There is not a preponderance of the sciences in the State universities, the percentage of degrees at Wisconsin being only 37 and at Michigan 38. Boston University appears to have conferred only three scientific degrees out of seventy-four. There was this year a large fall in the number of degrees in science conferred by Columbia, eleven, as compared with twenty-one and twenty-three in the two preceding years. Cornell, on the other hand, conferred this year twenty-seven degrees in science, surpassing all the other universities. Interesting particulars as to the varying popularity of different subjects of science are given. Chemistry, with forty-eight degrees, leads, having about double the numbers in physics, zoology, psychology, and mathematics. Botany comes next, and there is then a considerable drop to geology, followed by physiology and astronomy. In the case of the subjects not ranked under the natural and exact sciences, most degrees have been given in English history, economics, and philosophy.

On September 6 the *Times* published its first Educational Supplement, and if subsequent issues reach the same high standard of interest and usefulness, these supplements should do a great deal to educate the general public in educational matters and to develop an intelligent appreciation of the importance of securing for this country as efficient a system of national education as can be found anywhere. The articles, which are numerous, deal with many aspects of a complex problem; they are all, moreover, inspired by a broad outlook and a desire to assist the attainment of efficiency. Great prominence is given to the work of secondary schools and universities, and the importance of securing the right relationship between these grades of education is emphasised. One article, entitled "New Universities and New Schools," comes appropriately after the address of the principal of the University of London to the British Association last week. It deals with the difficult question of where the work of the secondary school should end and where that of the university should begin, and endeavours to make clear what precisely may be expected of a student desiring to matriculate. The writer properly maintains that it ought not to be impracticable to devise a leaving certificate in which both the views of schoolmasters and the university authorities are represented. The passport of entry to the university must certify both that the student is fit to leave school and that he has this or that range of abilities and equipment to enable him to undertake the work expected of him. The new venture deserves to succeed, and we commend this first issue to the attention of all who are interested in educational matters.

The forthcoming opening of the winter session of work at the technical colleges throughout the country is, as usual, preceded by the publication of a large number of new calendars and prospectuses. Among these, that of the Municipal School of Technology, Manchester, takes a prominent place by reason of the completeness of its provision of instruction in every phase of technical education which is likely to appeal to students in south Lancashire. This calendar, which runs to some 520 pages, shows that the school is fulfilling thoroughly its object of providing instruction in training in the principles of science in their application to the industrial arts. We are glad to notice that the authorities here insist that it is impossible for a student to obtain full benefit from the courses of instruction unless there has been adequate previous preparation, and that students are required to pass an entrance examination in subjects of general knowledge or to produce evidence satisfactory to the principal of their attainments. Special attention may be directed to the fact that the courses in the respective departments prepare for the degree of Bachelor or Master of Technical Science of the Victoria University of Manchester in the case of students who have matriculated, and that special courses of fourth-year post-graduate study and research are offered. The University of Liverpool publishes separately the particulars in connection with the faculty of engineering, of which Prof. J. A. F. Aspinall is chairman. The courses of study in the faculty afford a general scientific training for those who intend to become engineers, naval architects, architects and surveyors. The training is to be regarded as either preliminary to, or supplementary of, a pupilage under some engineer or course of apprenticeship with some engineering firm. Arrangements are made for students to spend the summer vacation in works, or to take a voyage as junior engineers in steamships. The prospectus of the evening classes and of the secondary school in connection with the East Ham Technical College points out that the numbers of students seeking admission have been so great that it has been found necessary to increase the accommodation by converting some of the workshops into class-rooms, and building a separate block of workshops and gymnasium at a cost of 3000*l*.

THE Aërial League of the British Empire proposes to found a practical school of aviation as a memorial to the late Hon. C. S. Rolls. In a circular letter recently received from the secretary of the league it is pointed out that such schools only exist abroad, and that few opportunities exist in England where students may attend laboratory classes; also that there are absolutely no facilities (except for very rich men) for practical tuition in the construction and handling of flying machines or for experimental testing of the selected designs of deserving inventors. A subcommittee of the league has been at work for some time past upon the project, and their proposals (which have been approved by the executive committee) are as follow:—(1) The primary aim of the school is to provide training in aëroplane manufacture and flight and to obtain a class of men grounded in the whole subject from beginning to end, the instruction to include such laboratory and theoretical work as funds and the gifts of apparatus may permit. The proposed laboratory to be situated centrally in London, to be open for the use of students from various technical institutions already providing elementary classes in the theory of flight, and also for public demonstrations in order to spread interest. (2) The school of aviation to be situated as near London as possible, and to be open to men who have undergone courses of training in great engineering schools, competent engineers, and mechanics. (3) The attention and the practical work of students to be chiefy directed to securing machines offering greater trustworthiness and stability, lower power and fuel consumption, diminished capital cost and expense of maintenance, and a higher factor of safety than the apparatus now used mostly in sporting contests. (4) In order that an early start may be made, two machines should be bought at once. Students themselves to build all further machines, and also those of selected inventors whose ideas are judged to be worthy of construction and practical trial. The result of this will be that novel machines can be built and tested at very low cost, and students, inventors, and instructors will alike benefit by the experience and analysis of results obtained. (5) Funds to be administered by an independent committee of management, including practical men of science and education experts. The estimated cost of the school is 1300*l*., and that of its running for the first year 1200*l*., *i.e.* 2500*l*. for the year, and the league solicits the generous and prompt support of all sympathisers.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 29.—M. Armand Gautier in the chair.—Joannes **Chatin**: The posterior sclerotic ring in birds.—M. **Gonnessiat**: Observation of the D'Arrest comet at the Observatory of Algiers. This comet was detected at Algiers on August 26, appearing as a feeble nebulosity with a slight central condensation of the fourteenth magnitude.—M. **Baillaud**: Remarks on the above. This comet has a period of six years eight months, and was not seen in 1904. Its position coincided with the calculations of M. Leveau, the difference between the calculated and observed positions being less than the ordinary field of a telescope.—Kotaro **Honda**: The law of variation of the coefficient of specific magnetisation of the elements by heating. Instead of the two laws of Curie, the author proposes the following: the effect of a rise of temperature on the magnetisation coefficient of an element is similar to that of a small increase of the atomic weight of the element. The experimental data in support of this are given.—G. D. **Hinrichs**: The atomic weights of precision of oxygen and silver.—M. **Busignies**: Some ethylenic cyclic derivatives (ether oxides) and their bromine derivatives. The alkyloxybenzophenones are treated with magnesium alkyl iodides, and give alkyloxydiphenylethylene and its homologues. The bromine addition compounds of these have also been prepared.—E. **Voisenet**: New researches on bitter wines and the acrylic fermentation of glycerol. Determinations of the amounts of acrolein in various wines showed that the bitterness increased with the amount of acrolein present.—Z. **Skrzynski**: Contribution to the study of mycosic sero-diagnosis.

CONTENTS.

PAGE
Ore Deposits. By **J. W. G.** 293
Observational Meteorology 293
Abstract and other Philosophy 294
Colour Chemistry 295
Our Book Shelf 295
Letters to the Editor:—
The Ratio between Uranium and Radium in Minerals.—**Frederick Soddy, F.R.S.** 296
Stagnant Glaciers.—**R. M. Deeley**; **G. W. Lamplugh, F.R.S.** 297
The Leaning Tower of Pisa.—**Edward G. Brown**; **Arthur T. Bolton** 297
The Origin of the Domestic "Blotched" Tabby Cat.—**H. M. Vickers**; **R. I. Pocock** 298
Lake Balaton. (*Illustrated.*) By **J. W. G.** 299
The British Association at Sheffield 300
Section B.—Chemistry (*Illustrated*).—Opening Address by **J. E. Stead, F.R.S., F.I.C., F.C.S., President of the Section** 302
Sub-section of B.—Agricultural Sub-section.—Opening Address by **A. D. Hall, M.A., F.R.S., Chairman of the Sub-section** 309
Notes 313
Our Astronomical Column:—
Rediscovery of D'Arrest's Comet (1910*c*) 317
The Recent Occultation of η Geminorum by Venus . 317
Search-ephemerides for Comets 1889 V. (Brooks) and 1890 VII. (Spitaler) 317
The Sun-spots of 1909 317
Water Vapour on Mars 317
Measures of Double Stars 317
The Permanent International Committee for the "Carte du Ciel" 317
Meteors and Bolides 317
History of Navigation 317
Meteoric Fireballs 318
Recent Hittite Discovery. By **D. G. Hogarth** . . 318
The International Zoological Congress at Graz (August 15-20, 1910) 318
The Third International Congress of School Hygiene at Paris, August 2-7, 1910 320
Veterinary Research in the Transvaal. (*Illustrated.*) 321
Halley's Comet 322
University and Educational Intelligence 323
Societies and Academies 324

THURSDAY, SEPTEMBER 15, 1910.

BIBLIOGRAPHY OF ATLASES.

Library of Congress. A list of Geographical Atlases in the Library of Congress, with Bibliographical Notes. Compiled under the direction of Philip Lee Phillips. Vol. i., Atlases. Pp. xiii+1208. Vol ii., Author List; Index. Pp. 1209–1659. (Washington: Government Printing Office, 1909.) Price 2.35 dollars the two vols.

THOUGH making no claim to be a complete list of atlases, this work marks a very important step towards a much-needed annotated bibliography of such publications, nothing on a similar scale having ever been attempted before. The collection dealt with is important enough to represent a large proportion of the whole material in existence, and the information supplied, both in the form of general notes and of complete lists of the maps contained in the more important atlas, will be of great value to students. These lists are of particular service in the case of early works, often found incomplete or broken up into their constituent items, but of great interest from the point of view of the history of geography.

In such early works the present collection is comparatively rich. The set of editions of Ptolemy's "Geography," so valuable as presenting a view of the progress of knowledge, on the academic side at least, during the century and more following the discovery of America, makes a near approach to completeness. Ortelius is well represented, and in a somewhat less degree, Mercator, though there is no copy of the great Italian atlas of Lafreri, somewhat earlier in date. Nor do we find the *Speculum nauticum* of Waghenaer, the earliest example of a purely hydrographical atlas, though we meet with Dudley's "Arcano del Mare," and many later works of a similar kind. Most of the best modern atlases are, of course, included. As might be expected, works American, either in origin or subject-matter, decidedly predominate, the items under "United States" numbering about two-fifths of the whole.

Valuable as the catalogue certainly is, and great as has evidently been the labour expended upon it, it could hardly be that imperfections should not be noticeable in matters of detail. The entire absence of headlines giving an indication of the broad subdivisions of the subject is a drawback, as is also the reference in the index, not to the pages of the work, but to the *numbers* of the main entries, placed as these are in no very conspicuous position, and never repeated when an entry covers several pages. The general arrangement is somewhat illogical, *special* subject headings always preceding *general* ones, though special topographical headings again follow the latter. In the notes the vague references to authorities are irritating (*e.g.* "cf. Nordenskiöld," after a quotation from that author). There seems no very consistent plan as regards the choice of atlases for analysis; thus there is no full list of the maps in Nordenskiöld's "Facsimile Atlas," though, curiously enough, some of the maps find a place in the index, when borrowed by other authors. It is certainly useful to find all the publishers of atlases grouped under "Publishers" in the index, but this hardly justifies the omission of the individual names from their proper places.

Universal knowledge cannot, of course, be expected from the best of editors, but further expert assistance might have saved some errors, these being sometimes due to the unquestioning acceptance of statements by earlier writers. Thus the fifteenth-century editor of Ptolemy, Dom Nicolaus Germanus, still appears as "Donis." The statement that the 1598 Italian version of Ptolemy was due to Cernoti is correct only in regard to the new matter added by Magini. The famous fifteenth-century map of Nicolas de Cusa is ascribed to Nicolas "Cusana," and, stranger still, the sixteenth-century humanist, Loriti, or "Glareanus" (so named from Glarus, in Switzerland), appears as "H. Loritz de Gloria."

But these are, after all, small matters to be set against the undoubted value of the catalogue, both for purposes of reference and as a step towards a still more complete list of atlases which we may hope to see published some day.

LEAD AND ZINC PIGMENTS.

Lead and Zinc Pigments. By Dr. C. D. Holley. Pp. xix+340. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 12*s*. 6*d*. net.

OWING to various causes, the development of the paint industry in the United States has been of a very special and interesting character. On the one hand there has been a large demand for ready-mixed paints for the protection of the wooden buildings which are still so common in that country, and on the other the existence of large deposits of zinc lead ores has led to the preparation of sublimed whites, which are largely used in the making-up of ready-mixed paints. In addition, there is the tendency, which we find in all industries in America, to replace hand by machine methods, and thus develop new and modified processes. A book, therefore, on the manufacture of lead and zinc pigments, written by one so thoroughly familiar with all the processes as Dr. Holley, is of great interest to English readers.

In the first place, a detailed description will be found of the mechanical processes of white-lead manufacture which have been so successful in the United States, although they never seem to have succeeded in replacing the ordinary Dutch process in this country. Detailed descriptions of the Carter process, the Matheson process, and others will be found, evidently written by one who is thoroughly familiar with them, while the photographs of actual plant are of great interest. In addition, the preparation of sublimed lead pigments, which has become of such great importance in the United States, although used to a comparatively small extent in this country, including sublimed white and sublimed blue lead, the preparation of zinc oxide, and the preparation of the mixed lead and zinc paints which are a big feature of the American paint industry, and are obtained by subliming mixed lead and zinc ores, and which contain various proportions of zinc oxide and lead sulphate, are fully described. The preparation also of the oxides of lead and lead chromes is dealt with, and the preparation and properties of zinc sulphide paints.

A very complete account is also given of the elaborate practical tests of various paints which are being made on special experimental stations in the United States at present, with the view of deciding which paints are most durable for outside use. These experiments are giving some very valuable results. For instance, the usual assumption in this country that white lead is the best pigment for protection of outside surfaces has apparently been quite disproved by these results. Zinc white, or mixtures of zinc white with white lead, prove to be more durable. These experiments are still being continued and the results published from time to time, and should be carefully watched by architects and engineers in this country, where similar experiments might well be carried out. The physical and chemical properties of these various whites and their analyses are also thoroughly dealt with; in fact, the whole book contains a great deal of very valuable information written from the American point of view, and should therefore be of special interest to all those connected with the paint industry in this country.

A. P. LAURIE.

METEOROLOGICAL TABLES.

Tables for the Reduction of Meteorological Observations. Prepared by Dr. G. C. Simpson, under the direction of Dr. Gilbert T. Walker, F.R.S. Pp. ix+95. (Calcutta: Government Printing Office, 1910.)

THE present revised edition of Blanford's meteorological tables, prepared for the routine work of the Indian meteorological service, contains in all sixteen tables, of which the first and last pairs are for the interconversion of barometric heights and of temperatures in the English and metric systems. The remaining tables are in English units. The relationship 1 metre = 39·37079 inches, adopted from the international tables, is an example of fictitious accuracy which might be discarded in view of the values found by Rogers (1893), 39·370155, and Benoit (1902), 39·370113. The same criticism applies to the expressions for the corrections to the barometric height H, for the variation of gravity with latitude (λ), and altitude (h), viz. $0{\cdot}00259 \cos 2\lambda\, H$ and $5{\cdot}97 \times 10^{-8} h\, H$. The arrangement in table vii., for reducing the barometer to sea-level, or for finding differences of height, is excellent. The *logarithms* are tabulated, and the temperature and humidity terms have been combined by assuming a constant value for the mean air-pressure occurring in the latter; the result is that the complicated process involved in applying the Smithsonian or international tables has vanished, and the desired value may be obtained by a simple calculation as accurately as the observations ordinarily allow. It is, however, *not* necessary to apply the latitude correction to the barometer readings in finding differences of height.

The major part of the volume is devoted to humidity tables for reducing psychrometric observations for temperatures between −20° and 130° F., and for pressures 29·7, 27·7, 25·8, 23·4, 19·7 inches. Presumably 25·8, 23·4 were retained because they are approximately the mean pressures at altitudes of 4000 and 7000 feet respectively, but it seems inappropriate to determine the increments of the argument, *pressure*, by unequal increments of *altitude*. The tables are strictly applicable to observations taken in light winds only.

A useful little table gives the mean daily range of pressure determined from ten tropical stations.

The tables are well and carefully printed on good paper, but the volume might with advantage be made of a more convenient size. The adoption of the principle, common in logarithmic tables, of neither printing nor allowing space for unnecessary figures, would permit this without sacrificing clearness.

E. GOLD.

PLANTS AND GARDENS.

Sweet Peas. By H. J. Wright. Pp. xi+116. Price 1s. 6d.

Pansies, Violas, and Violets. By Wm. Cuthbertson, J.P., and R. Hooper Pearson. Pp. xi+116. *Present-Day Gardening*, edited by R. Hooper Pearson. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1s. 6d.

Die Hiede. By W. Wagner. Pp. 200. (Leipzig: Quelle and Meyer, n.d.) Price 1.80 marks.

Niedere Pflanzen. By Dr. R. Timm. Pp. 194. (Naturwissenschaftliche Bibliothek für Jugend und Volk.) (Leipzig: Quelle and Meyer, n.d.) Price 1.80 marks.

Das Holz. By H. Kottmeier and F. Uhlmann. Pp. iv+143. (Leipzig: Quelle and Meyer, 1910.) Price 1.25 marks.

Der Pflanzengarten, seine Anlage und seine Verwerkung. By Prof. F. Pfuhl. Pp. 152. (Leipzig: Quelle and Meyer, 1910.) Price 2.50 marks.

THE dictum as to the endless making of books may be applied with particular force to works relating to gardening and nature study at the present day. To such an extent has the gardening fashion seized the country that every class of plants must now have its own special treatise. The two books first on the list are the opening volumes of a series entitled "Present-day Gardening," produced under the editorship of the editor of the *Gardener's Chronicle*, and they appear to be excellent alike in their coloured illustrations and in the letterpress. The illustrations are remarkably good examples of colour printing, and it is only in the case of some of the lilac shades that some criticism might be made. The text is both interesting and practically useful, and the plan followed is similar in both volumes, opening with some historical notes, general culture, the value of the plants for decoration, an account of standard varieties, &c. If forthcoming volumes maintain the level of those before us, the series should find high favour with the gardening public.

In "Niedere Pflanzen" and "Die Heide" we have two small German natural history books; the former deals with ferns, mosses, fungi, and algæ, and is a wonderfully compact and comprehensive little book, copiously illustrated with a frontispiece of Equisetum in colour. "Die Hiede" opens with an inferior coloured plate of Culluna, with attendant insects, but the letterpress demands full praise and the illustrations throughout the text are well executed. The history of the heath lands, the component plants, &c., are described in detail, and the biology of the flowers is also fully dealt with; a chapter is devoted to the trees of the heath land. The latter portion of the book gives an account of the animal life of the moor, and numerous figures are given of the various insects associated with this formation. Both volumes are practical and useful works, and the latter especially affords a model which might well be copied in England.

"Das Holz" is a short practical forestry manual, which, in small compass, gives a mass of useful information as to forestry matters in general, such as wood structure, measurement of timber, felling, haulage, &c., and of the industries connected with timber. A book on these lines would probably find a ready sale in England, and be of considerable value.

"Der Pflanzengarten" is concerned with the design and usefulness of a garden as a place for study, and is principally occupied in giving a description of the garden at the Kgl. Mariengymnasium, Posen, and with an account of the plants found therein.

OUR BOOK SHELF.

The Black Bear. By William H. Wright. Pp. vi + 127. (London: T. Werner Laurie, n.d.) Price 6s. net.

IN this well-illustrated volume the author has done for *Ursus americanus* that which he accomplished so successfully for *U. horribilis* in its fellow (see NATURE, vol. 82, pp. 423–4, 1910). The first fifty pages are devoted to a young black bear reared and tamed by Mr. Wright, while in the remainder the distribution and habits of the species are discussed in a manner indicative of intimate knowledge. Indeed, the author's acquaintance with the black bear appears to be as close as with its larger grey cousin. "Cinnamon" bears, it is shown, may be either of the black or the grey species, and the author is disposed to regard the glacier-bear (*U. emmonsi*) and the white bear of Gribble Island (*U. kermodei*) as specifically inseparable from the former. From among a number of interesting notes, attention may be specially directed to the author's observations with regard to the extremely small size and imperfect development of new-born bears, especially those of the present species. The cubs of the black bear are at first "absurdly small and pitifully helpless, weighing only from 8 to 18 ounces each, according to the number in the litter, and are born about two months before the dam emerges from her winter quarters." An old bear will weigh about 400 lb.; and the pups of a 40 lb. dog will be as large as the cubs of a bear of this weight. To explain this, the author suggests that a hibernating bear, which, of course, takes no food, could not nurse cubs proportionately so large as those of the dog; and, whether or no this be the right explanation, there can be little doubt that there is some connection between the hibernating habit and the diminutive size of the cubs.

The book is pleasant reading, and full of hunting and forest lore.

R. L.

Chemistry for Photographers. By Chas. F. Townsend. Fifth edition, revised. Pp. 129. (London: George Routledge and Sons, Ltd.; Dawbarn and Ward, Ltd., n.d.). Price 1s. net.

THE more of chemistry and physics the photographer knows the better is he able to understand his work, to overcome difficulties, and to meet new contingencies. It is impossible to set forth the main facts of chemistry in so small a volume as this, even if the matter is restricted to those subjects that have an immediate bearing on photography; but it is possible to do something useful in this direction even within so few pages. The author commences with burettes and pipettes, and goes on, rather unnecessarily, to gallipots and jampots. We do not think that such expressions as "The iron, as it were, says to the silver, 'You've got my NO_3; drop it!' And the silver has to drop it," assist in representing the subject clearly, and in this case the description would appear to give an incorrect impression. From about the middle of the book the chemistry almost disappears in favour of practical and empirical formulæ, with short instructions for various photographic operations. Some of the author's statements are open to criticism. We read, on p. 62, that "all chemical reactions are reversible." That as, when a photographie plate is exposed to light "there is no outlet for the products of decomposition—the excess of bromide or other halogen set free on reduction in this case—a state of equilibrium is reached at a certain point. If decomposition is carried beyond this point, reversal sets in, which may go the whole way until the original compounds are re-formed." At p. 86 we read that carbon tissue is thin, and at p. 94, in the five and a half lines devoted to Dr. Smith's "Uto" paper, that "it is rendered colour sensitive by means of anethol." Other misleading or unpractical statements might be quoted. A photographer who wishes to know something about combining proportions, the general properties of acids and alkalies, and a few other elementary chemical matters, will probably find what he wants here, with a good many items of miscellaneous information added.

Die Aufzucht und Kultur der Parasitischen Samenpflanzen. By Prof. E. Heinricher. Pp. v + 53. (Jena: Gustav Fischer, 1910.) Price 2 marks.

FOLLOWING upon his original investigations on Lathræa and other parasitic genera of the Scrophulariaceæ, Prof. E. Heinricher has prepared this small volume dealing with the propagation and cultivation of parasitic seed-plants that will appeal especially to gardeners charged with the supply of material for botanical laboratories. The notes refer to well-known European parasites and hemiparasites, and some less common genera, such as Tozzia, Osyris, and Phelipæa. One of the most interesting is *Osyris alba*, which flourishes and produces fine suckers on willows. *Phelipaea biebersteinii*, one of the Orobanchaceæ indigenous to the Crimea and the Caucasus, is worth growing for its flower; its natural host is *Centaurea dealbata*. Another novelty recommended by the author is a pot of *Melampyrum arvense*, which feeds on the roots of several shrubs and small trees.

LETTERS TO THE EDITOR.

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

Lord Morton's Quagga Hybrid and Origin of Dun Horses.

WILL you allow me to suggest that some of the data which speculators upon the antecedents and the history of the horse have made much use of are not too trustworthy?

First, I would suggest that there is doubt whether Lord Morton's famous quagga hybrid is a hybrid at all. Agassé's portrait of it and of its sire and dam are to be seen in the museum of the Royal College of Surgeons in London. According to the portrait, the hybrid was a bay with black "points," the blackness mounting just to the pastern joint, as it does in many bays.

Chestnut has been shown to be recessive to all other colours; and a chestnut never has black "points." Prof. Cossar Ewart tells us that "in their body colour none" of his hybrids took after their sire, the Burchell zebra, a close relation to the quagga. Now, in Lord Morton's case, we have a chestnut mare producing a bay, a colour she certainly does not contain. Is that possible?

Again, we have a chestnut and a quagga, whose legs were white, or, at any rate, a dirty white, producing a foal with black "points." Is that also possible? Unfortunately, there is one disturbing element in what has just been put forward; but it is not serious. I understand that Agassé may have painted the "hybrid" from a drawing, not from the life. But in a case so critical, and with Lord Morton at least to keep him right, it is scarcely possible he could have given the "hybrid" a colour and "points" it did not possess.

Next, I would suggest that the dun colour in horses is not a reversion. In view of the fact that one of our greatest men believed in the dun reversion, and also that it led him and others to argue the primitive horse to be dun and striped, my suggestion may be held to be very presumptive. All the same, it must be made.

In April last, the Royal Dublin Society published a paper for me on "The Inheritance of Coat Colour in Horses," in which it was pointed out somewhat tentatively, because the evidence then at command was small, that dun is dominant to chestnut, black, bay, and brown, and recessive to grey; while its relation to roan was not clear. Since that time a considerable body of further evidence has been got, and it all confirms the original conclusion. Accordingly, a dun foal cannot be got unless one of its parents is either a dun or a grey or a dun roan. Greys are, therefore, the only colour that could throw dun "reversions."

My chief purpose in asking you to publish this letter is to beg for evidence on the points at issue from anyone who would be good enough to send it. What is wanted is evidence—

(1) As to the body colours and leg markings of hybrids between zebras (especially Burchell zebras) and chestnut horses, and

(2) As to the parentage of dun horses.

Perhaps it may be well to say that, if there is difficulty in distinguishing bays, duns, and chestnuts, the following can usually be relied upon:—Unless white "stockings" intervene, bays and duns have always black "points." In bays the colour of the nostril patch is nearly always lighter than that of the face, but in duns there is no distinct break between the colours of the nostril patch and the face. Chestnuts have not black "points"; their legs are coloured like their bodies.

JAMES WILSON.

Royal College of Science, Dublin.

PROF. WILSON thinks the "bay" filly which Lord Morton says he obtained by crossing a chestnut mare with a quagga was not a hybrid, because he assumes that a chestnut does not contain a bay colour, and that the offspring of a white-legged quagga and a chestnut mare would not be likely to have black "points." Prof. Wilson also thinks "that the dun colour in horses is not a reversion," and that the primitive horse was not, as Darwin and others believed, "dun and striped."

The prevailing colour of all the wild Equidæ now living in Asia is dun, and the wild horse (*Equus przewalskii*) has dark points and usually a light muzzle. As crosses between varieties of Burchell zebras with white "points," and crosses between zebras and ponies have, usually, dark patches at the fetlocks, and as the body colour of zebra-horse hybrids is usually yellow, rufous, or leather-dun, it may be assumed that the remote ancestors of the modern zebras only differed in their coat colour from Prejvalsky's horse in being more richly striped.

The drawing of Lord Morton's filly by Agassé might be said to represent a bay or a bay-dun—that the filly was a bay-dun rather than a bay may be inferred from Lord Morton saying that in her colour, as well as in her form, the hybrid filly afforded "very decided evidence of her mixed origin." A light chestnut Iceland pony mare in my stud produced a bay-dun with dark "points" to a yellow-dun Prejvalsky stallion, and a richly striped yellow-dun Highland mare produced first a dark bay with dark "points" and then a light bay (also with dark "points") to a chestnut thoroughbred (Diplomat). I am hence not surprised that Lord Morton's chestnut Arab produced a filly of a bay or bay-dun colour to a quagga.

It has hitherto, so far as I know, not been pointed out that there are two kinds of duns, viz.:—(1) duns without either a dorsal band, shoulder or leg stripes, and (2) duns *with a dorsal band* and, as a rule, more or less distinct bars on the legs—sometimes also with zebra-like markings on the face, neck, shoulders, and trunk, and spots on the hind quarters. Duns *without stripes* of any kind are now and again obtained when a grey is bred with a black or with a bay. The dun colour in these unstriped horses is apparently not a reversion. Moreover, the offspring of two unstriped yellow-duns may be bay or brown.

Yellow-duns with a dorsal band and at least vestiges of leg bars are, in all probability, either the descendants of a long line of dun ancestors or are reversions. Owing to the elimination of duns by breeders—the Arabs thought duns only fit for Jews to ride—there probably does not exist to-day a yellow-dun thoroughbred, but now and again one sees a well-bred yellow-dun hunter with distinct leg bars—a descendant, perhaps, of the dun mare or the dun Arab which figure amongst the ancestors of Touchstone.

That dun is latent in some bays and blacks was proved recently by a black Shetland mare from Unst producing to a bay Arab (Insaf), with a dorsal band and leg bars a richly striped yellow-dun. There are striped white, yellow, leather, and mouse duns. I have obtained a striped white dun from a red-roan Arab mare and a yellow-dun Norse stallion; a striped yellow-dun from a bay Sumatra stallion and a mouse-dun Shetland-Welsh mare; a striped leather-dun from a yellow-dun Highland stallion and a chestnut Shetland-Arab mare; and a mouse-dun from a yellow-dun Highland stallion and a black Highland mare.

My crossing experiments do not support the view that chestnut never contains bay or that yellow-dun is always dominant with chestnut, bay, brown, and black—they on the whole support the view that characters are "patent" or "latent" rather than, as Mendelians say, "present" or "absent."

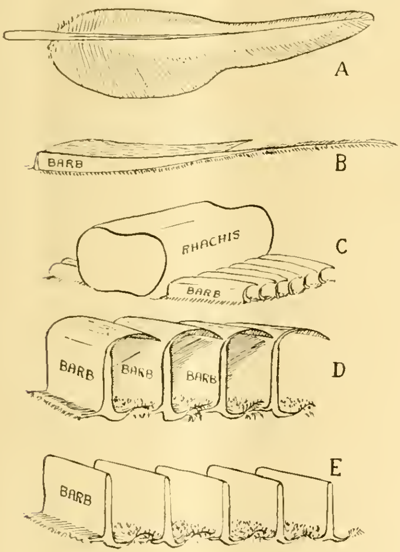
As to the colour of hybrids between a Burchell zebra and chestnut mares, I have little to say. A chestnut polo-pony mare produced three hybrids. In the first two (twins) the body colour at birth was of a rufous tint, and the stripes of a faint reddish-brown colour. When full grown, the body colour was of a leather-dun hue, the stripes being a slightly darker shade of the same colour. In the third hybrid the body colour, golden-dun at birth, was eventually a dark yellow-dun. The stripes in this third hybrid are of a brown colour, and extremely well marked on the neck and limbs. Dark-brown patches at the fetlocks represent black "points."

J. C. EWART.

An Undescribed Feather Element.

In all the European ducks, geese, and swans, and in certain game birds, there is a remarkable feature about the structure of the primary feathers that seems to be hitherto undescribed. The under surface of a feather from such a bird bears a distinct glistening "mirror" occupying that portion of the web adjoining the rhachis. It is quite visible to the unaided eye in any position of light, and may be readily detected by the finger-tip. A closer examination shows this area to consist of a series of narrow silvery (sometimes golden or brassy) membranes each closely overlapping the next distal barb. For illustration I have chosen the fourth primary of an adult Bewick's swan. In Fig. A the glistening area is left unshaded; in Fig. B a single barb is figured, with its membrane; Fig. C shows a portion of the rhachis with the web cut across to show the barbs with their membranes in section; Fig. D gives in transverse section four barbs with the curved membranes. This will be rendered clearer by a reference to the fifth diagram, which figures the barbs on a normal feather taken from a cormorant. In this bird the membranes are wanting.

So far as British birds are concerned, this feather



element is present only in the ducks and their allies, where it is always conspicuous; in the four British grouse, where it is again striking; and in the partridge and the pheasant. In certain exotic game birds (Lophortyx, Tragopan, Gallus, Catreus, &c.) it is quite absent, and this makes its uniform constancy in the Anatidæ all the more noteworthy. The total absence of the structure in the feathers of Steganopodes, Alcæ, Pygopodes, Gaviæ, and Tubinares suggests that it is not essential to the feathers of water birds; and it is, moreover, as conspicuous on the feathers of the Anatidæ with terrestrial habits as it is on those of the truly aquatic ducks. This leads one to look upon it as vestigial of some earlier structure, and as such it might be used for taxonomic purposes.

The diagram of the primary shows the emarginations or notches of the web that have been, and still are, used in the classification of birds—Circus, for example. The use or meaning of these notches has not been explained, so I may be allowed to point out that the shapes of the outer primaries are governed by the law of Avanzini. Prof. Roy, in Newton's "Dictionary of Birds," has shown how this law affects the general shapes of the wing feathers, but does not notice the notches. When the wing is fully extended, with the primaries spread out like the fingers of a hand, each feather must necessarily function as a separate wing or sail. As the position of the rhachis cannot be altered, the web is trimmed away to the necessary degree. The new feathers appear fully formed, but, in many cases, I have reason to suspect that the notching is increased by the subsequent wear of the adjacent feathers.

FREDK. J. STUBBS.

Stepney Borough Museum, E.

An Interesting Donkey Hybrid.

In his letter on the "Origin of the Domestic 'Blotched' Tabby Cat" (NATURE, September 8, p. 298), Mr. Vickers says, "after much diligent search I have been unable to find a single instance in which complete segregation has taken place in respect of all specific characters *when two well-defined species are crossed.*" Our knowledge of specific characters is too limited to make such a claim provable if put forward; but I have recently seen a hybrid between two very distinct species which, at all events, approaches that standard. This is a donkey belonging to Sir Claud Alexander, Bart., which he tells me was bred by Hagenbeck between a male dziggetai, or Mongolian donkey (*Equus hemionus*), and a female Nubian donkey (*Equus asinus*). Both these gentlemen are well acquainted with the species in question, which, as every zoologist knows, are very distinct forms. Yet, unless I had been told that the animal was a hybrid, I should unhesitatingly have identified her as a pure-bred African donkey. Her colour is grey, her legs are strongly barred with black, and she has a sharply defined black shoulder-stripe and black mottling at the base of the long ears. All these characters belong essentially to the African, as opposed to the Asiatic, species.

In one point an approximation to the Asiatic type is shown. This is a widening of the spinal stripe towards the croup, a feature which is certainly more marked than in any African donkey I have seen. Still, the stripe is not nearly so wide as in the dziggetai; and, seeing how variable is the width of this stripe in quaggas belonging to the same local race, I do not feel sure that its width in the donkey in question is not an individual peculiarity independent of inheritance.

It is quite true, as Mr. Vickers says, although he expresses the fact somewhat differently, that the progeny of two distinct species usually combines the characters of the parents in such a way as to be describable as intermediate between them. The notorious case of Ward's zebra may be quoted as an instance in point. Until its history was known and its true nature ascertained, this animal was regarded as a distinct species intermediate between Chapman's quagga and the mountain zebra. It is, in reality, as I have elsewhere shown, a hybrid between the two; and I cite the case here for comparison with that of the donkeys. Whereas the two striped species of Equus produced an "intermediate" when crossed, the two nearly self-coloured species gave a very different result, thus proving the impossibility of foretelling what the progeny will be like when two well-defined species interbreed. It may be claimed, moreover, I think, that this remarkable hybrid donkey weakens the force of Mr. Vickers's contention that the "blotched" and "striped" tabby cats can hardly be representatives of distinct species because their kittens are not intermediate between the two types when crossed.

R. I. POCOCK.

Zoological Gardens, September 1.

British Marine Zoology.

It is possible to have a considerable amount of sympathy with Mr. S. Pace and also with his critic, Prof. MacBride, and at the same time to differ from both on some points. Mr. Pace aims high in both :—(1) his "bibliography of all works dealing with the biology of the European seas," and (2) his "exhaustive faunistic survey of the marine life at one or more points on our coasts," and marine biologists must wish him all possible success in his venture; but the doubt remains whether he has not undertaken more than he can carry out, and whether it would not require the libraries and the staff and all the other resources of one or more scientific societies to produce the first, and the united work of the marine laboratories and other investigating organisations round the coast to deal adequately with the second object.

But even if Mr. Pace falls short of his ideal, he may still produce much—both bibliographical and faunistic—that will be of use in marine biology. This is a case where the success will depend entirely upon the proved utility. If Mr. Pace's bibliographical "Contributions," as they are called, give us something substantial that the other "Records" do not, we shall all use them and be thankful, and that is probably all Mr. Pace desires.

In regard to the "exhaustive and continuous systematic biological survey," one cannot but doubt whether Mr. Pace quite realises the magnitude of what he has set before him. I have been attempting for some years—with considerable support from others—to make a systematic survey (I do not think I ever imagined it would be exhaustive) of one small part of the coast in one little section only of marine zoology—viz. plankton—and I have found that the resources of a university laboratory and a fairly well-equipped biological station, a special steamer with expensive apparatus and a good many assistants, are all required to provide, and to deal with, sufficient data; and I believe that others, both in this country and elsewhere, have had much the same experience.

But still Mr. Pace, with a movable biological station of "relatively simple and inexpensive equipment," may do good faunistic work on parts of the coast not at present covered by the existing marine laboratories; and I must dissent from Prof. MacBride's attempt (NATURE, p. 253) to discourage such work. Every new biological station becomes a centre of useful work, brings in its contributions to knowledge, interests its local public, obtains support for scientific work, and rears up young naturalists, both professional and amateur. Prof. MacBride rightly alludes to the foundations laid by "the splendid amateurs of the last generation." I agree with him that "a great service to science would be accomplished if we could resuscitate this race"; and I believe that local biological stations are the most hopeful influences working in that direction.

Nor can one agree with Prof. MacBride in his evident desire to see one marine station at Plymouth monopolising the marine biological investigations of the whole country. Even if such a state of affairs were possible, the single station could not overtake all the functions of the half-dozen—such as Cullercoats, St. Andrews, Millport, Port Erin, &c. For example, take the needs of local universities. How could Plymouth be to St. Andrews what the Gatty marine laboratory is, or serve Newcastle as the Cullercoats laboratory does? In Liverpool, again (to take the case I know best), the zoology school has had about twenty senior students each year lately who have required a vacation course of marine biology, and have obtained it at very little expense at Port Erin. These students could not have gone to Plymouth: the distance and the expense are prohibitive. Or take the needs of local sea-fisheries authorities. Could a single marine station anywhere on the south coast serve adequately the Northumberland or the Lancashire districts?

Prof. MacBride says, "we should therefore regret very much to see another 'station' started." It reminds one of the opinions expressed some years ago that the number of universities in England should not be increased. Fortunately, such views did not prevail, and the provincial universities of England are justifying their existence. It will be the same with those centres of marine investigation which we call "stations." Each new one properly established in a suitable locality, and wisely directed, will have its own functions to perform, and will attract students and supporters—and each, I believe, will receive the support it deserves. I have long thought there ought to be a fine biological station in the Firth of Forth in connection with the great University of Edinburgh; surely there ought to be one on the south-east coast within easy reach of London, and possibly South Wales or the Bristol Channel might have another. That would not be too many for England. There are more than that number in America, although Prof. MacBride writes as if Wood's Hole alone served the zoological schools of that country as he suggests Plymouth should do here.

I cannot understand Mr. Pace's contention that the intrusion of the economic motive "must arrest, if it does not entirely hinder, scientific research"—and Prof. MacBride seems to approve the view. Has it done so in the case of the Kiel "Kommission," or of the International Organisation for the Exploration of the North Sea in the interests of fisheries exploitation? The reviews in NATURE from time to time of the scientific publications of the Scottish Fishery Board and the Irish and other scientific fisheries departments sufficiently show that scientific research is greatly promoted by these bodies with "economic motives."

Prof. MacBride does not, of course, intend to mislead us in any way, but the incompleteness of his statement in regard to Wood's Hole may give the erroneous impression, to those who do not know the facts, that there is no economic work carried on at that celebrated centre of fisheries investigation and cod and lobster hatching! The fact is that there are two well-equipped laboratories working side by side at Wood's Hole—the one for teaching and research, under the direction of Prof. Frank R. Lillie, and the other (and older one) for research and economic work, belonging to the Government Fisheries Bureau, formerly the U.S. Fish Commission. The latter, although dominated by the economic motive, has produced much good scientific work; and Dr. F. B. Sumner's recent faunistic survey of Vineyard Sound and neighbouring waters, issued from that "fisheries" laboratory, is probably very much on the lines of the work advocated by Mr. Pace, which he and (?) Prof. MacBride seem to think would be arrested or hindered by such an environment. For my part, I believe the economic environment to be most stimulating to scientific research in marine biology, so long as there is perfect freedom to carry on such research.

I think Prof. MacBride's final sentence would lead the reader to suppose that there was now only one biological station in Canada. When I left Quebec last October there were three! It is a rapidly advancing country: there may be more now. W. A. HERDMAN.

Port Erin Biological Station, August 28.

I THINK that Prof. Herdman in his letter in which he criticises a recent article of mine in this journal has misunderstood my meaning in one or two points. Nothing could be further from my wishes than to see one station monopolising all the biological work of the country. I quite agree with him that biological science would be better served by a multiplicity of stations, *provided that these were adequately equipped with funds and with workers*. All I contended was that in the present state of affairs in Great Britain it would be better to concentrate scientific support on one station which, so far as buildings and appliances are concerned, is adequately equipped, than to have it spread over a number of stations poorly provided with funds and with staff, and, *ipso facto*, incapable of affording opportunities of really first-class work. Prof. Herdman thinks that each new station will attract local support and enlarge the number of the devotees of marine zoology. I sincerely trust that he is right; but my experience has been that a poorly equipped station comes to be regarded by the local friends of education as an expensive toy, which they soon tire of supporting. Mr. Pace's appeal was primarily to the professional zoologists, and as the support of these is at present not sufficient to keep one station in proper financial health, I did not see how they could be expected to support two.

Prof. Herdman is mistaken in supposing that I agree with Mr. Pace that economic work necessarily "arrests, if it does not hinder, scientific research"; but I am sure he will agree that a station the sole aim of which was scientific would be the ideal one, and I must point out that his accusation of "incompleteness" in my statement that Wood's Hole was such a station is entirely unjustified. It is true, as Prof. Herdman says, that there are *two* stations in Wood's Hole, one supported by the Federal Government and devoted entirely to economic work, and the other supported entirely by zoologists; but the station which has attained world-wide fame, owing to the quantity and quality of the research which has issued from it, is the second and purely scientific one. I never maintained that Wood's Hole was the sole station in the States, but the number of stations there is far less in proportion to the number of universities than it is in this country. Prof. Loeb and the senior Chicago students for years spent every summer in Wood's Hole, although Chicago and Wood's Hole are 1000 miles distant, a striking commentary on Prof. Herdman's complaint of the distance of Plymouth as a bar to its usefulness to Liverpool students.

One word, finally, as to the Canadian stations. Prof. Herdman states that when he left Quebec last October there were three stations, not one as I had led readers of NATURE to suppose. As for ten years I was a member of the board under whose charge these three stations were placed, I can claim to know something about them, and I reiterate my statement that there is only one properly equipped station in Canada, which is situated in St. Andrew's, New Brunswick, and which was constructed in 1907 as the successor to a movable station which for seven years had been moved from place to place in eastern Canadian waters. Of the other two stations, one is situated on Lake Huron, and is very insufficiently equipped, and no work of any consequence has as yet been done there. The third is on Vancouver Island, and when last I heard of it (in the spring of 1909) it consisted of a wooden shanty, a boat, and one local naturalist, but all three stations were supervised by one board, an ideal far, as yet, from attainment in Great Britain.

E. W. MACBRIDE.

The Origin of the Domestic "Blotched" Tabby Cat.

SINCE writing my previous letter I have had an opportunity of seeing Mr. Pocock, and was glad to hear that he himself had brought the question of the origin of our domestic cats before the Mendelians.

Mr. Pocock has also brought to my notice an instance in which complete segregation has taken place in the first generation in the case of a cross between the Nubian donkey (*Equus asinus*) and the dziggetai (*E. hemionus*), in which the offspring was *practically* indistinguishable from the African species, with this exception, that the dorsal stripe was rather broader. There seems to be a general tendency for ass hybrids to resemble one parent more closely than the other. Curiously enough, I have myself since come across another such instance in the Chrysomelid genus Leptinotarsa.

Mr. W. L. Tower (Biol. Bull., Wood's Hole, xviii., 1910, p. 296, Pl. iv.), in experimenting with *L. undecemlineata* × *L. signaticollis*, discovered that under certain conditions of temperature the individuals produced in the first generation were indistinguishable from the female parent, and, what is stranger still, when interbred continued to produce this type for six generations! Different conditions of temperature gave different results; for instance, one experiment involving the same parentage gave "a single class of adults intermediate between the two parents, a mid-type." No consistency of gametic behaviour is here observable as is the case with our domestic cats, except in so far that certain conditions of temperature are always associated with one particular result.

Previous discussion on the origin of our domestic cats has certainly been concerned more with the *sylvestris* type, and the present interest in the *catus* type is entirely the result of Mr. Pocock's work in this direction; at the same time, the same writer says (Proc. Zool. Soc., 1907, p. 146), "of 'tabby' cats, as fanciers well know, there are two kinds." From the first I have appreciated the difference between dimorphism of colour and pattern, and the case of the leopard was brought forward as comparable "in its gametic behaviour" to the case of the "blotched" and "striped" tabby, though I freely admit this may not have been very clearly expressed in my letter.

The question of greater variation under domestication than in a state of nature rests more on botanical than on zoological evidence; I do not, however, push the inference further than being of some conditional value. Conservation of type is, however, an important factor in nature. We must, I think, for the present concur with Mr. Pocock in having an open mind and preserving an agnostic attitude on this subject.

H. M. VICKERS.

81A Princes Street, Edinburgh, September 10.

THE REFORM OF OXFORD UNIVERSITY.

IN the course of last year, Lord Curzon, as Chancellor of the University of Oxford, published a weighty memorandum on the "Principles and Methods of University Reform." The various proposals therein contained have formed the subject of exhaustive deliberations by the Hebdomadal Council, some of the results of which have been from time to time made public in the *Oxford University Gazette*. The committees entrusted by Council with the task of considering in detail the measures of constitutional and administrative reform suggested by the Chancellor's memorandum have in nearly every instance presented their report; and these reports, having been fully discussed, and accepted, with modifications, by Council, are now published in a volume which has lately been distributed to all members of the Congregation of the University.[1]

The conclusions arrived at by Council, which now await the verdict of the larger legislative bodies, Congregation and Convocation, are summarised by the Chancellor in an ably written introduction, couched in moderate and statesmanlike language. The changes advocated, though not revolutionary, are far-reaching in character, and bear evidence of very careful consideration of all the various interests and conditions involved. The first matter dealt with is the constitution of the University. On this head it is proposed to abolish the arrangement by which Council, the body which has the sole power of initiating legislation, is composed, as to its elected members, of heads, professors, and members of Convocation in equal proportions. The election is in future to be thrown open without distinction of "orders." Congregation is to be made more completely representative of the teaching and administrative elements in the University and colleges by the doing away with the qualification of mere residence. Convocation, the ultimate legislative authority, is to remain, as at present, the general assembly of all members of the University who have taken the M.A. degree and retained their names upon the books. The powers of Convocation are to be in some respects restricted, but it is provided that fuller opportunities of exercising the franchise shall be accorded than at present exist.

An important series of proposals, which have been embodied in a draft statute, relates to the reconstitution of the existing faculties and the creation of a general board of faculties which shall relieve Council of much of its present business with regard to examinations, and shall control the administration of the Common University Fund at present managed by a special delegacy. The changes suggested under this head, if carried out, will have the effect of limiting to some extent the independent action of the colleges, and of putting greater power, under the general supervision of the University itself, into the hands of the whole body of teachers in a given subject. It is a serious attempt towards improved co-ordination.

A measure which is likely to be discussed with much keenness, and to meet in some particulars with vigorous opposition, is the suggested establishment of an entrance examination to be passed before coming into residence; with which provision there is linked an assertion of the principle that Greek should no longer be required as a necessary subject for a degree in arts. It is perhaps not generally realised that although each college exacts its own requirements, differing in different cases, there exists at present

[1] Principles and Methods of University Reform. Report of the Hebdomadal Council, with an introduction submitted on behalf of the Council by Lord Curzon of Kedleston, Chancellor of the University. Pp. xli+98. (Oxford: Clarendon Press, 1910.)

no examination qualifying for entrance to the University. "Responsions," with its several alternatives, has gradually assumed the virtual position of such an examination; but there is still, so far as the University is concerned, no obligation to pass any one of these examinations before matriculating. The scheme outlined by Council provides for making either Latin or Greek optional, and allowing as substitutes certain modern languages, together with other subjects, such as elementary history, politics, chemistry, and physics. This provision is to apply to the existing Responsions, pending the establishment of a regular entrance examination.

A subject which has engaged the attention of Council at considerable length is that of the admission of a poorer class of students. The report is unfavourable to the project of a distinctively working-man's college within the University, but apparently not to the foundation of halls and hostels for students of narrow means, should endowments be forthcoming for such a purpose.

On the general question of finance, the report advocates the constitution of a new finance board, chosen partly from Council and partly from members of Convocation, both resident and non-resident, charged with the duty of advising the University as to its financial policy, and of reviewing the published accounts of University and colleges. The Chest Office would remain as an account office, an estates committee and office of works for the University; but the delegacy of the Common University Fund would cease to exist, its functions being transferred to the proposed general board of the faculties.

In dealing with the subject of fellowships, scholarships, and exhibitions, Council has been to a great extent limited by the fact that these matters are, under existing conditions, largely the private concern of the various colleges. Many recommendations have, however, been made, several of which there is reason to think are not unacceptable to the majority of the bodies concerned. It is proposed that scholars should have the option of resigning some or all of their emoluments, while keeping the name and status of scholar, the money thus saved going to the exhibition fund of the college, or being directly applied for the benefit of necessitous students. Exhibitions, it is thought, should be chiefly or entirely eleemosynary, and freedom should be allowed, under reasonable conditions, for scholars to pursue some other subject than that for which they were elected. The system of prize fellowship receives a modified degree of approval, and the bestowal of fellowships on a large scale expressly for research is discouraged. On the whole, the system of these pecuniary aids to learning would remain, even if all the suggestions of Council were adopted, very much as it is under present conditions. Many will think that the interests of learning and research, as distinct from routine teaching, have here received insufficient recognition.

Other matters which have come under consideration are the establishment of a diploma to suit the special requirements of a business career, the length of the academical year, the reform of the electoral boards for certain professorships, and the admission of women to degrees. Further steps are promised in all these directions.

In the foregoing remarks the aim has been to give a general idea of the proposals which have commended themselves to the Hebdomadal Council, under the presidency of the energetic Chancellor of the University. Criticism has for this purpose been avoided, but it is certain that opinions will greatly differ as to the merits of many of the measures advocated in the Chancellor's introduction and Council's report. All, however, we venture to think, will sympathise with Lord Curzon in bespeaking the serious consideration of Congregation and Convocation for the result of so much thought and labour. The spirit in which the work of reform has been taken in hand could not be better expressed than in the concluding words of the Chancellor's introduction, words which we here take the liberty of quoting:—"We have made no attempt to build a new Oxford on the ruins of an old. We have too profound a conviction of the part that is still capable of being played by the older universities, and, as we think, by our own in particular, in the life of the nation, to wish in any degree to impair either its essential character or its inspiring influence. We want Oxford to remain what it is, but to become, if it may be, better; still to keep alive the transmitted flame, but to see that it illumines every corner of the temple of knowledge and is accessible to all sections of the community; above all, since our University is an imperial training ground for character and intellect, to arrange that the scheme of life which produces the former is worthy and sound, and that the scheme of instruction which develops the latter is comprehensive and efficient."

F. A. D.

MEDICAL EDUCATION IN THE UNITED STATES AND CANADA.[1]

THE Carnegie Foundation has a dual function, to provide pensions for the profession in the United States and Canada, and "to encourage, uphold, and dignify the cause of higher education." It is in connection with the latter that the trustees have undertaken a study of medical education in these countries. The report, prepared by Mr. Abraham Flexner, a trained chemist, is in many respects a remarkable document, the publication of which, we are not surprised to hear, has caused a great sensation. There is no country in the world with medical schools at once so good and so bad as the United States. It would be hard to parallel in Europe conditions so favourable to the study of medicine at Harvard or the Johns Hopkins. On the other hand, a very large number of the medical schools are on a purely commercial basis, and offer an entirely inadequate education.

The report is divided into two parts. The history of medical education in the United States and its present status are set forth; the story is then told of the gradual development of the commercial medical school (a distinctly American product), of the modern movement for the transfer of medical education to the universities, and of the efforts to improve the standard of preliminary education. The present condition of medical studies is then fully discussed, and a forecast of the possible future is attempted.

The second part of the report gives in detail a description of the medical schools in each State, and in each province of Canada. Attention may be directed to chapters ii. and iii. of the report, dealing with the proper basis of medical education, and the actual basis, as containing much that is of interest to us in this country. The sections, too, on the laboratory branches and on the hospital and the medical school are very instructive; the first section is, in fact, an exceedingly able presentation of the whole subject of medical education. It is urged that the 155 medical schools at present existing should be reduced to thirty-one by abolition and consolidation.

The second part of the report is a critical analysis

1 "Medical Education in the United States and Canada." A Report to the Carnegie Foundation for the Advancement of Teaching. By Abraham Flexner, with an Introduction by Henry S. Pritchett. (Bulletin Number Four.) Pp. xviii+346. (New York, 1910.)

of every medical school in the United States and Canada under the heads of "Entrance Requirements," "Attendance," "Teaching Staff," "Resources Available," "Laboratory Facilities," "Clinical Facilities." The condition of some of the commercial schools is scarcely conceivable, and Chicago is well called, in respect to medical education, the plague-spot of the United States. Englishmen will read with interest the report on the condition of medical education in Canada, and it is nice to hear that in point of construction and equipment the Toronto and Montreal laboratories are among the best on the continent. Praise is meted out to the medical school in the comparatively new city of Winnipeg.

It is the purpose of the Foundation to proceed at once with a similar study of medical education in Germany, France, and Great Britain, "in order that those charged with the reconstruction of medical education in America may profit by the improvements in other countries." We understand that Mr. Flexner will be in this country early in October to pursue his work. The report cannot but be most helpful. It is thoroughly well done; perhaps the only legitimate criticism is an insufficient appreciation by its author of the extraordinary progress which higher medical education has made in the United States in the past twenty-five years.

THE SHEFFIELD MEETING OF THE BRITISH ASSOCIATION.

THE meeting of the British Association at Sheffield concluded with the usual votes of thanks on Wednesday of last week. The attendance of members from outside was quite up to the average, but the influx of new local members was small, with the result that the year was a lean one for grants for research, and it was found necessary to draw on the balances from former years. Notwithstanding, however, the small local support of the association itself, the reception accorded was a very warm and hearty one, and the arrangements left little to be desired. A special feature of the meeting was the visits to the large works, the magnitude of the operations carried out, and the combination of science with practical organisation making a great impression on the association as a whole. Indeed, the hearty cooperation of city and University, and the way in which science is applied in all the large industries, has been a matter of constant reference amongst members, whilst the natural beauties of the surrounding district have come as a surprise to all. With the possible exception of one or two sections, the scientific level of the papers read was high, and although no startling new discoveries were announced, there were many papers showing very real progress on old lines. Possibly the meeting may be remembered as that at which the achievement of at last isolating the positive electron was announced by Sir J. J. Thomson.

The constitutional question of the relation between the sections and their constitution has been very fully discussed, but with no final result. The matter is a difficult one. The multiplication of sections tends to overweight the association, as well as to increase the difficulties of the locality to provide the accommodation required for additional section and committee rooms with their assortment of lanternists and attendants. It is becoming increasingly difficult for a large town of the second rank adequately to house the association. It was admirably provided for in Sheffield—a city of close on 500,000 inhabitants—but the number of towns comparable with it can be counted on the fingers of the two hands. On the other hand, it is difficult to see to what already existing action a new subject, such, for example, as agriculture, could be attached as a sub-section. Some think no new branches should be admitted; others suggest that the papers on such a branch should be distributed amongst existing sections according to their affinity; whilst yet another suggestion has been made that the papers should be read at a joint meeting of several sections interested, *e.g.* agricultural papers at a joint meeting of sections B, K, and F. At the recent meeting, however, the subsection of agriculture has been a very successful and live one, managed in all respects as a separate section, and with a full complement of good papers.

At this year's meeting the attempt to bring together men of science of different categories working in allied subjects has been tried to a larger extent than in former years. There have been quite a large number of joint meetings of sections for the discussion of definite questions. It cannot be said that the result has been so generally successful as could be desired. Everybody acknowledges theoretically the value of such meetings, and most of those who have attended them their practical failure—at least, with certain brilliant exceptions, which merely show what they might be. The truth is that the conditions of success for such meetings have not been grasped by the organisers or the openers. It would be good policy on the part of the council to call a meeting of past recorders and sectional presidents to discuss this particular question. The complaint is very general that insufficient time is allowed, and no doubt there is some basis for this, but such discussions are apt to die out earlier than arranged, with consequent waste of time unless the whole discussions with set speakers is prearranged. Many of the most interesting discussions have been those arising spontaneously on some single paper. Not being reported, a speaker feels able to throw out half-considered suggestions or impressions of the moment, which strike fire and kindle the imagination of others, while all would hesitate to publish them in set form. Such discussions are really useful to the experts, and always interesting to the general audience. The failure of set discussions is as often as not due to the speaker who introduces the subject. Not a few feel called on to read a long paper of an hour's duration, taking the edge off the attention of their hearers and distracting them with a mass of details, instead of succinctly laying before them the definite points which require discussion. These remarks have been illustrated by special cases at the recent meeting. The joint discussions might be made so valuable that it is to be hoped the Council will take some steps to ensure that they are.

SECTION C.

GEOLOGY.

OPENING ADDRESS BY PROF. A. P. COLEMAN, M.A., PH.D., F.R.S., PRESIDENT OF THE SECTION.

The History of the "Canadian Shield."

CAN there be any greater contrast than Pleistocene Boulder Clay resting on Archæan gneiss, the latest of rocks covering the earliest, with almost the whole known history of the world in the interval between? It is a fascinating occupation for a geological dreamer to sit on some hillside in Scotland or Finland or Northern Canada, where the schists and gneisses rise in rounded ridges or bosses through Boulder Clay, and ponder on all the strange happenings that separate the clay from the rock beneath.

The clay, melting from its enclosed boulders under the frosts and rain, seems the very emblem of the fleeting things of yesterday; while the Archæan gneiss and greenstones are the type of the solid, imperishable framework of the earth, on which all the later rocks rest.

The Boulder Clay recalls the white surface of a

Continental ice-sheet with summer blizzards sweeping across it like those of the Antarctic tableland, while the gneiss beneath tells of a molten magma cooling during millions of years beneath miles of overlying rock.

It is the meeting-place of the geological extremes, and their contact marks the greatest of all discordances.

One thing the clay and the gneiss have in common—both were long neglected by geology; the Pleistocene beds because they were not rocks, but only "drifts," confused and troublesome things, hiding the real rocks, the orderly stratified formations; the "basal complex" because its schists and gneisses were fossil-less, complex, and mysterious products of the dim beginnings of a world still "without form and void." The molten sphere, with its slowly consolidating crust, belonged rather to the astronomer than the geologist.

Geology has, of course, long lost that attitude, and now finds some of its most seductive problems in these once neglected extremes of the earth's history. Those who distrust the "glacial nightmare" are now very few in number; but there are still revered veterans, like Prof. Rosenbusch, who speak of the Archæan gneisses as parts of the earth's *Erstarrungskruste*, and who frame theories of the earth's cooling and wrinkling in its hot and furious youth.

Over more than half of Canada the field geologist is forced to occupy himself with both the Pleistocene and the Archæan, since the two are almost everywhere together, while the fossil-bearing beds of the vast intervening time are absent. The seemingly unnatural conjunction is not entirely without advantages, for the Pleistocene has furnished the clue to certain very puzzling problems of the Archæan, as will be shown later.

The geologists of the world have long known the broad outlines of the Canadian Archæan or pre-Cambrian area through Suess's masterly portrayal of the "Canadian Shield," and through Dana's account of the "V Formation," about which the North American Continent was built up.

It must be remembered, however, that, though most of the territory has been roughly traversed by Bell, Tyrrell, Low, and other explorers, only a few districts in the south have had their geology worked out in detail, because of their valuable deposits of silver, nickel, and iron ores. It is only in these districts, and comparatively recently, that the succession of pre-Cambrian formations has been determined with certainty. In the wide spaces of the north only the most general relationships are known.

It is intended to bring together here our knowledge of the most ancient chapters in the history of North America as disclosed by recent field work.

Physiographic Features.

In its physiography, the Canadian Shield shows the features that might be expected from one of the oldest and most stable land areas of the world. It was reduced in very early times to a peneplain, but later was elevated, permitting the rivers to begin a process of dissection. This process had a recent interruption by the Pleistocene Ice Age, which blocked many of the valleys with moraines and gave rise to the most extensive tangle of lakes in the world. Physiographically, as well as geologically, the region shows a dramatic mingling of extreme youth with extreme old age.

The best account of this rejuvenated peneplain has been given by Dr. A. W. G. Wilson,[1] who shows that the gradients are very gentle, and suggests that two or more facets can be distinguished as having slightly different inclinations and as having been carved at different times. Here it will be unnecessary to take the matter up except in a general way.

The peneplain has been unequally elevated, parts standing 3000 or 4000 feet above the sea, and other parts sinking beneath its surface. Only at two marginal points can the Archæan surface be said to rise as mountains—in the Adirondacks, projecting south-east into the State of New York, and in the Nachvak peninsula, just east of Ungava Bay.

To the south-west and south the shield sinks, almost imperceptibly in many places, beneath the older Palæozoic rocks, and the same is true around the central depression of Hudson Bay. Toward the south-east the shield breaks off suddenly along the great fault of the Lower St. Lawrence, and apparently the precipitous north-east shore of Labrador indicates faulting on even a larger scale. It has been suggested that Greenland, the Highlands of Scotland, Scandinavia, and Finland may have been parts of a single great shield, now separated through the settling down of the sea-bottoms.

In detail, the region is full of variety of hill and valley, waterfall, river, and lake; but, on the whole, it is monotonous to the ordinary traveller from the constant repetition of similar forms, since there are no real mountain ranges and few outstanding "monadnock" hills to break the sky-line. The sweep of horizon from every hilltop seems horizontal, the summits around seldom rising more than 200 or 300 feet above the valleys, and all reaching nearly the same elevation.

The geologist finds, however, that this impression of general flatness is deceptive. In reality, the rock structures are usually more nearly vertical than horizontal, as in most Archæan regions. The schistose rocks, which form so much of the surface, commonly show dips of more than 60°, so that it is clearly a mountain region planed down to its foundations. The arrangement of valleys, ridges, and hills generally follows more or less closely these ancient rock forms.

Geological Structure.

Until recently, most of the geological work done in this northern territory has been track surveys following Indian canoe routes. Here and there moraines or old lake deposits hide the rocks for a space, but usually the geology is admirably displayed as one's canoe threads the intricate waterways of sprawling lakes spilling over from one irregular basin into another. On entering a new district there seems a hopeless confusion of pinkish gneiss and grey-green schist, but presently orderly forms take shape upon the map as the numberless bays and islands are explored, and the ground plan of vanished mountain ranges begins to show itself. Dr. Andrew C. Lawson, in his brilliant study of the Lake-of-the-Woods and Rainy Lake regions in 1884 to 1888, first brought out distinctly the relationships, and later work has added greatly to our knowledge of these ancient structures.

The typical arrangement is that of rounded or oval batholiths of gneiss, or of granite merging at the edges into gneiss, with schists dipping steeply away from them on all sides. Where the batholiths approach one another the green schists occupy narrow troughs between. As shown by Lawson, they are evidently the bottoms of synclines nipped in by the rising areas of granite and gneiss. Round these eruptive masses the schists have a strike parallel to the edge of the gneiss, so that they do not form ordinary synclines, but widen and narrow and swing in curves to adjust themselves to the varying relations of the batholiths. The meshes of green schist are often not complete, the curving ends feathering out to a point. In such places erosion has eaten the surface down below the bottom of the syncline.

The batholiths in Western Ontario are of all sizes, from a mile to sixty miles or more in diameter, and they are commonly somewhat elongated from west to east or from south-west to north-east. They do not always follow one another in orderly succession, but may lie scattered irregularly, almost like bubbles on foamy water. Yet on the large scale one can recognise a general trend in the direction of the longest axes of the batholiths, and the average strike of the schist in the various regions lies between 50° and 80° east of north, conforming to the same direction. This general east-north-east trend of the basement structures doubtless reveals the axial relations of the Archæan mountain ranges.

It is sometimes stated that the so-called V formation of North America was made up of two ranges converging toward the south, the easterly arm of the V parallel to the Appalachian mountains and the westerly one to the Rocky Mountains. The structural arrangement just outlined does not confirm this view, but suggests irregularly parallel chains, cutting the direction of the Rockies about

[1] "The Laurentian Peneplain," *Jour. Geol.*, vol. xi. No. 7, pp. 615–659.

at right angles and that of the Appalachians at an acute angle.

Of what kind were the mountains erected on these bubble-like foundations of gneiss, set in meshes of schist? In many places they do not seem to have formed continuous ranges such as those of the Rockies, but rather groups of domes of various sizes. Some of them were comparatively low; others seem to have been lofty, though broad. Of the low ones, the best known is that of the Grande Presqu' Isle in the Lake-of-the-Woods, an oval of gneiss eighteen by thirty-two miles in dimensions. Here the up-swelling could not have been great, since the schists dip away from the gneiss at low angles all round, and patches of green schist, remnants of the roof, or perhaps of unusually large blocks stoped from above, are found here and there in the interior.

On the other hand, the Rainy Lake batholith, thirty by fifty miles in dimensions, must have risen as a lofty dome, since the surrounding schists dip away at high angles (60° to 90°). The arch of which they were the bases must have swung thousands of feet above the present surface of the batholith. Passing inwards from the Keewatin, one finds at first immense slabs of the schist shifted a little and enclosed in gneiss, then bands of green material with softened edges, and finally darker cloudy streaks in the gneiss, representing more perfectly digested bands. As Lawson has shown, the outer edge of the batholith is of greyish hornblende syenite gneiss or hornblende granite gneiss, while the interior is of ordinary mica granite gneiss. The outer part has absorbed a certain amount of basic Keewatin material.

One cannot doubt that this zone of green schist fragments, followed by greyish hornblende rock, originally extended over the dome as well as round its edges. In the middle there is now a width of ten or twelve miles of the ordinary Laurentian gneiss. This implies, of course, that the upper part of the dome, afterwards removed, was several miles in thickness, and that the mountain mass rose correspondingly above the synclinal valleys. It must not be assumed that the dome had a regular surface, nor that it was unbroken. Such a batholith as that of Rainy Lake was not made by a single sudden up-welling of granite, but by a long succession of slow inflows from various quarters. Meantime, the rocks above must have been stretched and fractured during the long ages of elevation, and must have been exposed to the usual destructive forces, which may even have kept pace with the elevation during its late stages when differences of level became pronounced.

The coarse-textured granitoid gneiss making up the batholith must have cooled at great depths and exceedingly slowly.

The Raising of the Domes.

Some curious dynamical problems are involved in the raising of the domed mountains. It is conceivable that fluid lava could be forced by the unequal pressure of shifting mountain blocks through a suitable system of pipes into cisterns, so as to form laccolithic domes, but no such mechanism seems possible with batholiths. The granite of the batholiths was plastic rather than fluid, as shown by its having been dragged into the gneissoid structure. The areas affected covered sometimes 1000 square miles. We know of no system of dykes to serve as pipes or passages, of no solid floor beneath, of no faulted blocks to provide the pressure. It is generally assumed that the protaxial granites and gneisses in great mountain ranges have risen because of the relief from pressure beneath anticlines due to lateral thrust. It is doubtful if these irregularly scattered ovals, sometimes thirty miles across, can be adjusted to any system of anticlines.

Some years ago I ventured another explanation. Granite is specifically lighter than most of the greenstones and schists of the Keewatin, and molten granite, even if not at a very high temperature, is lighter than the relatively cold rocks above it. If the rocks above were unequally thick, so that some areas were less burdened than others, it is conceivable that these differences in gravity might cause the granite to creep slowly up beneath the parts with the lightest loads, while the overlying rocks sagged into synclines in the heavily loaded parts.[1]

Whatever their cause, these oval batholiths enclosed by meshes of schist are the most constant feature of the Canadian Archæan, though in many places erosion has cut so deeply that the meshes have all but disappeared, leaving only straight or curving bands of hornblende schist enclosed in the Laurentian gneiss. Very similar batholithic relations of the Laurentian with the Grenville series of Eastern Ontario are described by Drs. Adams and Barlow, though the batholiths are generally much smaller. Batholithic mountains were typical of the Archæan in North America, and, at least in some cases, also of Archæan regions in other parts of the world.

Subdivisions of the Canadian Pre-Cambrian.

Until recently the rocks of the Canadian Shield were usually divided into three parts—the Laurentian, the Huronian, and the Animikie and Keweenawan, the last two being only doubtfully included in the pre-Cambrian. These three divisions are still the only ones shown on the latest general map prepared by the Geological Survey. Lawson's separation of the Keewatin as a lower group than the Huronian was generally recognised as valid, but in practice the subdivision of the two in mapping was difficult, and was only carried out in detailed surveys. His proof that the Laurentian was eruptive and later than the Keewatin was accepted.

As the classification adopted by the American geologists in the Lake Superior region differed from that used in Canada, a Correlation Committee was appointed five or six years ago to draft a compromise, which runs as follows:—

Keweenawan
  Unconformity
Huronian { Upper (Animikie)
    Unconformity
  Middle
    Unconformity
  Lower }
  Unconformity
Keewatin
  Eruptive Contact
Laurentian

This compromise system is now generally in use in Canada, though if Canadian relationships alone were considered the Animikie would be separated from the Huronian and placed closer to the Keweenawan, and the Laurentian would be treated as consisting of eruptive rocks frequently later in age than the Lower Huronian.

The most natural classification for Canada would be as follows:—

Keweenawan
  Unconformity
Animikie
  Great Unconformity
Huronian { Upper
  Lower }
  Great Unconformity
Keewatin
Laurentian = post-Keewatin or post-Huronian granite and gneiss.

The laccolithic domes described on previous pages were formed partly in the interval between the Keewatin and the Lower Huronian, but mostly later than the Lower Huronian. Over much of the shield, however, our knowledge of the relations is not sufficient to separate the mountain structures of the two ages.

Let us now consider the history of the region during the successive periods suggested above.

Conditions during the Keewatin.

One naturally asks what the conditions were in Keewatin times before the earliest known laccolithic mountains were raised. The granitic texture of the eruptives implies very slow cooling under great pressure. The old interpretation of these rocks, following the usual conception of the nebular hypothesis, made them parts of the

[1] Bull, *Geol. Soc. Am.*, vol. ix. pp. 223-238.

earth's original crust, which cooled under the tremendous weight of an atmosphere including everything volatile at red heat, an atmosphere 200 or more times heavier than at present. We know, however, that this cannot apply to the Laurentian gneisses of Canada, since they push up eruptively through great thicknesses of older rocks—the Keewatin in the north and west, and the Grenville series in the east, including large amounts of water-formed deposits. Though these older rocks are now found only on edge in synclines protected on each side by domes of gneiss, there can be no doubt that they once spread out wide and flat on the surface of the earth.

The eruptives of the Keewatin have received most attention, but sedimentary rocks occur in it at all levels and with thicknesses of hundreds or thousands of feet. They include Lawson's Couchiching, with its great areas of mica schist and gneiss formed from what were originally muddy and sandy sediments. In other places quartzites and arkoses, slates and phyllites, represent less metamorphosed clastic materials. The slate is often black with carbon. In the north-west there is little limestone or dolomite, but the Grenville and Hastings series of the east, which are probably in part of Keewatin age, contain thousands of feet of limestone. All the ordinary types of sedimentary rocks were being deposited on the Keewatin sea-bottoms, and one type unlike modern sediments—the banded silica and magnetite or hematite of the "iron formation." The rock last mentioned belongs to the top of the Keewatin, and is very widespread. Its crumpled jaspers have attracted much attention because of their association with iron ore, but in reality the other varieties of sedimentary rocks are present in far greater amount both as to thickness and extent.

In almost every part of the western region there are associated with the sediments great sheets of basic lavas, agglomerates, and ash rocks, as well as smaller amounts of quartz porphyry, &c., showing that the Keewatin was one of the periods of great volcanic activity in the world's history. It is somewhat puzzling to find these predominantly basic volcanics in the Keewatin, while all the underlying eruptives of the Laurentian are decidedly acid, chiefly granite or syenite in composition.

The extensive sedimentary and eruptive rocks of this earliest formation imply that the ordinary geological processes were at work at the very beginning of known geological time, before the Archæan mountains came into existence. There must have been broad land areas where rocks like granite or gneiss weathered to mud and sand, probably under a cool climate, for the greenish arkoses and slates charged with carbon suggest cold rather than heat.

In the north-west volcanoes were active, but the east was comparatively free from eruptions. Both volcanic ash and ordinary clay and sand seem to have been spread out on the sea bottom in the Lake Superior region, and probably seaweeds throve in the mud. In the Grenville region the waters seem to have been clearer, and limestones were deposited on a very large scale, sometimes pure, but often muddy and mixed with a good deal of carbon, so that fucoids probably flourished here also.

If we reconstruct the conditions of the Keewatin, we must then assume continents which have entirely vanished, on which weather, rain, and rivers worked, sweeping sediments down to the shallow or deeper seas to be spread out on a bottom which has also disappeared. The sediments and lavas and tuffs may be said to rest on nothing, for the once fluid or plastic Laurentian gneiss, cradling their synclines and pushing up from beneath them, could not have been the foundation on which they were laid down. Though the floor on which they once rested has nowhere been found, one may be certain that its materials included silica, alumina, and alkalies in the right proportions to fuse into a granitic magma, and this is practically all that is known of the pre-Keewatin world in Canada.

Rise and Fall of the Early Laurentian Mountains.

After the work of the volcanoes, of rain and frost and rivers, of winds and tides and currents, had piled up miles of rock in Keewatin times, there came a great upheaval of mountains over thousands of square miles of the early Archæan surface. Possibly the earth was already shrinking through loss of volcanic material and of the steam and gases that exhale in eruptions. The Atlantic floor may have been settling down, thrusting inwards from the south-east, pushing up the weakened earth's crust beneath the shield into mountain rows; or it may be that some other cause must be sought for the somewhat haphazard domes which arose over such wide areas.

It may be suggested that the many thousands of feet of lava and stratified materials had so blanketed the lower-lying rocks that the heat from beneath crept up into them, softening and semi-fusing them, until in the slow lapse of time they began to flow sluggishly, ascending to form the wide-based domes of the Laurentian mountains. The source of the internal heat need not be discussed here. Uranium, with its various progeny, may have been as active then as now, or a more rapid axial rotation may have kneaded the discrete particles of a mass of planetesimals, and so warmed them up to the heat of fusion.

Then followed the deliberate and almost complete destruction of the great mountain system during a long period of time, which has left no known Canadian record. The sediments derived from this destruction may have been piled on the bed of the Atlantic as it sank. It is possible that Sederholm's Bottnian in Finland may partially fill the gap.

Whatever disposal was made of the débris, several thousands of feet must have been carved from the mountains and swept out of view during the immense interval which separates the Keewatin and early Laurentian from the Lower Hurnnian, for the next series of rocks rests with a great discordance on the upturned edges of the synclinally disposed Keewatin schists and the truncated domes of Laurentian gneiss.

The Huronian.

The Lower Huronian has very different relationships from the Keewatin. Where least disturbed, as north of Lake Huron and in the Cobalt region, the floor beneath it is often well preserved. Dr. Miller has shown that at Cobalt the surface of Keewatin and Laurentian was hilly or hummocky before the basal conglomerate of the Lower Huronian was deposited; and Prof. Brock, in describing the Larder Lake district to the north, refers to "the clean-swept and often rounded surface of the older rocks on which it is frequently laid down."[1]

The basal conglomerate of the Lower Huronian contains pebbles and boulders of all the Keewatin and Laurentian rocks that went before, and among them are found beautifully striated stones. It is the oldest known Boulder Clay or tillite. The vast period of subaërial destruction that carved away the early Laurentian mountains ended in a glacial period, the ice-sheets of which covered many thousands of square miles of North America, just as the last great period of peneplanation ended with the Pleistocene ice-sheets.

It is not a little impressive to see modern till resting on the Huronian tillite, and including fragments of it as boulders. It is possible to break out from the modern glaciated surface stones the underside of which received their polish and striæ in the Lower Huronian, while their upper surface has been smoothed and scratched by Pleistocene ice movements.

At Cobalt the tillite is accompanied by slate, which may be compared in all essential characters except hardness with the stratified clay of adjoining lake deposits of Pleistocene Age. The most recent and unconsolidated beds make clear the origin of some of the most ancient and, in appearance, most different rocks in the world.

In the Lake Huron region the action of ice was probably followed by an invasion of the sea, for the tillite is succeeded by thousands of feet of quartzite, arkose, and conglomerate, and by a few hundred feet of limestone. Possibly much or all of the limestones of the Grenville and Hastings series, which Dr. Adams reckons among the great limestone formations of the world, were formed at about the same time.

The Middle Huronian (Logan's Upper Huronian) is separated by a basal conglomerate, possibly glacial, from

[1] "Bur. Mines, Ont.", 1905, p. 31.

the Lower Huronian; but the break does not seem very profound, and the rocks do not differ much from those just described.

The least changed parts of the Huronian extend as a wide band for 200 or 300 miles north-east of Lake Huron, and in this area the uneven surface of Laurentian and Keewatin beneath the Lower Huronian Boulder Clay preserves for us a portion of the earliest dry land, the earliest peneplain known in America, and possibly in the world. This band has remained comparatively stable, while, so far as our information goes, all other parts of the Canadian Shield have undergone violent changes.

Rise of the Late Laurentian Mountains.

The Lower Huronian tillite has been found in many places throughout the Archæan region, over a stretch of 1000 miles from east to west, and 700 miles from north to south, so that in all probability deposits like the Pleistocene till covered most of the surface.

Everywhere, however, except in the band extending north-east from Lake Huron, it seems to have been involved in later mountain building, and has been so sharply folded in with the Keewatin as to destroy the appearance of unconformity. It is instructive to note that so long and momentous an interval was entirely overlooked by geologists or treated as of small importance until a few years ago. There is usually no angular discordance to be observed, and the secondary schistose structures of Keewatin and Huronian are similar and parallel. The Huronian boulder conglomerate has often been rolled out to a schist in which only the harder boulders can be recognised as lenses; and sometimes even they are lost entirely, so that no evidence of discordance remains.

It is evident that the invasion of the later Laurentian granites and gneisses was accompanied by very important dynamic and metamorphic effects. Most of the batholithic domes of North-western Ontario are post-Lower Huronian, and date perhaps from the Middle Huronian or the interval between it and the Upper Huronian (Animikie).

The granites and gneisses of this second time of mountain building have not been distinguished in mapping from those of the first in most places, and as they are both of precisely the same habit, it will probably never be possible to separate them completely. Thus far both have been included under the name Laurentian, which must be considered as representing a lithological facies rather than a geological period. It may be, however, that the formation of batholithic mountains never really ceased from the end of the Keewatin to the end of the Lower Huronian. As the rocks called Laurentian are entirely eruptive, they should not be limited to a definite time, but only to a definite set of conditions as to composition, rate of cooling, and amount of pressure.

As in the earlier cycle, the period of mountain-building was followed by a period of destruction, ending in a peneplain of very wide extent.

The Animikie or Upper Huronian.

The interval between the lower formations and the Animikie is of great magnitude, perhaps even greater than that between the Keewatin and the Lower Huronian, and Lawson has suggested for it the name of the Eparchæan Interval. The Animikie has not been found resting on the Middle Huronian in Canada, so that this formation may partly bridge the chasm. Unless the Middle Huronian quartzites include part of the products of erosion, we have no evidence as to the disposal of the many thousands of cubic miles of materials removed from the later Laurentian mountains.

The Animikie begins in most places with a thin basal conglomerate lying almost horizontally on the upturned edges of the previous schists and gneisses. Above this come chert, black slate, and other sediments, sometimes to the extent of 8000 or 10,000 feet. The slate often contains carbon enough to make an important coal region if collected in definite beds.

The whole no doubt implies a transgressing sea, which ultimately must have covered a very large part of the Canadian Shield, since rocks of this age are found over wide surfaces north-west of Lake Superior, near Lake Mistassinni, in the heart of Labrador, on the east side of Hudson Bay, and near Great Bear and Dubaunt lakes. These rocks are found in Labrador up to 1575 feet above the sea. This level, if extended in all directions, would submerge three-fourths of the Archæan peneplain.

At present these areas, though large, are widely separated; and it may be rash to assume that even soft, easily weathered rocks, like the Animikie slate, could have been completely removed from the intervening spaces. It is probable, however, that less than half of the Archæan then remained as dry land.

The Keweenawan.

There is an interval marked by a small discordance and a basal conglomerate between the Animikie and the Keweenawan, but the break in time was apparently not great. The two groups of rocks often occur together, though in many places the Keweenawan sediments overlap on to the Archæan, as in the neighbourhood of Lake Nipigon. Most of the Keweenawan sedimentary rocks are of shallow-water varieties, such as sandstone and conglomerate. At various places on the north-east shore of Lake Superior a coarse basal conglomerate is found as remnants preserved in small valleys or ravines in the granite. The ancient surface is now in process of resurrection by erosion, and the boulders once rolled on a Keweenawan shore are being freed from their matrix and once more set in motion by the waves of Lake Superior.

The Keweenawan, like the Keewatin, was a time of vigorous volcanic activity, and in post places the lava-sheets and laccolithic sills of diabase connected with their eruption far surpass the sediments in amount. The volcanic rocks are generally basic in character, and probably most of the diabase dykes widely found in almost all parts of the Canadian Archæan are of this age. The important deposits of copper, nickel, and silver in Northern Canada are closely bound up with the Keweenawan basic volcanic rocks or with deeper-seated diabases, probably of the same origin.

Here, as in the Keewatin, we are confronted with floods of basic lava coming up from unknown sources through the acid Laurentian gneiss. Do these basic lavas represent heavier segregations settling to the bottom during the slow movements of the granitic magma as it climbed into the Archæan batholiths? One might imagine these heavier and more liquid parts sinking beneath the lighter, more viscid, magmas of the domes, and remaining fluid until the mountain masses above had become completely solid. The supposed thrust from the Atlantic basin to the south-east might then bring strains to bear on the solid crust, more or less shattering and shifting its masses, squeezing up the still molten diabase through all the fractures and pores.

Several remarkable basins were formed in the Archæan peneplain by the ascent of these lavas, permitting the massive roof which formerly covered them to collapse by block faulting or by the formation of an irregular syncline. The basin of Superior seems to be of this nature. It is still rimmed by the Keweenawan lavas, sometimes accumulated to the thickness of 50,000 feet. Just to the north is the smaller basin of Lake Nipigon, with its edges and islands of biabase sheets, and to the east, near Sudbury, is the extraordinary synclinal basin, with which the great nickel mines are connected. These basins seem to have resulted from the collapse of the solid crust because of the removal of support when basic eruptives ascended from beneath.

Palaeozoic History.

The exact relation of the Keweenawan to the Cambrian is somewhat in doubt, though most geologists make it pre-Cambrian. The St. Mary's, or Lake Superior, sandstone, which rests upon the Keweenawan with a slight discordance and overlaps upon the Archæan, is generally called Cambrian; it contains no fossils, and occurs only along the shores of Lake Superior and St. Mary's River, so that its position in time is uncertain.

Potsdam sandstone, either Upper Cambrian or Lower Ordovician, rests upon the planed-down Archæan surface at the Thousand Islands and other points in Eastern Canada, often with a conglomerate at its base; and undoubted Ordovician limestones feather out upon the

Laurentian all the way from Saskatchewan and Manitoba on the north-west through Ontario to the city of Quebec on the east. These limestones represent an important transgression of the sea upon the Canadian Shield. Apparently the old hummocky surface was often pretty cleanly swept, so that limestone with very little fragmental material rests immediately upon the gneiss, but in other cases there is arkose or a basal conglomerate of Laurentian materials.

Occasionally Archæan hills rise island-like through the shaly limestone, which tilts away quaquaversally, as if the hill had protruded through the sediments. This appearance is probably due to the settling and shrinking of the mud in its consolidation to rock. Drill-holes east of Lake Ontario show that there were valleys hundreds of feet deep between these Archæan hills, so that in this region the peneplain was far from complete. These inequalities may be considered foot-hills of the Adirondack mountains farther east.

There is reason to believe that before the close of the Ordovician the sea crossed from the region of Lake Winnipeg to Hudson Bay, flooding all the lower parts of the shield; but probably most of Labrador and part of Franklin, north-west of Hudson Bay, remained as dry land.

The Silurian follows on the Ordovician without a discordance, and at this time the sea probably submerged an even larger part of the shield, since the Silurian limestone of James's Bay is only 250 miles from that south of the Great Lakes, and there are two outliers between—on Lakes Nipissing and Temiscaming. It may be added that the highland of Silurian limestone crossing Southern Ontario, with a bold escarpment facing north-east, rises hundreds of feet higher than the watershed towards Hudson Bay. The escarpment facing the Archæan "old land" corresponds to the Scandinavian "glint," and has a similar relation to the lakes of the Archæan border.

The Devonian Sea also encroached south of James Bay and along the south-west side of the shield from Clear Lake, in Saskatchewan, to Great Bear Lake.

What took place on the Archæan continent while the coal forests flourished on the lowlands to the south and to the far north is unknown, since no Carboniferous rock has been found on its surface.

Mesozoic and Cenozoic History.

Early Mesozoic times are a blank, but a few small outcrops of Cretaceous rocks resting on the Archæan toward the south-west show that portions of its rim were once more under water. Dr. Wilson believes that an important facet of the peneplain should be dated from the Cretaceous, since planation was going on in parts of the United States at this time; but no positive evidence of this is at hand.

Nor is there any evidence as to its history in the Tertiary before the oncoming of the Ice Age of the Pleistocene, when its whole surface was scoured more than once by great glacial sheets. The mantle of decayed rock which must have accumulated during the long dry land stage was almost completely swept away, leaving the rounded surfaces of ancient rock fresh and clean beneath the Boulder Clay.

In an important inter-Glacial interval and in post-Glacial times much of the morainic material was assorted in great lakes the shore and deep-water deposits of which cover large parts of the surface. With the departure of the ice, the sea once more transgressed upon the lower parts of the shield, but the land has been rising since, leaving a belt of marine deposits up to about 500 feet around the shores of Hudson Bay, the St. Lawrence, and the Atlantic.

How much of the Shield has been Covered?

It is generally stated that the Canadian Shield has been dry land since the Archæan, and hence that erosion has been taking place ever since that time. This is probably true for part of the north-eastern portion of the shield, and perhaps also the north-western, but much of the area, especially toward the south, was buried in early days under Palæozoic sedimentary rocks, and so protected from further destruction. These sediments are still being slowly stripped from the Archæan in many places.

This may account for the greater proportion of Huronian and Keewatin rocks in the south as compared with the north. It is probable that in the unprotected northern parts weathering agencies have eaten the higher Archæan rocks completely away from the Laurentian gneiss beneath. Before asserting this positively, however, it may be well to await more thorough exploration of the little known north.

It is possible, but not very probable, that the whole area was at one time covered with Ordovician or Silurian shale and limestone. If so, all traces of this capping have been removed from hundreds of thousands of square miles of its surface.

There is one very impressive feature of the Archæan as found beneath the later rocks. The peneplain, with its rounded, hummocky surface, seems exactly the same when one strips from it recent Boulder Clay, early Palæozoic shale or sandstone or limestone, Keweenawan eruptives, or even Lower Huronian tillite, where this has remained undisturbed. It is as though all the millions of years of destruction since the Middle Palæozoic had made only unimportant changes in the pre-Cambrian peneplain. When it is recalled that peneplanation took place twice in the pre-Cambrian, before the Lower Huronian and before the Animikie, one is almost driven to think that pre-Cambrian time is far longer than post-Cambrian.

Relation of the Shield to the Palaeozoic.

Except toward the east, the Canadian Shield sinks gently beneath Palæozoic beds, in most cases retaining its character as a peneplain. How far does it continue to the south and west beneath the sedimentary rocks, and to what depth does it extend?

The results of drilling at Toronto, eighty miles south of the contact, show gneiss and crystalline limestone at a depth of 1200 feet below the surface, or 940 feet below sea-level. Near Lake Erie, 130 miles to the south of the contact, the Archæan is reached at a depth of 3300 feet—2700 feet below sea-level. Its slope to Toronto is at the rate of 20 feet per mile, and from Toronto to Lake Erie at the rate of 35 feet per mile. This corresponds fairly well with the dip of the overlying Palæozoic rocks.

As the peneplain rises more than 1300 feet above sea-level at the watershed 300 miles north of Lake Erie, there is a difference of 4000 feet in a north and south direction, and if comparison is made with the Adirondack mountains 250 miles to the east, the difference even amounts to 6600 feet. It is probable, however, that the Adirondacks were a residual group of mountains never reduced to the general peneplain level. It is clear that the pre-Palæozoic peneplain has been greatly warped in later ages, perhaps as a result of the increasing load of sediments piled on its southern edge.

One is apt to think of these ancient crystalline rocks as an exceedingly solid and resistant block of the earth's crust, likely to undergo little deformation, so that this evidence of warping or doming of the surface comes as a surprise. In reality, shiftings of level under changes of load are normal in every region, and have been going on along the southern border of the Canadian Shield all through Pleistocene times, and perhaps continue now.

The proof of this is to be found in the differential elevation of the shore-lines of the great post-Glacial lakes, which ascend with an increasing grade toward the north (N. 20° E.). In the case of Lake Iroquois, the difference in level between the two ends of the earliest shore is more than 500 feet, and the grade toward the north even rises to 6 or 7 feet per mile. If we add 230 feet of deformation of the marine beaches, which followed Lake Iroquois toward the north-east after the final melting of the ice, there is a known change of level amounting to 730 feet within late Pleistocene times. There is reason to believe that similar changes of level took place during the inter-Glacial period recorded at Toronto and to the north.

The Pleistocene sinkings and risings are naturally accounted for by the piling up and removal of the thousands of feet of ice in the Glacial periods, though probably isostatic equilibrium was not reached in these movements.

We know that the ice was more than 4000 feet thick, since it passed over the tops of the Adirondack mountains.

This thickness of ice is equal in weight to about 1600 feet of rock, while the greatest known elevation since the removal of the load is not much more than 700 feet, implying that a weight of 900 feet of rock can be supported by the shield. It may be, however, that in the interior of Labrador, where no beach-lines give evidence as to changes of level, the doming is much greater than the amount suggested.

It is of interest to note that these adjustments to change of load take thousands of years to accomplish. The rise due to the melting of the Labrador ice-sheet may be going on slowly now, 30,000 or 40,000 years after the load was lifted.

These sinkings and risings must be accomplished by plastic flow outwards from beneath the loaded area or inward toward the area relieved of its load.

Instead of a rigid, unyielding shield, we must conceive a stiffly flexible covering over a plastic substratum, where during thousands of years adjustments of level, amounting to hundreds of feet, may take place; and during millions of years of removal of load by erosion, or of piling on of load through sedimentation, changes of level of thousands of feet can be accomplished. Such changes have taken place on the southern and western sides of the shield without any known rupture, while on the east the adjustment has been accomplished in part by great faults.

Has the Archæan, which is supposed to underlie the stratified rocks in all parts of the world, undergone the same vicissitudes?

Summary.

The history of the Canadian Shield begins in pre-Keewatin times, with land surfaces on which weathering took place, and seas in which mud and sand were deposited. If the earth were ever molten, that stage had long been passed before the Keewatin sediments were laid down, for they include carbon, probably derived from fucoids, which could not have lived in a hot sea.

The pre-Keewatin land surfaces and sea bottoms have totally disappeared, so far as known to Canadian geology. Apparently they have been fused and transformed into the gneisses of the Laurentian.

The Keewatin was a time of great volcanic activity, lava streams and ash rocks surpassing in amount the thick sheets of sediments. At the end of the Keewatin the thousands of feet of volcanic and clastic rocks were lifted as domes by the up-welling of batholiths of early Laurentian gneiss.

Then followed a profound gap in the record, during which the mountains were levelled to a hummocky peneplain. This gap represents a very long period of weathering and destruction on a land surface, ending in glacial action on a large scale.

The Lower Huronian begins with the deposit of a thick and widespread Boulder Clay, followed up by a transgression of the sea in which mud and sand, and also limestone and chert, were deposited.

After a short break similar processes went on in the Middle Huronian. During the Middle Huronian, or in the interval between it and the Upper Huronian (Animikie), mountain-building was renewed on a grand scale, many synclines of Keewatin and Lower Huronian rocks being caught between the rising batholiths of late Laurentian gneiss. A broad central band of the Lower Huronian escaped this process, however, and has preserved its original attitude on a floor of Keewatin and Laurentian.

The Animikie or Upper Huronian sediments which rest on the planed-down floor of upturned Lower Huronian, Laurentian, and Keewatin rocks, consist largely of chert and carbonaceous slate or shale, which lie nearly horizontal and have undergone very little change.

The Keweenawan follows the Animikie with only a small break, and includes shallow water-beds of sandstone and conglomerate, accompanied by immense outflows of lava. As a result of the outpouring of lava, great basins, like that of Superior, resulted. It is probable that during the Animikie and Keweenawan most or all of the Canadian Shield was covered by the sea.

The Keweenawan is generally held to mark the close of the Archæan (or Algonkian or Proterozoic). Low reports portions of these formations as having been caught in mountain-building of the Laurentian type in Labrador, but commonly they have not been disturbed.

During early Palæozoic times the Canadian Shield was more than once encroached upon by the sea, though probably much of the peninsula of Labrador, and perhaps a region north-west of Hudson Bay, escaped.

From the Devonian to the Pleistocene the shield seems to have remained dry land, and part of the Ordovician and Silurian capping of sediments was removed during this long period.

The succession of Pleistocene ice-sheets completed the work of denudation, and at the end of the Ice Age many thousands of square miles of the lower portions were once more beneath the sea.

Last of all, the region has been rising at unequal rates in different parts, as shown by the warping of marine and fresh-water beaches.

The surface of low hills and rounded knolls of gneiss and schists beneath the Pleistocene Boulder Clay resembles in every way that beneath the flat shales and limestones of the early Palæozoic, or the nearly horizontal sediments of the Animikie, or even the undisturbed parts of the Lower Huronian Boulder Clay. It may be that much of the surface has been covered with sediments and restored to daylight by subaërial erosion several times in succession. The greater part of the carving-down seems to have been done before the Animikie—*i.e.* within pre-Cambrian times—and the pre-Huronian surface seems as mature as any of the later ones. The bearing of this on the length of early geological time is evident. Pre-Huronian time includes the laying down of thousands of feet of Keewatin sediments, the elevation of early Laurentian mountains, and the levelling of these mountains to a peneplain. It may be as long as post-Huronian time.

NOTES.

PROF. F. W. DYSON, F.R.S., Astronomer Royal for Scotland, has been appointed Astronomer Royal in succession to Sir William Christie, K.C.B., F.R.S., who is to retire on October 1.

AT the age of seventy-eight years, and in his native place, Lunel, Eugène Rouché, the well-known mathematician, recently passed away. He entered the École Polytechnique in 1852, and on completing his course there devoted himself to teaching, in which he was very successful, and the composition of text-books, which quickly obtained a high and deserved reputation. The treatise on geometry which he wrote in partnership with Charles de Comberousse may be fairly called a classic, and is an excellent example of what such a work ought to be; many teachers in this country must have found it a most useful source to draw upon, both for theorems and for examples. Engrossed as he was by these occupations, Rouché found time to write a number of original notes and papers, and his talents received fitting recognition in 1896, when he was elected a free member of the French Academy of Sciences in succession to Baron Larrey. Friends who knew him intimately bear witness to his personal charm and vivacity, and the academy, on August 22, passed a vote of sympathy with his widow and family, after hearing a brief account of his career from the president, M. Emile Picard.

IN the death, in his seventy-seventh year, of Prof. Friedrich von Recklinghausen, of Strassburg, pathology loses one of its most distinguished investigators. Working along the lines marked out by Rokitansky and Virchow, v. Recklinghausen played a conspicuous part in building up our knowledge of pathological anatomy during the second half of the nineteenth century. His researches threw a great deal of light upon many aspects of disease of the circulatory system, especially the phenomena of thrombosis and embolism, well described in his great "Handbuch der allgemeinen Pathologie des Kreislaufs und der Ernährung," published in 1883. He devoted great attention to the study of "fibroid" tumours of the uterus and other pathological conditions of the female genital system, which formed the subject of another of his treatises. He also added greatly to our knowledge of general bone-diseases, such as rickets, osteomalacia, and acromegaly, and especially of the pathological changes in the form of the skull caused by rickets. His observations on the nature of a curious frog-like swelling under the tongue called "ranula," on hæmatogenous pigmentation of the skin, and on the heart condition he called "segmentatis myocardii," are well known; but perhaps his discovery of the association of multiple fibrous tumours of the skin with the distribution of cutaneous nerves is that most usually associated with his name as "Recklinghausen's disease."

MR. C. A. BRERETON, whose death, at the age of fifty-nine years, occurred on Monday last, was for many years associated with Sir John Wolfe Barry, K.C.B., F.R.S., in important engineering enterprises, such as the construction of the Barry Docks and railways, the Middlesbrough Docks, Surrey Commercial Docks, and the new bridge across the Thames at Kew. He also did a good deal of engineering work for the Caledonian, North-Eastern, Metropolitan, Metropolitan District, Whitechapel and Bow Railways, parts of the Great Northern and Piccadilly Tube, and for the Government of Natal. In recent years he was in business on his own account.

THE death is announced, in his fifty-ninth year, of Mr. William Earl Dodge Scott, curator of the department of ornithology at Princeton University. He was the author of "Bird Studies," "Story of a Bird Lover," "Birds of Patagonia," and many technical papers in scientific journals. Mr. Scott had done field work for the British Museum, the American Museum of Natural History, and other institutions.

DR. ROBERT AMORY, a well-known American writer on physiology and therapeutics, has died at his summer home at Nahant, Mass. He was born in 1842, graduated in medicine at Harvard in 1866, and was appointed in 1869 lecturer at Harvard on the physiological action of drugs. He was afterwards professor of physiology at the medical school of Bowdoin College.

THE death is announced, at the age of seventy years, of Mr. John Langton, consulting surgeon to St. Bartholomew's Hospital, and a former Hunterian professor of pathology and surgery at the Royal College of Surgeons. In 1900 he was Bradshaw lecturer.

IN connection with the fourteenth Flemish Congress of Natural and Medical Science, an International Scientific Exhibition will be held in Antwerp on September 17–25 next. The exhibits are to be classified as under:—Section i., physico-chemical sciences: including new apparatus and inventions, laboratory installations, lanterns, microscopes, and the scientific applications of photography; collections of chemical productions, geological specimens, and crystals. Section ii., biological science: apparatus for experimental research and demonstration, zoological and botanical collections, fossils, microscopical preparations, and photomicrographs. Section iii., medical science: experimental apparatus, pathological specimens, radiograms, surgical instruments and appliances; operation-room, sanatorium, and hospital furniture; electro-medical and X-ray apparatus. Section iv., scientific books and reviews.

THE twenty-seventh convention of the Association of Official Agricultural Chemists is to be held at Washington on November 10–12, when communications on the following subjects are to be given:—Phosphoric acid; nitrogen; potash; soils; inorganic plant constituents; insecticides; water; food adulteration; dairy products; foods and feeding stuffs; sugar (chemical methods and molasses methods); tannin; drugs and medicinal plants.

AN International Congress of Tuberculosis is to take place in Rome on September 24–30 of next year. Prof. Guido Baccelli is to be the president, and Prof. v. Ascoli, of Rome, the general secretary.

THE statue (by Mr. Bruce-Joy) of Lord Kelvin which is to be erected in Belfast is, according to the *Westminster Gazette*, in an advanced stage of completion. Lord Kelvin is represented as holding in his right hand the design of a gyroscope, and by the side of the effigy is a model of the Kelvin compass. The statue is to be cast in bronze, and will stand on a pedestal 12 or 13 feet high.

A GRANITE obelisk erected in the parish churchyard of Forfar to the memory of George Don, the Scottish botanist, was unveiled last week by Mr. G. Claridge Druce, who gave an address on Don's achievements as a botanist.

ACCORDING to the *Lancet*, the remainder of her estate (in addition to a million francs already bequeathed) has been left to the Pasteur Institute in Paris by the widow of the Marquis de Beauregard de Maubreuil d'Orvault.

THE New York correspondent of the *Times*, writing on September 12, states that Prof. Macmillan, who accompanied Commander Peary on his last voyage, reports from Labrador that he has made a successful exploration of the region westward from Davis Inlet to George River and the home of the Nasquapee Indians. Three lakes, the largest of which, called Misternipi, was twenty-five miles wide, were discovered.

THE American Philosophical Society gives notice that in December next it will award its Magellanic gold medal "to the author of the best discovery, or most useful invention, relating to navigation, astronomy, or natural philosophy (mere natural history only excepted)." Candidates for the award, who may be of any nationality, must send their claims (in English, French, German, or Latin) to reach the society in Philadelphia by November 1, but the award will not be made for any communication already published or for which a prize has been given elsewhere. Each MS. must bear a motto, device, or other signature, the author sending the society a sealed letter giving his real name and address in addition to the motto, &c., upon his essay.

A REUTER message from Paris states that a private conference of the official delegates of the various Governments at the Pure Food Congress has arranged to make certain methods of analysis international, with the consequence that when any food is in future submitted to an analytical test it will have to conform to that international standard.

IN the June issue of the *Philippine Journal of Science* Messrs. R. B. Bean and F. S. Planta publish the third of their studies of Filipino racial types at Taytay, this portion of the memoir being devoted to women. In measurements of the body, the greatest differences appear between the Primitive and the Iberian types, the women approximating to the former and the men to the latter. Between these comes the Australoid type, which in the crural index resembles the Negrito. In head measurements, the women have relatively broader heads, faces, and noses than the men; in other words, they are more Primitive than the local men or the women of Siberia, with whom a useful comparison is made. We now possess some materials for disentangling the complex racial elements in the population of the archipelago. As is usual with the work of this school of anthropology, the memoir is provided with elaborate statistical summaries and excellent photographic illustrations.

In our article on "Malaria Prophylaxis in India" (August 25), we remarked upon the somewhat discouraging fact that no instance of a drainage scheme with successful result was put before the recent Malaria Conference at Simla. Since then, however, we have received the report of an interesting lecture on the prevention of malaria by Dr. Malcolm Watson, of the Federated Malay States (Selangor). As is well known, Dr. Watson has long been conducting, with the assistance of the Government and Dr. Travers, the senior medical officer, an extensive campaign against malaria, principally by the method of drainage, and his lecture gives a brief but very interesting account of the work done. In two large stations, Klang and Port Swettenham, the disease has been almost entirely banished by drainage alone, with a saving of more than 400 lives per annum. As the case mortality of malaria is only about 1 per cent., this saving of mortality means an enormous saving in morbidity, which doubtless the inhabitants are able to appreciate. A similar improvement has been made in all the flat rural areas in the State, especially in many of the rubber plantations. Here the disease is carried by *Myzorhynchus umbrosus*, which does not breed easily in any running water; so that mere open surface drains suffice to banish the insect, especially when accompanied by removal of jungle. In the hilly land, however, *Nyssorhynchus willmori* appears to be the carrier—an insect which breeds readily in rapidly running streams—with the result that the ordinary drainage methods will probably be useless, closed pipe drains and other methods being required. Dr. Watson's energetic and long-continued campaign demonstrates not only the utility of drainage, which he maintains is the fundamental method against malaria, but also the fact that it must be intelligently carried out. It is probably neglect of this latter principle which has caused most of the reputed failures. Many other points are referred to in the lecture. For example, rice fields are found to be almost free from malaria, owing to the fact that, for some unexplained reason, the malaria-bearing species of Anopheline cannot thrive in their waters. Dr. Watson strongly emphasises the necessity for research on this point, and urges that a time may come when we may be able to deal with malaria at much less expense than by any method known at present—"we will be able to play with species of Anophelines, say to some 'go' and to others 'come,' and abolish malaria with great ease, perhaps hardly at any expense." We understand that a book by Dr. Malcolm Watson on "The Prevention of Malaria in the Federated Malay States" will shortly be published by Major Ross, with the aid of subscriptions from a number of rubber plantations collected for the purpose by Sir Frank Swettenham, the distinguished founder of the Federated Malay States. It seems a pity that Dr. Malcolm Watson was not invited to attend the malaria conference at Simla.

The Proceedings of the Royal Physical Society of Edinburgh (vol. xviii., No. 2, July) contain an interesting note by Prof. Graham Kerr on the presence of a posterior vena cava in Polypterus. The author points out that this vein, which forms so characteristic a feature of the higher vertebrates, is made up of two elements, being formed anteriorly by the primitive hepatic vein and posteriorly by the hinder portion of the posterior cardinal (inter-renal). The manner in which this has come about is indicated by the condition of the lung-fishes, Lepidosiren and Protopterus, in which the posterior extremity of the liver has become fused with the anterior extremity of the right kidney, and a venous anastomis has been established between these two organs, the large hepatic vein forming a direct channel for the passage of blood from the right kidney to the heart. It is interesting to find in the ganoid Polypterus that, while the primitive hepatic vein is developed into a large posterior vena cava which joins the fused posterior cardinals posteriorly, the anterior ends of the posterior cardinals still persist in a well-developed condition, though much larger on the right side than on the left. Polypterus in this respect combines the condition met with in higher vertebrates with that which is characteristic of fishes generally.

According to the report for 1909 and the first half of the current year, further particulars with regard to the movements of turbot and plaice have resulted from the investigations undertaken by the officials of the Northumberland Sea Fisheries Committee. A turbot, for instance, liberated at Skate Roads in August, 1907, was retaken nearly two years later about fifty miles from Aberdeen, while a plaice returned to the sea at the former locality in July, 1907, was recaptured in the following December near the Bell Rock. Experiments in artificially breeding lobsters have proved unsuccessful.

No. 2 of the tenth volume of the *Museums Journal* is chiefly devoted to a report of the conference held at York in July last, when the president, Dr. T. Anderson, devoted his address to volcanoes and their treatment in museums. Photographs are regarded as the best means of illustrating volcanic phenomena in public exhibition, as models and sketches alike nearly always show an exaggeration of the vertical scale, while the first-named of these are costly.

In the May issue of the Proceedings of the Philadelphia Academy Mr. T. Barbour relates the history of the discovery of the Chinese alligator, and the gradual acquisition of fuller knowledge of the species. It is stated that only a dozen specimens are known in collections, only one of which, and that recently acquired, is in America. The species appear to have a very limited distribution in the Yang-tse valley, most of the twelve specimens having been obtained near Wuhu and Chinkiang, although records exist to Poyang Lake and Nankin.

Zebras and zebra-hybrids form the subject of an illustrated article by Dr. E. Trouessart in *La Nature* for August 27, in which reference is made to the proposal to regard the members of the *Equus burchelli* group as specifically inseparable from the quagga.

As an appendix to the description of a new species of Platysaurus, Mr. J. Hewitt furnishes, in the Annals of the Transvaal Museum for November, a useful key to the genera of South African lizards.

It will be within the recollection of most botanists that Messrs. James Backhouse, of York, promoted a scheme in 1899 for the supply of botanical material to colleges and schools for demonstration and research, although recognising that for some time, at any rate, the venture would not be self-supporting. Subsequently the interests were transferred to the British Botanical Association, of which Dr. A. H. Burtt became the director. After ten years, notwithstanding the expansion of the original scheme and the increased demands due to the extension of nature-study, it has become apparent that the institution cannot exist as a private venture, and therefore it is proposed to enlist the help of individuals interested in the aims of the association and convert the undertaking into a public association of subscribers. This decision was formulated at a meeting of botanists and others, and an executive committee was elected to proceed with the enrolment of members and associates. As the institution exists purely for the preferment of botanical study and research, it is to be hoped that sufficient subscribers will be forthcoming to ensure its permanence.

THE seventh part of the *Prodromus Florae Britannicae*, an elaborate and critical revision of the British flora that is being prepared by Mr. F. N. Williams, has now been published by C. Stutter, 110 High Street, Brentford, and the author announces that the next part will conclude the Sympetalæ and the first volume. The present part enumerates thirty-five genera, beginning with Plantago and ending with Vaccinium, but the sequence of families is unusual. Two species new for Britain are recorded under Plantago, while five species only are admitted under Mentha, as the author follows the views elaborated by Malinvard, that several species generally accepted are merely hybrids. Among the numerous interesting notes attention is directed to the remarks on the oxlip, the occurrence of two blue pimpernels, and the use of the word "anthemia" for the whole mass of flower clusters of *Stachys arvensis*.

A NOTE on the protection of timber against white ants appears in the Transactions of the Royal Scottish Arboricultural Society (vol. xxiii., part ii.). Three processes are described, of which one is a contrivance for destroying white ants by pumping a poisonous smoke through their galleries, while the others are timber-treatment measures. Details of the Powell process are not disclosed, but "blue oil" is the specific which apparently has received recognition at the War Office.

DR. SVEN HEDIN contributes a short paper to the July number of *Petermann's Mitteilungen* in which he summarises the scientific results of his journey in Tibet during the years 1906–8. Preliminary notes on the meteorological observations and the geological collections are added by Dr. Nils Ekholm and Dr. Anders Hennig. The Swedish Government has voted a sum of 75,000 kroner, to be paid in equal instalments in 1911, 1912, and 1913, towards the cost of publication of the detailed reports, which are to consist of three volumes of memoirs and an atlas in two volumes. The text, which will extend to about 1500 pages, will consist of reports on geographical discoveries and observations, memoirs on the physical geography of Tibet, and special papers by Dr. Ekholm on meteorology and hypsometry, Dr. Olsson on astronomical observations, Dr. Hennig on geology, and Prof. Lagerheim, Dr. Ostenfeld, and others on botany. A map of Tibet on a scale of 1 : 1,000,000 will appear in 1912.

THE last number of the *Sitzungsberichte* of the Bavarian Academy of Sciences contains a communication from Prof. A. Rothpletz on the cause of the Californian earthquake of 1906, in which he points out that the triangulation of the central area of the region affected by the earthquake shows that it has undergone an extension amounting to about 1 in 30,000. This expansion may be explained by one of three hypotheses:—(1) as the result of the relief of tangential pressure in the earth's crust; (2) by a transference of heat and change in position of the isogeotherms; or (3) by magmatic intrusion; the first two being excluded as not fully accounting for the observed displacements, the third is accepted. The earthquake is, therefore, regarded as belonging to the class called cryptovolcanic by Prof. Hörnes, which Prof. Rothpletz prefers to call "injection" earthquakes; and as the San Francisco earthquake is considered to be due to movement along the San Andreas fault, indirectly caused by deep-seated intrusions, it becomes an injection-fissure earthquake.

THE eleventh "Review of Mining Operation in the State of South Australia," for the half-year ending December, 1909 (Adelaide, 1910, 26 pages, 3 plates), reports that the mining industry was hampered by the strikes at Broken Hill and of the New South Wales colliers, and by the low price of copper, the most important mineral in South Australia. Further progress is reported in boring for coal in the Permo-Carboniferous rocks of the Northern Territory, but only three inch seams of inferior coal were found during the six months reported. The most novel mine in South Australia is that being opened in the Carnotite lode, near Olary, and the report includes a short account of the mining operations in progress, and an analysis of the ore made under the direction of Prof. Dunstan. The ore is to be worked for radium. An attempt is being made to supply the tube mills at Broken Hill with flints from the local beaches. The flints now used are sent from Europe, and are said to come from Iceland, but as they are shipped to Australia as ballast, they have hitherto held the market against the local supply.

IN vol. vii., No. 1, of the fifteenth series of the Palæontologia Indica (Mem. Geol. Surv. India), Mr. F. R. C. Reed describes and illustrates a series of Cambrian fossils obtained by an officer of the Indian Survey from the Bhabeh rocks of Spiti, which, from the evidence of very scant remains, were provisionally assigned by the late Dr. Stoliczka to the Lower Silurian. A large proportion of the fossils consists of trilobites, none of which, so far as the condition of the specimens admits of forming an opinion, can be identified with European or American types; consequently, a number of new names appear in the memoir.

THE Rev. Dr. A. Irving writes to say that the letters of Messrs. Deeley and Lamplugh on "Stagnant Glaciers" in NATURE of September 8 (p. 297) "seem to overlook the important causal factor of solar radiation in connection with the question," and directs attention to an article of his, entitled "Solar Radiation and Glacier Motion," in NATURE, vol. xxvii., April 12, 1883, in which a series of laboratory experiments on the subject, with deductions, is given. The article in question was supplementary to a paper by the author on the mechanics of glaciers, which appeared in the Quarterly Journal of the Geological Society for February, 1883.

WE have received the report of the Hydrographer on Admiralty Surveys for the year 1909. The report shows that during the year extensive revisions of the charts of home waters were made by four vessels, the largest areas sounded being off the west coast of Scotland. Very important additions to our knowledge of British Columbian waters were made by H.M.S. *Egeria*, the increase in size and number of ships using the Edye, Beaver, and Schooner passages making the surveys of these channels specially valuable. H.M.S. *Mutine* carried out a number of important lines of soundings off the west coast of Africa, and in Australian waters H.M.S. *Fantôme* laid a line between Thursday Island and Cartier Island, the latter being formally annexed by Captain Pasco on March 17.

The connection between non-periodical variations of rainfall and famines in German East Africa is discussed by Dr. E. Kremer in No. 1, year 1910, of *Aus dem Archiv der Deutschen Seewarte*. Normal annual rainfall values can only be safely calculated from thirty to forty years' observations, and monthly values require a much longer period. These are not available for the district in question; the author directs attention to the fact, but he makes the best possible use of the short series at his disposal and of the information obtainable from travels and expeditions. The German colony extends from latitude 1°–12° S., and longitude 29°–40½° E., and the rainfall may be divided generally into one rainy period in the south and two rainy periods in the north. The greater part of the country has less than 40 inches of rain per annum; only the central and northern coastal districts and the mountainous parts receive more, while the whole of the interior tableland, to about longitude 33°, receives less than 30 inches. The author discusses the possibility of predicting famines or scarcity on the lines successfully followed in India, and shows, *e.g.*, that scanty rainfall, or its unfavourable distribution, in Zanzibar is followed by famine over a large part of the East African coast, and further that the distribution of atmospheric pressure in the months preceding the rainy periods is intimately connected with the amount of subsequent rainfall.

The Royal Meteorological Institute of the Netherlands has issued a paper, by Dr. P. H. Gallé, in which a large number of wind and current observations, chiefly from the Indian Ocean, are examined with the special purpose of testing the theories of Nansen and Ekman with regard to the effect of the deflecting force of the earth's rotation in changing the direction of drift currents and to the speed of current set up by wind action. Dr. Gallé finds that when the drift influence is alone at work in producing surface current, the angle between the wind and the resulting current is between 40° and 50°, substantially in agreement with the theoretical values. A wind velocity of 1 metre per second produces an average speed of current of between 4 and 5 centimetres per second.

Mr. H. T. Ferrar contributes an interesting paper on "The Creation of an Artificial Water-table in Egypt" to the July number of the Cairo *Scientific Journal*. The author is of opinion that the modern irrigation constructions in themselves have had little direct effect in raising the level of the subsoil water in the Nile delta, but he deals specially with the changes induced in the irrigation system of Lower Egypt by the works of Mohammed Ali Pasha, who in 1820 excavated a number of deep perennial canals capable of discharging the low-level summer supply of the Nile. Observations made at more than one hundred and fifty experimental tube wells support the view that there are two water tables in Lower Egypt: (1) a natural water-table, which is independent of the works of man except locally where extra permeability allows a constant supply of irrigation water to be added; and (2) an artificial water-table which was created by the act of the introduction of perennial irrigation by Mohammed Ali Pasha. It is thought that the artificial water-table (2) has gradually become higher, owing mainly to excessive watering of crops, until at the present day it has a deleterious effect upon the fertility of the soil. Mr. A. Lucas offers some criticism of Mr. Ferrar's conclusions in the August number of the same journal.

The *Journal de Physique* for September contains the full text of a communication made to the French Physical Society in March last by M. C. Féry, describing a spectrograph with a prism having spherical faces so designed that the image of the slit is in focus on the photographic plate. Both faces of the prism are concave to the incident light, and the back surface is silvered so as to reflect the light. The slit, the centres of curvature of the two faces, and the spectrum produced are on a circle which has the radius of the first surface of the prism for diameter. With a prism of quartz a metre from the slit and screen, the spectrum photograph obtained is 22 centimetres long, and the definition is very good throughout. Like the Rowland concave grating, the apparatus is astigmatic.

A new form of colorimeter has been sent for our inspection by Messrs. E. B. Atkinson and Co., Hull. The liquid to be tested is placed in a rectangular glass cell of a few cubic centimetres capacity, by the side of which works a vertical hollow glass wedge filled with a standard coloured solution. By means of a screw the wedge is raised or lowered, thus bringing various thicknesses of the standard colour into the same field of view as the cell. Both liquids are viewed horizontally through a slit against a white background, and the position of the wedge is adjusted until a depth of tint is found equal to that of the liquid under examination. A graduated scale shows how much the wedge has been raised, and by reference to a chart the corresponding proportion of colouring ingredient in the liquid is obtained. Wedges calibrated for certain purposes—*e.g.*, the colorimetric determination of iron, copper, ammonia, hæmoglobin, iodine—are supplied by the makers; but the user can himself readily calibrate the instrument for his own particular purposes. For example, a medical man could with little trouble construct a standard hæmoglobin chart for his own district. Other advantages claimed for this "universal" colorimeter are (1) saving of time, a reading requiring only about a minute; (2) exactness, since the two colour surfaces compared are contiguous; and (3) economy of cost. The apparatus appears to be especially suitable for operations involving a number of colorimetric estimations of the same type.

The fifteenth number (No. 3 of 1910) of the Italian review *Scientia*, now in its fourth year, is largely occupied with philosophy. The ideas of Poincaré, Bergson, Einstein, and the Pragmatists naturally form the text of discussions, such as that by F. Severi on "Hypothesis and Reality in Geometrical Science," or Chwolson's "Can we apply Physical Laws to the whole Universe?" or F. Enriques's criticism of Pragmatism. The theory of two star-streams interpenetrating one another is described by Mr. A. S. Eddington, of the Royal Observatory, Greenwich. M. Guignebert sketches the rise of Christianity in accordance with the sifted conclusions of recent research. Mr. Abegg's article on "Chemical Affinity" has a pathetic interest, from the fact that while it was in the press the author met his death in an aëronautic accident. The useful *rassegne* of various sciences are continued; Mr. E. S. Russell reviews the claims of epigenesis *versus* evolution. The advantages of a "mnemonic" theory of heredity, in accordance with the suggestions of Semon, Rignano, and Francis Darwin, involving an "interiorisation of external stimuli," is well put. M. Landry supplies his annual review of economic research. M. le Comte de Baillehache defends his system of electric units—a dimensional system—put forward last year in his "Unités électriques." Reviews of scientific periodicals, notes of scientific meetings, and critical notices of books, make up an issue that is very level in quality. The books reviewed are worth noting, viz. E. Borel, "Elements de la Théorie des probabilités"; Marcel Landrieu, "Lamarck, le fondateur du transformisme"; Georges Bohn, "La naissance de l'intelligence"; Georges Dwelshauvers, "La synthèse mentale"; W. Lexis, "Theorie der Bevölkerungs und Moralstatistik"; A. Solmi, "Storia del diritto italiano"; H. Bouasse, "Bachot et bachotage."

We welcome the first annual number of the Journal of the Bedales School Scientific Society. This society has been in existence for some years, holding meetings of the kind familiar in schools; and its members have also been engaged on pieces of experimental work, some touching the edge of new inquiry. This year the society prints accounts of certain members' work, as well as reports of the meetings, and the Journal shows that at Bedales science is at once a favoured pursuit in free time, and a well-treated part of the curriculum. The subject-matter is limited to physics and chemistry; next year, perhaps, biological notes might be included—Hampshire is an interesting county—and short articles as well as longer papers may suitably find a place in such a periodical. Of the papers, that by D. Jarintzoff on the rare earths is worthy of mention, as a painstaking attempt to grapple with the separation of metals of the cerium group, and shows careful reading as well as experimenting. A paper on coherer-action shows resource and ingenuity; the writer is rash, perhaps, in criticising a paper by Robinson, whose work was watched by Drude himself. A word of praise is due to the society's committee for the careful preparation of the Journal.

The Thermal Syndicate, Ltd., of Wallsend-on-Tyne, has sent us a reproduction of a photograph of the remains of their exhibit of "Vitreosil" laboratory apparatus at the Brussels Exhibition, from which it is evident that the fused silica ware successfully resisted the great heat to which the pieces had been subjected; some of the larger pieces had, however, been broken by the falling of heavy girders.

The ninth volume of the *Journal of Experimental Zoology* is, according to *Science*, to be a memorial to Prof. W. N. Brooks, prepared by his former students at Johns Hopkins University, and will be issued in four parts towards the end of the present year. It will contain a biographical sketch by Prof. H. V. Wilson, accompanied by three portraits in heliotype.

A useful list of binoculars and telescopes has reached us from Messrs. F. Darton and Co., 142 St. John Street, E.C., copies of which may be obtained from the address given.

OUR ASTRONOMICAL COLUMN.

Metcalf's Comet, 1910*b*.—No. 4440 of the *Astronomische Nachrichten* contains new elements and a daily ephemeris for Metcalf's comet. The elements were calculated by Dr. Kobold from places observed on August 11, 17, and 25, and give the time of perihelion as August 26·04673 (M.T. Berlin). The following is an extract from the ephemeris:—

Ephemeris for 12h. (M.T. Berlin).

1910	α (1910·0) h. m.	δ (1910·0) ° ′	log *r*	log Δ	Mag.
Sept. 14	15 30·4	+17 13·9	0·2862	0·3442	11·4
,, 18	15 29·2	+17 22·8	0·2877	0·3578	11·5
,, 22	15 28·4	+17 31·8	0·2895	0·3701	11·5
,, 26	15 27·9	+17 41·4	0·2916	0·3815	11·6
,, 30	15 27·8	+17 51·7	0·2939	0·3919	11·7

From this we see that the comet is now apparently nearly stationary about half-way between τ' and ι Serpentis. A note from Prof. Pickering states that when discovered, visually, by the Rev. J. H. Metcalf on August 8, the comet was of about the eighth magnitude.

A Suspected New Planet.—On examining a plate taken for Halley's comet on June 6, Prof. J. Comas Sola found the trace of an unknown, but undoubtedly real, object, which he suspects to be a tenth-magnitude minor planet. During an exposure of one hour the motion was apparently nearly due N. and S., making an angle of about 50° with the ecliptic; the following approximate position depends upon the position of the nucleus of Halley's comet according to Prof. Seagrave's ephemeris:—1910 June 6, 9h. 20m. (G.M.T.), R.A. = 10h. 13m. 22s., N.P.D. = 90° 40·5′; the motion in N.P.D. was of the order of +45′ *per diem* (*Astronomische Nachrichten*, No. 4440).

Definitive Elements for Comet 1852 IV.—A comprehensive discussion of the orbit of the comet discovered by Westphal, at Göttingen, on July 24, 1852, is published by Herr Adolf Hnatek in Nos. 4438–9 of the *Astronomische Nachrichten* (pp. 345–87). The final result confirms the period of sixty-one years, the actual value being 61·5554 years, and this comet should return in 1913.

A Suggested Volcanic Origin of Martian Features.—The theory that the various features and variations on the surface of Mars may be due to volcanic action is advocated by Dr. Wilhelm Krebs in No. 4439 of the *Astronomische Nachrichten*. During the opposition of 1909 various new features were observed, and these are held to indicate volcanic action, while the network of "canals" is compared with the network of seismic and volcanic tectonic lines met with in the earth's crust.

The Passage of the Earth through the Tail of the 1861 Comet.—In the September number of the *Bulletin de la Société astronomique de France*, M. R. Baer, of Rouen, describes the phenomena observed by him at Horbourg (Alsace) at the time of the earth's passage through the tail of comet 1861 II. He points out that the vertical pillar of light then seen by him at the northern horizon was analogous to that described by recent observers as being visible during the predicted passage of the earth through the tail of Halley's comet.

The Spectrum of Cyanogen.—No. 6, vol. xxxix., of the *Memorie di Astrofisica ed Astronomia* contains a note in which Comte de Gramont and M. Drecq discuss some results recently obtained by them during a research on the spectra of various mixtures of salts. They find evidence that the chief "cyanogen" band (3883·6) may be produced under conditions where the presence of the cyanogen compound is unlikely, carbon and nitrogen being present, however. Thus they suggest that the function of cyanogen may be simply to supply carbon and nitrogen, and that the appearance of this band does not necessarily imply the presence of the poisonous compound. Further, they point out that if this result be established, the passage of the earth through the tail of a comet such as Halley's, in the spectrum of which the band at 388 was prominent, becomes still less likely to produce any evil effects.

Researches on the Colours of Stars.—Employing the *réseau* method devised by M. Henry, M. Osten Bergstrand examined the spectra of a number of stars to compare the effective wave-lengths radiated by different spectral types and by different classes of coloured stars. The results are published in vol. ii. (series iv.), No. 4, of the Proceedings of the Royal Society of Sciences of Upsala, and embody several important conclusions. Among other things, M. Bergstrand finds that the stars may be sharply divided into white and yellow, with a marked discontinuity between the colour classes G.W.+ and W.G.−. For the white stars, the effective wave-length is, in the mean, about 420 $\mu\mu$, and for the yellow stars it ranges from about 435 to 450 $\mu\mu$; the corresponding spectral classes are B and A and K and M respectively. The effective radiation of pronounced red stars is about 460 to 470 $\mu\mu$. The intermediate classes, G.W.+ and W.G.− of the Photometric Durchmusterung of MM. Müller and Kempf, and the spectral classes F and G of Prof. Pickering, are relatively rare. It is also pointed out that as the effective wave-lengths vary between 411 and 470 $\mu\mu$, the employment of the same coefficient of refraction for all stars is inadmissible.

"MOCK SUNS."—From Mr. James F. Ronca we have received an account of the appearance of the phenomenon usually known as "mock suns," or "parhelia," which was observed by him at Eastbourne between 12.55 and 1.55 p.m. on September 10.

Mr. Ronca did not see the commencement of the apparition, but states that at 12.55 p.m. there was a slight haze, and some very thin clouds, distributed fairly uniformly over the sky, and, symmetrically described about the zenith, there was a brilliant circle of white light on the circumference of which lay the actual sun; two other points on this circle stood out as exceptionally brilliant spots. Then, with the sun as its centre, there was a much fainter, small circle, tangential to which there appeared a brilliantly coloured band intersecting the large circle at two points equidistant from the sun. This coloured curve could be traced only with difficulty beyond the confines of the large circle, but at the points of intersection with the latter the colours were of extraordinary brilliancy, the red in all cases being nearest the sun.

Mr. Ronca's account shows the phenomenon to have been of an extraordinary brilliancy, which was maintained for twenty minutes after he first saw it, and did not disappear finally until 1.55 p.m.

THE RELATION OF SCIENCE TO INDUSTRY AND COMMERCE.[1]

THE subject of this paper is so comprehensive that there will be no difficulty in understanding that attention has been restricted to one or two aspects of it only, and chiefly (since the paper is written by one engaged in educational administration) to that relation which exists between the scientific and technical education provided at higher institutions in this country, and the after careers of students. Even that relation cannot be treated in anything like an exhaustive manner within the limits assigned to me. My attention was specially directed to this matter some eighteen months ago by an opportunity which presented itself of reading some 150 letters written by past students of universities or of institutions of university rank. The letters were representative of an entire body of students whose education had been assisted. They came from students, men and women, who had taken degrees or diplomas in varying numbers during each of the last fifteen years. Four months ago, when, at the invitation of the committee of this section, I undertook to read this paper, steps were taken to extend the field of information. Some five hundred letters of inquiry were addressed to teachers of repute at home, in France, Germany, and America; to representative firms of employers, mostly at home, some abroad; and to thirty of His Majesty's consuls in Europe, Asia, and the two Americas. There have been before me also the written views of the presidents of vast industrial and commercial concerns in the United States, views collected in 1903 when I visited America as a member of the Mosely Commission. On the whole, my letters of inquiries have been treated with much sympathy, and I have had to examine a very considerable body of evidence of all kinds. I owe a great debt of thanks to the many distinguished men of science, and to many well-known leaders of industry and commerce, who have so generously given attention to my inquiry and have been kind enough to give me their views, some of them at great length.

I have endeavoured in what follows to reflect as faithfully as I can the different sets of views, and to add to them some views and suggestions, the result of my own experience.

Evidence from 150 Graduates.

First, as to the views of the 150 past students. These students all belong to the class for whom the earning of a living is imperative, and in the main they represent Oxford and Cambridge, and the London institutions of university rank.

Among minor points made by them are these:—The engineers emphasise the need of workshop practice under commercial conditions, finding that their future is in danger of being marred by lack of "works" experience, and some of those who have become industrial chemists express the need for five years' training: three for degree and two for research. The view of the engineer students needs no elaboration, for nowadays there is almost universal agreement that some form of the "sandwich" system affords the best possible method of training. The views of the chemists will be referred to later.

The students also complain that posts are obtained not on merit, but through influence. This contention is pointedly illustrated by a university college professor, who states that he knows one man who holds a most important berth, and is undoubtedly a first-class man in every sense of the word. This man took his university training as a mechanical engineer, and graduated with first-class honours, and did this after having had works' training extending over some eight years. On leaving college the man approached every mechanical firm of importance in Scotland in the hopes of getting a start. He found it impossible to do so. Finally, *through influence*, he did manage to obtain a junior berth, and is now the head of an important concern.

The most striking feature of the present occupations of the students is that only 10 per cent. have found their way into industry or commerce; another 10 per cent. have entered the higher ranks of the Civil Service, including technical posts. Some half-dozen are in the Church; another half-dozen are practising medicine; the remainder have taken to teaching, and it is clear in a fair number of instances that selection of a profession was not a matter of choice, but one of necessity. Many a man, towards the end of his university career, discovers for the first time that he has nothing to offer in the industrial or commercial market in return for a salary. If he has no technical knowledge or skill, he is, so far as his education helps him, in the same position as a secondary schoolboy, even if he is not handicapped on account of his greater age. Of those, also, who possess technical knowledge or skill, such as students of engineering or chemistry, a good many find themselves offered terms which pride, or poverty, or both, forbid them to accept. With pride I have no concern and no sympathy. Poverty is a different affair. When a man has spent his last penny in completing his university career, and when there is also pressure from home, there is no real choice between teaching, which is obtainable at 2*l*. or 3*l*. a week, however inadequately equipped the man may be for this purpose, and an office or a workshop at anything from, say, 10*s*. to 30*s*. per week. Sometimes the factory, shop, or business-house offers nothing, and occasionally a premium is required. It will easily be understood that in such circumstances an appeal is made by the students for more help in finding posts for university honours men, who are not eligible for the Civil Service, and who do not care to turn schoolmasters, and it will not be difficult to appreciate that at the critical point in his career—the selection of a means of earning a livelihood—a man is apt to write harshly of some of the slackness of university life, and to complain, as one of the most successful of them has done, that he wanted to be made a chemist, but his university insisted on his wasting his time on Divinity and did not even ask for German!

Evidence from the Staffs of Universities and of Technical Institutions.

A great change in the relations of the university and the market has occurred during the last quarter of a century. The general advance in the standard of education has produced a larger sympathy on the part of the market for educational institutions and their products; and the movement in favour of technical education has widened the range of objects of university education and the social classes from which university students are drawn, and has perhaps compelled the universities to have regard to the diversities in the world's work and to the functions they should discharge in preparing their students to live. During the period referred to a large number of technical institutions have sprung up all over the United Kingdom, and within quite recent years there have been strong influences at work to bring about coordination, if not incorporation of

[1] A paper read before the Educational Science Section of the British Association at the Sheffield meeting, by Mr. R. Blair.

the greatest of the technical institutions with the universities within the area of which they have emerged. The danger in the process of amalgamation is that it may be premature. It may come about before the realisation of what each institution in its own way, and in its own time, has had to contribute to national problems, and before it has been fully recognised that the annexation of a technical school is not merely the end of a rival, but the beginning of a new public responsibility, and that in the result the vitality and, if you like, the harsh industrialism and commercialism of the technical institution may be too much submerged by "academic control."

The evidence placed at my disposal shows, on the whole, a tone of great hopefulness. The hopefulness of tone to which I have referred is common. It is displayed by the newest of the large municipal technical institutions in the heart of a great industrial centre, and by some of our oldest universities. It is becoming evident that the institutions are recognising that, however much the market, in its quest after cheapness, has failed to distinguish the real from the spurious article, the institutions have been without much blame for placing inefficient machines on the market. An eminent professor of chemistry tells me that his whole "professional life is strewn with examples of the unwillingness of industry and commerce, the State, and municipal authorities of this country to take advantage of the services of young men who have received the highest technical training as chemists." But, he adds, "there is a tolerably rapid improvement taking place," and "we who are urging the importance of employing these highly trained young men have to remember that there has been a great lot of poor stuff turned out from the universities and technical colleges, and that the British manufacturer has a good deal to say in his own defence."

Agriculture and Allied Industries.

It is in connection with the agricultural colleges that there appears to be the least difficulty in showing that the students have found posts in agriculture or in allied industries. The case of agriculture may be somewhat exceptional. There has been so much development in this industry in recent years that there was bound to be a considerable demand for trained men. Moreover, many of the young men who have undergone a course of training in agriculture have done so in order to fit themselves for farming, or otherwise dealing with land as land agents or farm managers, on their own account. Further, it has for a fair number of years now been obvious that study in the agricultural colleges had to be combined with practice on the farm. The agricultural colleges also report that there is a considerable demand for their students in various branches of foreign and colonial land development work, such as tea, coffee, cotton, and rubber planting, management and extension of irrigation colonies, forestry, stock farming, and so on. A certain number of students trained at agricultural colleges are in demand for commercial undertakings in businesses associated with agriculture. For example, the German Potash Syndicate has a number of men representing their interests in various parts of the world who were educated at one of our oldest agricultural colleges, and the Permanent Nitrate Committee and the Sulphate of Ammonia Committee have also appointed agents or representatives who have gone through a similar course of training. The principal of the college attributes this preference for men who have received a college education instead of those who have had a business training only to the fact that the work undertaken by these representatives combines a large propagandist element with ordinary business management.

In Ireland the State directly organises the application of scientific education and of scientific knowledge to agriculture and allied industries. The Department of Agriculture and the county committees alone take advantage of young men who have received the highest technical training in agriculture. Since 1903 some sixty or seventy men have passed through the faculty of agriculture in the Royal College of Science, and all have been employed by the department or by the county committees. Farmers in Ireland operate on too small a scale to warrant them in employing experts as is done by large industrial concerns. Those who want expert assistance can get it through the county committees, or, for special work, from the department. In this way the faculty of agriculture is exerting a strong influence on agricultural practice. Leading farmers—those of the best education—make most use of the expert, and the smaller men follow them. In this way the influence of the Royal College of Science is far greater than is usually supposed to be the case. The college course fits men to take up the important positions of itinerant and special instructors, and the whole course has been designed specially for the one purpose. Moreover, the instructor and expert, after leaving college, are kept in touch with the work of the college and with that of instructors in other counties than their own or those adjacent. If the college taught, so to speak, in the air, and was not, as it is, part and parcel of a great organised system, it would do little good. No students of agriculture attend except those selected to become teachers and experts under the department and the local authorities. For such teachers and experts there is always a demand, since some of those who have been trained and who have worked as experts for a time leave—some to business, others go abroad to take up work as teachers or experts in the colonies.

In addition to this main work, the college trains experts in forestry, horticulture, and creamery management, and in these branches of Irish industry the trained men perform the same functions towards these industries as the agricultural expert does to agriculture proper. While no one who intends to become a farmer takes the Royal College of Science course—since this last would be out of all proportion to the capital invested in even the larger farms in Ireland—quite a number now attend shorter and less expensive courses at the Albert Agricultural College and elsewhere. There are thus other channels through which the higher technical training at the Royal College reaches those engaged in the agricultural industry, since these local colleges, stations, and winter schools are staffed by Royal College men who keep in touch with the central institution. The lesson which Ireland has to teach is that the faculty of agriculture in the Royal College of Science is part of a great organisation directly serving the interests of the agricultural industry, and not an independent institution pursuing knowledge for its own sake, or educating students without certainty of their profitable employment.

Engineering.

The evidence from the engineering colleges and institutions is also, on the whole, satisfactory. Here and there may be found somewhat doleful notes to the effect that the large majority of State departments and local authorities do not lay themselves out to take advantage of technically trained men, and in one case a view that has much popular currency has been put to me in fairly strong terms. It is to the effect that employers, especially those who have not very large and important undertakings, but who, nevertheless, would have their businesses improved by securing technically trained men, have an ignorant prejudice against such assistance. It is suggested as the possible explanation of their attitude that the employers fear that if they engaged men of greater attainments than themselves, they would simply be raising up possible opponents in their own line of business. There may be much truth in this view, which does not, of course, apply to first-class firms. But there is, I think, another worth full consideration: that the size of the business concern (the amount of capital sunk in it) has much to do with the employer's attitude. The employer does not possess the faith that will enable him to risk the addition of another salary to his working expenses; and no one, without a fair trial, is able to give him the mathematical demonstration which he seeks that the salary might often be saved merely out of the waste of materials which exists owing to the absence of scientific knowledge on the part of his men of the materials they are handling, and to their having to feel their way by experiments that are more in the nature of guesses. Such firms will be converted only by the example of others.

There is abundant evidence, however, that there is much less prejudice than formerly; that there is a growing tendency on the part of State and municipal authorities to secure for their services engineers who have received the highest training; and that this attitude is especially true of certain industries, the success of which depends absolutely upon highly competent, trained scientific experts, as, for example, the steel industry. I suggest that the growth of this attitude corresponds generally in time with increased recognition on the part of the teaching institutions that engineers cannot be wholly made at college. The colleges have at length realised that the student must from the first learn the limitations of practical engineering, and that this can be done by the introduction of a practical atmosphere, and without sacrificing any of the physical principles of engineering already well taught at the colleges.

One of our ancient universities says, "We have not now much reason to be dissatisfied with the attitude of employers towards our (engineering) students." Several of the largest of the technical institutions say they have no difficulty in placing their best students, and one university college states that there is a standing demand as soon as the college year ends, from several of the heads of engineering establishments within the neighbourhood of the college for the best students. But these heads of firms demand the "best," and are willing to pay a living wage right off to youths who have never before been in works, and have only their college training as qualification. It is added that second- or third-rate men are in very little demand, and there is often a difficulty in not being able to recommend youths of sufficiently high standard to fill vacant posts. This case recalls other colleges where students (the "best," at all events) have no difficulty in securing places owing to the personal connection established between the heads of the neighbouring works and the head of the engineering department.

The return issued by the Appointments Board of the University of Cambridge in February of this year is specially interesting. This return shows that the number of candidates for the mechanical sciences tripos whose names appeared in the honours lists of the years 1894 to 1906 inclusive was 252, that the Board obtained information as to the posts held by 176 of these men; of the 176, only 23 were engaged in teaching, while 122 were engaged as engineers in some manufacturing or commercial concern or in the public service at home or abroad. The return is the more satisfactory in that 133 of the names belong to the years 1902 to 1906, and in that most of the men have to spend at least two years as probationers of some form in works before they can secure a definitive appointment of any kind.

It has been pointed out to me, both by professors and the heads of large engineering firms, that there is still a defect in the college training of young engineers which ought to be immediately remedied. The view is so well presented by one of the colleges that I give it *in extenso*. "There are certain defects in the average college training. I consider that the question of cost in design, and the commercial side generally, receive quite inadequate attention in most colleges. Practically all engineering firms exist for making profit. Modern competition makes economic design, good efficiency, and cheap upkeep absolutely imperative. The employer wants men who can in their designs give the most for the money. It is therefore insufficient to teach design on physical principles alone. Methods of production, ease of repair, depreciation, even conditions of transit in large machines, all these and more must be considered in effective design. Such limitations as these should, I think, be brought before the student in greater measure than they are attempted at present. This will tend to 'practicalise' the student while his mind is still formative."

Chemistry.

The case of chemistry is more difficult. There is, unfortunately, no room for doubt that the British chemical industry has suffered largely by foreign—chiefly German—competition; and possibly no section of British manufacturers has been so severely lectured as those in whose processes applied chemistry was capable of playing a large part. The chemical manufacturers were told to follow their German rivals by enlisting the assistance of the chemist trained in the scientific laboratories at our leading institutions, and that the industrial face of Great Britain would be changed. The manufacturer did not apparently grasp the meaning of the arguments or the appeal: he may possibly have comforted himself with the feeling that as things had been, so would they be; he may even have looked at the works that needed reconstruction, at the state of the Patent Laws, at the character of the supplies of raw material, at labour, at capital, at agents, markets and means of transport, and may have come to the conclusion that the professorial lecturers understood none of these things; he may have chosen a chemist from an analyst's office or from a medical school, and have failed to discover that chemists were of any value. Whatever he did, and for whatever reason he did it, it has been stated in the papers before me that he did not give much heed to the scolding from the professorial chairs: he could not be persuaded that scientific education was essential to his business. And so in time the penalty had to be paid, and that, unfortunately, by many who had no choice in the matter. Perhaps, after all, the chemical manufacturer merited less odium than has been heaped on him. It is a human quality to believe in your fortifications until they are reduced to ruins at your feet. It may be true, also, that the chemical manufacturer was not tactfully wooed; and it certainly is true that under the name of chemist enough rubbish was supplied to him to break down his faith in the panacea. Twenty years ago the research chemist qualified for industrial work could scarcely be obtained from English laboratories. He had to be imported from Germany. The English schools turned out only analytical machines. The influence of a few well-known chemists and of the 1851 research scholarships has changed all this, but the manufacturer has not yet recovered from his early disappointment.

It is gratifying to find evidence of change. The public may not yet believe that "scientific activity is the real and solid basis of national prosperity," and all manufacturers may not yet be fully prepared to endorse the view that "industrial development is ultimately dependent on scientific development," or everywhere to demand chemists trained in *research* writ large, but they are learning or receiving lessons sometimes in ways not altogether creditable to British intelligence. One of our most distinguished chemists, and a man of large experience inside and outside of the college laboratory, says:—"I am very clearly of opinion that, with very few exceptions, the State and municipal authorities do not lay themselves out to take advantage of men from twenty to twenty-two years of age who have received the highest technical training as chemists. Municipal authorities require the services of men who have had a specialised training as chemical experts in connection with the working of the Food and Drugs Acts, and there is a tendency on their part to prefer the services of men who are willing to take underpaid positions. This does not conduce to the efficiency of the working of the Food and Drugs Acts, and the general community suffers in consequence of the lax administration of these Acts. Municipal authorities occasionally require the services of engineers and chemists in connection with municipal undertakings, as in gas and water supplies. As regards the chemists they employ in connection with such undertakings, I think, on the whole, the community is adequately served; the chemists employed, for example, in the manufacture of gas are, as a rule, well trained and competent to discharge their duties. As regards private employers, I am of the opinion that British manufacturers, as a body, are not yet fully sensible of the advantage which they might obtain by the employment of skilled chemists in manufactures in which chemistry plays a prominent part. There are, however, exceptions. Some of the best equipped works of this country—usually wealthy concerns—strive to keep in the forefront of industrial progress. We have in this country an increasing number of men of foreign extraction who are engaging in chemical manufacture, and it is significant to note that such employers are far more prone to enlist the services of expert chemists than are the rank and file of our own manufacturers. I think this is due to the circumstance that the advantages of a university training have come home to these people more directly than to our manufacturers, and they are more quick to perceive the material advantages of the application of the highest training in pure and applied science to their industries. I could give a number of illustrations of this fact by pointing to the existence of foreign firms who have secured for themselves in this country a pre-eminent position."

The statement as to the increasing number of men of foreign extraction engaging in chemical manufacture in England who are far more prone to enlist the services of expert chemists than are the rank and file of our own manufacturers points a lesson which is well illustrated from two other quarters. The secretary of the Cambridge Appointments Board says (*Empire Review*, January, 1905):—"A feature of the lists of matriculations (at Cambridge) for the years 1880–95 is the recurrence of German names, with the note, 'Now assisting his father in business.' From this it would appear that the representatives, naturalised in England, of the nation which has, more than any other, astonished the world by its industrial progress, have deliberately chosen for their sons a University career as a preliminary to business life."

The other illustration comes from British business life. Only one letter from a British manufacturer emphasises the need of research, and that is signed by a chemical manufacturer with a German name. As to evidence of change, one of the largest technical institutions says:—"We are fairly sure of placing at once all the best men who have taken a graduating course in any branch of applied chemistry." Another technical institution—probably the largest—states:—"We have been unable, during the last three or four years, to meet all the demands upon us for trained chemists, and at this moment we are unable to make nomination to two or three most important posts for which trained chemists are required because all our men are satisfactorily placed." From one of our oldest universities comes the statement:—"There is no difficulty in placing chemists of the highest rank in first-rate technical posts. By highest rank I mean people with approximately fellowship standing and great originality." Sir William Ramsay writes:—"Some months ago I had the curiosity to pick out from my class-lists, back to about 1890, one hundred names of men (and women) whose subsequent history I know. The result was, roughly: 60 in industry (analysts, private or in works, managers, proprietors of works, &c.); 25 in teaching posts (assistants in universities or university colleges, schoolmasters and a few professors—about 6); and 15 given up (married women, men who have changed their profession or dead)." The most gratifying fact about this analysis is that it suggests that 60 per cent. of Sir William Ramsay's students are pursuing industrial chemistry for a living.

An examination of the after-careers of the 1851 exhibitioners reveals the following results. It will be remembered that science scholarships are awarded annually by the Commissioners of the 1851 Exhibition. The scholarships are awarded for research in the experimental and observational sciences bearing upon industries. The nomination of scholarship holders is made by the authorities of twenty universities and university colleges within the British Empire, and, with rare exceptions, these nominations are confirmed by the Commissioners. The scholarships are of the annual value of 150*l*. a year, and are ordinarily tenable for two years. Between 1891 and 1906 there were awarded 262 scholarships. Of the holders, 145 are now engaged as professors, assistant professors, lecturers, or assistants in science colleges or other educational institutions; 76 hold positions in manufacturing firms or in public departments, and the remainder may be conveniently classified thus: scholars recently retired, 6; continuing research in private capacity, 12; engaged in professional pursuits, 10; deceased, 6; occupations unknown, 3; no longer engaged in scientific work, 4, of whom 3 are ladies. I find on further analysis that, of 112 scholars whose branch of science was chemistry, 50 are, or have been, engaged in industrial chemistry.

I am not able to provide more statistical details. As a rule, universities, university colleges, and technical institutions have not kept records of the after-careers of their students, and until quite recently most of the universities (and some not yet) have not had any organised means of giving assistance to students who may be seeking posts at the end of their college career.

Looking at the matter quite broadly, I see no reason for believing that the number of highly trained chemists who find their way from colleges into industrial chemistry is anything else than insignificant, compared with similar figures for Germany or the United States of America.

The following facts may aid in understanding the conclusion of "insignificant" which I have reached. In 1904 and 1905 an average of 400 chemists received the doctor's diploma or the technical high school diploma in Germany; with the materials at my disposal I have been unable to convince myself that there were in 1908 300 students of all faculties of applied science taking a fourth-year day course in British universities and technical colleges.

For some of these results our system of degree-giving is denounced in no measured terms. An able university professor says:—"The fact is, the whole thing—university teaching of chemistry—is turned upside down. Much of our university work is simply good secondary work. A pass B.Sc. degree, for example, is about the standard of a school-leaving certificate in a civilised country. Universities lay down syllabuses, time-tables, hours of work, and spend a large proportion of their energies in examination grinding. They teach for examinations instead of teaching for the diffusion and advancement of scientific knowledge. When a man arrives at a university he has a 'curriculum,' in other words, simply a glorified school syllabus, laid out for him, and is promised a degree in three years if he is a good boy. They do not do that in Germany. We are not," he continues, "really quite so bad in this country as regards our so-called 'honours' degrees, but the centre of gravity is wrong for all that. . . . The centre of gravity of the English system is still in the examination hall, even though a good man does stay on for several years of research afterwards." Others, who have clearly devoted themselves to a study of the matter, demand a five years' course for the making of a chemist, three for degree and two for research.

One of the most thoughtful memoranda sent to me by a university professor shows:—"On entering the research laboratory the graduates are rarely independent thinkers, and their knowledge is essentially 'book knowledge.' When freed from the necessity to attend lectures or to work for examinations they seem to pass through a stage when they actually have to struggle to develop their resources, and often the students with the best degrees make the poorest research workers. . . . Again, the business faculties of the students at this stage are poor, and their knowledge of modern languages as applied to scientific or commercial work is quite inadequate. These are deficiencies which I have to make good in the research department. . . . Students at this stage are not qualified to take up positions of responsibility. The graduate of twenty-two has, however, many latent possibilities which may be successfully developed by a course of research work." The time spent by the graduates in research work in the university laboratory is from two to three years, and the average age of the students on leaving is twenty-four to twenty-five. "Taking an average case," the professor continues, "I can say that at the end of the first year the research student has commenced to think for himself, to anticipate difficulties, and to overcome them when encountered. He begins by suggesting new working methods, and finally proposes new topics of research. He has a working knowledge of scientific and technical French and German, knows the original literature of his special topic, and is generally conversant with modern research thought. His business style has also improved greatly. A considerable advance in these respects takes place during the next year, and in most cases a two years' course is sufficient to produce a man who has had a good education and who knows how to use it. It is my experience that when students with this training enter technical work they master the literature of their new subject very quickly and effectively. They seem to be able in a short time to form an estimate of the present position and future possibilities of the new subject and to bring their speculative faculties into play. I therefore regard the time spent at research as a necessary part of scientific training if university graduates are to enter the field of technical work, and men thus equipped make most valuable officials, even taking into account the fact that they have no previous experience in the supervision of workmen, and have generally no knowledge of chemical engineering." But the British parent does not care to afford to keep his sons at the university until they are twenty-four to twenty-five years of age, especially as a period of probation has afterwards to be served in works, unless he sees that his money is going to be a good investment. And so we come back again to the manufacturer.

Other Subjects.

As to many of the other subjects in which the universities and higher technical institutions touch industry and commerce—architecture, biology, economics, and modern languages—there is little to be said on the side of the institutions. Biology is comparatively an unploughed field; the opportunities for economics are not yet fully developed. Railways, banks, insurance companies, and great business houses might, say the colleges, pay more attention to the really able economist. At the School of Economics a course of lectures in administrative subjects was arranged in the autumn of 1906 in order to equip officers for the higher appointments on the administrative staff of the Army and for the change of departmental services. This course is now annually attended by thirty officers selected for the purpose by the War Office. In order to provide the teaching required by candidates for the degree of B.Sc. in the faculty of economics and political science with honours in transport, the department of the school dealing with this subject has been developed. The lectures in this department, besides being open to students in the faculty, are attended by some 300 students engaged in railway administration. These students are drawn mainly from the staffs of the following railway companies:—the Great Western, the Great Eastern, the Great Northern, the London and South-Western, the Great Central, and the Metropolitan, their fees being in many cases paid for them by their companies. The lectures are also attended by members of the staffs of the other London railways, and occasionally by officials of Indian, colonial, and foreign railways, and other persons.

As for modern languages, it is alleged by the teaching institutions that the fundamental business attitude of England is entirely wrong. It will be seen later that this last view is amply confirmed from important and well-informed sources.

One further point of view of the colleges. Personality is by far the greatest factor; no amount of training can produce an exceptional man out of a man whose initial natural qualities are only second class.

VIEWS OF INDUSTRIAL AND COMMERCIAL FIRMS.

Answers to my inquiries have been received from a considerable number of large shipowners, from a few large shipbuilders, from nearly all the great railway companies, from a good many banking and insurance companies, from manufacturers of all kinds, and from employers' federations representing very large interests.

Elementary School Training.

Almost all explain their preference for elementary-school boys in such a way as to pay a well-deserved compliment, directly to the adaptability of the elementary-school boy, and indirectly to the existing system of elementary education. A good many speak in high terms of the value of evening schools, including technical institutes and schools of art. Banks and insurance companies almost invariably (but other firms as well) seek for the secondary-school product. There is some call for the man trained at the highest institutions, but this call is so much confined to firms the works or business of which require technical skill, that it is fully evident that the others do not yet feel the need for such men, nor know how to use them. There appears, also, with some frequency, the traditional fling at the public schools and at the universities.

Catch the boy as he leaves the elementary school, and induce him to attend evening classes; add to that the training of the workshop or the business house, and you have the fairly common plan of training those who will rise above the rank of "hands." From the best of these come the foremen; from those in turn the sub-managers are selected, and so on. It is interesting to see, however, that the possibility of a change is not unforeseen. "It happens," says one of our greatest industrial leaders, "that at the present moment all the men who fill the positions of responsibility in our office come from elementary schools. Naturally, they belong to a period when secondary schools were not so accessible as now, and probably the same remark may not be applicable to their successors."

There is much dissatisfaction with the existing system in those trades or industries in which apprenticeship was once common. "Time off" is occasionally allowed to attend day technical classes. But there is evidence that such a plan of training would not be generally acceptable, and I am told by one representative of a large set of interests that "the whole question of the method of teaching boys their trade in and on the works, seems in need of reform, . . . it is hardly possible for anything to be done in this way except by some compulsory scheme affecting all employers"; and by a representative of another vast set of interests that "As a matter of fact, the whole question of technical education is so unavoidably mixed up with the apprenticeship question in such a form as to make it impossible to deal with one without the other. Furthermore, the apprenticeship question is so clouded by the conflicting interests of the various unions, the unsatisfactory state of the law as regards employers, and other difficulties, that nothing short of a far-reaching Parliamentary scheme is likely, so far as my experience goes, to materially alter the situation."

The markets call emphatically for the "practical" man. A view more sympathetic with higher education, and not altogether uncommon, may be stated thus:—A man with practical training alone can do much; a man with technical training alone can do little; a combination is, therefore, essential. If only one can be had, which would be regrettable, that must be the practical man.

While, as I have already said, employers generally express the highest appreciation of the value of evening schools, technical institutes, and schools of art, as supplementary to the workshop, the factory, and the office, there is a good sprinkling of severe criticism. It is alleged that the schools are not practical, and that teachers of art as well as of science display much ignorance of the manufacturing process and of the limitations imposed by materials, machinery, and generally of the conditions of work and organisation necessarily enforced in a commercial business. This is, of course, no new view. It has been expressed to me all over the three kingdoms, and I fear there is much truth in it. Part of the ignorance is due to the exclusiveness of the manufacturer, who dreads the theft of his secrets. But the impression left on the employers is partly the fault of the schools. It was one of the defects of the technical education movement that it was hasty and tumultuous. Schools were not graded. Teachers and institutes set up claims impossible of fulfilment, and the British public misunderstood. Hence the doing, unfortunately not yet ended, of much mischief, which has had to be repaired.

This is, perhaps, the best place to direct attention to one of the commonest features of the employers' views. They think that evening schools, technical institutes, and schools of art may help the individual pupil; it does not enter their minds that such schools may aid their industries.

I have devoted more attention to the elementary side of technical education than might, at first sight, appear necessary. My object has been to show what the employer thinks of what he comes most in contact with. His views in that respect may serve as a guide to the kind of appreciation he is likely to give to that of which he knows less.

Higher Education.

I am much disappointed to find that a works of a technical character and with a world-wide reputation, says, "The men technically trained up to 20–22 years of age employed by us are comparatively few in number, and are generally such as have had special introduction to us," and I am also much surprised to find a large and well-known firm of engine-makers saying, "We have never had any application from the universities." Another firm, the name of which is a household word, says, "There are no proper ——— schools" (naming an important and common article of commerce which forms the subject of large industrial works), "in this country such as are found on the Continent, so it would be difficult for us to get properly trained men of 20 to 23 years of age straight from the university to fill the highest posts in our business." On the other hand, a professor of chemistry at a university, in which great stress is laid on the value of chemical research, says, "It is, perhaps, an index of the slender relationship between commercial chemistry and scientific work to state that although all the research done in my laboratory is in ——— " (using exactly the same term as the firm), "I have never had a single inquiry for a chemist from a manufacturer producing or using these compounds." I hope to serve as a labour exchange between this laboratory and that factory.

There is, again, a common impression that the training in the universities and higher institutions is not sufficiently practical, and much fear is expressed that the university man would not care for the continuous and laborious routine of commercial life. A gigantic association in the north of England, with extensive business ramifications all over the world, and at the works of which considerable chemical knowledge and a general scientific training is necessary, says: 'For our works, the youths who come to us have had a public school or grammar school education of modern type. They are taken from school and sent to the works for twelve months, after which, if they show ability, it is arranged that they should take a three-years' day course at a technical school and obtain the degree of B.Sc. They then go to our own laboratory, and a training specially suitable to our requirements is given to them." They add, "Provided a youth appears to be energetic and not to have suffered materially from the defects often induced by such a course, we should upon the whole prefer a man who had been to a university. . . . For our best positions in the commercial departments we prefer boys of 18 or 19 from good public schools" (I think it is the Manchester Grammar School type which is in mind), "to those who are younger, and we are equally glad to have university men, provided they are energetic and fond of work. Our opinion of the usual result of a course at the university is that it is not calculated to induce this spirit. The length of the vacations, and the great freedom enjoyed by undergraduates, do not form a good preparation for the absolute tie, the long hours, and the very short holidays of a business life."

This particular view was written in the north of England. Whether true as a criticism of some phases of our university life and work, it represents too common a view to be omitted. It is not true of some of our largest technical institutions, and I cannot think that it is true of the younger universities. But it may serve to show these institutions what spade work they must undertake. Let me return to criticisms. A general manager of one of our great railway companies says, "We have in the past appointed a few university men, but it is not an experiment which we are repeating." On the other hand, the general manager of another large railway company says, "In my opinion, no man is fitted for the higher posts in the engineering world unless he has received a full university education, and it is a great advantage to a man in the industrial and commercial world if he has had, and has made proper use of, a university training." And again by another, "The university or other technical institute curriculum does not enter into our estimate of the fitness of the individual. It is certainly in favour of the lad who has enjoyed it, but it is, after all, only a means to an end, and unless it has been intelligently employed by the favoured student, the less fortunate lad with definite aim is not irremediably out of the running."

The head of a chemical manufacturing company, which employs university trained men, puts his views thus: "We invariably find that men who come to us with the highest technical qualifications, either from a technical institute or from the universities, require a considerable time before they are able to utilise their knowledge practically. An analyst, for example, will take some time before he recognises the fact that analyses must be done quickly and accurately, and that no mistake in analyses is permissible; with regard to experimental work, it is also some time before a university man can be got to distinguish between results which are likely to be of practical value and those of only theoretical interest. Some men acquire their experience very quickly, others very slowly or not at all."

One more quotation under this head. A consulting engineer with a large practice, who employs twelve university or technical college trained men, in addition to a large technical staff of a lower grade, says, "I am a thurough believer in university and scientific training, but there is, no doubt, considerable difficulty in combining the university and practical training."

The general absence of replies of any importance from salesmen and merchants not manufacturers, may be taken as indication that the minds of business men of that type are not interested in the prublems presented to them by my letters of inquiry. The opportunities for the propagandist commercial traveller and for the economist have still to be developed. But when the War Office and great railway companies make use of the School of Economics, other State and municipal departments and great corporations will, sooner or later, follow.

Finally, the industrial and commercial firms point out, as the colleges do, that other qualities than those which generally show in an academic career are necessary in the fields of commerce and industry. Those are the business or economic sense, alertness, capacity for work, loyalty to the firm's interests, push, perseverance, social qualities, including good manners towards clients, tact towards subordinates, and capacity to get the best out of them, and generally the power to control men and things. These qualities do not, as a rule, show early, and consequently firms should in their own interests make the basis of selection large and broad.

In concluding this section, let me say that many British manufacturers, especially those under younger management, are displaying their economic sense in a new and interesting direction. Firms manufacturing common commodities and employing thousands of hands have invited me to visit their works, and have shown me that not only do they employ scientifically trained engineers and chemists, but they employ public-school men as managers, they employ on their permanent staff doctors and dentists for the sake of their hands, they provide much for the social and economic welfare of their workers, and generally they show that they take as much interest in the human as in the other material which comes into their works; and they do this, not as philanthropists, but as business men. They find that in the interests of their business the human material, as much as the coal and the steel and the sugar and the flour, can respond with more efficiency to scientific and generally enlightened management.

WHAT THE CONSULS-GENERAL SAY.

It is impossible to ignore the unanimity of the story told by H.M. Consuls and the experience and earnestness and sense of responsibility of the men who tell it. The main question submitted to them was this:

It has been said from time to time that British firms (merchants, manufacturers, and so on) do not sufficiently apply scientific methods to the canvassing of the various markets of the world, and in particular that, as a rule, their travellers and agents do not know the language of those with whom they are dealing; that advertisements, prospectuses, and so on are published in English, with English weights, measures, and money terms; that British firms do not sufficiently study the needs of the markets; and that in general there is a want of activity and enterprise of the right kind. The answer is, "To a large extent, true." And this answer is so emphatic, so unanimous, and withal so moderately stated and so clearly expressed, that it is not possible to regard it as incredulous. The story is as follows.

Commercial Education.

British merchants and manufacturers (and British shipowners) until about thirty years ago may be said to have had rather more than their share of the world's trade, and, comparatively speaking, made money so easily that they grew over-confident, relaxed their energies, and took little pains to improve their business methods as time went on and to learn from their competitors. It is only from about that time that they have begun gradually and slowly to realise—through the falling off of profits and through losing a share of the markets which they used to monopolise—that the traders and manufacturers of other countries, in particular those of Germany and of the

United States, have made up their minds to have, and have already succeeded in obtaining, a larger proportion of the world's trade than was previously left to them by Great Britain.

Our leading manufacturers are so strong, and their work of such excellence, that they can push themselves in any market; but it is not the same with other firms, and if these were to amalgamate they would acquire great strength. Cooperation is adopted in our shipping business with marked success, and should serve as an example for other industries.

The Britisher believes in competition and the survival of the fittest. The results, it is alleged, are a limited number of robust units and a mass of mediocrity which cannot resist foreign cooperation either in the home or foreign markets.

The great trouble is the lack of enterprise on the part of British firms in sending out travellers. Lamentation on this head is loud and frequent. Figures for two European countries are given to me. The first country is eminently suited for trade with England, more especially just now when the two countries have so much in common, and when "things English" are so much in vogue. The total number of commercial travellers' licences issued at "A" (the capital) during 1909 was 1203. During the same year 357 licences taken out at other towns were presented to the "A" police for visa. The 1203 licences were issued as follows:—to German commercial travellers, 605; to British, 142; to other nationalities, the remainder. Of the 357 the Germans had 146, the British 37; the remainder were distributed among various nationalities. The other country is also one which would also appear to be eminently suited for British trade. In the year 1908 (the figures for 1909 were not available) 7000 commercial travellers visited this country; 4700 were of German nationality, 1500 French, 61 represented Great Britain, the rest various.

In general, there is no complaint against the natural qualities of the British traveller; "a smart British business man accustomed to travel and deal with foreigners has no equal the wide world over, but, alas! there are too few of them." Another says:—"As regards the other qualities—push, activity, enterprise, and so on—they all seem to exist in such satisfying degrees in the British commercial man that if he direct his attention to rectifying the faults arising through this insular attitude, and the lack of commercial education which so narrows his outlook, the future would then look at least as hopeful as it does in any other country." A third maintains:—"There is no inherent quality in the Britisher which prevents his being able to compete successfully, not only in capturing new markets, but also in ousting his rivals who have been there before him. On the contrary, he possesses in as great as, if not in a greater, degree than any other nation just those qualities which eminently fit him for such work—endurance, perseverance, reliability (a very great adjunct), and concentration." And so on.

Until by scientific education the British realise that commerce means an intricate and complex organisation of intimately interconnected parts, they will lose many an opportunity, and their Consulates and Chambers of Commerce will be unable to do for them the work which could easily be done. Engineering, it is pointed out to me, is looked upon as a science, but commerce is not.

Metric Measures.

Failure to adopt the metric system places British manufacturers at a decided disadvantage. A French merchant, accustomed to one system of weights and measures, uniform and exact, resents receiving quotations from England in quantities which are absolutely mysterious to him. Circulars and price-lists, printed only in English with English weights, measures, and prices, are often sent to the Continent of Europe beautifully, even artistically, printed and illustrated; but they are of no practical use, as they are not understood by the persons for whose inspection they are intended. Only in cases where it is known that some member of the foreign firm is well acquainted with English, or has already dealt with English firms, can any practical result be looked for by sending out English catalogues. Further, a good deal of delay and inconvenience is sometimes caused at the Custom House through the use of the English system of weights and measures, owing to the fact that all weights and measures have to be reduced to the metric system before the goods are cleared.

Foreigners will not buy goods simply because they are British. The man who wishes to sell and to increase the number of his clients must seek the goodwill and favour of the buyer, and not look to the buyer so much to accommodate himself to the ideas and business rules of the manufacturer. Enough stress cannot be laid on the vital importance of personal acquaintance with the country, the people, their customs, needs, weaknesses, likings, and prejudices; and also with the local methods of doing business—in short, with everything and anything that can and does affect the market.

In this connection I would like to recall what Lord Cromer said to Lord Reay's Committee on the Organisation of Oriental Studies in London: "It is quite possible for an Englishman to pass half his life in the East and never understand anything about Easterns."

Foreign Languages.

If the requirements, industrial and commercial, of any country are to be understood thoroughly, a knowledge of the language of that country is essential. One Consul says:—"I have seldom met a foreign traveller who does not speak one or two languages besides his own." Another says:—"I have very seldom, I might say almost never, met an English commercial traveller who knew a word of ——" (the language of the European country from which he writes). If I were at liberty to identify the individual, by naming the country, it would be seen that his statement, while appearing incredulous, would really appear to be highly credible. Another Consul says —and others write to the same effect:—"Lastly, but perhaps first in importance, is the fact, which cannot be brought home too strongly to every young commercial man, viz. the absolute necessity of learning foreign languages. English, it is true, is spoken everywhere abroad, and although fresh business may possibly be secured in foreign countries by men who speak nothing but English, the circumstances are exceptional, and point to the fact that the goods are absolutely wanted and none others, and not to any special acumen on the part of the salesman. The majority of travellers, however, have goods to offer which are by no means unique, and in the sale of which they will have to compete very severely with rivals. The case of the man in this country (an extensive country, with large trade possibilities) who speaks nothing but English is too obvious to need any elaboration."

I will add but one further quotation:—"Until it is realised in the English system of education that modern languages are useful as means of communication between persons, and are not merely theoretical subjects in which a knowledge of grammatical rules results in the pupil being awarded a prize, they will probably continue to be handicapped." He adds, "I speak feelingly on this subject, as my own children have been able to converse comfortably in four or five languages, and after two or three years at a first-class school have since entirely forgotten how to use them, although two of the said languages are in their regular school course. I understand, for instance, that although when conversing they use the subjunctive mood naturally and correctly after certain conjunctions, they are unable to write out a list of all the conjunctions which govern the subjunctive, and consequently they are made to spend their time learning this and such-like rules instead of adding to their vocabulary as an infant does by daily practice."

The languages which these officers call upon the British traveller to learn are French, German, and Spanish. A knowledge of French will carry any commercial traveller through France, Belgium, Russia, Italy, and Switzerland, as well as through many parts of Germany. For Germany and Austria, German is necessary. Spanish is wanted for the Peninsula and the South American trade.

Let me repeat that the views set out above are not mine. They are those of His Majesty's Consuls at stations distributed over four continents.

THE PRESENT POSITION AND NEEDS.

I have now come to the last section of this paper. For fear of being misunderstood, let me say at once that I have no lack of respect for our ancient universities, and that any appearance of such in this paper is quite unintentional. It would, indeed, be difficult to exaggerate the share which our oldest universities have had in the formative life of this country, and the work of the past is still necessary. Universities must continue their detached work; they must pursue knowledge for its own sake or for the purely mental training it gives; they must continue to produce statesmen and churchmen and lawyers and doctors and schoolmasters, and they must educate the leisured classes. I would even go so far as to say that it is a national asset to have institutions setting the standard of efficiency and honour in national games. But the modern world needs something more, especially from the departments of applied science. The sympathy and support which these departments have received from the public have, to a large extent, been based on the belief that they would contribute to the success of national industry and commerce. The same holds true of the large technical institutions with day departments for young manhood. There is a public need, and in some cases a public demand. It is our object to increase the demand.

I have no magician's wand to offer as a means of revolutionising public opinion, and I should like to make clear that I have no thought of advocating mere imitation of German methods, which would be extremely foolish, if not disastrous. The industrial and commercial conditions and the character and traditions of the people of Britain and Germany are dissimilar. Again, the German universities endeavour to send out men ready to take their place immediately, not in the ranks, but as officers in the industrial and commercial armies. Further, the British system of education is so different that not to give heed to what exists would certainly court failure. Many useful lessons may, however, be gathered from a study of German methods; but possibly our most useful lessons are to be gathered from America, where the character of the people is more like our own, and where it is clearly realised that whatever training of the highest kind a man may have, he must still begin in the ranks and climb his way to the top. It has been said that British character and methods produce a few brilliant units and a mass of mediocrities. The surest road to success would probably be for the mass of mediocrities to adopt the methods of the brilliant units.

The normal attitude of the employers, if not of the public, may be expressed in three sentences:—(1) Only those value higher education who have felt the need for it. (2) The purely practical man can do much, the purely theoretical man can do little; a combination is therefore necessary. Should one quality only be obtainable, which would be regrettable, that quality should be the purely practical. (3) Teaching institutions may assist individuals to get on; they form no essential part of our industrial or commercial system.

For these three sentiments I suggest that we are all anxious to substitute three others:—(1) Setting aside exceptions, every man who achieves success must give so much time to fit himself for his work, whether the time is given in college under guidance and discipline or is expended in self-education. (2) In the end, and again setting aside exceptions, the man who has received the highest training in college under guidance and discipline will, other things being equal, achieve by far the greatest success. (3) The work of research and training carried on in technical school and university college is an integral part of any nation's successful industrial and commercial organisation.

Organisation and Management.

How is the substitution to be accomplished? The demand of the shareholders of an industrial or commercial concern for dividends forms a great stimulus to intelligence and activity on the part of the staff. Without such stimulus in a technical school or faculty of applied science there is a tendency for things to become comfortable. I suggest the following:—

(1) The management of all technical institutions and departments of applied science should be put on a business footing. The ordinary governing bodies, as a rule, serve for ordinary governing purposes. The chief need is that of consultative committees attached to all specialised faculties or departments, such committees to be advisory and to be composed of industrial or commercial leaders or experts of the highest reputation. This is probably the best and surest means of enlisting the full sympathy of industrial and commercial leaders. The faculty or department, the curriculum and the examinations, would benefit by having its work and methods criticised sympathetically by experts of the first rank. Such a committee would form the surest medium of communication between the college and the workshop; and its formation would certainly be followed by a wide extension of the appreciation of the advantages of technical education, because the captains of industry would learn exactly the character of the work done in college and how in practice to utilise it.

The head of the teaching department and his staff would by this means gain easy access to factory and workshop, and bring back some of their atmosphere to the laboratory. On the examining committee of the engineering department of the Glasgow and West of Scotland Technical college are the engineering director of the Fairfield Shipbuilding and Engineering Co. and the engineering director of John Brown and Co., Clydebank Shipbuilding and Engineering Works. Such men would probably be generally recognised as the leaders in their particular profession on the Clyde. I understand that it is their practice to look in great detail through worked papers and designs, and to give the engineering department of the college the benefit of their criticisms. Employers, parents, and students cannot but have faith in the instruction given in an institution so aided. Let me make it quite clear that I am not advocating a mixed governing body, but an advisory committee of experts attached to each technical department. Governing bodies should consult such advisory committees before appointing the head of a department or even the principal of a college or technical institution. In the qualifications of principals and heads of departments it is customary to give too much consideration to academic status and too little to industrial experience and business capacity. Such a consultative body as I have referred to would act as a corrective in this respect.

(2) A connection should be maintained with old students and a record kept of their after-careers. One of the means of success of the American colleges is the list of after-careers of their students. It is almost incredible how little has been done in Britain in this respect. I hope parents and the public generally will develop a habit of asking for such a list.

(3) At each technical institution and university there should be an organisation to assist students in getting placed. The Blue-book recently issued by the Board of Education shows how much English universities have in the past neglected this aspect of their work, and how much there is still to be done to establish appointments committees or bureaus. I am not overlooking the fact that much excellent work has been done by individual professors and occasionally by the secretary or the principal. But this was unorganised. I am asking for an organisation. The manufacturer and the merchant have been denounced in no measured terms by representatives of learning for their short-sightedness in not applying scientific methods to manufacturing and business processes; could not the manufacturer and the business man retaliate that not only have university and technical college goods been of such various qualities that it was impossible to discriminate, but also that scientific principles—even common business empirical methods—have not been applied to the marketing of school and college products? It is a discredit to the universities and technical colleges that they have so long neglected this obvious means of assisting students, this obvious means of promoting the cause they proclaimed.

(4) A change in curriculum and in degree requirements. Let me read some remarks on American colleges which I wrote in 1904. "Again, there is, in each American institution, a considerable 'mortality' or shedding of students. Some students find their general preparation insufficient; some find the pace too great; others find their funds give out; and some are advised that they have made a bad selection. In such cases the American student accepts advice, and acts promptly. At every step a student's work is known, and the faculty—staff of professors in each department—every four months discuss fully a student's work. The middle of the third year is the critical point in a student's career. At this stage the requirements of the Institute of Technology demand a final decision as to choice of work. Fifteen men in one department were, at this point, recently advised to change their courses or to withdraw from the institute. I was informed that, as a rule, 25 per cent. of the civil engineering students drop off at the same stage. These numbers have to be added to those who have previously 'fallen by the way.' The greatest patience is extended to the students, and the best advice is offered to them; but in the interest of the individual, as of the standing of the institute and of its influence on industrial work, such shedding of students is regarded as inevitable, and is acquiesced in. It does not follow that the men are 'wasted.' As a rule they find employment of a lower character than they were aiming at; they change the directions of their careers, to their own great advantage, or they pursue a course of studies on the same lines at a secondary institution—a two-year course school."

It appears to me that such kind of advice and action is necessary in British teaching institutions, but it is hardly possible under existing conditions.

(5) Another means of bringing the college class-room and laboratory into closer connection with factory, workshop, and office would be more liberal provision of short, specialised courses suitable to the heads of firms or their successors. I am not referring to that provision of evening courses which is made in technical schools and schools of art, but to provision, whether day or evening, of advanced courses for industrial and commercial leaders or their successors in institutions which there could be no presumed loss of self-respect in attending. Such courses are provided at several colleges; they need multiplication. I know that a large number of able men obtain, at much expense, instruction through private agencies, because the best institutions do not appear to cater directly for their needs under suitable conditions.

(6) As to modern languages, three things are necessary for the majority of students:—(i) less the scholar's and more the utilitarian point of view; (ii) more concentration during the later school and college years; and (iii) speaking generally, a better class of teachers.

In conclusion, let me say that this preliminary study of a very large question has disclosed much hopefulness of the future. The obstacles which university and other highly trained men encounter in getting a footing in the industrial world are still formidable, and the breaking down of the barriers between our highest teaching institutions and commercial life forms a specially difficult task. But there is plenty of need for first-class men, and there is not much difficulty in getting the exceptionally good man placed. It is gratifying, too, to find that His Majesty's Consuls speak in the highest terms of the personal qualities of our foreign commercial travellers.

On the side of education, too, there is much hopefulness. A distinguished university writer not long ago stated that the object of university education "was not how to keep our trade, but how to keep our souls alive." Between such a representative of university education and the business man who inquires what is the money value of a degree there is little room for accommodation. But the writer did an injustice to the universities, and the facts as to the objects of university education are against him. It may be true that in the long view the keeping of our souls alive is the object of university education, but even the oldest of our universities are becoming conscious that the immediate condition of saving our souls alive is that of saving our trade.

ROYAL SANITARY INSTITUTE.

THE twenty-fifth annual congress of the Royal Sanitary Institute, held at Brighton from September 5–10, was attended by upwards of 1200 members. To the address of the president, Sir John Cockburn, K.C.M.G., we have already referred (NATURE, September 8). Seeing that no fewer than sixty-three papers were printed *in extenso*, and many of them "taken as read" before discussion, it will be understood that it is impossible, within the limits of our space, to do more than glance at the general aspects of the work of the congress, endeavouring to indicate the drift of opinion on some of the more important questions which were raised. All problems relating to the health and physical well-being of the community are regarded as coming within the province of the Institute. In the Lecture to the Congress Dr. Arthur Newsholme set forth the now well-known statistics of diminishing birth-rate, and considered the arguments in favour of, and against, the present crusade against infant mortality. "Is it worth while to dilute our increase of population by 10 per cent. more of the most inferior kind?" The diminishing fertility-rate is as noticeable in the ranks of skilled artisans as it is in the ranks of the well-to-do. He concluded that it has not been proved that the inferiority of the offspring of the most fertile class, the unskilled, is due to inferiority of stock so much as to the unsatisfactory conditions into which they are born, and he strongly deprecated the attitude of that section of eugenists whose pass-word is "Thou shalt not kill, but need'st not strive Officiously to keep alive." The services of health visitors and the adoption of the Notification of Births Act are, the lecturer considered, the most hopeful agents and means whereby the death-rate of early life may be reduced.

The numerous papers and discussions we can but summarise under separate headings. *The Municipal Control of Tuberculosis.*—Compulsory notification of all cases was strongly advocated, and the removal of cases which cannot be nursed at home, without risk of spreading infection, to the empty wards of fever hospitals and small-pox hospitals; the risk of cross-infection being *nil* if suitable administrative measures be adopted. This system had its initiation in Brighton, so far as the use of hospitals is concerned, and its value has been thoroughly proved. Patients receive the educational treatment which gives them a practical understanding of the lives which, for the sake of other people, as well as for their own, they must henceforth lead. *Preventive Medicine in School Life.*—Much consideration was devoted to the work of the school medical officer, the administration of the Education Act of 1908 being, as everyone acknowledged, in a tentative and, in many respects, a very unsatisfactory phase. More financial support is needed. Inspection without school clinics is in many districts in which there is difficulty in obtaining treatment of very little use. The question of the periodical disinfection of school premises led to warnings regarding the danger of "sprinking a little carbolic acid, and leaving the rest to Providence." There are, indeed, few subjects in which sanitary authorities themselves are more in need of education than in the use of disinfectants. Faulty drains are not reconstructed, nor are their dangers lessened by an antiseptic odour which allays the anxiety of the public. Several papers were read upon school planning, and opinion appeared to be universally in favour of the Derbyshire and Staffordshire type, which provides efficient cross-ventilation of every class-room. Cross-lighting must, however, be avoided as far as possible. Open-air schools on the lines of the Thackley (Bradford) school, in which each class-room has a verandah for fine weather, were commended. Rectangular class-rooms with more direct lighting and warming by the sun's rays are to be preferred to square rooms. Appliances for drying cloaks and shoes should be provided. The treatment of tuberculous children and of the pre-tubercular was brought forward by Dr. Broadbent, who strongly advocated teaching such children in the open air, and a modified curriculum. The X-ray treatment of ring-worm was approved; but the utmost caution is necessary at the present time, lest its unskilful application should throw it into disrepute. *Disease Carriers.*—Probably about 3 per cent. of the cases of typhoid fever which have recovered from the disease continue to breed and distribute the germs (Brückner). To scarlet fever, diphtheria, cerebro-spinal meningitis, and measles some risk of the same kind is attached. The importance of this matter can hardly be exaggerated. Instruction in cleanliness, periodical examination of the excreta of typhoid carriers, disinfection of the alimentary canal by drugs, are obviously necessary; with restriction to such occupations as afford the least opportunity for the dissemination of disease. *Control of Foods.*—There can be no hope of freeing the milk supply from the bacillus of tubercle without more effective control of milk growers and milk sellers. At present the milk supply can be stopped only for one particular district, and the farmer is at liberty to send the condemned milk to any other district without incurring any penalty. *Housing and Town Planning.*—Dr. Fremantle argued that the expense and opposition which an attempt to proceed under the Regulations of 1910 will entail will deter municipalities from taking advantage of the Act. *Sewage Disposal.*—C. Chambers Smith maintained that economy in the disposal of sewage may be carried much further than at present. Sedimentation tanks and percolating filters are less expensive than contact beds. Shenton advocated the sterilisation of sewage effluents by hypochlorite of lime, proving with well-ordered figures the need for this final destruction of bacterial life, and showing the efficiency and inexpensiveness of the agent recommended. An interesting paper on the influence of underground waters on health was read by Baldwin Latham, who associates the epidemic appearance of fever with a fluctuating level of subsoil water, and especially with an unusually low water level.

A conference of women on hygiene was held under the presidency of the Countess of Chichester, at which questions of great practical importance in relation to the artificial feeding of infants and the influence of the employment of married women upon infant mortality were discussed; but the subject which aroused most interest was "Home-making Centres"—centres for the teaching of what in Canada is defined as household science. Whatever other items may be introduced into the curriculum to meet the needs of particular localities, the chief subjects taught at such centres must always be cooking, housewifery, dressmaking, the care of infants and children, personal and domestic hygiene.

In the popular lecture, which brought the proceedings of the congress to a close, Dr. Alex. Hill took the opportunity of directing attention to some of the recent triumphs of sanitary science, quoting especially from the report of Sir Rubert Boyce on the condition of the West Indies:—"Look to your laurels, Brighton! 'The West Indies are rapidly becoming the sanatoria which nature surely intended them to be.'" He next proceeded to expound the principles of Mendelism, answering, incidentally, Dr. Archdall Reid's objection that they have only been shown to hold good for human abnormalities and for the characters of cultivated plants and domestic animals by pointing out that, unless characters are either so unusual as to be "abnormal" or so much exaggerated by breeding as to be outstanding, it is impossible for the biologist to isolate them as allelomorphs. He then submitted a scientific basis for Dr. Newsholme's contention that all infant lives must be cherished by the community by showing photographs of a white albino guinea-pig from which the ovaries were removed soon after birth and replaced by those of a black guinea-pig; one of several litters of young, all black; and their white albino sire. The doctrine of the continuity of germ-plasm, the lecturer said, by throwing the origin of the individual so far back, has profoundly modified our ideas of the heritability of the moral and pathological characteristics of the immediate parents.

The congress was fruitful in discussion, and those who attended it will carry away many new conceptions and discard some misconceptions; but amongst the many congresses which meet at this season that of the Sanitary Institute stands somewhat apart in that it supplies the stimulus for the publication of a large number of papers of permanent value. Medical officers of health and others stationed in distant parts of Britain find in it an opportunity of putting their observations and reflections in print, and submitting them in this form rather than orally, to a considerable body of their fellow-workers. An admirable and extensive Health Exhibition was organised in connection with the congress.

INTERNATIONAL CONGRESS OF PHARMACY.

THE tenth International Congress of Pharmacy was held in Brussels on September 1 to 6, and was attended by over five hundred pharmacists. The Governments which sent official representatives were those of France, Italy, Spain, Russia, the United States, Norway, Denmark, Sweden, Holland, Greece, Hungary, China, Japan, the Ottoman Empire, Venezuela, the Argentine Republic, the Republic of San Salvadore, Guatemala, Haiti, and Chili. The delegates from the Pharmaceutical Society of Great Britain were Mr. Edmund White, a member of the society's council, and Mr. E. S. Peck, one of the permanent hon. secretaries of the British Pharmaceutical Conference. The most important subject which came up for consideration related to analytical methods. The international conference for the unification of the formulæ of potent drugs, held at Brussels in 1902, defined standards for a number of drugs and galenical preparations, but different methods of standardisation give different results, and it was one of the objects of the pharmaceutical congress to consider what steps could be taken to bring about the approximation of analytical methods. After a long discussion it was unanimously resolved, on the motion of Prof. Bourquelot, representing the French Government, to ask the Belgian Government to convene an interational conference, composed largely of practising pharmacists, for the purpose of unifying the methods of estimating potent drugs, with the recommendation that, for the estimation of alkaloidal preparations, preference should be given to gravimetric methods. The congress also agreed that it was desirable that pharmacopœias should indicate the precise methods of determining physical constants, and that in the case of chemical tests the reactions should not be capable of giving rise to any difference of interpretation. The related topic of the international unification of analytical reagents also received consideration, and the congress resolved to request pharmacopœiæ commissions to adopt as far as possible normal reagents or some multiple of the normal. The decisions on these two questions constitute the most useful part of the work of the congress.

Next in importance was the discussion on the sale of proprietary disinfectants, and the congress unanimously resolved to recommend that the sale of proprietary antiseptic products and disinfectants should be officially regulated. No such products should be sold unless the manufacturers of them shall have obtained a licence from the Government, only to be granted after the products shall have been officially examined both chemically and bacteriologically with the view of ascertaining if they possess the properties claimed for them. It was also resolved to recommend that all such products should be labelled with the name and address of the seller as well as the manufacturer, and that the bactericidal strength and the date of manufacture should be stated on the label.

Among other subjects discussed were:—(1) The desirability of a large representation of pharmacists on the commission charged with the preparation of an international pharmacopœia; the congress expressed approval of the principle. (2) The advisability of pharmacists making their own galenical preparations; the congress agreed that this was desirable where possible. (3) The limitation in each country by the State of the number of pharmacies; the congress approved of the principle of limitation and agreed on a method of limitation. (4) The desirability of instituting in schools of pharmacy courses on the macroscopy, microscopy, and chemistry of natural and pathological secretions; the congress agreed that such a course of study might with advantage be instituted.

In addition to the discussion on topics of general and pharmaceutical interest, several communications of purely scientific interest were presented. Prof. Bourquelot made a further contribution to the biochemical method of examination of vegetable glucosides hydrolysed by emulsin. He pointed out the relation between the optical properties and reducing power of the products of hydrolysis by emulsin, and suggested as an index of enzymolytic reduction the weight of reducing substances, calculated as glucose, formed in 100 c.c. by the action of emulsin corresponding to a rotation of 1° observed in a 2 dcm. tube. After showing the different uses of this method, he gave a list of medicinal plants in which the presence of glucoside had been shown by this means, but which had fallen into disuse, as no active principle had been separated formerly.

Prof. Herissey explained a chemical method of obtaining the true glucoside arbutin, which gives glucose and hydroquinone on hydrolysis with emulsin. Commercial arbutin, extracted from *uva ursi*, is a mixture of true arbutin and methyl arbutin, and this, on being treated with alcoholic potash, gives a precipitate of the potassium salt of true arbutin, from which the glucoside can easily be obtained in a pure state. This glucoside is apparently identical with that isolated recently from the leaves of the pear tree by Prof. Bourquelot and Mlle. Fiehlenhots.

Mr. Leger described his experiments which had led to the establishment of the constitution of the aloins. These experiments show that barbaloin and isobarbaloin are glucosides which can with difficulty be split into aloemodin and α arabinose. These two aloins are stereo-isomers. Nataloin, treated with sodium peroxide, furnishes methylnanatoemodine, decomposable by hydrochloric acid into nataloemodin and methyl chloride. Nataloin appears to contain in its molecule a pentose sugar.

Prof. Perrot described the method which he, in collaboration with Mr. Goris, has devised for obtaining dried plants in which the properties of the fresh plants are preserved; the principle upon which the method is based is the destruction of the diastase.

Mr. Hercod read a paper by himself and Mr. Maben on the assay of pepsin, and the congress decided to refer the question to an international committee with a view to establishing an international standard and method of assay.

Mr. Moller read a paper dealing with the determination of colours, and the congress agreed to recommend the adoption, as an international code of colours, of the code of Klinksieck and Valette.

The above is a brief summary of the work accomplished at one of the most interesting international meetings of pharmacists which has ever been held. It should also be mentioned that a decision was arrived at to form a permanent international pharmaceutical association, the headquarters of which will probably be at the Hague.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. PHILIP WARD, who has just been appointed a Commissioner of National Education in Ireland, is the first national teacher to fill the position. He is a former president of the National Teachers' Organisation.

THE following courses of Gresham science lectures are announced for delivery at the City of London School, Victoria Embankment:—Geometry, by Mr. W. H. Wagstaff, on October 4, 5, 6, and 7; physic, by Dr. F. M. Sandwith, on October 25, 26, 27, and 28; astronomy, by Mr. S. A. Saunder, on November 7, 8, 10, and 11.

PROF. GOLDWIN SMITH, according to the Toronto correspondent of the *Times*, has bequeathed the sum of 140,000*l.* to Cornell University "to show my attachment as an Englishman to the union of the two branches of our race on this continent with each other and with our common mother"; the greater part of Prof. Goldwin Smith's library, and 1800*l.*, are left to the University of Toronto.

THE new calendar of the Battersea Polytechnic shows an increase of work in all departments. In connection with the engineering and building department, new evening classes are being commenced in pattern-making and architectural measurements, and in connection with the gun-making section a course of study extending over three years has been arranged in gun and ammunition manufacture. A course has also been arranged by request of the Institute of Certificated Grocers on subjects which appeal to the grocery and provision trade. The chemistry department is extending its work by providing more advanced instruction in paper-making and bacteriology, and new classes in soap manufacture. In the women's department, a third-year day course of science as applied to housecraft has been arranged. The new library presented by Mr. Edwin Tate, at a cost of 8000*l.*, is to be opened by the Archbishop of Canterbury on Friday, October 21.

THE Belfast University Commissioners have decided to establish a faculty of commerce within the University, to consist of the professors and lecturers in the subjects of the faculty, and in addition there will be an advisory committee. In framing the curriculum the needs of three classes of students have been borne in mind:—those who are, or expect to be, engaged in business; those who are preparing for the administrative work of the State or the municipality; and those who contemplate social or philanthropic work. It is proposed to grant a degree in the faculty to matriculated students who have pursued prescribed courses of study for at least three years and who have satisfied the examiners in certain subjects. To meet the case of students unable to devote to these subjects the time necessary for the acquisition of a degree, a diploma in commerce or a diploma in social science will be granted after a two years' course and the passing of the prescribed examinations.

THE issue of the Bulletin of Armour Institute of Technology, Chicago, for May last, which has reached us, is a general information number, which differs little in character from the calendars and prospectuses published at this time of the year by colleges and technical institutions in this country. The work of the institute in Chicago was begun in 1893. Four-year courses in mechanical and electrical engineering were first organised. A union was effected with the Art Institute of Chicago for the purpose of developing the course in architecture which that institution had maintained since 1889. The result was the establishment of the Chicago School of Architecture. In 1899 the course in civil engineering was added, in 1901 the course in chemical engineering, and in 1903 the course in fire-protection engineering. The courses in these subjects all lead now to the degree of Bachelor of Science. Each of these four-year courses represents a balanced group system of studies, combining a thorough and broad scientific training with the elements of liberal culture.

THE Department of Agriculture and Technical Instruction for Ireland has issued its programme for technical schools and science and art schools and classes for next session. The regulations which were in operation during the session 1909–10 will continue in force, with one alteration only. Small schools are to be permitted to adopt specialised courses of instruction covering a period of two years only. A prefatory note points out that the schools and classes working under this programme are mainly, though not exclusively, evening schools, and adds that instruction in evening classes cannot form a substitute for the more general and systematic education given in day schools, whether primary, secondary, or technical. The work of such evening schools and classes constitutes a specialised form of education intended to fit those receiving it for industrial or commercial pursuits, or to render those already engaged in such pursuits more efficient in their work. Attendance is purely voluntary. Those attending are for the most part engaged, or about to be engaged, in some form of industry, and are meeting problems and difficulties which the evening technical school can help them to solve. They perceive that the higher branches of their calling may be reached only by increased technical skill and knowledge; but progress is hindered by several circumstances: hitherto the previous preparation of students joining evening technical schools has in many cases not been such as to fit them for the specialised form of instruction which it is the special function of such schools to impart. An attempt is made in these regulations to remedy this defect.

THE recently issued syllabus of classes at the Sir John Cass Technical Institute, Aldgate, for the coming session shows that graded curricula of study extending over several years are provided for those engaged in chemical, electrical, and metallurgical industries. In addition, several special courses of instruction are to be given; in the chemistry department there is to be a course of work for those engaged in the fermentation industries, which includes lectures and laboratory instruction in brewing and malting and on the micro-biology of the fermentation industries, as well as a series of courses on liquid, gaseous, and solid fuels. In the metallurgical department special courses of an advanced character are provided on gold, silver, and allied metals, on iron and steel, and on metallography. The winter session at the Merchant Venturers' Technical College, which has just commenced, is the fifty-first held in connection with this institution. It will be remembered that the faculty of engineering of the University of Bristol is provided and maintained in the college. The new calendar, in addition to necessary general information, supplies full particulars of the day classes of the Bristol School of Commerce, the faculty of engineering of the University of Bristol, the extensive evening classes, and the school of art. The calendar also contains a list of gifts and loans to various departments of the college made by numerous manufacturing firms and learned societies, which shows that the college authorities are successful in securing the cooperation of employers of labour and others in the useful work they are doing in providing suitable technical instruction for the workers of the district.

THE first congress of the newly established Textile Institute, the objects of which are to promote the interests of the textile trades, was opened on Thursday last at Bradford by Lord Rotherham, who, in his inaugural address, said he looked for the institute to do its part in establishing cordial relations between men of science and practical spinners and manufacturers. The delivery of the address was followed by the reading of a paper by Mr. F. Warner on technical education in relation to the textile industries, in the course of which the author said that the existing system of education is overcrowding the office and starving the factory and workshop. Great Britain cannot afford to scrap from 5 to 7 per cent. of the working population, and the remedy for the present evil is more technical instruction and the practical training of the rising generation in industry and trade. The old apprenticeship system had manifest advantages, and its revival was suggested; but modern technical instruction, properly applied, offers advantages to the student for advancement which were impossible to the apprentice. Day classes should, by the cooperation of employers, be arranged to a far greater extent than was now the case, and in this respect England is far behind modern practice in the textile trades abroad. An essential requirement is proficient art teaching, for though in the perfection of cloth structure British goods are unsurpassed, in the class of fabric in which design and colour are required the reputation of our manufacturers is on a lower plane. Mr. Warner advocated the formation of a national department which, controlled by a council composed of captains of industry in all branches of manufacture and commerce, and of artists, designers, and educationists, could deal directly with art and technical schools. A similar system should also be put in operation in local centres. The financial difficulty should be met both by local and Government aid.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 5.—M. Bouchard in the chair.—Madame P. **Curie** and A. **Debierne**: Metallic radium. Starting with 0·106 gram of the purest radium chloride (atomic weight 226·5), the method of Guntz for the preparation of metallic barium was followed. The radium chloride in aqueous solution was electrolysed with a mercury kathode and a platino-iridium anode. After the electrolysis the solution contained 0·0085 gram of the salt. The amalgam decomposed water and was readily attacked by the air. The dry amalgam was rapidly transferred to a clean iron boat, the latter placed in a quartz tube, and was rapidly evacuated. The distillation of the mercury from the amalgam offered some difficulties; to prevent visible ebullition, which resulted in loss by projection, the tube was filled with carefully purified hydrogen, the pressure of which was kept slightly above the pressure of the mercury vapour at the temperature of the boat. At the close of the operation the metal was left in the boat, brilliantly white, and melting sharply at 700° C. The authors regard this as sensibly pure radium. The metal alters very rapidly in air, blackening immediately, probably owing to the formation of a nitride. Some particles detached from the boat, falling on white paper, produced a blackening similar to a burn. Radium energetically decomposes water going into solution, indicating that the hydroxide is soluble. Radio-active measurements showed that the increase of activity followed the usual law for the production of the emanation, the limiting activity of the metal becoming normal. Since it was found that the metallic radium was much more volatile than metallic barium, it is proposed to purify the metal by sublimation in a vacuum.—Léon **Kolowrat**: The β rays of radium at its minimum activity. The author has repeated the experiments of O. Hahn and Mlle. Meitner, and has arrived at conclusions confirming the existence of a very absorbable β radiation.—Georges **Baume** and F. Louis **Perrot**: The fusibility curves of gaseous mixtures: compounds of methyl oxide and methyl alcohol with ammonia gas. The results of these cryoscopic researches are given in graphical form.—J. B. **Senderens**: The preparation of acrolein. It has been found that potassium bisulphate reacts catalytically with glycerol, so that, instead of adding the bisulphate in the proportion of twice the weight of glycerol, as is customary, one-fiftieth of this amount of the bisulphide is sufficient.—Paul **Gaubert**: Soft crystals and the measurement of their indices of refraction. Figures are given for the refractive indices of crystals of beeswax, ammonium oleate, ozokerite, paraffin, and lecithine.—R. **Robinson**: The vessels of the fork of the median nerve. A contribution to the study of the manual dexterity of man.

CONTENTS.

	PAGE
Bibliography of Atlases	325
Lead and Zinc Pigments. By Dr. A. P. Laurie	325
Meteorological Tables. By E. Gold	326
Plants and Gardens	326
Our Book Shelf	327
Letters to the Editor:—	
Lord Morton's Quagga Hybrid and Origin of Dun Horses.—Prof. **James Wilson**; Prof. **J. C. Ewart, F.R.S.**	328
An Undescribed Feather Element. (*Illustrated.*)—**Fredk. J. Stubbs**	329
An Interesting Donkey Hybrid.—**R. I. Pocock**	329
British Marine Zoology.—Prof. **W. A. Herdman, F.R.S.**; Prof. **E. W. MacBride, F.R.S.**	329
The Origin of the Domestic "Blotched" Tabby Cat.—**H. M. Vickers**	331
The Reform of Oxford University. By F. A. D.	331
Medical Education in the United States and Canada	332
The Sheffield Meeting of the British Association	333
Section C.—Geology.—Opening Address by Prof. **A. P. Coleman, M.A., Ph.D., F.R.S., President of the Section**	333
Notes	339
Our Astronomical Column:—	
Metcalf's Comet, 1910*b*	344
A Suspected New Planet	344
Definitive Elements for Comet 1852 IV.	344
A Suggested Volcanic Origin of Martian Features	344
The Passage of the Earth through the Tail of the 1861 Comet	344
The Spectrum of Cyanogen	344
Researches on the Colours of Stars	344
"Mock Suns"	345
The Relation of Science to Industry and Commerce. By R. Blair	345
Royal Sanitary Institute	353
International Congress of Pharmacy	354
University and Educational Intelligence	355
Societies and Academies	356

THURSDAY, SEPTEMBER 22, 1910.

ANIMALS OF THE ANCIENTS.

Die Antike Tierwelt. By Otto Keller. Erster Band, Säugetiere. Pp. xii+434. (Leipzig: W. Engelmann, 1909.) Price 10 marks.

FOR many years past the author of this interesting volume has been engaged in investigating the records relating to animals known to the ancients, with the object of identifying the various species described or depicted, and working out their past history and distribution, special attention, in the case of mammals, being directed to the larger and more interesting forms, and those which have been domesticated by man. The results of this protracted study are incorporated in the work, of which the first volume is now before me, and in many respects Dr. Keller is to be congratulated on the outcome of his labours, especially in regard to his treatment of the various species of the Primates and Carnivora, although even among these he does not appear to have made himself acquainted with all the recent literature on the subject, and notably the work of Dr. Lortet on the mummified animals of Egypt, now in course of publication in the Archives of the Lyons Museum.

Even in the case of the Carnivora, I cannot, however, agree with all the author's conclusions, as, for instance, the statement on p. 72 that domesticated cats owe their origin in part to the jungle-cat (*Felis chaus*). Indeed, it is difficult to believe that he is fully acquainted with the characteristics of that species, or he would have hesitated in identifying with it the cat depicted in a fresco from Pompeii, which is reproduced on p. 72, the tail being much too long, and the ears showing no trace of the distinctive tufts.

Leaving the Carnivora with this brief mention, I pass on to the Ungulata, where there is much more room for criticism, more especially in regard to the author's identification of animals represented in the ancient sculptures and cylinders of Syria and adjacent parts of Asia Minor with species indigenous to Central Asia and other distant regions. Nor is this all, for when Dr. Keller attempts to identify animals represented in the frescoes of ancient Egypt with species inhabiting northern Africa, he is, in many cases, to say the least, far from happy in his conclusions. In the upper figure on p. 295 we find, for instance, an antelope identified as a hartebeest (Butalis), although it is much more probably a lesser kudu (*Strepsiceros imberbis*), and is identical with the fresco from the Ptahhetep Chapel, reproduced in Fig. 3 of the present writer's paper on "Some Ancient Animal Portraits" (NATURE, vol. lxx., pp. 207–209, 1904), and provisionally identified with that species. Again, the animals in the lower figure (99) on the page cited are likewise termed Bubalis, although two species are clearly portrayed, one being the presumed lesser kudu, while the other is, I think, the brindled gnu (*Connochaetes taurinus*). Further, on p. 291, Fig. 94, we find a fresco identified with the addra gazelle (*Gazella dama ruficollis*),[1] although it clearly represents *G. soemmerringi*, as does Fig. 2 in my above-cited article. The white oryx (*Oryx leucoryx*), Fig. 95, the addax (*Addax nasomaculatus*), Fig. 97, and the Nubian ibex (*Capra nubiana*), Fig. 101, are, on the other hand, correctly identified.

Leaving animals indigenous to Egypt and the neighbouring countries, attention may be directed to Fig. 93A, which is the one reproduced in NATURE for September 2, 1909, in a review of Countess Cesaresco's "Man and Animals in Human Thought." In that work the animals shown in this Assyrian relief are described as goats, but it was pointed out in the review that they are much more probably gazelles, although I was wrong in suggesting the addra, in which the females are horned. Dr. Keller is likewise of opinion that they are gazelles, but identifies them with the Tibetan goa (*G. picticaudata*), a species with which the ancient Assyrians cannot, I conceive, have been acquainted. Such an identification is, moreover, perfectly unnecessary, seeing that in the goitred or Persian *Gazella subgutturosa* we have a practically local species which agrees in all respects—notably the hornless females—with the relief.

Having shown that the animals in this sculpture are of a local type, attention may be directed to Fig. 102, p. 301, which reproduces the figures on part of a cylinder brought by Sir H. Layard from Constantinople. One of the ruminants on this is identified by Dr. Keller with the Himalayan markhor (*Capra falconeri*), and the other with the Central Asian argali sheep (*Ovis ammon*). Both species, be it noted, are represented as being in captivity, under the charge of apparently Syrian attendants, and the female of the supposed markhor carries horns as long as those of the male, and has a kid. This renders it, I think, clear that both kinds were seen by the artist in the living condition, and if this be so, it is perfectly evident that they were not, respectively, markhor and argali; animals, the very existence of which could not, I submit, have been even known to the ancient Assyrians. It is no argument to state, as the author does on another page, that the Assyrians were in the habit of bringing two-humped Bactrian camels from Afghanistan, seeing that these animals now come as far south as the Crimea and the Caucasus. Moreover, the long horns of the female are fatal to the markhor theory. In my opinion there is every reason to regard the supposed markhor as Circassian domesticated goats, in which both sexes carry long spiral horns.

As to the supposed argali, I am less confident but unless they be domesticated sheep, it may be suggested that they are Pallas's tur (*Capra cylindricornis*), of the eastern Caucasus, and in any case there can be little or no hesitation in regarding them as representing a more or less strictly local species. In connection with sheep, it must suffice to mention that there is great doubt as to the identification of those in the Negadah plate, B.C. 6000–5000 (Fig. 106, p. 310), with the domesticated Hausa sheep of Nigeria, as they appear to represent the wild udad, or Barbary sheep (*Ovis lervia*, or *tragelaphus*), of North Africa generally.

[1] *Antilope damma* of the author.

In place, therefore, of foreign species, with which it seems impossible for the ancient Egyptians and Assyrians to have been acquainted, it seems to me that all the ruminants referred to by Dr. Keller are local forms, well known to the artists and sculptors by whom they were painted or chiselled. The same remark will, I believe, apply to the representations of the Indian elephant, like the one on the obelisk of Salmanassar II. (Fig. 130, p. 375), although the author regards these animals as of foreign origin. He appears, however, to be unacquainted with the definite record that at an early date the Assyrian kings hunted the Indian elephant in the Euphrates valley, this record being confirmed by the occurrence of fossilised remains of the so-called *Elephas armeniacus*, which may have been merely a local race of the former species, in Armenia.

The Indian elephant being thus shown to have been a local, instead of an imported, species in ancient Assyria, it may be suggested that if the unicorn animal on the obelisk of Salmanassar ii. be, as Dr. Keller suggests (p. 386, Fig. 133), the Indian *Rhinoceros unicornis*, which is known to have had formerly a much wider distribution than at the present day, that species may likewise have ranged in Assyrian times into Mesopotamia; and, if this be the case, it will be practically certain that all the animals represented by the artists of ancient Egypt and Assyria were more or less local species.

More criticism of much the same nature might be added, but sufficient has been stated to show that while the volume under review contains a very large amount of valuable information concerning the early history of well-known animals, at least the portion relating to ungulates stands in need of revision by a writer with a fuller knowledge of that group than the author appears to possess. R. L.

THE DESIGN OF REINFORCED CONCRETE STRUCTURE.

(1) *A Concise Treatise on Reinforced Concrete.* By C. F. Marsh. Pp. viii + 225. (London: Constable and Co., Ltd., 1909.) Price 7*s*. 6*d*. net.

(2) *Concrete-Steel Construction.* By Prof. Emil Mörsch. Authorised translation from the third (1908) German edition, revised and enlarged by E. P. Goodrich. Pp. ix + 368. (New York: The *Engineering News* Publishing Co.; London: Messrs. Constable and Co., Ltd., 1909.) Price 21*s*. net.

(3) *Il Cemento Armato e la sua applicazione practica.* By Cesare Presenti. Pp. 141. (Milan: Ulrico Hoepli, 1910.)

(4) *Le prove dei materiali da costruzione e le costruzioni in Cemento Armato.* By Giulio Revere. Pp. xii + 541. (Milan: Ulrico Hoepli, 1910.) Price 11 lire.

THE employment of reinforced concrete in connection with engineering and architectural structures has now become so general that a text-book on somewhat simpler and more condensed lines than those of Mr. Marsh's well-known treatise on "Reinforced Concrete" will be gladly welcomed by many engineers and architects. The present volume (1) has been, to a certain extent, based upon a series of lectures delivered by the author in the winter of 1908–9 at the Central Technical College, London; hence, in all cases the derivation of important formulæ has been fully dealt with, but lengthy and detailed descriptions of the various systems of construction have been omitted; this latter portion of the subject was fully dealt with in the author's manual.

The first two chapters deal respectively with the properties and the behaviour under bending of reinforced concrete, the important question as to the value of the modulus of elasticity (E_c) for the concrete which should be adopted in the calculations required in connection with the design of struts and beams is very fully discussed, and Mr. Marsh shows that we may safely assume it to be 2,000,000 pounds per square inch when the concrete is two or three months old, or, in other words, that the ratio of E_s/E_c may be taken as 15. In the third chapter the various assumptions which have to be made for purposes of calculation are briefly explained, and their validity discussed; it is shown that, when calculations are based on the safe working stress for concrete, it is sufficiently accurate for all purposes to assume a straight line stress-strain relation for the concrete as well as for the steel.

The rest of the book is devoted to methods of calculation; after a short discussion of the bending moments of beams and slabs partially built in at the supports, direct compression is taken up, and then the longitudinal, bond, and shearing stresses in rectangular section and T section beams with single or double reinforcement; pipes and similar structures subjected to either internal or external pressure are then dealt with; a very thorough and complete investigation is next given of the calculations which are necessary in the design of small, and large, span arches, and other pieces which are subjected to both direct stresses and to bending stresses. The design of reinforced concrete arches is always admittedly a difficult piece of work, and there is no doubt that the treatment which Mr. Marsh gives of this branch of reinforced concrete work will prove of great service to those who only occasionally have to deal with such structures, as the methods explained and discussed are simple and direct.

In the last chapter a brief description is given of the general methods of reinforcement which should be adopted in structural work.

Mr. Marsh, by his well-known treatise, established his position as a trustworthy guide in this important field of engineering and architectural design, and the present volume is quite worthy of the reputation thus acquired.

(2) Prof. Mörsch, in his capacity as director of the technical bureau of the well-known firm of Wayss and Freytag, has been responsible for the design and erection of the reinforced structures built by this firm during the past fifteen years; he has, therefore, in

part ii. of this book, which deals with the applications of reinforced concrete, confined himself entirely to work done by Messrs. Wayss and Freytag, and there is justification in regard to this choice, since the whole of the examples described have been designed in accordance with the rules and formulæ given by Prof. Mörsch in the first half of the book, and many of them, in accordance with the recommendations for the design and construction of reinforced concrete structures, issued by the Verbands Deutscher Architekten und Ingenieur Vereine, and the Deutscher Beton Verein in 1904.

The theory of reinforced concrete is fully and thoroughly discussed in part i. of this book, and it is this section which will be of great service to English and American designers, because it includes a mass of experimental data not hitherto readily accessible to those who wished to make use of these results in connection with any new piece of design work.

In an investigation as to the flexure of reinforced columns, Prof. Mörsch shows that a special calculation of their safety against rupture by flexure will only be required in exceptional cases; for the strength of reinforced columns with spiral reinorcement, the author accepts the conclusions of Considère, who showed that the carrying capacity would be 2·4 times as great with such a system as when the same amount of reinforcement was employed in the shape of longitudinal rods.

For calculations connected with simple bending, Prof. Mörsch adopts the usual hypothesis that the tensile strength of the concrete should be ignored; the gradual shifting upwards of the position of the neutral axis as the loading is increased is clearly shown by the plotted results of a series of careful tests made at the testing laboratory at Stuttgart. A valuable chapter is that devoted to the calculations necessary when bending is combined with axial forces; circular and annular sections are discussed, as well as those of rectangular form.

In rectangular metal beams the shearing stresses are unimportant, and may usually be neglected, but in reinforced concrete they are of great importance in considering the arrangement of the reinforcement, and Prof. Mörsch devotes several chapters to the consideration of this branch of the subject, which is often inadequately treated in works on reinforced concrete design; after a mathematical investigation, he deals fully with the results obtained in numerous experimental investigations, which he has himself carried out on T beams, both when simply supported and when continuous; the results obtained from the latter tests are exceedingly interesting and of great importance to designers of structures in which such continuous members are largely used.

In part ii. there are excellent illustrations of the use of reinforced concrete, examples having been selected from all the various types of buildings or structures for which this material has up to the present time been employed.

The recommendations of the German societies, already referred to, and the regulations of the Royal Prussian Ministry of Public Works, for the construction of reinforced concrete buildings, are printed as an appendix.

The translator, Mr. Goodrich, and the publishers are to be congratulated on the result of their labours. The illustrations, on the whole, are satisfactory, in spite of the difficulties connected with their reproduction, referred to in the publishers' note.

(3) The author adopts the usual hypotheses in order to obtain fairly simple formulæ for the design of beams, both smple and continuous; he takes E_s/E_c as equal to 15, and deals fully with both simple rectangular cross sections and T sections. The various formulæ are illustrated by numerous fully worked out examples.

In the second part of the work is given a number of graphical and numerical tables for facilitating the rapid calculation of the dimensions of beams of various classes for certain lengths of span under known loads, and examples are given to show how much labour is saved by the use of such tables; the maximum stresses permitted are those usually adopted in practice.

(4) The first half of this book is devoted to the subject of the testing of the materials of construction—stone, wood, metals, cements, &c. There is nothing novel or exceptional in this section in the method of treatment of a subject to which so many text-books have now been devoted. A special chapter is given to the subject of the microscopical investigation of the structure of metals, and to the application of this method to commercial testing.

The standard conditions for carrying out commercial tests of materials, as approved by the Italian Government, are printed in the form of appendices to the appropriate chapters, and will prove of interest to engineers who may have to carry out contracts for the Italian Government, or for local authorities in that country.

The second half of the book treats of constructional work in reinforced concrete; here the usual order adopted in text-books is inverted; the first ninety pages of this section are occupied with illustrations and descriptions of works of all classes—buildings, bridges, silos, harbour works, &c.—which have been constructed in ferro-concrete, and then follow several chapters devoted to the theories underlying the design of such structures. Most of the works illustrated have been carried out in Italy, where ferro-concrete work has developed much more rapidly than in Great Britain, and this section of the book will prove useful to designers of similar works in this country, especially as many of the reproduced working drawings are fairly fully dimensioned.

The mathematical treatment adopted in the chapter devoted to the design of columns and beams of all classes is that which has now become more or less stereotyped in text-books dealing with reinforced concrete. There is only a brief treatment of the arch, but continuous beams are very fully discussed.

T. H. B.

TEXT-BOOKS OF CHEMISTRY.

(1) *Practical Chemistry.* By Dr. James Bruce and Harry Harper. Pp. viii+240. (London: Macmillan and Co., Ltd., 1910.) Price 2s. 6d.

(2) *Qualitative Analysis. Tables for Use at the Bench.* By E. J. Lewis. (Cambridge: University Press, 1910.) Price 2s. 6d. net.

(3) *Outlines of Organic Chemistry. A Book Designed especially for the General Student.* By Dr. F. J. Moore. Pp. x+315. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 6s. 6d. net.

(4) *The Calculations of General Chemistry, with Definitions, Explanations, and Problems.* Second edition. By Prof. William J. Hale. Pp. xii+175. (London: George Bell and Sons, 1910.) Price 4s. 6d.

(5) *A.B.C. Five Figure Logarithms and Tables for Chemists, including Electrochemical Equivalents, Analytical Factors, Gas Reduction Tables, and other Tables useful in Chemical Laboratories.* By C. J. Woodward. Pp. iv+70. (London: E. and F. N. Spon, Ltd.; Simpkin, Marshall and Co., Ltd.; New York: Spon and Chamberlain; Birmingham: Cornish Bros., 1910.) Price 2s. 6d. net.

(1) THE first of these books contains in the space of 240 pages an account of the manipulative methods of chemical experiment, a selection of inorganic and organic preparations, instructions for physical measurements, such as the densities of liquids and vapour densities, qualitative analysis of simple salts, and a selection of volumetric and gravimetric methods. In spite of the large amount of ground which is covered, the work is excellently done, and it is a great advantage to find in a single small volume nearly all that is needed in the way of text-book instruction for the practical work of a course passing well beyond the standard of an intermediate B.Sc. course, and almost up to the standard of the final examination. Such criticisms as may be made refer only to matters of detail, and are not intended to detract from the value of a book which is undoubtedly one of the best that has appeared. It may, however, be noted that the method of making ethylene by means of phosphoric acid, as described by Newth in the Journal of the Chemical Society, is much superior to the older method, in which sulphuric acid was used, and should be generally adopted. The gas-regulator shown on p. 5 is less efficient than those in which toluene is used, and the pyknometer (Fig. 42) shown on p. 98 has been improved by the use of two bulbs instead of one, as recently described by Mr. W. R. Bousfield. In the volumetric work it is to be regretted that only one method of preparing a standard solution (normal Na_2CO_3 from $NaHCO_3$) is given, as the checking of these methods against one another forms an excellent test of the accuracy of the work, and is of far greater value than the estimation of acids and alkalis in variable commercial samples; moreover, the estimation of acids is far more accurate if carried out with the help of a standard acid and intermediate alkali than when a standard alkali is used, as in the former case all the errors which arise from uncertainty as to "end-point," &c., are eliminated.

Amongst the omitted methods are the preparation of standard caustic soda by weighing out sodium, dissolving in alcohol and diluting, and the preparation of standard acid by measuring the density of sulphuric acid of 80 to 90 per cent. strength, and diluting, as described by Marshall in the Journal of the Society of Chemical Industry. In the experience of the present writer these methods, in the hands of students as well as in work of the highest attainable accuracy, lead to exact results more readily than most of those that have been described. In the use of permanganate it is doubtful how far it is safe to rely on the purity of the crystals, and as the solutions are not altogether permanent, it would be well to treat them from the beginning as only approximately correct.

(2) The best guarantee of the quality of the material printed on these cards is the name of the author, whose "Inorganic Chemistry" has almost created a new ideal in elementary text-books. How far the idea of using printed and varnished cards will prove superior to the system of practical text-books is a matter that can only be worked out by actual experience in the laboratory.

(3) In comparison with the majority of text-books of organic chemistry, this volume starts with one great advantage—that the authors have not attempted to make it into a dictionary or table of physical constants. They have, therefore, been enabled to deal in a small volume with an unusually large amount of interesting and "advanced" material, usually reserved for works of a more pretentious character. This is in many respects a distinct advantage. On the other hand, they have omitted almost entirely the details of methods of preparation, and so have conferred on the subject with which they deal a certain impression of unreality, which might easily have been removed. If, however, the student who reads the book is at the same time carrying out a course of organic preparations, the risk that he may come to regard the subject as one of algebra and geometry—only loosely attached to experiment by the necessities of verification—will be removed, and the book may then prove both useful and suggestive.

(4) The use of numerical examples is an excellent way of impressing upon a student the meaning of equivalents, vapour densities, molecular and atomic weights; it is also necessary in order to secure accuracy in the calculation of analytical results, especially if this is to be done correctly under the hurried and somewhat unpractical conditions of a "practical examination." This need the author has attempted with some measure of success to supply. The chief fault of the book arises from the fact that most of his examples appear to have originated in the study instead of in the laboratory. No chemist would be likely to use in actual work the bewildering array of standard solutions referred to in chapter x., 2N, N, N/2, N/4, N/5, N/6, N/8, N/10, N/20, &c.; neither would anyone who had experience of the subject expect to obtain a theoretical yield of nitric oxide from 7N nitric acid and copper. These and other calculations of a similar character suggest that the author

is merely attempting to teach chemical arithmetic with no regard for the opportunities which arise of teaching chemistry at the same time. The figures actually resulting from the best experiments are so readily accessible that a book which fails to make use of them and substitutes obvious fictions is scarcely to be recommended.

(5) This book of tables is well compiled, and should prove useful, but the printing and binding are not as good as might be desired in view of the small size of the book and the price at which it is issued.

MINERAL SPRINGS AND WELLS OF ESSEX.

A History of the Mineral Waters and Medicinal Springs of the County of Essex. By Miller Christy and Miss May Thresh, with a critical note by W. H. Dalton. Essex Field Club Special Memoirs, vol. iv. Pp. vi+73. (Stratford, Essex: Essex Field Club; London: Simpkin, Marshall and Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

THIS work forms vol. iv. of the Essex Field Club Special Memoirs, and has been reprinted from the *Essex Naturalist*, with additions. As in most other English counties, there are in Essex a number of springs and wells that have attained notoriety as mineral or medicinal waters, and the authors have done well to prepare a full and precise account of them.

The earliest record is of a spring at Wanstead, which was regarded as a spa in 1619, but has long been lost to sight. Witham, Chigwell Row, and Upminster had mineral waters that were formerly reputed to be of medicinal value. No information is available concerning the particular constituents of the Witham Spa; the water of Chigwell Row was purgative, but of no importance; while that of Upminster contained Epsom salts. Tilbury water, obtained from a well, appears to have been most famous in Essex, but, as the authors remark, the saline ingredients were insufficient to justify its being considered a mineral water. Dr. Richard Russel, however, remarked in 1769 that the water "makes excellent Punch, and is extremely good for Tea." The only genuine mineral waters acknowledged in the present work are those of South Weald, Upminster, and Hockley, which contain as the more prominent ingredient magnesium sulphate. As the authors admit, every so-called mineral spring in Essex, with one exception, is now neglected, and almost forgotten; and as regards the waters in general they consider "that 'faith' was an important, if not the chief, element in the 'cures' they are credited with." Dovercourt Chalybeate Spa, discovered about 1852, is the sole remaining spa, and in a sample of the water sent in 1897 to Dr. J. C. Thresh, he reported that it contained under one grain of iron salts per gallon.

The authors express their indebtedness to Dr. Thresh for assistance in dealing with the Essex waters from a chemical point of view, and to Mr. W. H. Dalton for notes on the strata whence the waters are derived. Reference should have been made to the Bagshot Sands on p. 63, as the waters of Hockley, as well as those of South Weald, are derived from that formation or the passage-beds above the mass of London Clay. There are no deep-seated mineral waters in Essex, but the subject, as shown by the authors, is one of considerable interest, and by no means devoid of scientific importance.

H. B. W.

OUR BOOK SHELF.

(1) *Edible and Poisonous Fungi.* Board of Agriculture and Fisheries. Pp. 28. With 25 coloured plates. (London: His Majesty's Stationery Office, 1910.) Price 1*s.*

(2) *Guide to Mr. Worthington Smith's Drawings of Field and Cultivated Mushrooms and Poisonous or Worthless Fungi often Mistaken for Mushrooms, Exhibited in the Department of Botany, British Museum (Natural History).* Pp. 24. (London: Printed by Order of the Trustees of the British Museum, Natural History, 1910.) Price 1*s.*

(1) THE publication of this pamphlet by the Board of Agriculture and Fisheries is intended doubtless to broaden the "mushroom" diet of country dwellers. Whether this object will be attained depends primarily on the doubtful possibility of creating an interest in a lethargic public, and further, in making quite clear the somewhat abstruse differences between the clean and the unclean. With regard to means of discrimination, reliance is placed on coloured plates and short descriptions, to which are added a few hints on preparation for table. What is distinctly lacking is an attractive general account, with information regarding the kinds exposed for sale in foreign market places, where there is often a considerable variety. The list of edible species does not include either the chantarelle or the truffle, while another notable omission is a warning that individuals vary greatly in their power of digesting fungal ferments.

(2) The pamphlet issuing from the British Museum (Natural History) is valuable both as a scientific exposition by one of our most eminent fungologists and also as an authoritative guide for the use of those interested in mushroom cultivation. The descriptions are semi-popular, and the coloured figures are artistic, accurate and well rendered. The setting of the text, as also the plain directions for detecting the poisonous species, add to the practical utility of the pamphlet, which fulfils one of the chief objects of the Trustees, inasmuch as it provides accurate and useful information for the benefit of the general public.

Fractures and Separated Epiphyses. By A. J. Walton. Pp. vii+288. (London: E. Arnold, 1910.)

IN a short preface the author explains that this book is intended for the use of students and those first commencing hospital appointments, but there is every reason to believe it will prove of great value to practitioners in general. Mr. Walton does not confine himself to advising any one method of treatment, but concisely places before the reader the various treatments advocated, with an open-minded criticism of their several points.

The chapters dealing with the etiology and general methods of treatment are, considering the largeness of the subject, both clearly and shortly dealt with, yet nothing of importance has been omitted. In describing the fractures peculiar to each bone, with their treatment, special attention is given to the dates of union in the various epiphyses, and the injuries which they are liable to sustain. The accompanying illustrations, reproduced from radiographs of fractures seen at the London Hospital, are typical and excellent. The book show great care in preparation, and can be recommended to all who need a short, practical work on this subject.

FRANK ROMER.

LETTERS TO THE EDITOR.

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

Gauss and Non-Euclidean Geometry.

PROBABLY someone will before this have directed your attention to a statement in NATURE of June 30 regarding Gauss's share in the discovery of non-Euclidean geometry; but in case this may have escaped notice, even after the lapse of three months, I venture to bring it again before your readers. Speaking of Mannoury's book—"Methodologisches und Philosophisches zur Elementar-mathematik"—"G. B. M." says "there is one remarkable statement made which deserves mention. Dr. Mannoury says that in December, 1818, F. K. Schweikart sent to Gauss a note asserting the existence of a geometry in which the sum of the angles of a triangle is less than two right angles, and in which the altitude of an isosceles triangle with a finite base has a finite upper limit. This goes far to demolish the claim made for Gauss that he was the first to assert the possibility of a consistent system of geometry distinct from Euclid."

The story of Gauss and the non-Euclidean geometry will probably always be incomplete, as he never published his investigations on this subject, and what is known of them has been gleaned from his correspondence and some notes only recently found among his papers (cf. Gauss, "Werke," Bd. viii., Leipzig, 1900). But neither Engel nor Stackel—to whom we owe much of what has been written on the theory of parallels—nor any of the other writers on this phase of non-Euclidean geometry, have asserted that Gauss ever published any statement of his theory, large or small. The most that has been claimed for Gauss is that before Lobatschewsky, in 1826, and Bolyai, in 1832, published their statement of the geometry which will always be associated with their names, also even before Schweikart in 1818 had drawn up the note to which reference is made above, Gauss himself was convinced of the logical possibility of a geometry independent of the fifth postulate, and had mentioned many of his conclusions to his friends, verbally or in writing.

What happened with reference to Schweikart is well known. The whole story is to be found in Gauss's letter of 1819 to Gerling, by whom the memorandum had been submitted to Gauss at the request of the author. Like the subject of a recent political controversy, it could be written on half a sheet of notepaper; and it called forth from Gauss the warmest praise. With it he fully agreed. In fact, his results were exactly the same as those he had already obtained. His own work, he added, he had developed so far as to have fully solved all the problems of the new geometry. Some of his results he sent to Gerling to be communicated to Schweikart himself.

It is not of much importance whether before this date we have any reference to these investigations; but such is actually forthcoming in Wachter's letter to Gauss two years earlier, where he speaks of their conversation at Göttingen, and wonders "whether the anti-Euclidean geometry or your geometry is true."

And more valuable, as showing Gauss's real position, is his well-known letter to Wolfgang Bolyai in 1832, when he had received from him a copy of Johann's famous work:—"If I begin by saying that I cannot praise this work [of Johann's] you will assuredly be surprised for a moment. But I cannot say anything else. To praise it would be to praise myself. In fact, the whole contents of this work, the path which your son has followed, and the results to which he has been led, agree almost completely with my own meditations on this subject, some of them as old as thirty to thirty-five years."

This is but one of several statements of the same kind which we find in the correspondence of Gauss now available. Still, he would have been the last person to assert any claim for himself in the matter. Indeed, it was "a very great pleasure to him that it was actually the son of his old friend who had made this advance upon him in such a remarkable fashion." Yet there is ample evidence that the ideas contained in Schweikart's memorandum were already known to him, and that with much of the work of Lobatschewsky and Bolyai he was familiar long before they themselves had made these discoveries. To them belongs the independent discovery of their geometry, and its complete and systematic development. By their names it will always be called. To Schweikart, to a small extent, to Gauss to a much larger, can be given the credit of having realised that, along the path which Lobatschewsky and Bolyai travelled, complete success was bound to be achieved.

H. S. CARSLAW.

The University, Sydney, August 10.

An Oblique Belt on Jupiter.

OWING in the main part to the swift axial rotation of the planet Jupiter, it is usual to find the dark belts, which constitute the principal configuration of his visible surface, lying both parallel to one another and to the planet's equator. An instance of obliquity of one of the bands relatively to the others is rare, and a most definite and striking example of the kind was recorded in the northern hemisphere in 1860. A recent phenomenon akin to this was observed in the spring months of the present year. Although in this case the band was a faint one, yet the marked trend which it exhibited called for special notice, and the more important facts relating to it might be briefly recorded here.

It attracted my attention, when engaged in a systematic study of the planet, first on April 1, and was subsequently observed on the following nights:—April 6, 8, 23, 28, May 2 and 7. After the last-mentioned date it was not seen again, partly on account of its growing faintness, and partly because the prevailing telescopic seeing was not inducive to a close scrutiny of the planet. During this observed interval a number of careful drawings of the region in question were executed, as well as a series of central-meridian transits of spots situated in and around the slanting belt. Some of these spots had been watched several months[1] prior to the appearance of this belt, so that the rotational velocity of the surface matter in this particular region was, on the whole, fairly accurately ascertained.

The oblique belt, which was a new formation, stretched itself across the white zone between the S. temperate and S.S. temperate belts. Nowhere, however, did it coalesce with these two belts, a point which can be better understood from the accompanying drawings than from a description alone. Its separate existence was due, evidently, to a repulsive action exerted upon it by the belts, which seemed to form a barrier against any further displacement in latitude.

The region of the oblique belt could always be readily recognised, even under poor definition, by reason of an abnormal dark patch of matter which occupied the site where the oblique belt crossed over the central part of the zone in which it was situated. This patch presented a concave outline both east and west, and the oblique belt passed uninterruptedly through it. A white spot (*c*) preceded it, and a fainter one was at times seen on the following side. This curious patch became visible earlier than did the oblique belt, and its greater durability enabled it to remain in view long after the belt had ceased to be visible.

The quicker drift of the spots A and B relatively to E, F, and G will be noticed in the drawings. The dark patch, with its condensation D, was carried along at about the same rate of velocity as A and B, and all, therefore, participated in one and the same current. The white spot C drifted at the same rate as the spots E, F, G, and, as will be noted, it was being gradually overtaken by the dark patch. Thus we observe the relative movements of two independent currents. They disclosed the noteworthy fact that the dark patch was in reality a distended part of the current about A and B, having evidently forced its way northwards across the slower current round C to the spots E, F, G. The condensation D formed part of the oblique belt. Whether the rest of this belt participated in the quick current of A and B is not known; but if such was really the case, we have here at least a clue as to the cause of the curious trend of the belt. The material of a

[1] Opposition of Jupiter occurred on March 31, 1910.

quick current often trespasses upon a slower moving one, a fact which is manifested by wispy shadings and spots protruding considerably into an adjacent current. Such an intrusion of matter might have occurred in the region of the S.S. temperate belt, and by continuing its northerly course slowly but interruptedly, its rapid westerly drift combined would cause it to drift in a W.N.W. direction. The result would be for the matter to form a slanting streak across the disc, and it is possible, and not improbable, that the oblique belt under discussion has found its origin through a similar cause.

An Oblique Belt in Jupiter, 1910.

The movements of the seven spots lettered in the drawings are tabulated as under:—

Name of spot	First and last date of observation	Average monthly drift (3 days)[1]	Rotation period h. m. s.	
A	1910, Feb. 9 / 1910, May 7	+28·5	9 55 2·8	Current I.
B	1910, April 1 / 1910, May 7	+31·0	9 54 59·5	Current I.
D	1910, April 1 / 1910, May 7	+28·5	9 55 2·8	Current I.
C	1910, Jan. 16 / 1910, April 23	+17·0	9 55 18·1	Current II.
E	1910, March 5 / 1910, April 23	+15·8	9 55 19·7	Current II.
F	1909, Dec. 13 / 1910, April 23	+14·3	9 55 21·7	Current II.
G	1909, Dec. 30 / 1910, April 1	+17·5	9 55 17·4	Current II.

The oblique belt was situated on the opposite side of the planet to the red spot, and the longitudes of the condensation D might be given here:—

1910	1910
April 1 = 169°·2	April 23 = 146°·9
„ 6 = 161·6	May 2 = 140·2
„ 8 = 156·1	„ 7 = 133·4

Leeds, September 3. SCRIVEN BOLTON.

[1] Relatively to the adopted zero meridian of System II., based on a rotation period of 9h. 55m. 40·6s. (*Nautical Almanac*).

Tests for Colour-vision.

AN article in NATURE for August 18 deals aptly with the question of testing for colour-vision. It is to be hoped that the committee at present inquiring into the matter will advocate that testing should be carried out in future in conditions resembling as nearly as possible those on which seamen ordinarily follow their calling. It does not seem quite practical or fair to test indoors a man's ability to pick up lights in the open. The conditions of light inside and outside vary so much, as do those of inside and outside darkness. A sailor's business is not to match colours, but to pick up and distinguish instantly lights that may be seen, far or near, through varying conditions of atmosphere.

The sight of the average seaman, from practice, is probably much keener than that of the average landsman. The sailor's eyes are trained to adapt themselves to varying conditions of outside darkness.

The suggestion of spectrum tests is good, provided that such testing is made supplementary only to the practical open-air tests with flags by day and sidelights by night. The object of the tests is to ascertain the candidate's faculty for instant recognition of a flag or light, and there is no difficulty whatever in providing efficient practical tests. It is unnecessary, and even mischievous, to try to puzzle a candidate with combinations of lights and shades such as never occur in the course of his practical work.

It is to be hoped that the committee which is investigating the matter will allow common sense and practical ability to rule its recommendations for future examinations. D. WILSON-BARKER.

The Thames Nautical Training College, H.M.S. *Worcester*, Greenhithe, September 19.

Fireball of September 2.

THE remark in NATURE of September 8 (p. 318), as to the necessity of further observations for determining the height and velocity of meteors encourages me to send the following note:—

At 9.5 p.m. on September 2, from Earlstone Common, four miles south of Newbury, I had a good view of the meteor described by the Rev. J. C. W. Herschel as seen from near Wellington College. I have seen brighter meteors, but never one that remained so long in sight, and its course was marked for a long way by a streak of light, showing very clearly the route it had taken. When I first caught sight of it, it appeared to be rising in the sky, through the Camelopard, and it passed almost exactly over β and γ of the Little Bear, over η Draconis, between π and ρ Herculis, and over α Ophiuchi, vanishing perhaps 15 degrees further south in the Serpent. Rising and falling in its flight like a thrown cricket-ball, it seemed to be quite close at hand.

EDMUND J. WEBB.

Burghclere, Newbury, September 9.

MR. EDMUND J. WEBB's highly interesting account of the fireball of September 2, in conjunction with other descriptions which have now come to hand, enable the real path to be well determined.

The radiant point of the meteor was near β Aurigæ, or at about $87°+41°$, and the height of the object from about 98 to 44 miles from over the North Sea to S.S.W. coast of England. The meteor had an unusually long flight right across the country from N.N.E. to S.S.W., and its visible course of 352 miles was probably traversed at a velocity of 40 miles per second. It is only rarely that a fireball is seen in this country with such an extended trajectory. Most of the observers only saw a part of the path. The radiant was near the horizon in N.N.E.

The fireball was seen by the Rev. F. C. Lees, Sutton, Surrey; Rev. C. L. Tweedale, Otley, Yorks; Col. E. E. Markwick, Boscombe, Hants; and many other observers.

W. F. DENNING.

The Law of Definite Proportions.

PERHAPS a reader of NATURE will be good enough to solve the following question.

If an amount of heat is supplied to a volume of ice, water, and vapour *at* the triple point, and *remaining at* the triple point, and the same volume, while the heat is being supplied, are water and vapour formed in definite relative proportions from the ice? That is, is the ratio of vapour to water independent of the amount of heat supplied, or of the original proportions of the three phases?

C. E.

King Edward VII. School, Sheffield.

FIRE TESTS WITH TEXTILES.[1]

THE frequent accidents caused by the ignition of highly inflammable wearing apparel have directed wide attention to the possibility, by suitable treatment, of rendering materials like flannelette non-inflammable. The interest aroused by the subject is further increased by the fact that most of the fatal accidents occur to very young children, and apparently the number of such accidents is not diminishing.

Thanks must be given to the British Fire Prevention Committee for the efforts being made to investigate the subject in a thoroughly scientific manner, and for the report before us, which contains the results of experiments on 456 samples of cloth. These were divided into the five following groups:—(*a*) Flannelette ("non-flam," commercial); (*b*) flannelette ("non-flam," special); (*c*) flannelette (ordinary); (*d*) "union" (a mixture of cotton and wool); (*e*) flannel; (*f*) flannelette (fine finish). The method of testing employed was briefly as follows:—A yard of the cloth was suspended from three hooks fixed in a beam, the lower edge was kindled by the flame of a wax taper or spirit lamp. At the end of sixty seconds any flame was extinguished, and the portion of material burned carefully measured. In many cases photographs were taken before and after the ignition, and these supply more vivid illustrations of the results than the pages of statistics which follow. In some cases made-up garments were suspended on wire frames and tested as before. The different samples were also tested before and after repeated washings. Manifestly this is a point of great importance, and it was proved that in the case of "non-flam" materials there was practically no difference as regards fire resistance between samples washed once and those washed twenty times.

The general nature of the results may be briefly stated. Unquestionably the flannelette known as "non-flam" justifies its name. Samples of this material are only charred where they have been in contact with the flame; they are non-inflammable.

Ordinary flannelette as received from the manufacturer burned up through the centre of the sample,

(*a*) (*b*)

Demonstration Tests with Garments: (*a*) Flannelette ("Non Flam Commercial) at 120 seconds. (*b*) Flannelette (Ordinary) at 60 seconds.—From "Fire Tests with Textiles."

and from 25 to 40 per cent. of the material was consumed, while after *one washing* from 92 to 100 per cent. was destroyed. The material known as "union," a mixture of cotton and wool, as might be expected, is less inflammable than flannelette; from 57 to 66 per cent. of the material, after one washing, was burnt.

In the case of flannel the charring only reached as far as the power of the flame extended. Lastly, the flannelette (fine surface) is shown to be very like the ordinary, and in many cases the sample was completely consumed. This investigation appears to have been carefully conducted, and the report should be widely circulated. The illustrations explain themselves: (*a*) a "non-flam," made-up garment, after 120 seconds; (*b*) a made-up garment, ordinary flannelette, after 60 seconds.

[1] Fire Tests with Textiles. Flannelette known as "Non-Flam" Flannelette, Ordinary Flannelette, "Union" Flannelette submitted for test by Messrs. Whipp Bros. and Tod, Ltd., Manchester. The Committee's Report, pp. 48 ("Red Books" of the British Fire Prevention Committee, No. 148.) (London: The British Fire Prevention Committee, 1910.) Price 5s.

THE CASTES AND TRIBES OF SOUTHERN INDIA.[1]

THIS, if not quite the most workmanlike, may justly claim to be the most voluminous contribution to the publications of the Ethnographical Survey of India. The facts for which Mr. Thurston is personally responsible were collected in a series of tours throughout the Madras Presidency, in which he was able to combine the collection of specimens for the museum under his charge with a considerable amount of original work. He gives a lively account of the difficulties which he experienced in examining and measuring the shy jungle folk in whom he was most deeply interested; and the combined tact and enthusiasm with which he conducted these inquiries deserve hearty recognition. With his own personal investigations he has combined contributions from other writers, among whom the work of Mr. F. Fawcett, much of which is already familiar to students of the periodical bulletins of the Madras Museum, is the most valuable. To these have been added numerous extracts from census reports, district manuals, and similar literature; and the large series of excellent photographs adds largely to the interest and value of the work.

It is, however, to be regretted that, apparently from pressure of other duties, Mr. Thurston has been unable to arrange this great mass of material in a form suited to the needs of students. The articles contain much undigested material, and little has been done to classify this in a series of well-ordered paragraphs, each provided with a marginal heading, and bringing together the accounts of tribal organisation, domestic ceremonies, religious beliefs, and the like. It is obvious that the bulk of the work might have been much reduced by judicious compression; and, as native States like Mysore and Cochin are engaged in ethnographical surveys of their own population, it was unnecessary to give more than references to their preliminary bulletins. There is nothing in the shape of a subject-index; and though a good start was made by Mr. W. Francis in his report on the census of 1901 to compile a bibliography of the literature of the subject, Mr. Thurston has done nothing to supplement it. A protest must also be made against the habit of the writer, which has already greatly impaired the value of his useful "Ethnographic Notes on Southern India," published four years ago, of giving in the notes merely the names of his authorities without precise references. This gives a slovenly appearance to the work which it otherwise does not deserve.

We might also have expected from the author an exposition of his views on the prehistoric ethnology of the province. The Dravidian question is always with us, and though he supplies some facts which may assist in its solution, his personal views on the subject are nowhere definitely stated; and he seems to have abandoned in despair any attempt to indicate how far the existing jungle tribes are related to that remarkable people who reared the great series of megalithic monuments which abound on the Nilgiri plateau, the relics from which, excavated by Mr. Breeks and others, form the most interesting collection in the museum under his charge. Two important facts, however, can be gathered from his notes on the physical characteristics of the people; first, that the primitive Negrito element is not so widely distributed as some authorities have assumed. It is not apparent among the Kotas and Badagas, who seem to be later immigrants into the hill country from the plains, and it is found only among the more primitive tribes, like the Irulas and Kurumbas. Even among them it is important to note that prognathism and wooliness of hair appear as aberrant characters. In the second place, when we speak of the Dravidian head form, we must remember that it is not consistently uniform throughout the Presidency. Whatever may be the causes of this variance of type—the influence of environment or miscegenation—about which Mr. Thurston, with his characteristic caution, declines to express an opinion, it is certain that the type in the northern district is subbrachycephalic or mesaticephalic, while it is only in the Tamil and Malayalim countries that we find it to be dolicho- or subdolicho-cephalic.

The chief interest in the ethnography of southern India lies in the startling variances of culture which appear throughout the population. For an example of what is apparently the lowest type, we may turn to the Yānādis, a dark-skinned, platyrhine, under-

FIG. 1.—Toda Woman. From "Castes and Tribes of Southern India."

sized tribe inhabiting the Telugu country. Their religion is a crude form of animism; they make fire by friction; eat their food almost raw, merely scorching or warming the flesh of the animals which they kill; and yet, with the curious inconsistency which pervades the Hindu social system, they are regarded by the higher classes as gentlemen of the forest, are allowed to draw water from wells used by high-caste people, and may carry it to Brahmans. In direct contrast to them we may refer to the Nāyādis, a tribe in the plains little higher in culture than the Yānādis, who live by collecting jungle products, and are regarded as so impure that in their begging rounds they are compelled to stand at a distance from respectable houses, and to make their appeals for charity in stentorian tones.

A higher type of culture is reached in the Badagas, the agriculturists of the hills, where the pastoral element is represented by the Todas, and the industrial

[1] "The Castes and Tribes of Southern India." By Edgar Thurston, assisted by K. Rangachari. Vol. i., A and B. Pp. lxxiii+397. Vol. ii., C—J. Pp. 501. Vol. iii., K. Pp. 500. Vol. iv., K—M. Pp. 501. Vol. v., M—P. Pp. 487. Vol. vi., P—S. Pp. 458. Vol. vii., T—Z. Pp. 439. (Madras: Government Press, 1909.)

by the Kotas. Mr. Thurston's account of these people forms one of the best articles in his work. They live in dread of the more savage Kurumbas, by origin

FIG. 2.—Nāyādis making Fire. From "Castes and Tribes of Southern India."

Negritos, who, like many other secluded races, are supposed to possess the power of necromancy. Every Badaga family pays them a sort of retaining fee in the shape of an annual tax and special dues at funeral and pregnancy rites, in return for which the Kurumba is bound to treat cases of diabolical possession or of the evil eye by means of appropriate spells. But the Kurumba needs to be cautious in exercising these uncanny powers, for instances are quoted of cases in which he has been suspected of unfair dealing, and "his hut is surrounded at night, and the entire household massacred in cold blood and their houses set on fire."

At the head of the social system stand the Brahman and the Toda. The entry of both into the social system of south India is comparatively modern. Mr. Lewis Rice, in his recent summary of the epigraphical evidence from Mysore and Coorg, finds that there is no record of Brahmans in those regions before the second century of our era; and other authorities, like that great scholar, the late Dr. Burnell, fix their migration from the north at even a later date. This fact accounts for two interesting characteristics of religious and social life. The Brahman being a newcomer, and not, as in northern India, evolved from the family priests of the invading tribes from Central Asia, reached the south with all his tabus and restrictions well established, and these were intensified by contact with the non-Aryan tribes, who were regarded as quite outside the pale of orthodoxy. The result was twofold. In the first place, the line of distinction between the Brahman and the outcast was more clearly marked than in the north; and, secondly, south Indian Brahmanism, affected by its environment, and saved from the disturbing influences of cataclysms to which it was exposed in north India from the successive invasions of foreign tribes like Scythians, Huns, and Mongols, was permitted to develop on lines peculiar to itself, and thus assumed a character very different from that which it displays in the Panjab, the Gangetic Valley, and the Delta of Bengal.

The special characteristics of south Indian Brahmanism are most effectively illustrated by Mr. Fawcett's excellent account of the Nambutiris of Malabar, with their intense craving after what they deem personal purity, their elaborate system of tabus, and their placid, reflective life spent in an endless round of elaborate ceremonial and devotion to the study of the Sanskrit Scriptures. In these respects they hold a position unique among the Brahmans of India, and the remarkable phase of religious and social life illustrated by them deserves attentive study.

Even more interesting is that remarkable race, the Todas. Mr. Thurston has wisely referred his readers to the exhaustive monograph on this tribe by Dr. W. H. R. Rivers, an excellent example of the successful application of the intensive methods of study

FIG. 3.—Yānādis. From "Castes and Tribes of Southern India."

applied to one of the smaller groups. Mainly on the ground of the exceptional hairiness observable in the Nambutiri Brahmans, he is inclined to accept the brilliant suggestion made by Dr. Rivers from a study of their emigrations preserved by the tribe, that the Todas are comparatively new arrivals in the Nilgiri plateau, and that they are connected in race with the Malabar group of Brahmans. Mr. Thurston records a curious fact which escaped the observation of Dr. Rivers, that their extreme reverence for the herd of sacred buffaloes is shown by the rule that when the animals are driven from one grazing ground to another, the women of the tribe are not permitted to tread upon the track of the holy beasts, but must be lifted over it by the men of the tribe.

In spite of the imperfections in the literary arrangement of his work, to which we have directed attention, Mr. Thurston's volumes constitute a monumental record of varied phases of south Indian tribal life, the traditions, manners, and customs of the people. Though in some respects it may be corrected or supplemented by future research, it will long retain its value as an example of out-of-door investigation, and will remain a veritable mine of information, which will be of value to his fellow-officers in acquiring a knowledge of the people, and a storehouse from which the armchair ethnologist will draw abundant facts of the highest value and interest.

A HISTORY OF BIRDS.[1]

OF the series of four volumes to be published under the title of "Animal Life: an Evolutionary Natural History," the editor, Mr. Pycraft, has himself contributed that on birds. The reader will at once be struck by two facts, first, that the subject is treated from the point of view of the evolutionist, as opposed to that of the systematist, and, secondly, that the author is never satisfied until he has inquired into, and, if possible, explained, the various phenomena that meet the eye of the ornithologist. As he tells us in his preface, and as we gather from the excellent introduction by Sir Ray Lankester, which practically summarises the whole work, the study of birds is here presented as one of living organisms, moulded in part by an inherent constitution, and in part by the struggle for existence.

A great array of facts is marshalled in order before us, and presented in attractive fashion, while Mr. Pycraft's well-known skill is particularly evident in the osteology and pterylography; but we must confess that he seems to us somewhat hard upon the "field-naturalist," the results of whose labours he terms "a pitifully small gain to science." It is true that such an one often lacks the training or opportunity necessary for scientific research, but his province is more especially to supply material for the work of his fellows, and must never forget that Darwin and Wallace—not to mention later instances—were essentially field-naturalists.

[1] "A History of Birds." By W. P. Pycraft. With an introduction by Sir Ray Lankester, K.C.B., F.R.S. Pp. xxx+458. (London: Methuen and Co., 1910.) Price 10s. 6d. net

The volume begins with a brief but sufficient summary of the general structure of birds, and proceeds to consider their phylogeny, their relationship to reptiles, and their development from climbing arboreal forms to those endowed with full powers of flight. The writer's views on this part of the subject are clearly shown by a "genealogical tree," while a woodcut is given of one of the hypothetical primitive types, or pro-aves.

From the ancestral forms of birds we pass on to a sketch of their present distribution and of the generally accepted zoo-geographical regions. Mr. Pycraft accepts the theory that the entire class originated in the northern hemisphere, with the possible exception of the Sphenisci; but the close connection of the latter in his tree of descent with the decidedly northern Colymbi seems to run counter to this contention.

Environment and its effects next come under discussion, with selected examples of adaptation to the surroundings. Here we find the view definitely adopted that a moist atmosphere leads to darker pigmentation and a dry atmosphere to lighter tints, but we are not inclined to follow our author implicitly here without further proof.

Emperor Penguin brooding its Young. From "A History of Birds."

Migration is always an interesting subject, and we concur with Mr. Pycraft in paying little attention to very precise "lines of flight"; whether, however, he is right in holding that the trend of migration is due north and south, apart from physical obstructions, is a much more debatable question.

The interrelations of birds and other animals, and their connections with plants, form the subject-matter of three well-written chapters, while an account of the relations between the sexes is not only instructive in itself, but naturally leads us on to the theory of sexual selection. The "displays" of various species, the pugnacity of the males, and so forth, are set forth at due length; but, on the whole, our author minimises the importance of sexual as opposed to natural selection, and believes that the latter, working on the discontinuous variations which undoubtedly occur, tends to preserve those varieties which finally persist.

Nidification and incubation, eggs and young, and the care of the latter, are next considered, while Mr. Pycraft has much to tell us of what we may learn from the immature bird, whether in the embryonic stage or otherwise, of its precocity or helplessness, its downy condition, its seasonal changes, and its differences from the adult. We notice that he thinks that nest-building is "a product of selection and is instinctive," and that all eggs were perhaps originally white and assumed protective coloration only where necessary.

Artificial varieties and the question of inheritance of acquired characters are treated by the author at some length, while his natural bent towards anatomy enables him to deal fully and successfully with the interesting and important subjects of structural and functional adaptations, and to conclude a work, which we heartily commend to our readers, with a detailed account of various instances of homoplasy.

The numerous illustrations, some of which are new, add much to the value of the book.

REFORMS OF THE CALENDAR.

IN the August number of *Himmel und Erde*, Prof. Förster has a paper on calendar reform, on which, though it is rather discursive, a few words may be of interest. The main point of the paper is to suggest that the International Congress of Chambers of Commerce should take up the question of altering the rule for keeping Easter, which has, from the beginning of the Christian Church, been regulated by luni-solar chronology. That sort of chronology was observed over a large part of Asia, and is by the Jews to the present day, making the year consist of twelve and thirteen months alternately, the months following the moon. But, of course, this does not make the correspondence exact, and other intercalations were necessary. The old Roman calendar was also luni-solar, the months being made to contain twenty-nine and thirty days alternately, which would give only 354 days in a year, so that an additional or intercalary month had to be inserted in alternate years of varying length.

As Dr. Förster remarks, the old Roman calendar had degenerated into a true monster of chronological complication ("zu einem wahren Monstrum von chronologischer Verwirrung"), when it occurred to Julius Cæsar that it would be best to discard the moon altogether as a time-measurement and regulate the calendar by the sun, as had been done in the old Egyptian chronology, a country in which the annual overflow of the Nile was of surpassing importance, and, of course, depended on the solar season.

Cæsar had no occasion to trouble about the days of the week in his calendar. All European nations have followed in the main his calendar, but have had to make a special case of the great Easter festival and the ecclesiastical dates depending on it. But there is no real necessity for falling back upon a Jewish or luni-solar method of reckoning in this respect.

In the years 1872 and 1873 the Rev. J. Newland Smith, of Greenwich, published and distributed two pamphlets on "Eastertide," pointing out that the present complicated rule for keeping Easter was not fixed by any Church regulation; the Council of Nicæa having only decided that it should always be kept on a Sunday. Had Mr. Newland Smith lived (he died in 1880) he hoped that a Bill would have been introduced into Parliament on the question. The proposal in his first pamphlet was that Easter should be kept either on April 9 (that being one probable date of the first Easter day), if that day were a Sunday, or, if not, on the following Sunday; in the second, that it should be always kept on the second Sunday in April, which would include the 9th.

Dr. Förster, in the article before us, makes a similar proposition, which he commends to the International Congress of Chambers of Commerce, that Easter should be kept on the Sunday following April 4, so that it would always fall between the 5th and 11th.

He hopes that other changes may be effected in the calendar, and particularly that the congress may be the means of inducing the Russians and the Greek Church generally to follow the Western usage and replace the Julian by the Gregorian calendar, or some modification of it.

Perhaps we may be allowed the suggestion that the dropping of a leap year each 128th year would be both more convenient and more accurate than the existing Gregorian rule.

W. T. L.

THE DYNAMICS OF FÖHN.[1]

MUCH has been written about the dynamics of Föhn, and the general principles involved in it are well understood, yet the processes by which an air current descends and displaces potentially colder air are still somewhat obscure. As in his previous studies of the same subject, Dr. Ficker has followed the method of examining in detail a large number of individual cases. The process is a laborious one, but we agree with the author that it is essential to follow out individual cases if we wish to arrive at a clear understanding of the processes involved. Average results may be very misleading; very probably the condition of things represented by averages never actually occurs.

In all cases examined, Föhn was preceded by typical anticyclonic conditions, with a very stable stratification of the atmosphere. In many instances the valley temperatures were actually lower than those observed simultaneously on the summits. Special attention was given to the time of commencement of Föhn at different stations, which can be accurately determined from thermograph traces. Föhn sets in earliest at the high stations at the head of the valleys, and makes its way gradually to lower levels. Stations at the same altitude experience the onset of Föhn approximately simultaneously, even though they be in different valleys. In a few instances, Föhn made its appearance at Hachlaching, a station near Munich, on the Bavarian plateau, but on all such occasions the outbreak occurred there long after Föhn had established itself in the higher valleys. The suggestion that barometric minima skirting the north-west coast of Europe exert an aspirating action on the lower strata of the atmosphere, and so cause the Föhn, thus falls to the ground.

Local conditions determine the outbreak of Föhn. During the continuance of anticyclonic conditions the valleys become filled with a mass of more or less stagnant air, cold, at any rate in winter, by reason of its contact with the mountain sides, which are chilled by radiation. Above this we find a region of potentially warmer air, and at the junction of the two layers there is often a sudden actual increase of temperature with altitude. The cold air drains away to lower levels. This process is accompanied by a gradual rise of temperature, but the winds associated with it cannot be regarded as true Föhn, because the vertical temperature gradient in them is much less

[1] "Innsbrucker Föhnstudien IV. Weitere Beiträge zur Dynamik der Föhns." By Dr. H. v. Ficker. Pp. 61. (Wien: Alfred Holder, 1910.)

than the adiabatic for dry air. The air removed by drainage is replaced by air from above, which flows down the mountain valleys like a river, often with a tumultuous rush. In this descending current, which is the true Föhn, the temperature gradient is that of the dry adiabatic. The onset of Föhn at a given station occurs when the upper level of the cold air sinks to the level of the station.

In their early stages all Föhns are fed by air which has travelled horizontally to the mountain ridges, and then descended on the northern side. There is no evidence of ascent of air on the southern side of the range during this first, or "anticyclonic," stage. If Föhn persists, a condition of things often develops in which there is heavy rain, and a marked absence of diurnal range of temperature on the south side of the Alps, and simultaneously the temperatures are much lower to the south than to the north of the range. We have then unmistakable evidence of the ascent of air on the south and of its subsequent descent on the north of the range. The conditions which determine whether an "anticyclonic" Föhn shall develop into this second or "stationary" stage need further investigation. R. G. K. L.

RESPIRATION AT HIGH ALTITUDES.[1]

PROF R. F. FUCHS, with Dr. Deimler, has confirmed the statement of Zuntz and his co-workers and of Durig, that the oxygen use of the human body during work is greatly increased at altitudes above 3000–4000 metres. While on the Colle d'Olen the O_2 use of Fuchs was only 3 per cent. more than at Erlangen; it was 36 per cent. more on the Capana Regina Margherita.

Fuchs and Deimler lived in the hut on the top of Monte Rosa for some weeks, and proved this point conclusively. This increased use of oxygen explains why most tourists are taken with mountain sickness at altitudes above 3000–4000 metres.

The oxygen needs cannot be supplied by the respiratory and circulatory mechanisms in the face of the falling partial pressure of oxygen, and the high oxygen use. Training and acclimatisation economise the oxygen use, increase the oxygen combining power of the blood, the power of the respiratory and circulating mechanisms.

The respiratory quotient sinks to a very low level, *e.g.* 0·53 after work, while the resting value is only 0·6–0·7 at these high altitudes. To explain this, it is supposed either that glycogen is built out of fat and protein in the body, or that substances are not completely burnt in the body, but are given off as lactic acid in the urine. We know that lactic acid is excreted in the urine after a hard run, when the oxygen used is greater than the supply.

A. Loewy and Franz Müller recently have found that the respiratory quotient is reduced by sea-bathing, *e.g.* from 0·88 at Berlin to 0·73 at the North Sea. The diet was the same. There is some evidence that the protein metabolism is different both in high altitudes and after the sea-bathing, but further work is required to explain the low quotients. Under the special conditions substances, such as proteins and their derivatives, may be oxidised, which share but little in the combustion process of the body. Fuchs suggests that the new building of hæmoglobin may explain partly the high oxygen use and the low respiratory quotient. It is generally agreed that a stay in high altitudes does increase the hæmoglobin of the body. LEONARD HILL.

[1] "Physiologische Studien im Hochgebirge: Versuche über den repiratorischen Stoffwechsel im Hochgebirge." By R. F. Fuchs and T. Deimler. Sitzungsberichte der Physikalish-medizinischen Sozietät in Erlangen. Band 41, 1909.

NOTES.

THE ninth meeting of the International Meteorological Committee will be held in Berlin on Monday next, September 26, and following days. It will be preceded by meetings of the Commission for Terrestrial Magnetism and Atmospheric Electricity, of which General Rykatcheff is president and Dr. A. Schmidt is secretary, and by meetings of the Magnetic Observations Committee of the International Association of Academies. Of other commissions which originated with the International Meteorological Committee, those concerning scientific aëronautics, the correlation of solar and terrestrial changes, a proposed *Système Mondial*, weather telegraphy, and maritime weather signals have held meetings in the past year, and their reports will come up for consideration at Berlin. Among new proposals to be considered is one by Prof. V. Bjerknes, of Christiania, for the organisation and publication of strictly synchronous meteorological hourly observations of the air at the surface and above at a large number of stations, with the view of studying in detail the precise changes that take place. Since the last meeting of the International Meteorological Committee, at Paris in 1907, many changes have taken place in the *personnel* of the committee. Death has removed MM. Lancaster, Pernter, and Eliot, while M. Hepites has resigned his directorship of the Roumanian Meteorological Service, and consequently ceases to be a member of the committee. The new members appointed to fill the vacancies are MM. van Everdingen (Holland), Ryder (Denmark), Trabert (Austria), and G. T. Walker (India). Dr. W. N. Shaw, director of the Meteorological Office, is the president of the committee, and Prof. G. Hellmann, director of the Royal Prussian Meteorological Institute, is the secretary.

MR. R. NEWSTEAD, of the University of Liverpool, who, it will be remembered (see NATURE, June 30, p. 530), was dispatched three months ago to Malta by the Liverpool School of Tropical Medicine to investigate the relation of sand-flies to public health, has now returned. It is understood that in the forthcoming report upon the expedition practical measures for dealing with the various disease-carrying insects in the island will be suggested, Mr. Newstead having brought back a considerable amount of material, not only with reference to sand-flies, but also to other carriers of disease.

THE National Fund Airship, which has just been completed, made its first successful flight at Moisson on September 14. It is a little more than a year ago since Mr. Eric Stuart Bruce, the late honorary secretary of the Aëronautical Society of Great Britain, was asked to visit France to make an exhaustive examination into the various types of dirigibles in connection with the national airship, with the result that the Lebaudy type was selected. This latest Lebaudy airship may certainly be said to be the finest semi-rigid dirigible in the world. It is 337 feet 10 inches long, 39 feet $5\frac{1}{2}$ inches in diameter, and has a gas capacity of 353,165·8 cubic feet. It contains three ballonets. The motive power is derived from two four-cylinder Panhard-Levassor petrol motors of 135 horse-power each. The two propellers are made of wood. Mr. Bruce is now acting as honorary secretary to the test committee of the National Fund Airship.

ATTENTION has from time to time been directed to the flower gardens upon vacant land in the neighbourhood of the Strand. The Selborne Society has been investigating a still more interesting building site in Farringdon Street, scarcely removed from the heart of the city. Although this plot has only been cleared for about two years, no fewer than twenty-eight species of flowering plants and ferns have established themselves upon it. Mosses, liverworts, and others of the more simple plants are also represented. Mr. J. C. Shenstone is preparing a detailed list, which will be published in the October number of the *Selborne Magazine*.

THE council of the Concrete Institute has decided to offer a medal annually for the best paper submitted relating to concrete and its applications.

THE Royal Philosophical Society of Glasgow announces that its Graham medal, awarded for original research in any branch of chemical science, is now open to competition. Particulars as to the award are obtainable from the secretary of the society, 207 Bath Street, Glasgow.

THE Incorporated Institution of Automobile Engineers will hold its opening meeting for the present session on October 12, when the president, Mr. F. W. Lanchester, will deliver an address on "Factors that have Contributed to the Advance of Automobile Engineering, and which Control the Development of the Self-propelled Vehicle."

DR. FREDERICK A. GENTH, jun., a prominent American toxicologist, died on September 1 at Lansdowne, Pennsylvania, at the age of fifty-five. He was a member of several foreign chemical societies, and had held official positions at home in connection with the University of Pennsylvania, the Medico-chirurgical Hospital of Philadelphia, and the State Department of Agriculture.

MR. JOSEPH A. HOLMES, director of the technological branch of the U.S. Geological Survey, has been appointed by President Taft to the directorship of the newly established Bureau of Mines. The functions of the new office will be to investigate and report upon safety appliances, and to inquire into the improvement of the methods of mining in general. Mr. Holmes, who is now in his fifty-first year, was professor of geology and natural history in the University of North Carolina from 1881 to 1891, and State geologist of North Carolina from 1891 to 1904, when he entered the service of the national geological survey. He was chief of the department of mines and metallurgy at the St. Louis Exposition in 1904.

THE death is announced of Prof. William H. Niles, who was professor of geology and geography in the Institute of Technology at Massachusetts from 1871 to 1902, and head of the department of geology at Wellesley College since 1888. Although perhaps best known as a teacher and public lecturer, he was author of papers on glacial phenomena and on the physical geology and geography of Massachusetts. In 1874 he directed attention to natural disturbances which occurred in quarries, whereby anticlinal structures were produced, owing to lateral pressure and the relief caused by the removal of rock. Prof. Niles was president of the Boston Natural History Society from 1892 to 1897. He was born on May 18, 1838, and died on September 13 of this year.

THE death is reported, at the ripe age of eighty-three, of Dr. Charles A. Goessmann, for nearly forty years professor of chemistry at the Massachusetts Agricultural College. A native of Naumburg, he graduated at Göttingen, where he was a favourite student, and afterward the assistant, of Wöhler. A report he had made on the value of sorghum as a source of sugar led to his invitation by a former American fellow-student to become scientific director of a sugar refinery in Philadelphia. After occupying that post from 1857 to 1861, he spent eight years as chemist of the Onondaga salt works, where he made important contributions to the chemistry of brines, meanwhile devoting part of his time to the professorship of chemistry at the Rensselaer Polytechnic Institute at Troy, N.Y. The most valuable part of his life-work was done at the Agricultural College at Amherst, which he made a training ground for agricultural and technical chemists. The State of Massachusetts appointed him also director of its agricultural experiment station and analyst to its board of health. He is credited with having exerted, directly and through his pupils, a powerful influence over the attitude of American agriculturists to scientific education.

WRITING in the *Times* of Friday last, Prof. R. Meldola says that it appears to have been overlooked that Erasmus Darwin, the grandfather of Charles Darwin, besides prophesying the introduction of steam as a motive power, foretold, in the following lines, the advent of aërial navigation :—

"Soon shall thy arm, unconquered steam, afar,
Drag the slow barge and drive the rapid car;
Or on wide waving wings expanded bear
The flying chariot through the streams of air;
Fair crews triumphant leaning from above
Shall wave their fluttering kerchiefs as they move;
Or warrior bands alarm the gaping crowd,
And armies shrink beneath the shadowy cloud."

THE first Universal Races Congress, "to discuss, in the light of modern knowledge and the modern conscience, the general relations subsisting between the peoples of the West and those of the East, between so-called white and so-called coloured peoples, with a view to encouraging between them a fuller understanding, the most friendly feelings, and a heartier cooperation," is to be held, under the presidency of Lord Weardale, in London on July 26–29, 1911. We notice that among the papers to be brought before the congress are the following :—Definition of race, tribe, and nation, by Brajendranath Seal; anthropological view of race, by Prof. v. Luschan; sociological view of race, by Prof. A .Fouillée; the problem of race equality, Mr. G. Spiller; differences in customs and morals and their resistance to rapid change, by Prof. G. Sergi; intellectual standing of different races and their respective opportunities for culture, by Mr. J. Gray; inter-racial marriage, by Dr. J. Deniker.

THE report for the past year of the Madras Government Museum, so long associated with the reports and bulletins issued by Mr. E. Thurston, now appears under the signature of his successor, Mr. J. R. Henderson. The most important addition during the year was the establishment of the marine aquarium, of which a description appeared in these columns (February 3). This is now stocked with fish and other marine forms of life collected on the coast, and forms a most attractive exhibit. Numerous accessions to the numismatic cabinet are recorded, the most important being a Roman *denarius* attributed to Quintus Cassius Longinus (B.C. 60), and a second to the Emperor Augustus. These furnish additional corroboration of the importance of the sea trade between Rome and southern India during this period. The present specimens were unearthed in the Coimbatore district.

THE last issue (vol. v., part v.) of the Archæological Publication of the University of California is devoted to an account of the Chimariko tribe of Indians inhabiting Trinity County, in north California. They first came into contact with the whites early in the last century; but their final destruction began with the sudden eruption of gold miners in the early 'fifties, by whom they were overwhelmed and dispersed. The information now collected was obtained by Mr. R. B. Dixon from a woman, the sole survivor of the tribe, and from a male member of a neighbouring group who was well acquainted with their language and customs. They seem never to have assimilated their culture to that of the neighbouring powerful Huba tribe, and it has been suggested, with some degree of probability, that they were a branch of the Shastan stock, which advanced from the north in a south-westerly direction, and with which they exhibit in their mythology certain resemblances. All the scanty available information about their culture and language has now been adequately collected by Mr. Dixon.

MESSRS. DULAU AND CO., LTD., have published in the series of Drapers' Company Research Memoirs a study of the mortality of the tuberculous in relation to sanatorium treatment, by Mr. W. Palin Elderton and Mr. S. J. Perry. The method adopted is to compare the number of deaths observed amongst the tuberculous with the number that would be expected on the basis of the English life-table (1) for patients of certain sanatoria, (2) for Pollock and Williams's cases, which were observed before the days of sanatorium treatment. The authors show that the mortality of tuberculous patients who are undergoing or have undergone treatment is much heavier than that of the general population, and the mortality even of the apparently cured cases is about twice as heavy. The mortality of sanatorium patients does not show any improvement on that of Williams and Pollock's cases, but comparison is difficult, owing to the way in which the older figures were given. It is precisely this comparison, however, which is of importance. The fact that the mortality of sanatorium patients is greater than that of the general population has no bearing on the real question at issue, for even a perfect cure of tuberculosis could surely not be expected, as an incidental result, to turn a weakling into a strong man, nor to render the mortality of the highly selected population in question the same as that of the population at large.

IN the report of the Warrington Museum for the year ending on June 30 last, attention is directed to the large number of donations received, which included 2436 specimens, as against 1645 in the previous twelvemonth.

IN the September number of the *Selborne Magazine* Mr. E. G. Woodd states that an additional protected area for birds has recently been established by the County Council in east Sussex. The area extends from Eastbourne to Hastings, and inland so far as Lewes, and within these limits such birds and their eggs as specially need protection have been scheduled.

WE have received the report of the Sarawak Museum for 1908–9, in which it is announced that Mr. J. Hewitt has been succeeded as curator by Mr. J. C. Moulton. Collecting expeditions have been made to neighbouring districts, which resulted in the addition of interesting specimens, and a catalogue of the birds in the collection was completed during the period under review.

THE International Commission on Zoological Nomenclature has issued through the Smithsonian Institution (Publication No. 1938) a series of twenty-five opinions in regard to matters of dispute in nomenclature. Among many cases, it will perhaps suffice to mention that the committee are in favour of retaining the generic name Simia for the orang-utan.

THE *Entomologists' Monthly Magazine* for September contains a beautifully coloured plate of nine species of rare British beetles, all of small size. According to the authors—Messrs. Champion and Lloyd—of the accompanying notes, one of the most interesting of these is the species named by Dr. Sharp *Eudectus whitei*, of which the single known example was captured by its describer on the summit of Ben-a-Bhuid, Braemar, in the summer of 1871.

A USEFUL catalogue of Danish zoological literature, compiled by Mr. Svend Dahl, has been published by J. B. Lybecker at Copenhagen under the title of "Bibliotheca Danica, 1876–1906." It comprises 262 pages of text, of which 186 are devoted to a list of authors and their works. The manner in which this list is arranged is, however, difficult to understand, as the names are given neither in alphabetical order nor according to date of birth. A specific and subject index to the various papers and books occupies 68 pages, and the volume concludes with an index of authors.

To vol. xii., part ii., of the Proceedings and Transactions of the Nova Scotian Institute of Science, Prof. G. H. Perkins communicates a fully illustrated memoir on cetacean remains from the superficial deposits of Canada. The main object of the communication is a skeleton in the museum at Halifax, discovered about 1873 on the Jacquet River, New Brunswick, which is identified as that of a narwhal (*Monodon monoceros*). Other skeletons, respectively in the museums of MacGill University, Montreal, and Montpelier, belong to the white whale described by Thompson as *Delphinapterus vermontanus*. Whether this is more than a large race of the existing *D. leucas* the author is doubtful.

THE third number of vol. ii. of the Journal of the College of Agriculture, Imperial University of Tokyo, is devoted to entomological subjects, such as Japanese Arctianæ, Panorpidæ, and Mantispidæ, mainly of interest to specialists. Mr. R. Inoue communicates, however, a paper on experiments with silkworms, in which the quantity of mulberry-leaves consumed by the larvæ at different periods of their existence is recorded. Other experiments show that "carbon dioxide, even when pure, has no influence upon the silkworms, and does not act as poison; but when the worms are reared in air containing more than 5 per cent. of the gas they lose their appetite, and their growth is more or less retarded, especially in the earlier stages."

SOME interesting observations on the eyes of trilobites are published by Prof. C. D. Walcott in a paper on Olenellus and other genera of the Mesonacidæ (forming the sixth of a series on Cambrian geology and palæontology), published as No. 6 of vol. liii. of the Smithsonian Miscellaneous Collections. Dr. Lindström expressed the opinion some years ago that all Cambrian trilobites were blind, as he was unable to detect eyes on the upper surface of the cephalon. Such eyes have, however, been detected in one of the American forms by the author, and show the facetted outer surface. It is also suggested that maculæ may occur on the under surface—hypostoma—of the Mesonacidæ, as these have been detected by Lindström in other types. After quoting Prof. A. Agassiz to the effect that trilobites are frequently found lying on their backs, and that young king-crabs (Limulus) often swim and feed in an inverted position, Prof. Walcott suggests that "in all probability the eyes of the hypostoma were of service when the trilobite was lying on its back on the sand or mud, and it was on this account that they were thus developed. It is highly probable that the adult trilobite crawled about the bottom and did not swim freely in the water to the extent that it would be necessary for it to see the bottom. Its habits must have been very much like those of Limulus when in search of food."

WE have received from Mr. J. Wrench Towse, clerk to the Fishmongers' Company, two notices which give useful summaries of the regulations made by Parliament and by the Fisheries Local Committees relative to the seasons for fishing with respect to salmon, trout and char, crabs and lobsters.

A SCHEME for the cultivation in Dalmatia of the spineless variety of cactus raised by Burbank is advocated with considerable reason by Dr. C. C. Hosseus in *Adria* (August), the object being to supply cattle fodder, of which there is a deficiency. The author points out that the natural conditions are favourable, and indicates how the scheme should be inaugurated.

THE details of a Rhododendron producing double flowers in its wild state are given by Dr. M. Miyoshi in the Journal of the College of Science, Imperial University, Tokyo (vol. xxvii., art. 11). The species *Rhododendron brachycarpum* grows in the mountains of central and northern Japan. The anmalous plants shower a second partial or complete corolla whorl. The author notes that double flowers have also been recorded for *Rhododendron ferrugineum* in the Tyrolese Alps, and for *Rhododendron albiflorum* in North America.

MR. C. J. CHAMBERLAIN continues to provide original information regarding the lesser known cycads, his latest contribution, in the *Botanical Gazette* (December, 1909), being a general description of *Dioon spinulosum*, based upon observations made in southern Mexico, where the plants grow in such profusion as to form almost a forest, and the largest specimens attain a height of 16 metres; this species, therefore, in contrast to the short-stemmed *Dioon edule*, supplies the tallest cycads known, with the exception of *Cycas media*. The leaves of an average specimen are about 20 cm. long, and bear more than a hundred pinnæ on either side. The ovulate cones are the largest known for any gymnosperm, as they may weigh as much as 15 kilos, and measure 50 cm. in length by 27 cm. in diameter. No staminate cones were collected in Mexico, but the author describes a specimen received from the Missouri Botanical Garden.

ONE of the most interesting articles in the Transactions of the Scottish Arboricultural Society (vol. xxiii., part ii.) is a contribution by Sir John Stirling-Maxwell giving early results of trials in Inverness-shire with the Belgian system of tree planting on turfs. Intended primarily for afforestation on moors, but also suitable for rough, grass-covered ground, the system consists in turning over turfs, leaving them to dry and sweeten for some months, and then planting in the centre in a heap of soil enriched with a small proportion of basic slag. The young plants take a year to become established, and then grow on quickly. The author also recommends the Sitka spruce, *Picea sitchensis*, for planting at an elevation of about 1000 feet, in which there is agreement with the conclusions communicated in an article by Mr. H. M. Cadell, who considers that it is superior to larch, Scots pine, and Norway spruce for growing in an exposed situation.

DR. A. WILMORE, in a paper in the *Geological Magazine*, 1910, p. 357, has carefully reviewed what is known of the relations of uralite and other secondary amphiboles to their parent minerals. He accepts the possibility of an interchange of material between permeating liquids and an original pyroxene, and does not regard uralite as necessarily an exact paramorph of a pyroxene.

THE geological section of the Belfast Naturalists' Field Club has issued its report for 1909–10 in the Proceedings of the club, and it is clear that a large amount of educational work results from its meetings and excursions. The interesting volcanic neck at Scawt Hill, and a selected series of Cretaceous exposures, have been studied, and a class has been formed under Dr. Dwerryhouse for petrological work. The section is fortunate in continuing to include several members whose contributions involve sound original research.

WE have received the *Bibliotheca Geographica*, issued by the Berlin Gesellschaft für Erdkunde, for the year 1906. This volume, the fifteenth of the series, has been prepared under the editorship of Dr. Otto Baschin; it contains no important changes in general arrangement, but, like all works of the kind, tends to grow in bulk with the ever-increasing volume of the annual output of geographical literature. One of the most characteristic features is the steady increase in the proportion of publications dealing with geographical principles and methods as distinct from purely regional and descriptive matter.

IN vol. xxiii. of the *Annalen des k.k. Naturhistorischen Hofmuseums* Prof. Friedrich Berwerth describes in full detail the meteoric iron which fell on August 1, 1898, near Quesa (39° N., 0° 40′ W.), in the province of Valencia, Spain, and makes an important contribution to the study of the structure of such bodies. Thanks to the generosity of Kommerzialrat J. Weinberger, the entire mass, with the exception of a small piece weighing 30 grams, which had been previously broken off in Spain for use in the investigation of the character of the meteorite, has been added to the fine collection in the Vienna Museum. A slice weighing 375 grams has been cut from it, and the total weight of the mass is now 10,370 grams, 300 grams being lost in cutting. Thanks to its excellent state of preservation, Prof. Berwerth is able to determine that the wedge-like shape of the iron is due to the large development of an octahedron and an icositetrahedron face, the remaining surfaces being three small octahedron faces. He discusses at some length the nature of the depressions—rhegmaglypts (ῥῆγμα, fracture; γλύφειν, engrave) as he terms them—caused by the fierce heat generated by the meteorite's swift rush through the earth's atmosphere; they must not be confused with the hollows due to weathering which are ordinarily seen in irons. The paper is illustrated by reproductions of several excellent photographs.

THE meteorological chart of the North Atlantic for October, issued by the U.S. Weather Bureau, contains an instructive account of the great tropical storm of October, 1909, known as the Key West Hurricane, accompanied by synoptic charts showing the weather conditions over the North Atlantic from October 10–15. The Weather Bureau records verify the general laws of cyclonic movements in the West Indies, announced by the late Father Viñes, that the storms reach further westward as the season advances; they also show that averages of tracks can be given but little weight in forecasting those of individual hurricanes. Observations indicated that a disturbance was developing in the Caribbean Sea on October 2, but the probable course of the storm could not be determined until October 6. On October 9, during its passage over the western part of that sea, a destructive wave swept from the Gulf of Mexico over the low-lying islands and coast of Yucatan. On October 10 the centre of the disturbance had curved and began to move north and north-east, and on October 11 the barometer at Key West (Florida Channel) fell to 28·50 inches, the lowest ever recorded there, and more than 6 inches of rain fell in $2\frac{1}{4}$ hours, the damage being estimated at nearly a million dollars. The Weather Bureau duly warned the seaports of the progress of the storm, and thereby effected great saving of life; on the Florida East Coast Railway, for instance, 3000 workmen were withdrawn from dangerous points; and the vice-president of the line writes:—"Positively not a life was lost in the storm. . . . Warning by the Weather Bureau enabled us to fully protect all employés and equipment."

THE Central Weather Bureau at Melbourne has recently issued an average rainfall map and isohyets of New South Wales, the first of a series now in course of preparation which will include all the States. These maps will be of great economic value in connection with corn-growing and the keeping of all kinds of stock, for which a knowledge of the rainfall is of prime importance. The map in question clearly shows that the greatest rainfall occurs on and adjacent to the Pacific coast, where the annual amounts range from 30 inches in the south to 60 and even 70 inches in the north. The isohyets and grades of shading plainly show the decrease of the rainfall to the westward. If a 15-inch rainfall is sufficient to ensure payable wheat-growing, the map shows that it can safely be done practically as far west as long. 146°, and even further in the south; but, generally speaking, over the country further to the westward, embracing an area of some 122,000 square miles, the rainfall does not reach 15 inches, and is under 10 inches over an area of about 45,000 square miles in the extreme west of the colony. Mr. Hunt points out that the most remarkable feature of the map is the comparatively light rainfall in the district extending from Delegate, in the south, to Yass, about 2° to the northward, owing to the condensation of moisture by the ranges of mountains by which it is enclosed.

DR. H. FRITSCHE, emeritus director of the Pekin Observatory, in a recent work ("Die saecularen Aenderungen der Erdmagnetischen Elemente," Riga, 1910) makes an attempt, to which boldness at least must be conceded, to extend our knowledge of terrestrial magnetism to epochs prior to direct observation. He starts with the assumption that during the last several thousand years there have been no outstandingly large changes in the earth's magnetism—a hypothesis for which much may be said in spite of the deductions drawn by Folgheraiter from the magnetism of Etruscan vases—and that such changes as have occurred can be represented by periodic terms. For these periods he assumes 500, 700, and 900 years, but his reasons for this choice of periods are rather obscure. He attacks the problem by taking as his knowns the values he has calculated from observations for the Gaussian coefficients for the epochs 1575, 1675, 1811, and 1892. Regarding the Gaussian coefficients as expressed by periodic terms with unknown coefficients, he determines the coefficients by reference to the four epochs just mentioned. He thus obtains general expressions from which Gaussian constants are derivable for any given epoch, and he makes use of these for the construction of isogonal charts for the epochs 1200, 1300, 1400, and 1500 A.D. Tables are given for the values of the Gaussian constants extending back to 2700 B.C. Dr. Fritsche's work must have entailed an enormous amount of onerous calculation, but it must be regarded as of an exceptionally speculative character.

IN a communication made to the Institution of Electrical Engineers in April last, which appears in the August number of the Journal of the institution, Mr. W. P. Digby directs attention to the advantages to engineers of tests of the electrical conductivity of the water with which they have to deal. He shows how, with a simplified conductivity tube and a form of "megger" with its scale graduated to give conductivity directly, an engineer may detect immediately a change in the nature of the feed-water for a boiler, or the amount of priming, or the development of a leak in the condensers, and may control with much greater certainty water-softening or oil-eliminating plants. It is only by actual work with the apparatus under workshop conditions that its utility in practice can be tested and established, and it seems well worthy of a thorough trial by engineers.

THE *Engineer* for September 9 contains an illustrated article on the new armoured concrete viaduct at Rotterdam. This viaduct measures 1600 m.—very nearly a mile—in length, and was commenced in 1904, and is composed of many normal bays and bridges of various types. Each pier of a normal bay is composed of four columns supporting the four armoured concrete girders which go to make up the arch. The lower faces of these girders are curved or arched, while the upper faces are flat. The concrete used was composed, for the most part, of 450 kilos. of Portland cement to half a cubic metre of river sand and one cubic metre of gravel, the sizes of the stones in which varied between 5 mm. and 30 mm. in diameter. Under test loads, a 20 m. arch was deflected 3·26 mm., or 1/6140 of the span. A 15 m. arch was deflected 1·57 mm., or 1/9550 of the span. Normal bays not resting on abutments were deflected, as an average, 1 mm., or 1/9770 of the span; normal bays resting on abutments were only deflected 0·6125 mm., or 1/12600 of the span.

AN article in *Engineering* for September 9 contains an interesting discussion on the progress of aviation during the past year. The progress on the more practical side has been much more striking than in the records achieved. The number of machines which will actually fly is enormously greater, and they do so with much less uncertainty. The greatest advance has been made in cross-country flight, and this is of the utmost importance. While flight may now be looked upon as a fair certainty when the weather is really calm, such weather is rare, in this country at all events. Hence the greatest interest attaches to the progress of flight in a wind, and in this direction the advance has been considerable. Cross-country flights are now undertaken in quite strong winds. The aëroplane has, in the last year, ceased to be a mechanical curiosity, which could do little save make exhibition flights in exceptional weather over a prepared track, and has become a practical machine for progress across country. We have therefore now got to the stage when the aëroplane must be reckoned with as a machine which is a practical factor in human life, and, if progress is as rapid in the future as in the past, it will very soon be a most serious factor. Even in its present state, a machine which can travel seventy miles an hour, and fly at such a height that hitting it would be extremely difficult, must have its uses in war, and with increase in the lifting power, speed, and radius of action, these uses must very rapidly augment. Its useful capabilities in time of peace are less easy to foresee; but that a machine which can travel in any direction with the speed of an express train is destined to have an important influence on civilised life is obvious.

OUR ASTRONOMICAL COLUMN.

FURTHER OBSERVATIONS OF HALLEY'S COMET.—In Bulletin No. 20 of the Kadaikánal Observatory Messrs. Michie Smith and John Evershed give an account of the observations of Halley's comet made with various instruments during April and May. A number of photographs, which may fill in the blanks between those taken in America and in Europe, were secured with a 5-inch Grubb portrait lens of 33·8 inches focal length. On certain of these there are many distinct tails and a number of fine details; other plates were exposed in a half-plate Ross camera giving a scale of 1 mm. = 17·5′. Mr. Evershed used a 9¼-inch reflector, of 74 inches focal length, fed by a 16-inch cœlostat, and secured a number of photographs showing the intricacies of the structure in the head, the scale being 1 mm. = 110″.

Spectrograms were also secured, and show the differences between the radiations from the head and those from the tail observed in Daniel's comet 1907*d*; the continuous spectrum of the nucleus shows, faintly, a considerable number of Fraunhoferic lines attributable to reflected sunlight. In the head, the pair of "cyanogen" radiations at λ 3871 and λ 3883 appear to account for at least two-thirds of the total emission, and the preliminary examination shows no essential variation in the spectrum between April 19 and May 15. In the very strong band at λ 4645–4744, five or six separate lines can be distinguished on some of the spectrograms. Visual observations showed that the very bright comet lines in the green and blue could be traced a long distance into the tail and to some considerable distance on the other side of the nucleus.

Notwithstanding the small dispersion (1 mm. = 73 A. at 4227), measurable displacements of the cometary lines, as compared with lines in the spectrum of Venus, were found, and on May 2 gave a relative approach of 77 km. per sec., the ephemeris value being 68 km. per sec.; but to this must be added the recessional velocity of Venus.

The programme for the detection of the comet during transit was very complete, and is described in detail, but, as has been stated before, no trace was found.

Observations of the tail were made by Mr. Evershed, who describes its appearance during May 18–21. He suggests that the persistence of the phenomenon in the east may be explained by supposing the tail to have been very broad in the direction of its motion, although relatively narrow in the direction at right angles to this; with a strong curvature, this would account for the apparent length of time for the earth to make the complete passage.

In the September number of the *Bulletin de la Société astronomique de France* there are reproduced some excellent photographs taken by M. Mascart at Teneriffe, as well as a number of drawings and accounts by various other observers.

Dr. C. D. Perrine, director of the Observatorio Astronómico of the Argentine Republic, writing from Córdoba on August 18, says:—"It will be of interest to your readers to know that we are still observing Halley's comet. It is some 2′ or 3′ in diameter, of about the ninth magnitude, with a nucleus of eleventh magnitude. It is getting so low in the west, however, that we will not be able to follow it much longer."

THE DISTANCES OF RED STARS.—Another contribution to the question of the correlation between spectral type and parallax, in the form of an abstract of a paper read by Dr. H. Norris Russell, appears in No. 195 (vol. xlix.) of the Proceedings of the American Philosophical Society. Dr. Russell compared the parallaxes of stars measured by Mr. Hinks and himself at Cambridge with the spectral types determined at Harvard, and found that the percentage of orange and red stars increases steadily as the distance from our system decreases. Further, a comparison of the observed parallaxes of stars having large proper motions with the parallaxes computed from Kapteyn's formula shows that while the formula stands for the stars of all classes taken together, there are marked deviations when spectra types are considered separately; the observed parallax of the red stars is nearly twice the computed value. As all the stars considered are similar in apparent brightness, it follows that redness is attended by intrinsic faintness, the reddest stars averaging one-fiftieth the brightness of the sun. On the other hand, some bright-red stars, such as Arcturus and Antares, are known to be at great distances, and are probably at least one hundred times as bright as the sun.

This conclusion confirms the important hypothesis (now well established on other grounds) that there are two classes of red stars, one class getting hotter, the other cooling. In the intermediate stages the stars would be hotter, passing through orange and yellow to white, and back to red as it approached extinction.

"MOCK SUNS" AT EASTBOURNE.—From Mrs. A. M. Butler, of Reigate, we have received further particulars of the "mock suns" phenomena referred to in these columns last week as having been seen at Eastbourne on September 10. Mrs. Butler and her daughters watched the phenomena from 12.45 p.m., and saw everything described by Mr. Ronca except the fainter small circle to which the brilliant chromatic curve was tangential. In addition they saw, to the S.E. of the sun, part of another coloured curve, having its convex side turned towards the actual sun. From an effective coloured sketch of the phenomena, drawn by Mrs. Butler, it would appear that this second curve, which was seen at 1.20 p.m., was of about the same radius as the former, and would have barely intersected it had both been continued.

ASTRONOMY IN INDIA.—From the *Pioneer Mail* of August 26 we are pleased to learn that an association for the promotion of astronomy has been formed in India. It is to be known as the Astronomical Society of India, and has its headquarters at Calcutta.

The special objects of the society will be to assist observers by holding meetings, whereat papers will be read and discussed, and by disseminating astronomical news. It is proposed also to found a library of astronomical literature and to publish a journal for each month of the session. The president is Mr. H. G. Tompkins, Treasury Buildings, Calcutta, to whom all communications should be addressed.

THE CRUSADE AGAINST CONSUMPTION.

FOR many years the National Association for the Prevention of Consumption worked away unostentatiously but pertinaciously. The experience gained during these years must now be to them of great value in the educational crusade they have undertaken. During the past year an educational exhibition has been going the round of London, into the provinces, east and west and north, to Oxford, Cambridge, Liverpool, Edinburgh, &c. Nothing has been more gratifying or more promising for the ultimate success of this crusade than the keen interest that has been taken in this exhibition, and in the lectures and conferences by all sorts and conditions of men—and women, too, for that matter. We should, naturally, expect public health authorities to be interested, but all who have seen the audiences gathered together at these lectures and conferences cannot but have been impressed by the intelligent interest taken, even by the very poor, in the question of the prevention of the spread of tuberculosis. Some of the work undertaken by the association at one time appeared to come dangerously near interfering with or overlapping the work of the local medical authorities, and with hospitals and associations already in existence; but through the good sense of those who, though working in different directions, are mutually interested in putting a check on the spread of consumption, the danger of such overlapping is gradually being minimised.

The class amongst which tuberculosis is most prevalent, the badly housed and badly fed, has, up to the present, and very naturally, entertained a suspicion that those who looked upon tuberculosis as an infective disease might interfere too much with the liberty of the tuberculous worker, and by isolating him deprive him of his means of subsistence. Nowhere has the educational campaign done better work than in bringing home to these people the immense importance of observing certain fundamental principles of hygiene, not only in their own immediate interest, but in the interests of those with whom they are most closely associated. It is now well known what precautions tuberculous patients should take, and as soon as this knowledge can be brought to the patient and his friends there will be some chance of getting these precautions adopted. There seems to be little doubt that the National Association for the Prevention of Consumption has the power to help and cooperate with similar organisations already in existence, and that it may even be of assistance to the authorities working with and under the Local Government Board, but what they are best qualified to undertake is, undoubtedly, that national educational movement to which Mr. John Burns has given his official approval.

The carrying on of this movement requires funds, large funds, and a special appeal committee has been formed, which, acting under the presidency of the Earl of Derby, is setting about to collect, in the first instance, a sum of 5000*l.* annually to be devoted to this work. That the necessary fund will be obtained can scarcely be doubted, especially as a most elaborate system of collecting small sums has been organised; moreover, those who will be most immediately benefited are already taking a very keen interest in making this scheme a success, and the committee have announced that they have already received offers of assistance from working-men's clubs and institutes affiliated to the Institute Union, and the Billposters' Association of Great Britain; whilst the post-office authorities have promised assistance, or have granted facilities which will help to form the nucleus of a fund such as could be obtained in no other way. Further, those endowed with a larger share of this world's goods have manifested an equal willingness to help, but the object is such a good one, the outlet for expenditure is so wide, and the promise of such an enormous return is so great, that if five times the sum asked for be subscribed it may be advantageously spent. The time has come when the annual loss of 50,000 or 60,000 lives from consumption—a preventable disease—is a blot on our civilisation. When we *knew not* we could not be blamed for our want of initiative and lack of energy, but now that we *know*, inaction is criminal.

RECENT PAPERS ON PETROLOGY.

UNDER this head may be included work on the minerals that build up rocks, since modern petrology depends on the understanding of the causes that have brought certain mineral constituents into association. This is true even of the fragmental rocks, where the correct appreciation of a detrital mineral may lead up to the source and the relative age of the deposit. Experimental work on minerals has, moreover, almost always a geological aim, though compounds have a way of arising artificially under conditions that seem improbable in nature.

Improvements in methods of research will be found in Mr. F. E. Wright's paper on the "Measurement of Extinction Angles in Thin Section" (*Amer. Journ. Sci.*, vol. xxvi., p. 349), where the intensity of light for different positions of a crystal-plate between crossed nicols is dealt with mathematically. The methods of observation in general use are critically discussed, and the principle of the twinned selenite plate, introduced by Sommerfeldt in 1907, is further developed by the author in his artificial quartz twin plate (p. 374). Since the eyes of observers differ in regard to their sensitiveness to certain tints, this plate may be made wedge-shaped, so that the most serviceable tint may be selected. Mr. Wright also introduces (p. 377) a bi-quartz wedge-plate. A plate of right-handed quartz, cut normal to the optic axis, is fixed side by side with a left-handed one of the same thickness. Above each is set a wedge of quartz of the opposite sign of rotary polarisation, the two wedges tapering in the same direction. Except where the wedge and the plate below it are of the same thickness, the two similar wedges will show colours of similar intensity. If a crystal-plate lies beneath the wedge-plate, and is not in a position of extinction, a difference of intensity appears in the two wedges, and a thickness can be selected that gives, by the rotation produced, the most sensitive effect to meet the case of each experiment.

Dr. J. W. Evans (Proc. Geol. Assoc., vol. xxi., p. 79) gives a useful paper for students on the systematic examination of a thin section of a crystal with an ordinary petrological microscope, in which his double quartz-wedge, described in 1905, is effectively introduced for determining the relative retardation of the rays in a section of a doubly refracting crystal.

Messrs. Allen, White, Wright, and Larsen (*Amer. Journ. Sci.*, vol. xxvii., p. 1) provide a characteristic synthetic study of diopside and its relations to calcium and magnesium metasilicates, in which the minerals produced at various temperatures are subjected to a thorough optical examination. Etch-figures are used to show minute crystallographic changes that result from dissolving one member of the metasilicate series in another, the resulting minerals being shown to be actual solid solutions (p. 39). Some of the substances produced are as yet unknown in nature, and a rhombic $MgSiO_3$ mineral arises at about 1365°, which resembles olivine in form, and which is quite distinct from enstatite (p. 30). The stable form of $MgSiO_3$ is, curiously enough, that known from meteorites only, and is styled clinoenstatite.

Messrs. Wright and Larsen also introduce us to new views on quartz (*ibid.*, p. 421). In treating of quartz as a geologic thermometer, they make use of Le Chatelier's observation in 1890 that quartz undergoes a reversible change at about 575°, as indicated by a sudden change in its expansion-coefficients, birefringence, and circular polarisation. Mügge regards the low temperature α-quartz as trapezohedral-tetartohedral, and the high temperature β-form as probably trapezohedral-hemihedral. "At ordinary temperatures all quartz is α-quartz, but if at any time in its history a particular piece of quartz has passed the inversion point and been heated above 575°, it bears ever afterward marks potentially present which on proper treatment can be made to appear" (p. 425). Quartz formed on the low temperature side, such as that of veins and geodes, shows trigonal trapezohedra, more regular twinning than the β-form (as discovered on etching), more frequent intergrowths of right- and left-handed forms, and an absence of the effects of shattering that appear in quartz cooled down from the high-temperature form. The authors verify these points by an examination of quartz from ordinary veins and from pegmatites.

M. Borisov (*Trav. Soc. imp. des. Nat. de St.-Pétersbourg*, vol. xl., p. 46) describes quartz in druses from the Government of Olonetz; the form is the rhombohedron, with a polar angle reading 85° 47′, so that we have a rare type resembling cubes. Mr. R. S. Bassler (Proc. U.S. Nat. Mus., vol. xxxv., p. 133) traces the remarkable changes by which fossils in the carboniferous limestone of Kentucky have been converted into geodes of chalcedony and quartz, and his photographs alone would claim the attention of petrologists and palæontologists alike.

Students of silicates will note the paper by Messrs. Shepherd, Rankin, and Wright (*Amer. Journ. Sci.*, vol. xxviii., p. 293), on the binary systems of alumina with silica, lime, and magnesia, in which andalusite and sillimatrite receive experimental treatment. A very useful statement is included (p. 322) as to the six phases of crystallised silica now known, the α and β forms, respectively, of quartz, tridymite, and cristobalite. Mr. Larsen (*ibid.*, p. 263) examines the refractive indices and densities of some of his artificially prepared silicates and their glasses. Incidentally, he finds that glasses rich in lime and magnesia cannot be prepared, owing to their strong tendency to produce crystals—a tendency well recognised among basic igneous rocks. Messrs. Washington and Wright (*ibid.*, vol. xxix., p. 52) discover, in a felspar from the Mediterranean islet of Linosa, a molecule corresponding to soda-anorthite, and look forward (p. 70) to naming the actual $Na_2Al_2Si_2O_8$ felspar, when forthcoming, Carnegieite. Since the felspar that they really possess is a new species, and receives the name of Anemousite, it seems quite grasping to look so far ahead, even from the very open windows of the Carnegie Institution.

Mr. F. Cornu (*Verhandl. k. k. Reichsanstalt*, 1909, p. 41), in a preliminary and slightly polemical demonstration, promises an important work on the importance of "Hydrogelen im Mineralreiche" which will need to be considered by all who deal with soils and products of decay. The author claims that our method of heating thin slices in Canada balsam removes the water from essential substances in the case of weathered rocks, and he here opens up a new field, which will, we hope, be promptly cultivated.

M. G. Césaro (*Bull. classe des Sci., Acad. roy. de Belgique*, 1909, p. 435) has made a comprehensive study of the mesotype group of zeolites, including a mesolite from Kenbane Head, co. Antrim (p. 447), once alleged to be galactite. The author (p. 492) ultimately concludes that galactite is a mixture of natrolite and scolezite.

A new light is thrown on nephrite by Prof. Steinmann (*Sitzungsber. niederrhein. Gesell. Nat. u. Heilkunde in Bonn*, 1908, pub. 1909, p. 1), who concludes that the Ligurian examples were originally dykes in the surrounding olivine-rocks, and had the composition of websterite or diopside-rocks. The expansion of the peridotites, due to serpentinisation, caused pressures throughout the mass, and the dykes became converted into the schistose nephrites that now remain. The brecciated and slickensided character common in serpentine-rock is aptly accounted for by this chemical expansion. "Schwellungsmetamorphose" (p. 13) is introduced as an appropriate term, and Steinmann holds that the Ligurian serpentines received their main mineral characters before the occurrence of the great movements that folded them in among the Alps.

This paper, connecting mineral changes and large rock-masses, may lead us on to igneous rocks in general. Mr. R. A. Daly (Proc. Amer. Acad. Arts and Sci., vol. xlv., 1910, p. 211) has sought to establish the average chemical compositions of igneous-rock types, and his results, largely based on Osann's collection of modern analyses, are likely to serve as standards for all who use ordinary rock-names. The number of analyses employed is shown in each case, and we are naturally left to presume that no very widely differing types are included here under the same name. A second series of averages is generously given, in which the figures are re-calculated with water omitted. Mr. Daly (p 236) urges that Rosenbusch's classification, as here emphasised, is objective and natural in a highly useful degree. Comparisons can now be easily made, by using these tables, between rocks of different grain, and the author points out that dacite is the effusive type of "granodiorite," rather than of the far less siliceous quartz-diorites of our ordinary terminology. On p. 240 we find a characteristic suggestion as to the cause of the similarity of composition of rocks of various degrees of antiquity, since "in general, differentiation in batholiths, when well advanced, restores the condition temporarily disturbed by magmatic assimilation."

Mr. G. P. Merrill (*Amer. Journ. Sci.*, vol. xxvii., p. 469) concludes from averages of analyses of stony meteorites, compared with those of terrestrial rocks, that magmatic differentiation could not have produced our rocks from planetesimal material of meteoritic composition. But he does not quite touch the main question, though he goes near it (p. 470). Surely the rocks of our crust are an extremely thin film on an interior of unknown composition. A planet like the earth, when duly disrupted, would supply exceedingly little material of the kind familiar to the geologist, and a vastly preponderating mass of far more basic character. Æons might go by before a chip of the crust fell upon another planet. Moreover, have not the glassy globules found in the superficial deposits of Bohemia (Bouteillenstein and Moldavite) been claimed by a high authority as of meteoritic origin?

Mr. R. T. Chamberlin, while keeping his eye on planetesimals, has published through the Carnegie Institution a paper on "The Gases in Rocks," in which a large amount of new material is made available. In the course of experiments, most gas arises from rocks that contain the greatest proportion of ferromagnesian minerals (p. 27). The discussion of the condition of the gases that are found to exist in rocks covers ground of great interest to geologists. The author affirms, with Suess, that the water and gases of the interior (p. 69) "form an integral part in the magmas, having been vital factors in their development from the primitive planetary matter." Lavas, it is urged, originate far below the possible reach of surface-waters (p. 73), and thus bring up original water with them. On the other hand, Dr. Johnston-Lavis ("Mechanism of Volcanic Action," *Geol. Mag.*, 1909, p. 437) continues to urge that the water found in lavas is absorbed by them as they rise into the moist layers of the upper regions of the crust. Mr. R. A. Daly (*Journ. of Geology*, vol. xvi., p. 401), in a paper on the origin of augite-andesite, supports the views of Scrope and Darwin on the differentiation of an igneous magma by fractional crystallisation. His views are quoted several times, under the name of Daley, in a remarkable paper by Dr. H. I. Jensen, on the distribution, origin, and relationships of alkaline rocks (Proc. Linn. Soc. N.S.W., vol. xxxiii., p. 491). The rather dubious term "alkaline" is here used to denote "rich in combined alkalies," and the rocks discussed are those that might be conceived to originate by differentiation from a foyaite-magma. Dr. Jensen examines their distribution in space and time, and concludes that they are almost all associated with Cainozoic earth-movements. The Christiania series (p. 502) is merely known to be post-Silurian, and may therefore be Eocene. "Alkaline rocks are continental and occur in areas of normal faulting above and possibly shear below" (p. 515). They are attributed to the melting and assimilation of sediments rich in alkalies (such as were formed when our earth's surface first cooled below 100° C.), as they gradually sank under the weight of Palæozoic and Mesozoic deposits. The crustal re-adjustments of the Eocene period allowed them to be expelled within the low-pressure regions, *i.e.* the continents, towards which they had gradually flowed. There is much more in this paper than might appear from so generalised a summary. Dr. Jensen's thorough study of the types of rock with which he deals is evidenced by several papers on their occurrence in eastern Australia, published in the last two years (Linn. Soc. N.S.W. and Australasian Association for the Advancement of Science, 1908–9).

Messrs. A. Boudariat and Johnston-Lavis (*Bull. Soc. Belge de Géol.*, tome xxii., 1909, p. 103) describe the occurrence of a basalt in the volcanic cone of Tritriva in central Madagascar, which has enriched itself with abundant grains of quartz at the expense of an underlying gneiss. The quartz-grains show the aureole of augite that is so common round inclusions of quartz in basic rocks. At Tritriva the volcanic chimney that was blown through the gneiss is clearly visible, and Dr. Johnston-Lavis makes some just remarks on the analogy with the so-called quartz-basalts of other areas, and on the modification of lavas by absorption.

Mr. C. B. Travis (Proc. Liverpool Geol. Soc., vol. x., p. 311) has examined the Ordovician rhyolites of Nant Ffrancon, Carnarvonshire, and gives good reason for agreeing with Iddings and Parkinson that lithophysal cavities, such as those traceable in the large Welsh spherulites, were original features of the lavas. The view that all such cavities are due to decomposition of solid structures was abandoned, however, by its supporters so far back as 1892.

The petrology of sedimentary rocks still attracts few workers. Dr. Woolacott (Univ. Durham Phil. Soc., Memoir i., 1909) describes a brecciated magnesian limestone in a paper illustrated by views of the rock as it occurs in the open field. Experiment (p. 5) leads to an estimate of the thrust concerned as having generated a pressure of 300 tons to the square foot. Mr. G. Linck, so well known for his researches on chemically deposited limestones, contributes a lucid paper on these rocks to the *Naturwissenschaftliche Wochenschrift*, 1909, p. 689. The Canadian Mining Institute publishes (Journ., vol. xii., 1909) a general paper by Mr. E. Coste on petroleums and coals, strongly supporting the "solfataric" view of the origin of petroleum. Mr. A. J. Cox (*Philippine Journ. Sci.*, vol. iii., p. 301) investigates the Philippine coals as fuels, and concludes that they may compete successfully with those of Australia. This subject is also dealt with by Mr. W. D. Smith ("Mineral Resources of the Philippine Islands," Bureau of Science of Manila, 1909). Barytes is so frequent as a cementing material in rocks that Dr. Trener's discussion of its origin in mineral waters rising from below is of general petrological interest (*Jahrb. k.k. Reichsanstalt*, Bd. lviii., p. 439).

As regards the petrography of special areas, we may note the excellent "Introduction to Petrography and the Collections of Rocks" published by the Royal Scottish Museum, Edinburgh (1909, price 1*d*.). Emphasis is here laid on Scottish examples. Dr. W. F. Hume, in his "Notes on the Petrography of Egypt" (*Geol. Mag.*, 1908, p. 500) gives a concise sketch that ought to be reprinted for the use of travellers. Mr. F. Kretschmer (*Jahrb. k.k. Reichsanstalt*, Bd. lviii., p. 527) describes the "Kalksilikatfelse" near Mahrisch-Schönberg in the Sudetic, and shows them to have become mineralised by the granite of the chain, while (p. 571) certain dyke-like pyroxene-pegmatites have arisen from the absorption of limestone into the invading igneous material. Dr. Hinterlechner and Mr. C. von John, in an elaborate paper on the eruptive rocks of the Bohemian Eisengebirge (*ibid.*, Bd. lix., p. 127), show that the alteration of the sediments into crystalline schists is not here dependent on the amount of dynamic influence. Where pressure has been least, the crystallisation is most marked, and is due to the intrusion of a mass that was once regarded as a primitive core. This, the earliest granite of the area, is later than Lower Silurian sediments, and Dr. Hinterlechner believes that it was intruded after the folding of the district. Since Devonian beds are here involved, this red gneiss may be of Upper Devonian or Carboniferous age. A paper of this kind emphasises the fact that in true petrology the laboratory merely subserves the work done in the open field.

G. A. J. C.

REPORTS ON CLIMATES.

THE results of the meteorological observations at the principal stations in the system of the Deutsche Seewarte for the five-year period 1901–5, and for the ten-year period 1896–1905, recently published, complete the series of these valuable statistics for the thirty years 1876–1905. They include the mean monthly, seasonal, and annual values, and extremes or other data relating to the various elements, deduced from observations generally made three times daily, and in practically the same form as in previous instalments. The heights of some of the barometers above sea-level have changed from time to time, but in order to permit easier comparison of one period with another, this inconvenience has been minimised by reducing the observations to agree with the levels given in previous publications. Otherwise, as usual in the case of barometrical observations at climatological stations, the readings are not reduced to sea-level.

The meteorology of Peru is discussed by Dr. J. Hann in the *Sitzungsberichte* of the Vienna Academy of November 4, 1909. The observations of the various stations on which the discussion is based have been published in the Annals of the Harvard College Observatory, to which we have previously referred; the tables were carefully prepared for publication under the direction of Prof. S. J. Bailey, of Arequipa, and are mostly printed *in extenso*, with mean values, but without discussion. In the present work Dr. Hann has submitted the results of the various elements to minute investigation by the laborious process of harmonic analysis. This brings out many interesting points; we propose here only to make a few general remarks on the most important station, on the summit of the Misti (lat. 16° 16′ S., long. 71° 25′ W.), at the great elevation of 5850 metres above sea-level. Dr. Hann points out that the agreement of the daily range of the barometer with that of the highest stations in Europe and America is very noteworthy; the principal maximum occurs between noon and 1h. p.m., and the minimum about 5h. a.m. The mean annual temperature (1893–5) was −7·8° C.; January, −6·0°; May, June, and August, −9·7°. The thermometer, even on very fine days, rarely rose above freezing point. Above 4600 metres, only snow or hail was observed; a certain amount of snow remains during nearly the whole year, but a few clear days suffice to clear off the greater part of a heavy snowfall.

A valuable paper on the climate of the Lower Guinea coast and hinterland, by Dr. R. Sieglerschmidt, appears in vol. xxiii., part i., of *Mitteilungen aus den deutschen Schutzgebieten*; it is the more important from the fact that, with the exception of a short discussion of the rainfall of the Cameroons by Fitzner in 1907, no general paper on the climate of that district has been published for some years. Among the earlier papers may be specially mentioned the results of the Loango expedition (published in 1878), observations at Vivi and other places by Freiherr v. Danckelman (1884), and the reports by Lancaster and Meuleman on the climate of the Lower Congo (1897). Dr. Sieglerschmidt's article deals exhaustively with each of the meteorological elements, and the general results confirm those given by Dr. Hann in his "Klimatologie," that the air-pressure on the Lower Guinea coast has a single yearly range, and that the yearly means decrease from south to north, while the temperature (reduced to sea-level) increases considerably towards the interior, except in the extreme north. Rainfall increases along the coast from almost complete rainlessness to that of the second wettest district of the globe. The oceanic air-current, which from June to September (or October) extends from the north of Angola to the Cameroons far into the interior, has a great influence on the yearly range of temperature, rainfall, &c., while in the hinterland of the north and south districts the yearly range is determined by the alternation of summer warmth and winter cold of higher latitudes.

The climate of Berlin, part ii., air-temperature, by Prof. G. Hellmann (with the assistance of Messrs. G. v. Elsner and G. Schwalbe), forms part No. 6, vol. iii., of the *Abhandlungen* of the Royal Prussian Meteorological Institute. In this valuable and laborious investigation the observations are dealt with in great detail and for various periods from the year 1701. In the following table we quote the maximum and minimum readings for 1830–1907, and the mean monthly and yearly values for 1822–1907, in centigrade degrees:—

	Jan.	Feb.	March	April	May	June
Mean max. ...	1·4	3·3	7·0	12·9	18·5	22·5
Mean min. ...	−3·2	−2·0	0·2	4·3	8·8	12·8
True mean ...	−1·1	0·5	3·4	8·6	13·6	17·5
	July	August	Sept.	Oct.	Nov.	Dec.
Mean max. ...	23·8	22·8	19·0	12·9	6·3	2·7
Mean min. ...	14·3	13·9	10·5	6·4	1·6	−1·4
True mean ...	18·9	18·1	14·6	9·5	3·9	0·7

Yearly mean, 9·0; absolute maximum, 37·0 (July 20, 1865); absolute minimum, −25·0 (January 29, 1830, January 22, 1850).

The author points out that the earlier period was somewhat colder than the later; this was noticeable in all the winter months, especially in January, while greater heat in summer, especially in May and August, was observed, but he considers that it would be premature to assume that a permanent change of climate has taken place. The principal anomalies in the yearly range are the cold periods in the middle of February and June, and the warm periods near the end of September and middle of December. The cold spell of May 11–13, popularly known as the days of the Ice Saints, is not specially noticeable. The chief cause of these anomalies in the annual range of temperature is the distribution of air-pressure in Eurasia, especially the position of the barometric maximum.

A comprehensive discussion of the rainfall of northern Spain and Portugal, by Dr. W. Semmelhack, is contained in *Aus dem Archiv der Deutschen Seewarte* (1910, No. 2). It deals with many aspects of the subject, including horizontal and vertical distribution of amount and frequency, isohyets and tabular means of years and seasons, thunderstorms, &c., embracing a period extending from 1861 to 1900. The rainfall is affected chiefly by conditions of pressure over the Atlantic, Mediterranean, and the Continent, and its yearly distribution is therefore subject to considerable fluctuation. To give details would require much space, but a rough idea may be gained from the fact that about 4 per cent. of the area in question receives an amount not exceeding 12 inches; 53 per cent., approximately 12–27½ inches; 17 per cent., 27½–39½ inches; 23 per cent., 39½–59 inches; 3 per cent., more than this amount. The extreme values are 9·6 inches at Palencia (Old Castile) and 113 inches at Sierra d'Estrella. The monthly extreme values vary very greatly; the highest are met with on the N., N.W., and W. coasts. In March, 1886, 48·7 inches were recorded at Sierra d'Estrella, but in the dry districts of the central plateau the greatest monthly amounts are little above 6 inches; rainless months occur at times at nearly all the stations.

BIRD NOTES.

To the July issue of the *Quarterly Review* Dr. H. Gadow communicates an instructive article on the nature and meaning of the colours of birds. After pointing out the fallacy of the idea that the colouring of such birds as the scarlet ibis or white egret can be in any sense protective, the author discusses the diverse means by which colour is produced in birds, showing that while black and the red and yellow group are pigmentary, blues and greens are so-called structural tints, due to the reflection from the surface of the feathers of an undue proportion of short light-rays. Metallic colouring, which usually occurs in black feathers, is due, of course, to another cause. Dr. Gadow next proceeds to describe the sequence in which various colours replace one another with the advance of specialisation. As regards the cause of colour-specialisation, the author rejects both natural and sexual selection, remarking that if the latter were the inducing factor, every group and species would have its own taste, and each individual would strive to develop its yellow patches into orange and then into red. For the explanation offered in place of natural and sexual selection, we must refer our readers to the article itself.

In the August number of Witherby's *British Birds* the editor congratulates his readers on the satisfactory response which has been made this season to his appeal for assistance in marking birds. Nearly 11,000 rings were distributed, and schedules recording the marking of between 5000 and 6000 birds have been already received. The cooperation is invoked of all into whose hands ringed birds may fall. In the same issue Mr. W. Frohawk describes and illustrates the feeding habits of the razorbill, remarking that all the specimens which have come under his special notice fed on sand-launces. These fish, to the number in some cases of so many as half a dozen at a time, are held transversely in the beak, and the marvel is how the bird manages to capture and hold one after the other without losing those previously caught. Possibly each is killed when caught; but even then it is difficult to see how the catch is procured and retained.

To the August number of the *Popular Science Monthly* Prof. F. H. Herrick contributes the third and final instalment of an article on instinct and intelligence in birds. It is concluded that many of the alleged cases of intelligence are really due to habit, and that "all the intelligence which birds may on occasion exhibit seems to give way under the spell of any of the strange instincts. . . . They seldom meet emergencies by doing the intelligent act, and, in spite of the anecdotes, probably but seldom come to the effective aid of their companions in distress. On the other hand, I have more than once seen a mother bird try to pluck a hair or piece of grass from the mouth of a nestling."

Another instance of intelligence is afforded, in the author's opinion, when a gull, after feeding its young for three weeks on partially digested fish, offers them entire squids to swallow. The practice displayed by young kingfishers of arranging themselves in a row and showing a tendency to walk backwards is, however, attributed to habit formed underground; while the time it takes for hole-nesting birds to change their place of entrance when a more convenient access has been afforded is an instance of the dominance of habit over intelligence.

THE BRITISH ASSOCIATION AT SHEFFIELD.

SECTION D.

ZOOLOGY.

OPENING ADDRESS BY PROF. G. C. BOURNE, M.A., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

In choosing a subject for the address with which it is my duty, as President of this Section, to trouble you, I have found myself in no small embarrassment. As one whose business it is to lecture and give instruction in the details of comparative anatomy, and whose published work, *qualecunque sit*, has been indited on typical and, as men would now say, old-fashioned morphological lines, I seem to stand self-condemned as a morphologist. For morphology, if I read the signs of the times aright, is no longer in favour in this country, and among a section of the zoological world has almost fallen into disgrace. At all events, I have been very frankly assured that this is the case by a large proportion of the young gentlemen whom it has been my fate to examine during the past two years; and, as this seems to be the opinion of the rising generation of English zoologists, and as there are evident signs that their opinion is backed by an influential section of their elders, I have thought that it might be of some interest, and perhaps of some use, if I took this opportunity of offering an apology for animal morphology.

It is a sound rule to begin with a definition of terms, so I will first try to give a short answer to the question "What is morphology?" and, when I have given a somewhat dogmatic answer, I will try to deal in the course of this address with two further questions: What has morphology done for zoological science in the past? What remains for morphology to do in the future?

To begin with, then, what do we include under the term morphology? I must, first of all, protest against the frequent assumption that we are bound by the definitions of C. F. Wolff or Goethe, or even of Haeckel, and that we may not enlarge the limits of morphological study beyond those laid down by the fathers of this branch of our science. We are not—at all events we should not be—bound by authority, and we owe no allegiance other than what reason commends to causes and principles enunciated by our predecessors, however eminent they may have been.

The term morphology, stripped of all the theoretical conceptions that have clustered around it, means nothing more than the study of form, and it is applicable to all branches of zoology in which the relationships of animals are determined by reference to their form and structure. Morphology, therefore, extends its sway not only over the comparative anatomy of adult and recent animals, but also over palæontology, comparative embryology, systematic zoology and cytology, for all these branches of our science are occupied with the study of form. And in treating of form they have all, since the acceptance of the doctrine of descent with modification, made use of the same guiding principle—namely, that likeness of form is the index to blood-relationship. It was the introduction of this principle that revolutionised the methods of morphology fifty years ago, and stimulated that vast output of morphological work which some persons, erroneously as I think, regard as a departure from the line of progress indicated by Darwin.

We may now ask, what has morphology done for the advancement of zoological science since the publication of the "Origin of Species"? We need not stop to inquire what facts it has accumulated: it is sufficiently obvious that it has added enormously to our stock of concrete knowledge. We have rather to ask what great general principles has it established on so secure a basis that they meet with universal acceptance at the hands of competent zoologists?

It has doubtless been the object of morphology during the past half-century to illustrate and confirm the Darwinian theory. How far has it been successful? To answer this question we have to be sure of what we mean when we speak of the Darwinian theory. I think that we mean at least two things. (1) That the assemblage of animal forms as we now see them, with all their diversities of form, habit, and structure, is directly descended from a precedent and somewhat different assemblage, and these in turn from a precedent and more different assemblage, and so on down to remote periods of geological time. Further, that throughout all these periods inheritance combined with changeability of structure have been the factors operative in producing the differences between the successive assemblages. (2) That the modifications of form which this theory of evolution implies have been rejected or preserved and accumulated by the action of natural selection.

As regards the first of these propositions, I think there can be no doubt that morphology has done great service in establishing our belief on a secure basis. The transmutation of animal forms in past time cannot be proved directly; it can only be shown that, as a theory, it has a much higher degree of probability than any other that can be brought forward, and in order to establish the highest possible degree of probability, it was necessary to demonstrate that all anatomical, embryological, and palæontological facts were consistent with it. We are apt to forget, nowadays, that there is no *a priori* reason for regarding the resemblances and differences that we observe in organic forms as something different in kind from the analogous series of resemblances and differences that obtain in inanimate objects. This was clearly pointed out by Fleeming Jenkin in a very able and much-referred to article in the *North British Review* for June, 1867, and his argument from the *a priori* standpoint has as much force to-day as when it was written forty-three years ago. But it has lost almost all its force through the arguments *a posteriori* supplied by morphological science. Our belief in the transmutation of animal organisation in past time is founded very largely upon our minute and intimate knowledge of the manifold relations of structural form that obtain among adult animals; on our precise knowledge of the steps by which these adult relations are established during the development of different kinds of animals; on our constantly increasing knowledge of the succession of animal forms in past time; and, generally, on the conviction that all the diverse forms of tissues, organs, and entire animals are but the expression of an infinite number of variations of a single theme, that theme being cell-division, multiplication, and differentiation. This conviction grew but slowly in men's minds. It was opposed to the cherished beliefs of centuries, and morphology rendered a necessary service when it spent all those years which have been described as "years in the wilderness" in accumulating such a mass of circumstantial evidence in favour of an evolutionary explanation of the order of animate nature as to place the doctrine of descent with modification on a secure foundation of fact. I do not believe that this foundation could have been so securely laid in any other way, and I hold that zoologists were actuated by a sound instinct in working so largely on morphological lines for forty years after Darwin wrote. For there was a large mass of fact and theory to be remodelled and brought into harmony with the new ideas, and a still larger vein of undiscovered fact to explore. The matter was difficult and the pace could not be forced. Morphology, therefore, deserves the credit of having done well in the past: the question remains, What can it do in the future?

It is evident, I think, that it cannot do much in the way of adding new truths and general principles to zoological science, nor even much more that is useful in the verification of established principles, without enlarging its scope and methods. Hitherto—or, at any rate, until very recently—it has accepted certain guiding principles on faith, and, without inquiring too closely into their validity, has occupied itself with showing that, on the assumption that these principles are true, the phenomena of animal structure, development, and succession receive a reasonable explanation.

We have seen that the fundamental principles relied upon during the last fifty years have been inheritance and variation. In every inference drawn from the comparison of one kind of animal structure with another, the morphologist founds himself on the assumption that different degrees of similitude correspond more or less closely to degrees of blood-relationship, and to-day there are probably few persons who doubt that this assumption is valid. But we must not forget that, before the publication of the "Origin of Species," it was rejected by the most influential zoologists as an idle speculation, and that it is imperilled by Mendelian experiments showing that characters may be split up and reunited in different combinations in the course of a few generations. We do not doubt the importance of the principle of inheritance, but we are not quite so sure as we were that close resemblances are due to close kinship and remoter resemblances to remoter kinship.

The principle of variation asserts that like does not beget exactly like, but something more or less different. For a long time morphologists did not inquire too closely into the question how these differences arose. They simply accepted it as a fact that they occur, and that they are of sufficient frequency and magnitude, and that a sufficient proportion of them lead in such directions that natural selection can take advantage of them. Difficulties and objections were raised, but morphology on the whole took little heed of them. Remaining steadfast in its adherence to the principles laid down by Darwin, it contented itself with piling up circumstantial evidence, and met objection and criticism with an ingenious apologetic. In brief, its labours have consisted in bringing fresh instances, and especially such instances as seemed unconformable, under the rules, and in perfecting a system of classification in illustration of the rules. It is obvious, however, that, although this kind of study is both useful and indispensable at a certain stage of scientific progress, it does not help us to form new rules, and fails altogether if the old rules are seriously called into question.

As a matter of fact, admitting that the old rules are valid, it has become increasingly evident that they are not sufficient. Until a few years ago morphologists were open to the reproach that, while they studied form in all its variety and detail, they occupied themselves too little—if, indeed, they could be said to occupy themselves at all—with the question of how form is produced, and how, when certain forms are established, they are caused to undergo change and give rise to fresh forms. As Klebs has pointed out, the forms of animals and plants were regarded as the expression of their inscrutable inner nature, and the stages passed through in the development of the individual were represented as the outcome of purely internal and hidden laws. This defect seems to have been more distinctly realised by botanical than by zoological morphologists, for Hofmeister, as long ago as 1868, wrote that the most pressing and immediate aim of the investigator was to discover to what extent external forces acting on the organism are of importance in determining its form.

If morphology was to be anything more than a descriptive science, if it was to progress any further in the discovery of the relations of cause and effect, it was clear that it must alter its methods and follow the course indicated by Hofmeister. And I submit that an inquiry into the causes which produce alteration of form is as much the province of, and is as fitly called, morphology as, let us say, a discussion of the significance of the patterns of the molar teeth of mammals or a disputation about the origin of the cœlomic cavities of vertebrated and invertebrated animals.

There remains, therefore, a large field for morphology to explore. Exploration has begun from several sides, and in some quarters has made substantial progress. It will be of interest to consider how much progress has been made along certain lines of research—we cannot now follow all the lines—and to forecast, if possible, the direction that this pioneer work will give to the morphology of the future.

I am not aware that morphologists have, until quite recently, had any very clear concept of what may be expected to underlie form and structure. Dealing, as they have dealt, almost exclusively with things that can be seen or rendered visible by the microscope, they have acquired the habit of thinking of the organism as made up of organs, the organs of tissues, the tissues of cells, and the cells as made up—of what? Of vital units of a lower order, as several very distinguished biologists would have us believe; of physiological units, of micellæ, of determinants and biophors, or of pangenes; all of them essentially morphological conceptions; the products of imagination projected beyond the confines of the visible, yet always restrained by having only one source of experience—namely, the visible. One may give unstinted admiration to the brilliancy, and even set a high value on the usefulness, of these attempts to give formal representations of the genesis of organic structure, and yet recognise that their chief utility has been to make us realise more clearly the problems that have yet to be solved.

Stripped of all the verbiage that has accumulated about them, the simple questions that lie immediately before us are: What are the causes which produce changes in the forms of animals and plants? Are they purely internal, and, if so, are their laws discoverable? Or are they partly or wholly external, and, if so, how far can we find relations of cause and effect between ascertained chemical and physical phenomena and the structural responses of living beings?

As an attempt to answer the last of these questions, we have the recent researches of the experimental morphologists and embryologists directed towards the very aim that Hofmeister proposed. Originally founded by Roux, the school of experimental embryology has outgrown its infancy and has developed into a vigorous youth. It has produced some very remarkable results, which cannot fail to exercise a lasting influence on the course of zoological studies. We have learnt from it a number of positive facts, from which we may draw very important conclusions, subversive of some of the most cherished ideas of whilom morphologists. It has been proved by experiment that very small changes in the chemical and physical environment may and do produce specific form-changes in developing organisms, and in such experiments the consequence follows so regularly on the antecedent that we cannot doubt that we have true relations of cause and effect. It is not the least interesting outcome of these experiments that, as Loeb has remarked, it is as yet impossible to connect in a rational way the effects produced with the causes which produced them, and it is also impossible to define in a simple way the character of the change so produced. For example, there is no obvious connection between the minute quantity of sulphates present in sea-water and the number and position of the characteristic calcareous spicules in the larva of a sea-urchin. Yet Herbst has shown that if the eggs of sea-urchins are reared in sea-water deprived of the needful sulphates (normally 0·26 per cent. magnesium sulphate and 0·1 per cent. calcium sulphate), the number and relative positions of these spicules are altered, and, in addition, changes are produced in other organs, such as the gut and the ciliated bands. Again, there is no obvious connection between the presence of a small excess of magnesium chloride in sea-water and the development of the paired optic vesicles. Yet Stockard, by adding magnesium chloride to sea-water in the proportion of 6 grams of the former to 100 c.c. of the latter, has produced specific effects on the eyes of developing embryos of the minnow *Fundulus heteroclitus*: the optic vesicles, instead of being formed as a widely separated pair, were caused to approach the median line, and in about 50 per cent. of the embryos experimented upon the changes were so profound as to give rise to cyclopean monsters. Many other instances might be cited of definite effects of physical and chemical agencies on particular organs, and we are now forced to admit that inherited tendencies may be completely overcome by a minimal change in the environment. The nature of the organism, therefore, is not all important, since it yields readily to influences which at one time we should have thought inadequate to produce perceptible changes in it.

It is open to anyone to argue that, interesting as experiments of this kind may be, they throw no light on the origin of permanent—that is to say, inheritable—modifications of structure. It has for a long time been a matter of common knowledge that individual plants and animals react to their environment, but the modifications induced by these reactions are somatic; the germ-plasm is not affected, therefore the changes are not inherited, and no permanent effect is produced in the characters of the race or species. It is true that no evidence has yet been produced to show that form-changes as profound as those that I have mentioned are transmitted to the offspring. So far the experimenters have not been able to rear the modified organisms beyond the larval stages, and so there are no offspring to show whether cyclopean eyes or modified forms of spicules are inherited or not. Indeed, it is possible that the balance of organisation of animals thus modified has been upset to such an extent that they are incapable of growing into adults and reproducing their kind.

But evidence is beginning to accumulate which shows that external conditions may produce changes in the germ-cells as well as in the soma, and that such changes may be specific and of the same kind as similarly produced somatic changes. Further, there is evidence that such germinal changes are inherited—and, indeed, we should expect them to be, because they are germinal.

The evidence on this subject is as yet meagre, but it is of good quality and comes from more than one source.

There are the well-known experiments of Weismann, Standfuss, Merrifield, and E. Fischer on the modification of the colour patterns on the wings of various Lepidoptera.

In the more northern forms of the fire-butterfly, *Chrysophanus (Polyommatus) phlaeas*, the upper surfaces of the wings are of a bright red-gold or copper colour with a narrow black margin, but in southern Europe the black tends to extend over the whole surface of the wing and may nearly obliterate the red-gold colour. By exposing pupæ of caterpillars collected at Naples to a temperature of 10° C. Weismann obtained butterflies more golden than the Neapolitan, but blacker than the ordinary German race, and conversely, by exposing pupæ of the German variety to a temperature of about 38° C., butterflies were obtained blacker than the German, but not so black as the Neapolitan variety. Similar deviations from the normal standard have been obtained by like means in various species of Vanessa by Standfuss and Merrifield. Standfuss, working with the small tortoiseshell butterfly (*Vanessa urticae*), produced colour aberrations by subjecting the pupæ to cold, and found that some specimens reared under normal conditions from the eggs produced by the aberrant forms exhibited the same aberrations, but in a lesser degree. Weismann obtained similar results with the same species. E. Fischer obtained parallel results with *Arctia caja*, a brightly coloured diurnal moth of the family Bombycidæ. Pupæ of this moth were exposed to a temperature of 8° C., and some of the butterflies that emerged were very dark-coloured aberrant forms. A pair of these dark aberrants were mated, and the female produced eggs, and from these larvæ and pupæ were reared at a normal temperature. The progeny was for the most part normal, but some few individuals exhibited the dark colour of the parents, though in a less degree. The simple conclusions to be drawn from the results of these experiments is that a proportion of the germ-cells of the animals experimented upon were affected by the abnormal temperatures, and that the reaction of the germ-cells was of the same kind as the reaction of the somatic cells and produced similar results. As everybody knows, Weismann, while admitting that the germ-cells were affected, would not admit the simple explanation, but gave another complicated and, in my opinion, wholly unsupported explanation of the phenomena.

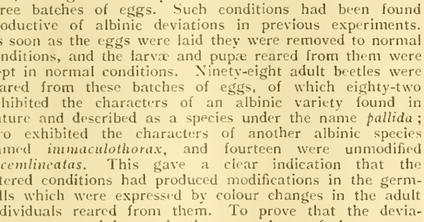
In any case this series of experiments was on too small a scale, and the separate experiments were not sufficiently carefully planned to exclude the possibility of error. But no objection of this kind can be urged against the careful and prolonged studies of Tower on the evolution of chrysomelid beetles of the genus Leptinotarsa. Leptinotarsa—better known, perhaps, by the name Doryphora—is the potato-beetle, which has spread from a centre in North Mexico southwards into the isthmus of Panama and northwards over a great part of the United States. It is divisible into a large number of species, some of which are dominant and widely ranging; others are restricted to very small localities. The specific characters relied upon are chiefly referable to the coloration and colour patterns of the epicranium, pronotum, elytra, and underside of the abdominal segments. In some species the specific markings are very constant, in others, particularly in the common and wide-ranging *L. decemlineata*, they vary to an extreme degree. As the potato-beetle is easily reared and maintained in captivity, and produces two broods every year, it is a particularly favourable subject for experimental investigation. Tower's experiments have extended over a period of eleven years, and he has made a thorough study of the geographical distribution, dispersal, habits, and natural history of the genus. The whole work appears to have been carried out with the most scrupulous regard to scientific accuracy, and the author is unusually cautious in drawing conclusions and chary of offering hypothetical explanations of his results. I have been greatly impressed by the large scale on which the experiments have been conducted, by the methods used, by the care taken to verify every result obtained, and by the great theoretical importance of Tower's conclusions. I can do no more now than allude to some of the most remarkable of them.

After showing that there are good grounds for believing that colour production in insects is dependent on the action of a group of closely related enzymes, of which chitase, the agent which produces hardening of chitin, is the most important, Tower demonstrates by a series of well-planned experiments that colours are directly modified by the action of external agencies—viz., temperature, humidity, food, altitude, and light. Food chiefly affects the subhypodermal colours of the larvæ, and does not enter much into account; the most important agents affecting the adult coloration being temperature and humidity. A *slight* increase or a *slight* decrease of temperature or humidity was found to stimulate the action of the colour-producing enzymes, giving a tendency to melanism; but a large increase or decrease of temperature or humidity was found to inhibit the action of the enzymes, producing a strong tendency to albinism.

A set of experiments was undertaken to test the question whether colouration changes induced by changed environmental conditions were inherited, increased, or dropped in successive generations. These experiments, carried on for ten lineal generations, showed that the changed conditions immediately produced their maximum effect; that they were purely somatic and were not inherited, the progeny of individuals which had been exposed to changed conditions through several generations promptly reverting when returned to normal conditions of environment. So far the results are confirmatory of the well-established proposition that induced somatic changes are not inheritable.

But it was found necessary to remove the individuals experimented upon from the influence of changed conditions during the periods of growth and maturation of the germ-cells. Potato-beetles emerge from the pupa or from hibernation with the germ-cells in an undeveloped condition, and the ova do not all undergo their development at once, but are matured in batches. The first batch matures during the first few days following emergence, then follows an interval of from four to ten days, after which the next batch of eggs is matured, and so on. This fact made it possible to test the effect of altered conditions on the maturing germ-cells by subjecting its imagos to experimental conditions during the development of some of the batches of ova and to normal conditions during the development of other batches.

In one of the experiments four male and four female individuals of *L. decemlineata* were subjected to very hot and dry conditions, accompanied by low atmospheric pressure, during the development and fertilisation of the first three batches of eggs. Such conditions had been found productive of albinic deviations in previous experiments. As soon as the eggs were laid they were removed to normal conditions, and the larvæ and pupæ reared from them were kept in normal conditions. Ninety-eight adult beetles were reared from these batches of eggs, of which eighty-two exhibited the characters of an albinic variety found in nature and described as a species under the name *pallida*; two exhibited the characters of another albinic species named *immaculothorax*, and fourteen were unmodified *decemlineatas*. This gave a clear indication that the altered conditions had produced modifications in the germ-cells which were expressed by colour changes in the adult individuals reared from them. To prove that the deviations were not inherent in the germ-plasm of the parents, the latter were kept under normal conditions during the periods of development and fertilisation of the last two batches of eggs; the larvæ and pupæ reared from these eggs were similarly subjected to normal conditions, and gave rise to sixty-one unmodified *decemlineatas*, which, when bred together, came true to type for three generations. The *decemlineata* forms produced under experimental conditions also came true to type when bred together. Of the *pallida* forms produced by experimental conditions all but two males were killed by a bacterial disease. These two were crossed with normal *decemlineata* females, and the result was a typical Mendelian segregation, as shown by the following table:—



This is a much more detailed experiment than those of Standfuss, Merrifield, and Fischer, and it shows that the changes produced by the action of altered conditions on the maturing germ-cells were definite and discontinuous, and therefore of the nature of mutations in De Vries' sense.

In another experiment Tower reared three generations of *decemlineata* to test the purity of his stock. He found that they showed no tendency to produce extreme variations under normal conditions. From this pure stock seven males and seven females were chosen, and subjected during the maturation periods of the first two batches of ova to hot and dry conditions. Four hundred and nine eggs were laid, from which sixty-nine adults were reared, constituted as follows:—

Twenty (12 ♂, 8 ♀) . .	apparently normal *decemlineata*.
Twenty-three (10 ♂, 13 ♀).	*pallida*.
Five (2 ♂, 3 ♀) . . .	*immaculotho. a.x.*
Sixteen (9 ♂, 7 ♀) . .	*albida*.

These constituted lot A.

The same seven pairs of parents subjected during the second half of the reproductive period to normal conditions gave 840 eggs, from which were reared 123 adults, all *decemlineatas*. These constituted lot B. The *decemlineatas* of lot A and lot B were reared side by side under normal and exactly similar conditions. The results were striking. From lot B normal progeny were reared up to the tenth generation, and, as usual in the genus, two generations were produced in each year. The *decemlineatas* of lot A segregated into two lots in the second generation. A^1 were normal in all respects, but A^2, while retaining the normal appearance of *decemlineata*, went through five generations in a year, and this for three successive years, thus exhibiting a remarkable physiological modification, and one without parallel in nature, for no species of the genus Leptinotarsa are known which produce more than two generations in the year. This experiment is a sufficient refutation of Weismann's argument that the inheritance of induced modifications in *Vanessa urticae* is only apparent, the phenomena observed being due to the inheritance of two kinds of determinants—one from dark-coloured forms which are phyletically the oldest, and the other from more gaily coloured forms derived from the darker forms. There is no evidence whatever that there was ever a species or variety of potato-beetle that produced more than two, or at the most, and then as an exception, three broods in a year.

The modified albinic forms in this last experiment of Tower's were weakly; they were bred through two or three generations, and came true to type, but then died out. No hybridisation experiments were made with them, but in other similar experiments, which I have not time to mention in detail, modified forms produced by the action of changed conditions gave typical Mendelian characters when crossed with unmodified *decemlineatas*, thus proving that the induced characters were constant and heritable according to the regular laws.

I have thought it worth while to relate these experiments at some length, because they seem to me to be very important, and because they do not appear to have attracted the attention in this country that they deserve.

They are confirmed to a very large extent by the experiments of Prof. Klebs on plants, the results of which were published this summer in the Croonian Lecture on "Alterations of the Development and Forms of Plants as a Result of Environment." As I have only a short abstract of the Croonian Lecture to refer to, I cannot say much on this subject for fear of misrepresenting the author; but, as far as I can judge, his results are quite consistent with those of Tower. *Sempervivum funckii* and *S. acuminatum* were subjected to altered conditions of light and nutrition, with the result that striking variations, such as the transformation of sepals into petals, of petals into stamens, of stamens into petals and into carpels, were produced. Experiments were made on *Sempervivum acuminatum* with the view of answering the question whether such alterations of flowers can be transmitted. The answer was in the affirmative. The seeds of flowers artificially altered and self-fertilised gave rise to twenty-one seedlings, among which four showed surprising deviations of floral structure. In two of these seedlings all the flowers were greatly altered, and presented some of the modifications of the mother plant, especially the transformation of stamens into petals. These experiments are still in progress, and it would perhaps be premature to lay too much stress upon them if it were not for the fact that they are so completely confirmatory of the results obtained by similar methods in the animal kingdom.

I submit to you that evidence is forthcoming that external conditions may give rise to inheritable alterations of structure. Not, however, as was once supposed, by producing specific changes in the parental soma, which changes were reflected, so to speak, upon the germ-cells. The new evidence confirms the distinctions drawn by Weismann between somatic and germinal variations. It shows that the former are not inherited, while the latter are; but it indicates that the germ may be caused to vary by the action of external conditions in such a manner as to produce specific changes in the progeny resulting from it. It is no more possible at the present time to connect rationally the action of external conditions on the germ-cells with the specific results produced in the progeny than it is possible to connect cause with effect in the experiments of Herbst and Stockard; but when we compare these two kinds of experiments, we are no longer able to argue that it is inconceivable that such and such conditions acting on the germ-plasm can produce such and such effects in the next generation of adults. We must accept the evidence that things which appeared inconceivable do in fact happen, and in accepting this we remove a great obstacle from the path of our inquiries, and gain a distinct step in our attempts to discover the laws which determine the production of organic form and structure.

But such experiments as those which I have mentioned only deal with one aspect of the problem. They tell us about external conditions and the effects that they are observed to produce upon the organism. They give us no definite information about the internal changes which, taken together, constitute the response of the organism to external stimuli. As Darwin wrote, there are two factors to be taken into account—the nature of the conditions and the nature of the organism, and the latter is much the more important of the two. More important because the reactions of animals and plants are manifold; but, on the whole, the changes in the conditions are few and small in amount. Morphology has not succeeded in giving us any positive knowledge of the nature of the organism; and in this matter we must turn for guidance to the physiologists, and ask of them how far recent researches have resulted in the discovery of factors competent to account for change of structure. Perhaps the first step in this inquiry is to ask whether there is any evidence of internal chemical changes analogous in their operation to the external physical and chemical changes which we have been dealing with.

There is a great deal of evidence, but it is extremely difficult to bring it to a focus and to show its relevancy to the particular problems that perplex the zoologist. Moreover, the evidence is of so many different kinds, and each kind is so technical and complex, that it would be absurd to attempt to deal with it at the end of an address that has already been drawn out to sufficient length. But perhaps I may be allowed to allude to one or two generalisations which appear to me to be most suggestive.

We shall all agree that, at the bottom, production and change of form is due to increase or diminution of the activities of groups of cells, and we are aware that in the higher animals change of structure is not altogether a local affair, but carries with it certain consequences in the nature of correlated changes in other parts of the body. If we are to make any progress in the study of morphogeny, we ought to have as exact ideas as possible as to what we mean when we speak of the activities of cells and of correlation. On these subjects physiology supplies us with ideas much more exact than those derived from morphology.

It is, perhaps, too sweeping a generalisation to assert that the life of any given animal is the expression of the sum of the activities of the enzymes contained in it, but it seems well established that the activities of cells are, if not wholly, at all events largely, the result of the actions of the various kinds of enzymes held in combination by their living protoplasm. These enzymes are highly susceptible to the influence of physical and chemical media, and it is because of this susceptibility that the organism responds to changes in the environment, as is clearly illustrated in a particular case by Tower's experiments on the production of colour changes in potato-beetles. Bayliss and Starling have shown that in lower animals, protozoa and sponges, in which no nervous system has been developed, the response of the organism to the environment is effected by purely chemical means. In protozoa, because of their small size, the question of coadaptation of function hardly comes into question; but in sponges, many of which are of large size, the mechanism of coadaptation must also be almost exclusively chemical. Thus we learn that the simplest and, by inference, the phyletically oldest mechanism of reaction and coordination is a chemical mechanism. In higher animals the necessity for rapid reaction to external and internal stimuli has led to the development of a central and peripheral nervous system, and as we ascend the scale of organisation this assumes a greater and greater importance as a co-ordinating bond between the various organs and tissues of the body. But the more primitive chemical bond persists, and is scarcely diminished in importance, but only overshadowed, by the more easily recognisable reactions due to the working of the nervous system. In higher animals we may recognise special chemical means whereby chemical coadaptations are established and maintained at a normal level or in certain circumstances altered. These are the internal secretions produced by sundry organs, whether by typical secretory glands (in which case the internal secretion is something additional and different from the external secretion), or by the so-called ductless glands, such as the thyroid, the thymus, the adrenal bodies, or by organs which cannot strictly be called glands, namely, the ovaries and testes. All these produce chemical substances which, passing into the blood or lymph, are distributed through the system, and have the peculiar property of regulating or exciting the specific functions of other organs. Not, however, of all the organs, for the different internal secretions are more or less limited and local in their effects, one affecting the activity of this and another the activity of that kind of tissue or organ. Starling proposed the name hormones for the internal secretions because of their excitatory properties (*ὁρμάω*, to stir up, to excite).

Hormones have been studied chiefly from the point of view of their stimulating effect on the metabolism of various organs. From the morphologist's point of view, interest chiefly attaches to the possibility of their regulating and promoting the production of form. It might be expected that they should be efficient agents in regulating form, for, if changes in structure are the result of the activities of groups of cells, and the activities of cells are the results of the activities of the enzymes which they contain, and if the activities of the enzymes are regulated by the hormones, it follows that the last-named must be the ultimate agents in the production of form. It is difficult to obtain distinct evidence of this agency, but in some cases, at least, the evidence is sufficiently clear. I will confine myself to the effects of the hormones produced by the testes and ovaries. These have been proved to be intimately connected with the development of secondary sexual characters, such, for instance, as the characteristic shape and size of the horns of the bull; the comb, wattles, spurs, plumage colour, and spurs in poultry; the swelling on the index finger of the male frog; the shape and size of the abdominal segments of crabs. These are essentially morphological characters, the results of increased local activity of cell-growth and differentiation. As they are attributable to the stimulating effect of the hormone produced by the male organ in each species, they afford at least one good instance of the production of a specific change of form as the result of an internal chemical stimulus. We get here a hint as to the nature of the chemical mechanism which excites and correlates form and function in higher organisms, and, from what has just been said, we perceive that this is the most primitive of all the animal mechanisms. I submit that this is a step towards forming a clear and concrete idea of the inner nature of the organism. There is one point, and that a very important one, upon which we are by no means clear. We do not know how far the hormones themselves are liable to change, whether by the action of external conditions or by the reciprocal action of the activities of the organs to which they are related. It is at least conceivable that agencies which produce chemical disturbances in the circulating fluids may alter the chemical constitution of the hormones, and thus produce far-reaching effects. The pathology of the thyroid gland gives some ground for belief that such changes may be produced by the action of external conditions. But, however this may be, the line of reasoning that we have followed raises the expectation that a chemical bond must exist between the functionally active organs of the body and the germ-cells. For if, in the absence of a specialised nervous system, the only possible regulating and coadapting mechanism is a chemical mechanism, and if the specific activities of a cell are dependent on the enzymes which it holds in combination, the germ-cells of any given animal must be the depository of a stock of enzymes sufficient to insure the due succession of all its developmental stages as well as of its adult structure and functions. And as the number of blastomeres increases, and the need for coordination of form and function arises, before ever the rudiments of a nervous system are differentiated, it is necessary to assume that there is also a stock of appropriate hormones to supply the chemical nexus between the different parts of the embryo. The only alternative is to suppose that they are synthesised as required in the course of development. There are grave objections to this supposition. All the evidence at our disposal goes to show that the potentialities of germ-cells are determined at the close of the maturation divisions. Following the physiological line of argument, it must be allowed that in this connection "potentiality" can mean nothing else than chemical constitution. If we admit this, we admit the validity of the theory, advanced by more than one physiologist, that heritable "characters" or "tendencies" must be identified with the enzymes carried in the germ-cells. If this be a true representation of the facts, and if the most fundamental and primitive bond between one part of an organism and another is a chemical bond, it can hardly be the case that germ-cells—which, *inter alia*, are the most primitive, in the sense of being the least differentiated, cells in the body—should be the only cells which are exempt from the chemical influenees which go to make up the coordinate life of the organism. It would seem, therefore, that there is some theoretical justification for the inheritance of induced modifications, provided that these are of such a kind as to react chemically on the enzymes contained in the germ-cells.

One further idea that suggests itself to me and I have done. Is it possible that different kinds of enzymes exercise an inhibiting influence on one another; that germ-cells are "undifferentiated" because they contain a large number of enzymes, none of which can show their activities in the presence of others, and that what we call "differentiation" consists in the segregation of the different kinds into separate cells, or perhaps, prior to cell-formation, into different parts of the fertilised ovum, giving rise to the phenomenon known to us as prelocalisation? The idea is purely speculative; but, if it could be shown to have any warrant, it would go far to assist us in getting an understanding of the laws of the production of form.

I have been wandering in territories outside my own province, and I shall certainly be told that I have lost my way. But my thesis has been that morphology, if it is to make useful progress, must come out of its reserves and explore new ground. To explore is to tread unknown paths, and one is likely to lose one's way in the unknown. To stay at home in the environment of familiar ideas is no doubt a safe course, but it does not make for advancement. Morphology, I believe, has as great a future before it as it has a past behind it, but it can only realise that future by leaving its old, home, with all its comfortable furniture of well-worn rules and methods, and embarking on a journey, the first stages of which will certainly be uncomfortable, and the end is far to seek.

SECTION E.

GEOGRAPHY.

OPENING ADDRESS BY A. J. HERBERTSON, M.A., PH.D., PROFESSOR OF GEOGRAPHY IN THE UNIVERSITY OF OXFORD, PRESIDENT OF THE SECTION.

GEOGRAPHY AND SOME OF ITS PRESENT NEEDS.

Geographical Progress in the Last Decade.

AT the close of a reign which has practically coincided with the first decade of a new century, it is natural to look back and summarise the progress of geography during the decade. At the beginning of a new reign it is equally natural to consider the future. Our new Sovereign is one of the most travelled of men. No monarch knows the World as he knows it; no monarch has ruled over a larger Empire or seen more of his dominions. His advice has been to wake up, to consider and to act. This involves taking existing geographical conditions into account. It will be in consonance with this advice if I pay more attention to the geography of the present and future than to that of the past, and say more about its applications than about its origins. Yet I do so with some reluctance, for the last decade has been one of the most active and interesting in the history of our science.

Among the many geographical results of work in the past decade a few may be mentioned. The measurement of new and the remeasurement of old arcs will give us better data for determining the size and shape of the Earth. Surveys of all kinds, from the simple route sketches of the traveller to the elaborate cadastral surveys of some of the more populous and settled regions have so extended our knowledge of the surface features of the Earth that a map on the scale of 1 : 1,000,000 is not merely planned, but actually partly executed. Such surveys and such maps are the indispensable basis of our science.

The progress of oceanography has also been great. The soundings of our own and other Admiralties, of scientific oceanographical expeditions, and those made for the purpose of laying cables, have given us much more detailed knowledge of the irregularities of the ocean floor. An international map of oceanic contours, due to the inspiration and munificence of the Prince of Oceanographers and of Monaco, has been issued during the decade, and so much new material has accumulated that it is now being revised. A comparison of the old and new editions of Krümmel's "Ozeanographie" shows us the immense advances in this subject.

Great progress has been made on the geographical side of meteorology and climate. The importance of this knowledge for tropical agriculture and hygiene has led to an increase of meteorological stations all over the hot belt—the results of which will be of value to the geographer. Mr. Bartholomew's "Atlas of Meteorology" appeared at the beginning, and Sir John Eliot's "Meteorological Atlas of India" at the end, of the decade. Dr. Hann's "Lehrbuch" and the new edition of his "Climatology," Messrs. Hildebrandsson and Teisserenc de Bort's great work, and the recent studies of the Upper Atmosphere, are among the landmarks of progress. The record is marred only by the closing of Ben Nevis Observatory at the moment when its work would have been most necessary. To appreciate the progress of climatology it is only necessary to compare the present number and distribution of meteorological stations with those given in Bartholomew's Atlas of 1899. I have not time to recapitulate the innumerable studies of geographical value issued by many meteorological services, observatories, and observers—public and private—but I may direct attention to the improved weather maps and to the excellent pilot charts of the North Atlantic and of the Indian Ocean published monthly by our Meteorological Office.

Lake studies have also been a feature of this decade, and none are so complete or so valuable as the Scottish Lakes Survey—a work of national importance, undertaken by private enthusiasm and generosity. We have to congratulate Sir John Murray and Mr. Pullar on the completion of a great work.

In Geology, I might note that we now possess a map of Europe on a scale of 1 : 1,500,000 prepared by international cooperation, and also one of North America on a smaller scale; both invaluable to the geographer. The thanks and congratulations of all geographers are due to Prof. Suess on the conclusion of his classical work on the Face of the Earth, the first comprehensive study of the main divisions and characteristics of its skeleton. English readers are indebted to Prof. and Miss Sollas for the brilliant English translation which they have prepared.

A new movement, inspired mainly by Prof. Flahault in France, Prof. Geddes in this country, Profs. Engler, Drude, and Schimper in Germany, has arisen among botanists, and at last we have some modern botanical geography which is really valuable to the geographer. I wish we could report similar progress in zoological geography, but that, I trust, will come in the next decade.

I pass over the various expensive arbitrations and commissions to settle boundary disputes which have in many cases been due to geographical ignorance, also the important and fascinating problems of the growth of our knowledge of the distribution of economic products and powers, existing and potential, and the new geographical problems for statesmen due to the political, economic revolutions in Japan and China.

It is quite impossible to deal with the exploration of the decade. Even in the past two years we have had Peary and Shackleton, Stein and Hedin, the Duke of the Abruzzi, and a host of others returning to tell us of unknown or little known parts of the globe. We hope to hear soon from Dr. Charcot the results of the latest investigations in the Antarctic.

Further work is being undertaken by Scott and his companions, by Bruce, Amundsen, Filchner, and others in the South or North Polar ice worlds; by Longstaff, Bruce, and others in the mountains of India and Central Asia; by Goodfellow and Ryder in New Guinea; and by many other expeditions.

One word of caution may perhaps be permitted. There is a tendency on the part of the public to confuse geographical exploration and sport. The newspaper reporter naturally lays stress on the unusual in any expedition, the accidental rather than the essential, and those of us who have to examine the work of expeditions know how some have been unduly boomed because of some adventurous element, while others have not received adequate popular recognition because all went well. The fact that all went well is in itself a proof of competent organisation. There is no excuse for us in this section if we fall into the journalist's mistake, and we shall certainly be acting against the interests of both our science and our section if we do so.

The Position of Geography in the Association.

It was not my intention in this address to raise the question of what is Geography, but various circumstances make it desirable to say a few words upon it. We are all the victims of the geographical teaching of our youth, and it is easy to understand how those who have retained unchanged the conceptions of geography they gained at school many years ago cavil at the recognition of geography as a branch of science. Moreover, the geography of the schools still colours the conceptions of some geographers who have nevertheless done much to make school geography scientific and educational. Many definitions of geography are consequently too much limited by the arbitrary but traditional division of school subjects. In schools, tradition and practical convenience have, on the whole rightly, determined the scope of the different subjects. Geography in schools is best defined as the study of the Earth as the home of Man. Its limits should not be too closely scrutinised in schools, where it should be used freely as a coordinating subject.

The present division into sections of the British Association is also largely a matter of practical convenience; but we are told that the present illogical arrangement of sections distresses some minds. No doubt there are some curious anomalies. The most glaring, perhaps, is that of combining mathematics with physics—as if mathematical methods were not used in any other subject.

There is undoubtedly a universal tendency to subdivision and an ever-increasing specialisation; but there is also an ever-growing interdependence of different parts of science. The British Association is unquestionably bound to take the latter into account as well as the former. At present this is chiefly done by joint meetings of sections: a wise course, of which this section has been one of the chief promoters. It is possible that some more systematic grouping of sections might be well advised, but such a reform should be systematic, and not piecemeal. It is one which raises the whole question of the classification of knowledge. This is so vast a problem, and one on which such divergent opinions are held, that I must apologise for venturing to put forward some tentative suggestions.

It might be found desirable to take as primary divisions the Mathematical, Physical, Biological, Anthropological, and Geographical groups. Mathematical applications might also be considered in each of the sections which use mathematical notations. In the Physical Group there should be the subdivisions Physics and Chemistry. Each would devote a certain proportion of time to its applied aspects, or these might be dealt with in sub-sections, which would include Engineering and Applied Chemistry. In the Biological Group there would be Botany, Zoology, in both cases including Palæontology and Embryology, and Applied Biology, which would be dealt with in one or other of the ways I have suggested, and would include Agriculture, Fisheries, &c. (Medicine we leave out at present.) In the Anthropological Group, in addition to the present Anthropology and Economics, there should be a section on Psychology, which might or might not be attached to Physiology, and have the Education Section as a practical appendage. In the Geographical Group there would be Geography and Geology, the practical applications of Geography and Geology being considered in joint meetings with other sections or else in sub-sections—for instance, Geography and Physics for questions of Atmospheric and Oceanic Circulation, Geography and Economics for questions of Transportation, &c.

The Need for Classification and Notation in Geomorphology, &c.

So much, then, for the classification of Geography with reference to the other sciences. I should like to say a few words about the subdivisions of geography and the vexed question of terminology.

In the scheme of the Universe it is possible to consider the Earth as a unit, with its own constitution and history. It has an individuality of its own, though for the astronomer it is only one example of a particular type of heavenly bodies. As geographers, we take it as our unit individual in the same way that an anatomist takes a man. We see that it is composed of different parts, and we try to discover what these are, of what they are composed, what their function is, what has been their history.

One fundamental division is into land, water, and air. Each has its forms and its movements. The forms are more obvious and persistent in the land. They are least so in the atmosphere, though forms exist—some of which are at times made visible by clouds, and many can be clearly discerned on isobaric charts. The land is the temporarily permanent; the water and atmosphere the persistently mobile, the latter more so than the former. The stable forms of the land help to control the distribution and movements of the waters, and to a less extent those of the atmosphere. How great the influence of the distribution of land and water is on the atmosphere may be seen in the monsoon region of eastern Asia.

The study of the land, the ocean, and the atmosphere has resulted in the growth of special branches of knowledge—Geomorphology, Oceanography, and Climatology. Each is indispensable to the geographer, each forms an essential part of the geographical whole. Much research work is and will be carried on in each by geographers who find their geographical studies hampered for the lack of it. As geographical progress is to a considerable extent conditioned by progress in these subjects, it would be legitimate to examine their needs. Time, however, will admit only a note on one of the barriers to progress in geomorphology—the lack of a good classification and notation.

Geomorphology deals with the forms of the land and their shaping. Three things have to be kept clearly in view: (1) The structure, including the composition, of the more permanent substance of the form; (2) the forces which are modifying it; and (3) the phase in the cycle of forms characteristic of such structure acted on by such forms. We may say that any form is a function of structure, process, and time. The matter is even more complicated, for we have instances, *e.g.* in antecedent drainage systems, of the conditions of a previous cycle affecting a subsequent one—a kind of heredity of forms which cannot be neglected.

The geomorphologist is seeking for a genetic classification of forms, and in the works of Betrand, Davis, de la Noë and de Margerie, Penck, Richthofen, Suess, and Supan and their pupils are being accumulated the materials for a more complete and systematic classification of forms. As you all know, the question of terms for the manifold land-forms is a difficult one, and apt to engender much more controversy than the analysis of the forms themselves. I believe that we shall find it advantageous to adopt some notation analogous to that of the chemists. I have not yet had time to work such a notation out in detail, but it might take the form of using different symbols for the three factors noted above—say, letters for different kinds of structure, Arabic figures for processes and Roman figures for the stage of a cycle the form has reached.

Take a very simple set of structures and indicate each by a letter:—

			Undisturbed	Faulted
Structure ...	homogeneous ...		... A	A′
	layered	horizontal ...	B	B′
		tilted...	... C	C′
		folded	... D	D′
	mixed		... E	E′

If pervious or impervious, a *p* or an *i* could be added—*e.g.* a tilted limestone with faults would be $C'p$.

Next, indicate the commoner erosion processes by Arabic numerals:—

Process ..	moving water	1
	ice	2
	wind	3
	sea	4

One process may have followed another, *e.g.* where a long period of ice erosion has been followed by water erosion we might write 2·1, where these alternate annually, say 21.

The phase of the cycle might be denoted by Roman figures. A scale of V might be adopted, and I, III, and V used for youthful, middle-aged, and old-aged, as this has been called, or early, middle, and late phases, as I prefer to term them. II and IV would denote intermediate phases.

A scarped limestone ridge in a relatively mature phase like the Cotswolds would be, if we put the process first, 1 C^1 III.; a highland like the Southern Uplands of Scotland would be denoted by the formula 1. 2·1 E^1 III.

This is the roughest suggestion, but it shows how we could label our cases of notes and pigeon-hole our types of forms—and prevent for the present undue quarrelling over terms.[1] No doubt there would be many discussions, for example, about the exact phase of the cycle, whether ice, in addition to water, has been an agent in shaping this or that form, and so on. But, after all, these discussions would be more profitable than quarrels as to which descriptive term, or place-name, or local usage should be adopted to distinguish it.

The use of such notations in geographical problems is not unknown. They were employed by Köppen in his classification of climate; and now, in the case of climatology, there is coming to be a general consensus of opinion as to what are the chief natural divisions, and the use of figures and letters to indicate them has been followed by several other authors. This should also be attempted for oceanography.

If any international agreement of symbols and colours could be come to for such things it would be a great gain, and I hope to bring this matter before the next International Geographical Congress.

[1] What I wish to make clear is that it is not necessary to invent a new term for every new variety of land form as soon as it is recognised. It will suffice at first to be able to label it. The notation will also stimulate the search for and recognition of new varieties.

The Need for Selecting Natural Geographical Units.

We have still to come to Geography proper, which considers land, water, and air, not merely separately but as associated together. What are the units smaller than the whole Earth with which our science has to deal?

When we fix our attention on parts of the Earth and ask what is a natural unit, we are hampered by preconceptions. We recognise species, or genera, families, or races as units—but they are abstract rather than concrete units. The reason for considering them as units is that they represent a historical continuity. They have not an actual physical continuity such as the component parts of an individual have. Concrete physical continuity in the present is what differentiates the geographical unit. Speaking for myself, I should say that every visible concrete natural unit on the Earth's surface consisting of more than one organic individual is a geographical unit. It is a common difficulty not to be able to see the wood for the trees; it is still more difficult to recognise that the wood consists of more than trees, that it is a complex of trees and other vegetation, fixed to a definite part of the solid earth and bathed in air. We may speak of a town or State as composed of people, but a complete conception of either must include the spacial connections which unite its parts. A town is not merely an association of individuals, nor is it simply a piece of land covered with streets and buildings; it is a combination of both.

It is true that in determining the greater geographical units, man need not be taken into account. We are too much influenced by the mobility of man, by his power to pass from one region to another, and we are apt to forget that his influence on his environment is negligible except when we are dealing with relatively small units. The geographer will not neglect man; he will merely be careful to prevent himself from being unduly influenced by the human factor in selecting his major units.

Some geographers and many geologists have suggested that land forms alone need be taken into account in determining these larger geographical units. Every different recognisable land form is undoubtedly a geographical unit. A vast lowland, such as that which lies to the east of the Rocky Mountains, is undoubtedly a geographical unit of great importance, but its geographical subdivisions are not necessarily orographical. The shores of the Gulf of Mexico could not be considered as geographically similar to those of the Arctic Ocean, even if they were morphologically homologous. The lowlands of the polar regions are very different from those at or near the tropics. The rhythm of their life is different, and this difference is revealed in the differences of vegetation.

I wish to lay great stress on the significance of vegetation to the geographer for the purposes of regional classification. I do not wish to employ a biological terminology nor to raise false analogies between the individual organism and the larger units of which it is a part, but I think we should do well to consider what may be called the life or movement going on in our units as well as their form. We must consider the seasonal changes of its atmospheric and of its water movements, as well as the parts of the Earth's crust which they move over and even slightly modify. For this purpose a study of climatic regions is as necessary as a study of morphological regions, and the best guides to the climatic regions are the vegetation ones.

By vegetation I mean not the flora, the historically related elements, but the vegetable coating, the space-related elements. Vegetation in this sense is a geographical phenomenon of fundamental importance. It indicates quality—quality of atmosphere and quality of soil. It is a visible synthesis of the climatic and edaphic elements. Hence the vast lowlands of relatively uniform land features are properly divided into regions according to vegetation—tundra, pine forest, deciduous forest, warm evergreen forest, steppe, and scrub. Such differences of vegetation are full of significance even in mountainous areas.

The search after geographical unity—after general features common to recognisable divisions of the Earth's surface, the analysis of these, their classification into types, the comparisons between different examples of the types—seem to me among the first duties of a geographer.

Two sets of studies and maps are essential—topographical and vegetational—the first dealing with the superficial topography and its surface irregularities, the latter relating to the quality of climate and soil.

Much has been said in recent years—more particularly from this Presidential chair—on the need for trustworthy topographical maps. Without such maps no others can be made. But when they are being made it would be very easy to have a general vegetational map compiled. Such maps are even more fundamental than geological maps, and they can be constructed more rapidly and cheaply. Every settled country, and more particularly every partially settled country, will find them invaluable if there is to be any intelligent and systematic utilisation of the products of the country. Possessing both sets of maps, the geographer can proceed with his task.

This task, I am assuming, is to study environments, to examine the forms and qualities of the Earth's surface, and to recognise, define, and classify the different kinds of natural units into which it can be divided. For these we have not as yet even names. It may seem absurd that there should be this want of terms in a subject which is associated in the minds of most people with a superfluity of names. I have elsewhere suggested the use of the terms major natural region, natural region, district, and locality to represent different grades of geographical units, and have also attempted to map the seventy or eighty major natural regions into which the Earth's surface is divided, and to classify them into about twenty types. These tentative divisions will necessarily become more accurate as research proceeds, and the minor natural regions into which each major natural region should be divided will be definitely recognised, described, and classified. Before this can be done, however, the study of geomorphology and of plant formations must be carried far beyond the present limits.

The value of systematic and exhaustive studies of environment such as those I suggest can hardly be exaggerated. Without them all attempts to estimate the significance of the environment must be superficial guesswork. No doubt it is possible to exaggerate the importance of the environmental factor, but it is equally possible to undervalue it. The truly scientific plan is to analyse and to evaluate it. Problems of the history of human development, as well as those of the future of human settlements, cannot be solved without this. For the biologist, the historian, the economist, the statesman, this work should be carried out as soon and as thoroughly as is possible in the present state of our knowledge.

A beginning of systematic geographical studies has also been made at the opposite end of the scale in local geographical monographs. Dr. H. R. Mill, one of the pioneers of geography in this country and one of my most distinguished predecessors in this chair, has given us in his study of south-west Sussex an admirable example of the geographical monograph proper, which takes into account the whole of the geographical factors involved. He has employed quantitative methods so far as these could be applied, and in doing so has made a great step in advance. Quantitative determinations are at least as essential in geographical research as the consideration of the time factor. At Oxford we are continuing Dr. Mill's work. We require our diploma students to select some district shown on a sheet of this map for detailed study by means of map measurements, an examination of statistics and literature which throw light on the geographical conditions, and, above all, by field work in the selected district. Every year we are accumulating more of these district monographs, which ought, in their turn, to be used for compiling regional monographs dealing with the larger natural areas. In recent years excellent examples of such regional monographs have come from France and from Germany.

The geomorphologist and the sociologist have also busied themselves with particular aspects of selected localities. Prof. W. M. Davis, of Harvard, has published geomorpholngical monographs which are invaluable as models of what such work should be. In a number of cases he has passed beyond mere morphology and has directed attention to the organic responses associated with each land form. Some of the monographs published under the supervision of the late Prof. Ratzel, of Leipzig, bring out very clearly the relation between organic and inorganic distributions, and some of the monographs of the Le Play school incidentally do the same.

The Double Character of Geographical Research.

To carry on geographical research, whether on the larger or the smaller units, there is at present a double need—in the first place, of collecting new information, and, in the second place, of working up the material which is continually being accumulated.

The Need for the Systematic Collection of Data.

The first task—that of collecting new information—is no small one. In many cases it must be undertaken on a scale that can be financed only by Governments. The Ordnance and Geological Surveys of our own and other countries are examples of Government departments carrying on this work. We need more of them. The presidents of the Botanical and Anthropological Sections are, I understand, directing the attention of the Association to the urgent necessity for complete Botanical and Anthropological Surveys of the kingdom. All geographers will warmly support their appeal, for the material which would be collected through such surveys is essential to our geographical investigations.

Another urgent need is a Hydrographical Department, which would cooperate with Dr. Mill's rainfall organisation. It would be one of the tasks of this department to extend and coordinate the observations on river and lake discharge, which are so important from an economic or health point of view that various public bodies have had to make such investigations for the drainage areas which they control. Such research work as that done by Dr. Strahan for the Exe and Medway would be of the greatest value to such a department, which ought to prepare a whether by government departments or by private We shall see how serious the absence of such a department is if we consider how our water supply is limited, and how much of it is not used to the best advantage. We must know its average quantity and the extreme variations of supply. We must also know what water is already assigned to the uses of persons and corporations, and what water is still available. We shall have to differentiate between water for the personal use of man and animals, and water for industrial purposes. The actualities and the potentialities can be ascertained, and should be recorded and mapped.

The Need for the Application of Geographical Methods to already Collected Data.

In the second direction of research—that of treating from the geographical standpoint the data accumulated, whether by Government departments or by private initiative—work has as yet hardly been begun.

The topographical work of the Ordnance Survey is the basis of all geographical work in our country. The Survey has issued many excellent maps, none more so than the recently published half-inch contoured and hill-shaded maps with colours "in layers." Its maps are not all above criticism; for instance, few can be obtained for the whole kingdom having precisely the same symbols. It has not undertaken some of the work that should have been done by a national cartographic service—for instance, the lake survey. Nor has it yet done what the Geological Survey has done—published descriptive accounts of the facts represented on each sheet of the map. From every point of view these are great defects; but in making these criticisms we must not forget (1) that the Treasury is not always willing to find the necessary money, and (2) that the Ordnance Survey was primarily made for military purposes, and that the latest map it has issued has been prepared for military reasons. It has been carried out by men who were soldiers first and topographers after, and did not necessarily possess geographical interests.

The ideal geographical map, with its accompanying geographical memoir, can be produced only by those who have had a geographical training. Dr. Mill, in the monograph already referred to, has shown us how to prepare systematised descriptions of the one-inch map sheets issued by the Ordnance Survey.

The preparation of such monographs would seem to fall within the province of the Ordnance Survey. If this is impossible, the American plan might be adopted. There the Geological Survey, which is also a topographical one, is glad to obtain the services of professors and lecturers who are willing to undertake work in the field during vacations. It should not be difficult to arrange similar cooperation between the universities and the Ordnance Survey in this country. At present the Schools of Geography at Oxford and at the London School of Economics are the only university departments which have paid attention to the preparation of such monographs, but other universities will probably fall into line. Both the universities and the Ordnance Survey would gain by such cooperation. The chief obstacle is the expense of publication. This might reasonably be made a charge on the Ordnance Survey, on condition that each monograph published were approved by a small committee on which both the universities and the Ordnance Survey were represented.

The Geological Survey has in recent years issued better and cheaper one-inch maps, and more attention has been given to morphological conditions in the accompanying monographs; but it is necessary to protest against the very high prices which are now being asked for the older hand-coloured maps. The new quarter-inch map is a great improvement on the old one, but we want "drift" as well as "solid" editions of all the sheets. The geographer wants even more than these a map showing the quality of the solid rock, and not merely its age. He has long been asking for a map which would indicate the distribution of clay, limestone, sandstone, &c., and when it is prepared on the quarter-inch, or better on the half-inch, scale the study of geomorphology and of geography will receive a very great stimulus and assistance.

The information which many other Government departments are accumulating would also become much more valuable if it were discussed geographically. Much excellent geographical work is done by the Admiralty and the War Office. The Meteorological Office collects statistics of the weather conditions from a limited number of stations; but its work is supplemented by private societies which are not well enough off to discuss the observations they publish with the detail which these observations deserve. The Board of Agriculture and Fisheries has detailed statistical information as to crops and live stock for the geographer to work up. From the Board of Trade he would obtain industrial and commercial data, and from the Local Government Board vital and other demographic statistics. At present most of the information of these departments is only published in statistical tables.

Statistics are all very well, but they are usually published in a tabular form, which is the least intelligible of all. Statistics should be mapped, and not merely be set out in columns of figures. Many dull Blue-books would be more interesting and more widely used if their facts were properly mapped. I say *properly* mapped, because most examples of so-called statistical maps are merely crude diagrams, and are often actually misleading. It requires a knowledge of geography in addition to an understanding of statistical methods to prepare intelligible statistical maps. If Mr. Bosse's maps of the population of England and Wales in Bartholomew's Survey Atlas are compared with the ordinary ones, the difference between a geographical map and a cartographic diagram will be easily appreciated.

The coming census, and to a certain extent the census of production, and probably the new land valuation, will give more valuable raw material for geographical treatment. If these are published merely in tabular form they will not be studied by any but a few experts. Give a geographer with a proper staff the task of mapping them in a truly geographical way, and they will be eagerly examined even by the man in the street, who cannot fail to learn from them. The representation of the true state of the country in a clear, graphic, and intelligible form is a patriotic piece of work which the Government should undertake. It would add relatively little to the cost of the census, and it would infinitely increase its value.

The Need of Reorganising the Geographical Factor in Imperial Problems.

With such quantitative information geographically treated and with a fuller analysis of the major natural regions it ought to be possible to go a step further and to attempt to map the economic value of different regions at the present day. Such maps would necessarily be only approximations at first. Out of them might grow other maps prophetic of economic possibilities. Prophecy in the scientific sense is an important outcome of geographical as well as of other scientific research. The test of geographical laws, as of others, is the pragmatic one. Prophecy is commonly but unduly derided. Mendeléeff's periodic law involved prophecies which have been splendidly verified. We no longer sneer at the weather prophet. Efficient action is based on knowledge of cause and consequence, and proves that a true forecast of the various factors has been made. Is it too much to look forward to the time when the geographical prospector, the geographer who can estimate potential geographical values, will be as common as and more trustworthy than the mining prospector?

The day will undoubtedly come when every Government will have its Geographical-Statistical Department dealing with its own and other countries—an Information Bureau for the administration corresponding to the Department of Special Inquiries at the Board of Education. At present there is no geographical staff to deal geographically with economic matters or with administrative matters. Yet the recognition of and proper estimation of the geographical factor is going to be more and more important as the uttermost ends of the Earth are bound together by visible steel lines and steel vessels or invisible impulses which require no artificial path or vessel as their vehicle.

The development of geographical research along these lines in our own country could give us an Intelligence Department of the kind, which is much needed. If this were also done by other States within the Empire, an Imperial Intelligence Department would gradually develop. Thinking in continents, to borrow an apt phrase of Mr. Mackinder's, might then become part of the necessary equipment of a statesman instead of merely an after-dinner aspiration. The country which first gives this training to its statesmen will have an immeasurable advantage in the struggle for existence.

The Need for the adequate Endowment of Geography at the Universities.

Our universities will naturally be the places where the men fit to constitute such an Intelligence Department will be trained. It is encouraging, therefore, to see that they are taking up a new attitude towards geography, and that the Civil Service Commissioners, by making it a subject for the highest Civil Service examinations, are doing much to strengthen the hands of the universities. When the British Association last met in Sheffield geography was the most despised of school subjects, and it was quite unknown in the universities. It owed its first recognition as a subject of university status to the stimulus and generous financial support of the Royal Geographical Society and the brilliant teaching of Mr. Mackinder at Oxford. Ten years ago Schools of Geography were struggling into existence at Oxford and Cambridge, under the auspices of the Royal Geographical Society. A single decade has seen the example of Oxford and Cambridge followed by nearly every university in Great Britain, the University of Sheffield among them. In Dr. Rudmose Brown it has secured a scientifically trained traveller and explorer of exceptionally wide experience, who will doubtless build up a Department of Geography worthy of this great industrial capital. The difficulty, however, in all universities is to find the funds necessary for the endowment, equipment, and working expenses of a Geographical Department of the first rank. Such a department requires expensive instruments and apparatus, and, since the geographer has to take the whole World as his subject, it must spend largely on collecting, storing, and utilising raw material of the kind I have spoken of. Moreover, a professor of geography should have seen much of the World before he is appointed, and it ought to be an important part of his professional duties to travel frequently and far. I have never been able to settle to my own satisfaction the maximum income which a department of geography might usefully spend, but I have had considerable experience of working a department the income of which was not very far above the minimum. Until now the Oxford School of Geography has been obliged to content itself with three rooms and to make these suffice, not merely for lecture-rooms and laboratories, but also for housing its large and valuable collection of maps and other materials. This collection is far beyond anything which any other university in this country possesses, but it shrinks into insignificance beside that of a rich and adequately supported Geographical Department like that of the University of Berlin. This fortunate department has an income of about 6000*l.* a year, and an institute built specially for its requirements at a cost of more than 150,000*l.*, excluding the site. In Oxford we are most grateful to the generosity of Mr. Bailey, of Johannesburg, which will enable the School of Geography to add to its accommodation by renting for five years a private house, in which there will temporarily be room for our students and for our collections, especially those relating to the geography of the Empire. But even then we can never hope to do what we might if we had a building specially designed for geographical teaching and research. Again, Lord Brassey and Mr. Douglas Freshfield, a former President of this Section, have each generously offered 500*l.* towards the endowment of a professorship if other support is forthcoming. All this is matter for congratulation, but I need hardly point out that a professor with only a precarious working income for his department is a person in a far from enviable position. There is at present no permanent working income guaranteed to any Geographical Department in the country, and so long as this is the case the work of all these departments will be hampered and the training of a succession of competent men retarded. I do not think that I can conclude this brief address better than by appealing to those princes of industry who have made this great city of Sheffield what it is to provide for the Geographical Department of the University on a scale which shall make it at once a model and a stimulus to every other university in the country and to all benefactors of universities.

IONISATION OF GASES AND CHEMICAL CHANGE.[1]

THE term "catalytic" was introduced by Berzelius to describe a number of chemical actions which would only take place in the presence of a third substance, which itself was apparently unchanged throughout the reaction. The first cases of such actions were investigated by Sir Humphry Davy in 1817. He showed that many mixtures of gases were caused to unite in the presence of finely divided platinum at temperatures far below those at which union ordinarily took place. Some years afterwards Faraday investigated similar actions, and attempted to explain them by a supposed condensation of the gases on the surface of the metal.

Thirty years ago Prof. H. B. Dixon investigated the behaviour of carbon monoxide and oxygen when they were dried as completely as possible, and he discovered that in these circumstances electric sparks caused no explosion. Some years before Wanklyn had discovered that purified chlorine did not act on sodium, but he did not identify the impurity, now known to be a trace of water, which causes the vigorous action which takes place in ordinary circumstances.

In 1882 Cowper investigated the action of dried chlorine on several metals, and found that the removal of moisture in many cases inhibited the reaction.

In the following year, working in Prof. Dixon's laboratory at Balliol College, I found that purified carbon could be heated to redness in dried oxygen, and that sulphur and phosphorus could be distilled in the same gas without burning. In the investigations which followed, some thirty simple reactions have been tried by myself and others. It has been shown that hydrogen and chlorine can be exposed to light without explosion, ammonia and hydrogen chloride mixed without union, sulphur trioxide can be crystallised on lime, ammonium chloride and mercurous chloride give undissociated vapours, hydrogen and oxygen can be exposed to a red heat without explosion, and lastly, in 1907, nitrogen trioxide was obtained as an undissociated gas for the first time by carefully drying the liquid and evaporating into a dried atmosphere.

The amount of water necessary to carry on these chemical reactions is extremely small, certainly less than 1 mg. in 300,000 litres. There is no accepted explanation of its catalytic effect, and in the same way the catalytic power of platinum is still a mystery. Dr. Armstrong's theory, that only water which is capable of conducting an electric current is capable of bringing about these chemical actions, seems to be supported by the fact that water can be formed in heated tubes containing very pure hydrogen and oxygen without the explosive combination of the gases taking place. That great purity does affect the chemical activity of water was proved by an experiment shown during the lecture. Two tubes, one containing water of a very high degree of purity and the other containing ordinary distilled water, were placed side by side in the lantern. Into each was filtered some liquid sodium amalgam, and while vigorous effervescence was seen in the less pure water, the very pure specimen was apparently without action for some minutes, and even at the end of the lecture its action had not attained the same vigour as that in the other tube.

In 1893 Sir J. J. Thomson (*Phil. Mag.*, xxxvi., 321) showed that if the combination of atoms in a molecule is electrical in its nature, the presence of liquid drops of water, or drops of any liquid of high specific inductive capacity, would be sufficient to cause a loosening of the tie between the atoms, and this might result in chemical combination of the partially freed atoms to form new molecules. He showed in the same paper that drying a gas very completely stopped the passage of a current of 1200 volts. In the same year I was able in the same way to prevent the passage of discharge from an induction coil, a discharge which would traverse a spark gap of three times the distance in undried gas.

Shortly after the discovery of Röntgen rays, it was found that they would ionise a gas through which they passed. At the time it was thought that this ionisation was similar to that taking place in electrolysis. If this were so the rays would probably cause chemical union to take place even in a dried gas, and accordingly Prof. Dixon and I undertook some experiments on the subject, which were published in a joint paper (Chem. Soc. Jour., 1896). The results were negative; no chemical action could be detected. Since that time the ionisation of gases has been shown to be of quite a different nature. The negative ion has been shown to be a particle of the mass of about 1/1500th that of the hydrogen atom, and the positive ion is the residue. Since the ionisation of gases is different from that in electrolysis, the retention of this term is much to be deprecated. It is suggested that the term ionisation should be retained for electrolytic dissociation, and for the different process which takes place in gases under the action of Röntgen rays, &c., a new name, electromerism, should be adopted. The electron would thus be the negative electromer.

It is probable that electrolysis and true ionisation may take place in gases, as in the decomposition of steam by electric sparks of a particular length. An experiment recently devised seems to show that in mercury vapour, which ordinarily consists of atoms, something of the nature of ionisation without electrolysis can take place. If oxygen be admitted to the interior of a mercury lamp from which the current has just been cut off, a considerable quantity of mercuric oxide is produced, although the temperature of the lamp (about 150°) is far lower than would suffice to bring about the union of ordinary mercury vapour with oxygen.

In order to test further the question as to whether electromerism can bring about chemical change, I have investigated the action of radium bromide on very pure and dry hydrogen and oxygen. The gases were sealed up with some radium bromide contained in an open silica tube. The containing vessel was provided with a vacuum gauge, by means of which the combination of 1/5000th

[1] Discourse delivered at the Royal Institution on Friday, March 11, by Dr. H. Brereton Baker, F.R.S.

part of the gases could be easily detected. No action whatever was observed, although the substances were left in contact for two months. A further experiment showed that, as was to be expected, very dry air undergoes electromerism when subjected to the action of radium. Two more tubes were then set up, similar to the first, containing mixtures of carbon monoxide and oxygen, one very dry and the other containing traces of moisture, and although the radium bromide was in contact with them for more than three months, not the slightest contraction could be observed. In these cases, therefore, electromerism produces no chemical change.

There was, however, a possibility that electromerism might bring about a chemical action in a mixture of gases which was under conditions which were nearly, but not quite, suitable for chemical action to take place. The gaseous mixtures mentioned only combine, even when moist, at a red heat. Since the experiments were done at 20°, they only show that electromerism does not produce chemical action in gases which are otherwise unable to combine.

There remained the possibility that if gases were just on the point of combining, increasing the electromerism might accelerate the rate of action. I sought for a case of simple chemical union which would proceed at a manageable temperature, and at a rate which could be measured. Of those tried, the reaction between hydrogen and nitrous oxide was found to be the most suitable. The gases used were as pure as possible, but dried only by passing through phosphorus pentoxide tubes. They were found to combine with great uniformity when heated in clean Jena glass tubes to 530°. An electric resistance furnace was used, consisting of a wide silica tube which formed the heated chamber. It is known that many substances when heated produce electromers in a gas; lime is fairly efficient, thoria more so, and, of course, radium bromide most of all. In the first experiment two tubes of the same Jena glass, containing the hydrogen and nitrous oxide mixture, were heated side by side. One contained some lime, and in order to make the conditions as similar as possible an equal quantity of powdered Jena glass was introduced into the other. As soon as the requisite temperature was reached, the action proceeded rapidly in the tube containing lime, the rate in the first five minutes being five times the rate of combination in the tube containing only powdered glass. After fifteen minutes the second tube had caught up the first, and the rates of union were equal up to the completion of the action. With thoria the effect was still more marked, the rate increasing to twenty times the rate in the tube containing the glass. Finally, about 2 mg. of radium bromide was heated in the mixture of gases. As soon as the combining temperature was reached, the gases in the radium bromide tube exploded.

From these three experiments it is seen that, as the amount of electromerism was increased, there was a rapid increase in chemical action.

I have recently been able to show that if the union of carbon monoxide and oxygen takes place in a strong electric field, which has the effect of removing electromers, the chemical action is diminished. Similar experiments are in progress with the mixture of hydrogen and chlorine, combining under the influence of light.

The next experiment tried illustrates one way in which the electromerism of a gas may bring about chemical change. Hydrogen sulphide and sulphur dioxide can be mixed at the ordinary temperature in presence of traces of moisture, but in presence of liquid water decomposition takes place into sulphur and water. The gases were dried before mixing by calcium chloride, which leaves about 4 mg. of water vapour per litre in the gas. After mixing, a small open silica tube containing about 2 mg. of dried radium bromide was introduced. After six hours no apparent change had taken place in the gas; there was no deposit of sulphur on the sides of the jar, and it seemed at first as if no action had been produced. On opening the jar, however, an inrush of air was noticed, and the contents were almost odourless. On heating the radium tube a large quantity of water was driven off, and a copious sublimate of sulphur was seen. The whole of the gaseous contents of the jar had condensed in the small tube containing the radium bromide. The explanation of this action of radium bromide is probably simple. Water vapour condenses on the electromers emitted, liquid drops are formed, and in them the chemical action takes place.[1]

Prof. Townsend has recently published an account of some experiments in which he has shown that there is a very marked decrease in the mobility of negative electromers in the presence of an amount of water vapour represented by a pressure of 1/10th mm. The air, in his experiments, was subjected to the action of Röntgen rays.

It is concluded that water in a form approaching to that of a drop is condensed on the electron even when a very small quantity is present. If this deposition of water molecules on electromers goes on when the amount of water present is still smaller, the theory of Sir J. J. Thomson affords a satisfactory explanation of the influence of moisture on chemical change, since some electromers are always present in ordinary gases.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE *Lancet* states that the University of Bristol is to receive the sum of 1000*l.* from the estate of the late Miss J. L. Woodward for the foundation of a scholarship in music or botany, to be known as the "Vincent Stuckey Lean Scholarship."

IT is proposed that the Congress of the Universities of the Empire shall be held in London in June, 1912, and a meeting of the Vice-Chancellors of the British universities is to take place in November next with the object of drawing up a provisional scheme of subjects to be discussed at the congress, which scheme will then be submitted to the overseas universities for suggestions.

AN Institute of Colonial Medicine has been established in connection with the faculty of medicine of the University of Paris. The first session will begin on October 13 and end at the close of the year. The following courses of instruction are announced:—Technical bacteriology and hæmatology, by Prof. Roger; parasitology, by Prof. Blanchard; surgery in tropical countries, by Dr. Morestin; ophthalmic affections, by Dr. Lapersonne; general epidemiology, by Prof. Chantemesse; tropical pathology and tropical hygiene, by Dr. Wurtz; and dermatology, by Prof. Gaucher in collaboration with Dr. Jeanselme.

ATTENTION has been directed here from time to time to the movement in this country to establish universities in China. We learn from the *Times* of September 13 that the success of the proposed Hong Kong University seems assured. Sir Frederick Lugard, the Governor of Hong Kong, has taken a prominent part in demonstrating the advantages likely to accrue from the undertaking, and he has been generously assisted by large contributions from the leading Chinese and others in the colony. Sir Hormusji Mody has offered to erect the buildings, whatever their cost (estimated at about 30,000*l.*), in accordance with the approved plans. Dr. Ho Kai, C.M.G., has given 18,000*l.*; Mr. J. H. Scott, senior partner of Messrs. Butterfield and Swire, has announced a gift of 40,000*l.* on behalf of his own and allied firms; and the Central Government at Peking has sent a substantial contribution. The bare minimum sum required has now been practically raised, and Sir Frederick Lugard and his helpers are appealing to the British public for the amount required to make the University worthy of British prestige. It may be pointed out that though there is no antagonism between them, there is no connection between this scheme and that associated with Oxford and Cambridge for the establishment of a university at Hankau, on the Yangtsze.

THE annual meeting of the Institution of Mining Engineers was held at the University College, Nottingham, last week. In welcoming the members, Sir Joseph Bright, chairman of the council of the college, said they hoped in the near future to establish a chair of mining

[1] I have invariably noticed that water collects in tubes containing radium preparations exposed to undried air. The salts are not at all deliquescent, the crystals appearing quite sharp-edged under the microscope. I found that 10 mg. of radium bromide exposed to an atmosphere saturated at 0° for two days caused a deposition of water on its surface weighing 1·5 mg.

engineering at the college. A paper was read at the meeting by Prof. H. Louis on the Mining School at Bochum, Westphalia, in the course of which he said that in Germany there are schools devoted to the better education of miners and the elementary training of colliery officials. The course lasts two years, and the men attend for eight hours weekly for a year and a half, and for ten hours weekly during the last six months. It cannot, he said, be imagined that the Germans would have continued those institutions for nearly a century had they not found that it paid them to do so. Surely it is high time to abandon our insular policy of not profiting by the experience of our neighbours in matters of such vital importance. In Prof. Louis's opinion it would be easy enough for the various British coalfields to form miners' funds like that raised in Westphalia for the same purpose. Future legislation should, he suggested, enact that in any coalfield where a large majority—say two-thirds—of the producers decide to take advantage of its provisions power shall be given to constitute a fund, and a levy upon the entire output of the field should thus be legalised, the fund to be administered and applied very much as the Westphalian miners' fund has been.

An examination of the calendars, prospectuses, and announcements of the London polytechnic institutions for the session which is now commencing serves to show how well the metropolitan area is provided with facilities for technical and scientific instruction. The encouragement which is extended by the authorities to the plan of giving a distinguishing character to the curricula of certain of these colleges is well brought out by an inspection of the announcements in connection with the winter's work at the Northampton Institute. We can only give a few examples. The classes in submarine cable work are being continued, and more advanced classes are projected in radio-telegraphy. The success of the pioneer courses in aëronautics given last winter has been so marked that the subject is being developed. The instruction in electroplating is being brought more into line with the actual requirements of the trade, and arrangements have been made to extend the advanced work in sight-testing and physiological optics. The South-Western Polytechnic at Chelsea continues to provide courses of study suited for a great variety of technological purposes, and also for university students. We notice from the calendar of the day work at this college that students are informed that those who enter for technical instruction should have received previously a sound English education, and should have acquired an elementary knowledge of mathematics and, if possible, of physics and chemistry. The courses are arranged to occupy three years. On entering the student states whether he wishes to be trained as a mechanical or electrical engineer, or as a consulting or industrial chemist. In any of these cases he has mapped out a complete course of study. Students who have completed a three years' course should be in a position to obtain situations in important industrial firms. Birkbeck College, too, continues its excellent work. The new calendar has again to point out that the usefulness of the college is curtailed by its limited accommodation, and its pressing need is for increased space. More spacious college buildings, with additional class-rooms and larger laboratories better adapted to modern requirements, would give a great stimulus to the work of the college and add to its public utility. We notice that 1293 students attended its classes last winter, and that about a quarter of them were women.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 12.—M. Bouchard in the chair.—J. **Guillaume** and J. **Merlin**: Occultation of η Geminorum by Venus, July 26, 1910, observed at Lyons. As the planet was only 9° above the horizon, the images observed were unsteady. The data are given in full, and calculations made of the diameter of Venus.—Carl **Störmer**: Theorems on the general equations of motion of a corpuscle in a magnetic and electric field superposed.—Paul **Floquet**: A comparison of the different methods of measuring the dielectric constant. Paraffin extracted from ozokerite has been shown by M. Malclès to possess no residual charge and to be without any appreciable conductivity. This paraffin has been utilised for comparing at the same instant the values of the dielectric constant obtained by two different static methods. The results agreed within 1 per cent., and a similar concordance was obtained for measurements based on the relative velocities in air and in paraffin of Hertzian waves.—Philippe **de Vilmorin**: Researches on Mendelian heredity.—J. **Athanasin** and J. **Dragoin**: The association of elastic and contractile elements in muscle.—E. **Roubaud**: The evolution of instinct in Vespides. Remarks on the social wasps of Africa, genus Belonogaster.—Joseph **Roussel**: The existence of three horizons of calcium phosphate in Algeria and Tunis.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts ii. and iii. for 1910, contain the following memoirs communicated to the society:—

February 26.—R. **König**: Conformal representation of the surface of a solid angle.—B. **Dürken**: The behaviour of the nervous system after extirpation of the limb-rudiments in the frog.—O. **Berg**: The Thomson effect in copper, iron, and platinum.

March 12.—Kurt **Wegener**: Aërological results obtained at the Samoa Observatory in 1909.

April 30.—R. **Fuchs**: Linear homogeneous differential equations of the second order with four essentially singular points.

CONTENTS.

PAGE
Animals of the Ancients. By R. L. 357
The Design of Reinforced Concrete Structure. By T. H. B. 358
Text-books of Chemistry 360
Mineral Springs and Wells of Essex. By H. B. W. 361
Our Book Shelf 361
Letters to the Editor:—
Gauss and Non-Euclidean Geometry.—**Prof. H. S. Carslaw** 362
An Oblique Belt on Jupiter. (*Illustrated.*)—**Scriven Bolton** 362
Tests for Colour-vision.—**Commander D. Wilson-Barker** 363
Fireball of September 2.—**Edmund J. Webb; W. F. Denning** 363
The Law of Definite Proportions.—**C. E.** 364
Fire Tests with Textiles. (*Illustrated.*) 364
The Castes and Tribes of Southern India. (*Illustrated.*) 365
A History of Birds. (*Illustrated.*) 367
Reforms of the Calendar. By W. T. L. 368
The Dynamics of Föhn. By R. G. K. L. 368
Respiration at High Altitudes. By Leonard Hill, F.R.S. 369
Notes 369
Our Astronomical Column:—
Further Observations of Halley's Comet 374
The Distances of Red Stars 374
"Mock Suns" at Eastbourne 374
Astronomy in India 374
The Crusade against Consumption 374
Recent Papers on Petrology. By G. A. J. C. 375
Reports on Climates 377
Bird Notes 378
The British Association at Sheffield.
Section D.—Zoology.—Opening Address by **Prof. G. C. Bourne, M.A., D.Sc., F.R.S., President of the Section** 378
Section E.—Geography.—Opening Address by **A. J. Herbertson, M.A., Ph.D., Professor of Geography in the University of Oxford, President of the Section** 383
Ionisation of Gases and Chemical Change. By Dr. H. Brereton Baker, F.R.S 388
University and Educational Intelligence 389
Societies and Academies 390

THURSDAY, SEPTEMBER 29, 1910.

HISTORY OF BOTANY.

A History of Botany, 1860–1900, being a Continuation of Sachs' "History of Botany, 1530–1860." By Prof. J. Reynolds Green, F.R.S. (Oxford: Clarendon Press, 1909.) Price 9s. 6d. net.

BOTANICAL science has been fortunate in having had as historian a botanist of such wide knowledge and mature judgment as the late professor of botany in the University of Würzburg. Sachs' "History of Botany," which covers the period from the sixteenth century up to 1860, will always rank, not only as a standard history of botany, but also as the model of a critical study of the growth and progress of scientific thought. Botanists will be grateful to the delegates of the Clarendon Press for their decision to arrange for the continuation of the history of botany up to the close of the nineteenth century, the latter half of which has witnessed such a surprising development of the biological sciences under the stimulus of Darwin's "Origin of Species," published a year before the date at which Sachs' "History of Botany" stops. Sachs himself lays the greatest stress upon the change in outlook in morphological and systematic botany produced by Darwin's epoch-making work; but though he frequently refers to the new conception of evolution, he does not deal in detail with the Darwinian theory of evolution, owing, no doubt, to his conviction that it marked the beginning of a new era, rather than the close of the period under his consideration.

Dr. Green, who has undertaken the honourable task of continuing Sachs' history, has therefore had, as he recognises in his introduction, a very clear starting point for his survey of botanical progress during the latter half of the nineteenth century. Yet he does not commence his history, as might have been expected, with an account of the Darwinian theory of evolution. The fact that the publication of the "Origin of Species" took place a year prior to 1860, the date at which Dr. Green takes up the history, should not have been allowed to stand in the way of his dealing fully with the subject, since it received no detailed treatment in the earlier history. Even if this omission is technically justifiable, one would at least have expected a chapter dealing with such botanical work as has confirmed, elaborated, or modified the Darwinian theory of evolution. Yet Darwin's own amplifications of his theory as detailed in his "Variation of Animals and Plants under Domestication," published in 1868, are not recorded, nor is the theory of pangenesis, put forward by Darwin in 1868, and elaborated by De Vries, either mentioned or criticised. One cannot help feeling that the omission of all discussion of the theory of evolution is a serious blemish to this history of botany. It would indeed have been legitimate to have included a consideration of the work of Weismann and other zoologists who have contributed to the establishment of the theory of evolution. Some discussion, it is true, bearing on evolutionary principles is to be found in the chapters dealing with the morphology of plants, but the importance of the subject warrants a more special treatment.

In general, Dr. Green has adhered to the lines on which Sachs founded the original work, and commences with a consideration of the advances in our knowledge of the morphology of plants. In the first chapter, dealing with the nature of the alternation of generations, he discusses the classic work of Hofmeister, who first clearly established the homologies in the various groups of the Archegoniatæ, and formulated the theory of the alternation of generations obtaining in these plants. Then follows a careful and critical account of the later and divergent views as to the antithetic or homologous nature of these alternating generations, a divergence of opinion which continues to the present time. Dr. Green gives us also an excellent and impartial summary of the opposing views on morphology, on one hand the school of organographers led by Goebel, which considers that physiological requirement is the main factor affecting changes of structure, while the rival school of Naegeli and Celakovsky attributes differentiation to some inherent tendency of the protoplasm to develop in the direction of increasing complexity. In this field of thought, too, the close of the century found active difference of opinion. The difficulties, on the other hand, which had arisen with regard to the proper interpretation of the flower were, as is shown in the chapter on the morphology of the flower, largely overcome by the general acceptance of Goebel's view of the independent morphological value of the sporangium.

To the chapter on taxonomy is added a brief account of the various Floras published during the latter half of the nineteenth century, but this somewhat cursory treatment of the subject of geographical distribution of plants as an annex to systematic botany does not do justice either to the general importance from an evolutionary point of view of the distribution of plants, nor does it allow of an adequate consideration of the physiological and ecological bearing of the more recent work on plant geography. The publication of the "Origin of Species," it has been said, "placed botanical geography on an entirely new basis," yet no one would gather this from the meagre treatment accorded it in this new history of botany. Sir Joseph Hooker's great memoir on the "Distribution of Arctic Plants" is dismissed in two lines, and yet, in conjunction with his "Introductory Essay to the Flora of Tasmania," it probably did more than any other publication to win the support of botanists for the Darwinian theory of evolution. The total omission of any mention of Warming's "Ecology of Plants" and of Schimper's "Plant Geography on Physiological Basis," which represent the trend of modern studies in plant distribution, seems most unfortunate. It is equally regrettable that the series of monographs which have appeared in Engler's "Jahrbücher" and the important work of Drude on plant geography have been left out of consideration.

An interesting feature of the history is the inclusion of a special chapter on palæobotany, a branch of study conspicuously absent from Sachs' history, for before 1860 our knowledge of fossil plants, based mainly on plant impressions, was too inexact and too uncertain to be of much value in the discussion of the relationship of plants.

But with the publication of the classic memoirs of Renault and of Williamson a precise knowledge of the extinct vegetation of at least one geological period led to striking advances in our knowledge of the extinct vascular cryptogams, and the discovery, at the beginning of the present century, of the seed-bearing nature of many of the fern-like plants of the Carboniferous period, led to a remarkable advance in our conception of the course of evolution of plants and an unexpectedly complete vindication of Hofmeister's views. There is no more striking testimony of the stimulus given to the study of palæobotany by Renault and Williamson than the band of still active workers in France and England, the work of which is passed in review in chapter v.

It is perhaps in consonance with the general trend of advance in botanical science that physiology should receive a fairly lengthy treatment, but a perusal of book iii. certainly gives the reader the impression that the author has given a somewhat more detailed account of the problems of this branch of botany, and that subjects of equal importance connected with the anatomy of plants have been less generously treated.

One must take into consideration that none of the chapters on physiology deal with the physiology of the reproductive processes. These are dealt with partly in connection with the alternation of generations, and partly in connection with the morphology of the flower. But the physiology of reproduction really merits a chapter to itself, in which the modern views of the nature of fertilisation might have been more fully set forth, and the splendid work of Darwin and Müller on self- and cross-fertilisation might then have received ampler treatment.

Grateful as we feel to Dr. Green for the summaries of work done in the various fields of botany, and recognising fully their usefulness, we close the book with a feeling that it lacks the breadth of treatment and the perspective of Sachs' history. But in making this somewhat invidious comparison, we do not wish to detract from the careful and painstaking work of the author, which is shown by the very large number of books and papers which he passes under review. His task has been doubly difficult, partly owing to the fact that he has had to deal with innumerable memoirs rather than with a smaller number of great works, and partly owing to the fact that he has been called upon to write the history of a comparatively short period of scientific advance, a period, moreover, so recent as to make it difficult to get a proper perspective. These difficulties might have daunted the most courageous, and we feel duly indebted to Dr. Green for undertaking the onerous task and providing us with so useful a summary of the work done during the latter half of the nineteenth century in so many fields of botanical research.

FUELS AND FURNACES.

Fuel and Refractory Materials. By Prof. A. H. Sexton. Second edition. Pp. x+364. (London: Blackie and Son, Ltd., 1909.) Price 5*s*. net.

THIS work deals generally with natural and prepared fuels, with coal-washing, recovery of by-products, the types of furnaces for metallurgical purposes, with the working of these furnaces in regard to the economical use of fuel, with the measurement of the high temperatures produced, and the commercial testing and calorimetry of fuels, as well as with the natural refractory materials and the apparatus made from these.

The book is packed with information on this very extensive subject, although it is a little loose in places, sometimes in expression, at others with regard to information given.

On p. 39 calorific power is defined as the heat evolved, which is ambiguous. On p. 59 coal is stated to be the only important fuel except natural gas and oil, but for much special Government work and for the higher class Sheffield steels, the irons made with charcoal fuel in Sweden and elsewhere are of the greatest importance; also, later, it is stated that charcoal *has* been used in blast-furnaces, whereas at least quite recently there was charcoal pig-iron being made in one blast-furnace in Cumberland, and it is also extensively made in such countries as Sweden.

The time-honoured diagrams of charcoal burning in piles remind one how they shocked the commercial sensibilities of a former student, who was also a Swedish ironmaster, as all the beautifully arranged trunks shown would, according to him, have been cut up into planks for sale, and visits to several charcoal-burning districts confirmed the statement.

Coalite, the product of the coking of coal at a barely visible red-heat, is just mentioned, and as this new departure in coking is creating such an amount of interest in the hope that it may help in the future to reduce the smoke produced in those worst of offenders, domestic fire-grates, one would have liked a little more said about coalite.

A good account is given of fuels generally, but the cost of illuminating gas is stated as varying from 2*s*. 6*d*. to 8*s*. per 1000, whereas in Sheffield it varies from 1*s*. 4*d*. to 1*s*. per 1000 cubic feet.

The description of the use of steam in producers is very well done, but the statement that no producer is satisfactory that allows any sensible amount of CO_2 to pass into the gas is too severe, as in ordinary works practice it is not feasible to reduce the CO_2 below 4 to 6 per cent. by volume, and there is no advice given on the important matter of the thickness of the bed of fuel that should be kept for normal working.

Silicon, manganese, &c., important fuels in metallurgical operations, are not mentioned.

In dealing with standards of temperature it is not clearly enough stated that the present accepted standard is the gas thermometer, and in the description of the Wanner pyrometer, the statement that

"W" is a Nicols prism will be apt to confuse the student. The resistance pyrometer is said to give the correct temperature to a tenth of a degree at 1000° C., but owing to the coating required to protect the platinum wire for most work, nothing like this accuracy will be obtained in practice. In speaking of the useful Féry spiral pyrometer, it is indicated that one of its objections is that it will only give "black body" temperatures, but surely this limitation applies to the other radiation pyrometers also.

The account of the manufacture of Sheffield steel-melting crucibles is not correct, nor is the statement (p. 346) that the crucible is "put to dry, after which it is used without firing," as these crucibles are subjected to a very careful firing, or annealing, on a very ingeniously designed annealing grate. Also, amongst the addition of non-plastic material added to enable the crucible to be made without cracking, are mentioned burnt clay, silica, and graphite; but in Sheffield work the material used is the best ground coke-dust, which not only has this effect, but by forming a solid skeleton to the material of the crucible at temperatures at which the fireclay material is quite soft, enables the crucible to stand the necessarily rough usage to which it is subjected during the making of crucible steel, without losing its shape. If from any little accident in the annealing of the crucible air has been allowed to impinge on any part of it so as to burn out the coke-dust, the crucible loses its shape at these portions, and is exceedingly difficult to manipulate.

The whole subject-matter of the book covers a very wide field, and these critical observations are not intended to indicate that the work will not be a useful one for students, but are only intended to set them on their guard in cases where it will be necessary for them to know the exact state of practical work, or to compare with other authorities where their own experience seems to differ from the statements made in the book.

A. McWilliam.

MEDICAL PARASITOLOGY.

A Handbook of Practical Parasitology. By Prof. Max Braun and Dr. M. Lühe. Translated by Linda Forster. Pp. viii+208. (London: J. Bale, Sons and Danielsson, Ltd., 1910.) Price 10*s.* 6*d.* net.

THIS is a handy and very useful work by two extremely competent authorities, and well worth translating into English for the benefit of medical men and others to whom the German language may present difficulties. The book is divided into three parts—(i.) Protozoa, (ii.) Helminthes, and (iii.) Arthropoda. Each of these sections begins with an introductory portion, in which, after a general account of the group, very full directions are given for its practical study, with an excellent summary of the most important and useful methods of technique. The group is then dealt with systematically, those forms most important for the purposes of the book being described in their place in the classification, and for each main subdivision a common and easily obtained type is described in detail with directions for procuring and studying it. The information given is in general accurate and up-to-date—the date, that is to say, of the German edition—and the figures are clear and well executed.

In the Protozoa the step is taken of abolishing the class Sporozoa and elevating its two principal subdivisions, Neosporidia and Telosporidia, to the rank of independent classes. The Neosporidia are placed immediately after the Rhizopoda, while the Telosporidia follow the Flagellata, but with subtraction of the Hæmosporidia, which are classified with the Trypanosomidæ amongst the Flagellata as the third order, Binucleata, of that class. In their treatment of these organisms the authors take up an advanced neo-Schaudinnian standpoint with regard to certain highly controversial questions.

The term Helminthes has no zoological significance, but is used in a sense convenient for medical requirements to comprise the Trematodes, Cestodes, Nematodes, and Acanthocephala; not, however, the leeches. In the section Arthropoda, which is a brief one, an account is given of the mites, Linguatulids, lice, fleas, and parasitic Diptera. The Arthropods which transmit parasites, such as ticks and "stinging-flies" (*sic*), are dealt with under the Protozoa.

The translation is, in general, clear, but some curious results arise from the translator's desire to anglicise scientific terms. It appears to be a rule with her to convert the termination "-idium," plural "-idia," into "-ide," plural "-ides," and the consequences are in many cases very puzzling. "Coccide," for instance, suggests a cochineal insect, but means in this book a coccidian parasite. No zoologist would ever guess the meaning of "Myxides," used to denote individuals of the common parasite of the bladder of the pike, *Myxidium lieberkühni*. Most zoologists, and many people who are not zoologists, are familiar with chromidia, disguised here as "chromides." In these and many other cases the meaning of the term used can only be inferred from the context or deduced from analogy. It is also very misleading to use the term "carnivori" to denote birds of prey (p. 60); "small-pox" on p. 32 should be carp-pox; and *Trypanosoma*, in the description of Fig. 14, should be *Trypanoplasma*. It is to be regretted that the eminent zoologists and others, to whom the translator expresses her indebtedness for assistance, did not correct these vagaries.

E. A. M.

POPULAR ASTRONOMY.

(1) *Astronomy, a Handy Manual for Students and Others.* By Prof. F. W. Dyson, F.R.S. Pp. vii+247. (London: J. M. Dent and Sons, Ltd., 1910.) Price 2*s.* 6*d.* net.

(2) *Chats about Astronomy.* By H. P. Hollis. Pp. vi+226. (London: T. Werner Laurie, n.d.) Price 3*s.* 6*d.* net.

MANY signs point to the fact that the popular interest in astronomy grows from day to day. Perhaps in revolt against the merely utilitarian the world will not willingly let die the least obviously practical of the sciences. The production of books, urged by this increased interest, and rendered necessary by the extraordinary modern progress of the science, is not behind the demand. That diverse tastes and capacities have to be catered for is clearly seen in the characters of the above books. The first, condensed, but logical and lucid, will appeal essentially to the lover of astronomy having a mind comparatively trained to precise thinking, while the second frankly provides for the reader who needs spoon-feeding, and likes printed talk.

(1) A simple account of the methods and results in astronomy, without unnecessary detail, and clearly stated for the student and general reader, is the aim and in great part the achievement of this handy little manual. Such faults as the book possesses spring mostly from a too great conciseness. In such subjects as the finding of the solar parallax and the estimation of the distance of the Milky Way, it is better to keep in mind the weaker brethren than the resolute student. Too great economy of words ceases to be a virtue. Jumps, however, requiring undue intellectual effort on the part of the reader are not of frequent occurrence, while the general precision and clarity are ample compensations.

The work is comprehensive in scope, embracing the ancient astronomy and its development through the Copernican system to the most modern outlook on the universe. Recent work on astrophysics, the more intimate study of suns, near and far, is effectively presented. Very few mistakes have been noticed, though what seems an erroneous inference from diagram lxxxiv. leads to the inversion of the relative masses of Sirius and its companion, while it might be inferred from a statement on p. 116 that a magnetic field is a property of all sun-spots. This certainly is not proven.

The reproductions are effective and well chosen, and the diagrams, while efficient, have a home-made look about them which is quite pleasant, though the practice of using Roman numerals to indicate them seems wholly without virtue. An efficient and tasteful binding and handy format are further recommendations for a remarkably cheap book.

(2) Though dealing somewhat discursively with such parts of astronomy as are of most popular appeal, the common sense and individuality of the writer prevent the treatment from becoming banal. To the man in the street interested in the phenomena of the skies, the book may be recommended, and he will no doubt read it with interest and profit. In great part the author restricts himself to the realm of naked-eye astronomy. Both the manner and matter and the definiteness with which the subject is treated suggest and encourage a practical acquaintance with the phenomena on the part of the reader. The earth and its movements, stars and planets, sun-spots and comets, and the changes of the moon are among the subjects informingly and chattily dealt with. A brigbtly and amusingly written chapter on astronomers and their work gives an excellent account of a much misunderstood profession. The inset reproductions are sufficiently good, but the general appearance of the book might certainly be improved.

MARINE BIOLOGICAL RESEARCH IN BRITISH SEAS.

(1) *Bulletin Trimestrie: Conseil Permanent International pour l'Exploration de la Mer. Résumé des Observations sur le Plankton des Mers explorées par le Conseil pendant les Années,* 1902–1908. Edited by H. M. Kyle. Part i. Pp. xxxiv+79, and 10 plates. (Copenhague: And. Fred Høst et Fils, 1910.)

(2) *The Decapod Natantia of the Coasts of Ireland.* By Stanley M. Kemp. Scientific Investigations, 1908, Department of Agriculture and Technical Instruction for Ireland, Fisheries Branch. Pp. 190+23 plates. (Dublin: 1910.) Price 3*s.* 6*d.*

(3) *Report of a Survey of the Trawling Grounds on the Coasts of Counties Down, Louth, Meath, and Dublin.* By E. W. L. Holt. Part I., Record of Fishing Operations. Scientific Investigations, 1909, No. 1, Department of Agriculture and Technical Instruction for Ireland. Pp. 538+2 plates. (Dublin: 1910.) Price 3*s.*

(1) IN 1908 the International Council resolved to prepare a report on the plankton work carried out by tbe countries participating in the international fisheries investigations, and the present bulletin contains the first instalment of tbis report. The bulletin begins with lists of the stations and times of investigation, and of the kinds of nets employed and the occasions on which they were worked. Special reports are then given, in which various specialists deal with the annual and seasonal abundance of the main groups of animal and plant organisms represented in the catches. The groups so far summarised are the Tintinnoidea, Halosphæra and Flagellates, Cladocera, Pteropoda, and Copepoda. Following these special reports are synoptical charts representing the abundance and seasonal distribution of the commoner species contained in the groups studied. The material thus summarised is very considerable; 332 stations in all were worked, some 14,000 hauls were made, and altogether about 800 species of planktonic organisms were identified. It is evident, however, that the deduction of general results from this mass of material has been a difficult task. The coordination of the observations has been imperfect from the first; many changes have been made, and there has been confusion in the choice of methods of investigation. Nevertheless the results obtained are of very great value, and general facts of distribution in relation to the physical changes taking place in the sea emerge clearly from the study of tbe data. The report provides a concise and valuable summary of this extensive investigation.

(2) This is a minute and careful account of forty-seven species of decapod natant Crustacea (fifty-four in all are recorded from the entire British sea-area) collected by the Irish Fishery cruiser *Helga* off the coasts of Ireland, the main localities investigated being Rathlin Deep, the Irish Sea between Dublin and the Isle of Man, the deep water of Counties Cork and Kerry, and the region near the Porcupine Bank. The report, which is a valuable addition to our knowledge of the British marine fauna, includes full details of

the localities fished, as well as the physical conditions of the sea during the operations. The economic aspect of the research is not neglected.

(3) This is the first instalment of the results of an extensive survey of the Irish fishing-grounds, which is now being carried on by Mr. Holt and his colleagues. It is well known to those engaged in actual fishery administration that mere statistics of the quantities of fish landed at the ports afford, in themselves, information of very little value for a rational regulation of the industry. Fishery authorities competent to their work must obviously obtain at first hand a knowledge of the natural conditions of the sea areas under their control, and this has been the object of the Irish survey. The observations recorded are those of fishing operations carried on by the cruiser *Helga* at such times as her attention was not being directed to the detection of predatory trawlers; they include lists of the fishes present on the fishing-grounds visited, with the numbers taken per haul, and the individual measurements of those caught. It is quite impossible to summarise the results here stated, but one may say with confidence that the report is a contribution of essential value for a real understanding of the natural conditions of the British fisheries. J. J.

OUR BOOK SHELF.

Science in Modern Life. Prepared under the editorship of J. R. Ainsworth Davis. Vol vi., Engineering. By J. W. French. Pp. vi+225. (London: The Gresham Publishing Co., 1910.) Price 6s. net.

THE first half of this book is devoted to the various systems of power production, and the other half to the application of such power to the manifold needs of mankind; there is also a short account of the properties of, and the modern methods of manufacturing on a large scale, the chief materials used in constructional work.

In a book of this nature, which is evidently intended to give non-technical readers an intelligent idea of the remarkable work done by the engineer in providing for the varied daily needs of communities living under the complex conditions of civilised life, it is a pity that space should have been given to descriptions of machines and methods which are obsolete, and are only interesting from the historical point of view. In dealing with high-speed engines, there are two illustrations and some amount of letterpress devoted to the Willans and Robinson central valve engine, which is no longer made, though, of course, such engines are still to be found in generating stations and factories where they were installed some years ago, and where they will remain until unfit for further service; it is, however, an obsolete type. In discussing water-tube boilers Mr. French states that "of these types the most extensively adopted in the navies of the world is the Belleville water-tube boiler." This is incorrect; no recent British warship has been fitted with this steam generator, which did not prove altogether satisfactory.

That the section which deals with the applications of power is well up to date is shown by the chapter dealing with aërial navigation and hydroplanes. The latest types of machines are described and discussed. The cable-way illustrated on p. 127 was used in connection with the building of the new low-level lighthouse at Beachy Head, and not, as stated, for the Eddystone Lighthouse.

There are a dozen excellent plates, and about 600 other illustrations, which will greatly increase the utility of the book to those readers who are not familiar with such technical matters. T. H. B.

Vegetationsbilder. Edited by Prof. Dr. G. Karsten and Prof. Dr. H. Schenck. Eighth series. Part 1. Trockensteppen der Kalahari. F. Seiner. Part 2. Von den Juan Fernandez Inseln. Carl Skottberg. Part 3. Die schwäbische Alp. Otto Feucht. Part 4. Aus Bosnien und der Herzegovina. L. Adamovič. Parts 5–6. Die Flora von Irland. Prof. T. Johnson. With six plates in each part. (Jena: Gustav Fischer, 1910.) Price 4 marks each part.

THE eighth series has progressed rapidly, as six parts have been published within the year. For the first time the British Islands is represented, namely, in the double part dealing with the flora of Ireland, arranged by Prof. Johnson. It would be difficult to improve on the subjects chosen, which include *Arbutus unedo*, one of the original forest trees, *Erica mackaii*, *Erica mediterranea*, *Daboecia polifolia*, *Euphorbia hibernica*, *Eriocaulon articulatum*, and *Eryngium maritimum*. All the photographs are excellent, and the number takes rank among the best. European countries are also represented in the pictures of the plant associations of Bosnia and Herzegovina, contributed by Prof. L. Adamovič, and those illustrating the Swabian Alps, provided by Mr. O. Feucht. Naturally the magnificent spruce, *Picea omorika*, endemic to Bosnia, is selected by Prof. Adamovič for illustration, and another subject is *Pinus leucodermis*; other photographs portray associations on the chalk, serpentine, and screes. The slopes and cliffs of the Swabian Jura are rich in calcicolous plants, of which *Saxifraga aizoon* and *Saxifraga decipiens* are two of the most prominent; the illustrations of *Laserpitium Siler* and of Juniper trees about eight feet high also attract attention. The part devoted to the Kalahari desert contains photographs of the well-known trees *Copaifera mopane*, *Copaifera coleosperma*, *Kigelia pinnata*, and *Acacia haematoxylon*, in their natural habitats; a remarkable large shrub, *Sesothamnus Seineri*, discovered by the author, presents striking xerophytic characters. Dr. C. Skottsberg illustrates a number of endemic plants. *Boehmeria excelsa*, a tree growing to a height of eighteen feet, *Juania australis*, a pinnate-leaved palm, *Gunnera palmata*, and a strong root-climbing fern, *Arthropteris altescendens*, are confined to the island of Masatierra; scenes from the island of Masafuera show forest of *Myrceugenia Schultzei* and the tree fern, *Dicksonia berteroana*.

Light Visible and Invisible. By Silvanus P. Thompson, F.R.S. Second edition, enlarged. Pp. xiii+382. (London: Macmillan and Co., Ltd., 1910.) Price 6s. net.

THE first edition of Prof. Thompson's popular book was reviewed at length in NATURE of March 31, 1898 (vol. lvii., p. 506). To the new edition have been added chapters on radium and the manufacture of light, the latter being the lecture given to a popular audience at the meeting of the British Association at York in 1906. We have little doubt that with these additions the volume will continue to be read widely.

A Home-work Atlas of Maps in Black and White. Edited by Prof. L. W. Lyde. Pp. 15. (London: A. and C. Black, 1910.) Price 1s.

THESE simple maps, showing in a striking way the essential facts of the geography of each of the continents, should prove of real use in schools to give pupils guidance as to how, when answering questions, long verbal descriptions may be saved by judicious diagrams.

LETTERS TO THE EDITOR.

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

British Marine Zoology.

PROF. MACBRIDE'S letter in NATURE of September 15 does not require a detailed answer, as some of his statements are merely matters of opinion; but there are a few points on which I should like to comment..

(1) Prof. MacBride says we are unable to support properly one biological station, and that he does not see how we "could be expected to support two"—the second being evidently that proposed by Mr. Pace. But why does he try to ignore the three or four other existing stations? They are all supported; some of them, so far as regards students and researchers, are very well supported indeed.

(2) When he refers to some biological station as an "expensive toy," which in his experience its local friends "soon tire of supporting," one would like to ask of what station he is writing? The statement does not seem to apply to any of those mentioned.

(3) It is difficult for one who has followed the work of the U.S. Bureau of Fisheries Laboratory at Wood's Hole to understand Prof. MacBride's words in regard to it. He says it is "devoted entirely to economic work." A moment's thought of the scientific researches issued from that laboratory by Sumner and others shows the inadequacy of such a description.

(4) As to the Canadian stations, again I think Prof. MacBride does but scant justice to praiseworthy efforts. The western station at Nanaimo was visited last September by a party of biologists from the British Association, who were, to say the least, more appreciative than Prof. MacBride.

But the main thing I want to say is that Prof. MacBride, both in his original article and in his reply to my criticism, has, it seems to me, a false ideal. Expensive equipment, large funds, increased support—these are his keynote; and not a word is said as to a rich and varied fauna, physical features affording natural facilities for research and sympathetic personal service—the factors in the case that give character and tradition to a biological station.

W. A. HERDMAN.

IT would be interesting to know what biological stations Prof. MacBride had in mind when writing the letter which appeared in NATURE of September 15.

Prof. MacBride states that it would be better to concentrate scientific support on one station than to have it spread over a number of stations poorly provided with funds and with staff, and, *ipso facto*, incapable of really first-class work. Surely there is more than one station in Great Britain which is capable of affording opportunities of first-class work, and I venture to think that the number of workers attending some of the smaller stations is ample proof of their usefulness.

The case cited by Prof. MacBride, of Chicago students travelling 1000 miles to Wood's Hole, will, I am afraid, not help many of our Liverpool students to attend vacation courses other than those held now at Port Erin, and Chicago students would have to travel nearly 1000 miles in any case to reach the sea.

There is, to my mind, a great advantage in having biological stations near to our universities, so that it is possible to reach them quickly and frequently. Such stations would serve the departments of zoology, botany, physiology, and biochemistry, and the staff of these departments would feel more at home there than at some station which was only visited at odd times, and in the control of which they would not be so immediately concerned. As a result there would be more encouragement for students to work at these laboratories, and little time lost in preparation.

With regard to the economic side of the controversy, one might quote from a paper by the director of the Fisheries Laboratory at Wood's Hole:—"But the life of the sea is an interrelated whole. Hence the futility of endeavouring, even on economic grounds, to restrict our investigations to food fishes or other animals of obvious commercial importance."

WM. J. DAKIN.

Port Erin Biological Station, September 19.

THERE are one or two matters alluded to in Prof. Herdman's and Mr. Dakin's letters on which I should like to say a word or two.

(1) I had no desire to ignore existing biological stations other than Plymouth, but, until Mr. Pace's circular appeared, I think I am correct in saying that the Marine Biological Association was alone in making its appeal for support to all the zoologists in the United Kingdom. The other stations depend on local support.

(2) The curiosity of Mr. Dakin and Prof. Herdman as to the particular station which "local friends tired of supporting" is, I think, uncalled for. Prof. Herdman's unrivalled acquaintance with biological institutions in this country surely includes acquaintance with a station which has been closed.

(3) I held up the station at Wood's Hole as an example of a laboratory devoted to purely scientific ends, and supported solely by professional biologists. That valuable scientific work of general interest occasionally issues from the laboratory of the U.S. Bureau of Fisheries, which was founded and is maintained for research on economic lines, is totally irrelevant.

(4) As to my want of appreciation of "praiseworthy efforts" in Canada, is Prof. Herdman aware that every cent of expense in connection with all three stations in Canada is borne by the Federal Government, which also pays the travelling expenses of workers?

Finally, in regard to "ideals," I would in all modesty oppose my experience to that of Prof. Herdman. For the last twenty years I have been engaged in zoological research. On a good many occasions I have visited small biological stations, but the only stations where I have been able to bring research to a successful issue are those of Naples and Plymouth, which in the matter of boats and apparatus are thoroughly equipped, and which in the matter of "sympathetic personal service" are very near perfection. A biological station where senior students can handle living animals is one thing, and one where advanced research can be done is another. In Plymouth we possess a station of the second kind, certainly, to say the least, better equipped than any other in the kingdom. It will be a thousand pities if it has to curtail its usefulness for lack of support. It was this strong feeling of the absolute necessity of a well-equipped laboratory which led me in 1906, after several summers of futile attempts to utilise the small movable laboratory, to make the motion at the meeting of the Biological Board in Ottawa which resulted in the building of the permanent station at St. Andrews, New Brunswick.

E. W. MACBRIDE.

The Spotted Kudu.

IN the *Times* of September 23 and the *Field* of September 24 (vol. cxvi., p. 607) I have given preliminary notices of the skull and skin of a hitherto unknown kudu shot by Mr. Ivor Buxton to the west of the Arusi plateau of Gallaland, in the Sahatu Mountains, and south-east of Lake Zwei, at an estimated height of 9000 feet above sea-level. As the owner has promised to present the specimen to the British Museum, I take this opportunity of making it the type of a new species.

The specimen is an adult bull, its full age being indicated by the worn condition of the cheek-teeth. The head, neck, and body are covered with coarse dark-brown hair, much more like that of a Kashmir stag or a mule-deer than that of either of the striped kudus, and the fronts of the legs are dark greyish-brown, and the remainder grey. The throat and chest lack the abundant fringe of long hair characteristic of the typical kudu, but are marked by two broad patches of white, one above the other, while the body-skin shows large white spots on the flanks and hindquarters, but no kudu-like stripes. The face has the usual tragelaphine white markings. The horns are of the kudu-type, but with a much more outward direction, and are greatly inferior in length to those of the typical species, their tips being worn to a yellow straw-colour, as in the nyala and situtunga. They have also a more distinct back ridge than in other kudu horns, and thereby again approximate to those of the two last-named species; while the bony cores have no ridge corresponding to that on the sheaths. The skull has a transverse diameter of $4\frac{1}{2}$ inches across the orbits, and a contour length of $15\frac{1}{2}$ inches, the corresponding dimensions in a skull of the typical species with horns of the same length being $5\frac{1}{2}$ inches and $14\frac{3}{4}$ inches.

The spotted kudu, as I have called the new species, is in great degree intermediate between other kudus and the situtunga and nyala. It agrees approximately in size with the typical kudu, but in horn-characters is to a certain extent intermediate between that species and the situtunga or nyala. In the presence of a white patch on the throat and a second on the chest it resembles the lesser kudu and situtunga, as it also does in the absence of a neck frill; but in its long, coarse, dark, and white-spotted coat it comes much nearer male situtungas and nyalas than to either of the striped kudus. The ears are rather narrower and more pointed than in the typical kudu.

I propose to name the species *Strepsiceros buxtoni*, reserving for future consideration the question whether this species does not render it advisable to merge the genus Strepsiceros in Tragelaphus. If that course were adopted, the typical kudu would become *Tragelaphus strepsiceros*, the lesser kudu *T. imberbis*, and the spotted kudu *T. buxtoni*.

R. Lydekker.

The Habits of Worms.

So little is known about the habits of worms that it seems desirable to place on record any new observation calculated to throw light on the subject. On September 17 I received from Mr. Edwards, curator of the Worcester Museum, a small tube containing about half a score of living worms. The letter which accompanied the tube informed me that the worms were found in a lavatory basin. It was assumed that they had found their way up through the waste-pipe, as none had been found when the plug was fixed in the bottom of the basin. The worms were taken in the morning when the plug was not inserted, and when the water had been very slowly dripping all night. They were found singly, but when placed in a tube coiled themselves into a ball, and were difficult to separate. Each worm was about three-quarters of an inch in length, possessed of red blood, and having five to eight setæ in each bundle. These features, together with the shape of the brain and spermathecæ, show the species to be *Pachydrilus subterraneus*, Vejdovsky. It was first described in 1889, and on April 8, 1892, I received it from the late Dr. Plowright, of King's Lynn. This was the first British record; but it has since been found by Mr. Southern and myself in various parts of the British Isles. It was obtained by Prof. Vejdovsky from the underground waters of Lille and Prague, and has more than once been sent to me by irate persons who complained that it had been found in their drinking water.

Pachydrilus (Lumbricillus) belongs to the large and important order of enchytræids, some of the species of which are parasitic upon plants, while others feed on decaying leaves and vegetable matter, and yet others live in the water. As I am preparing a monograph of British annelids for the Ray Society, I am exceedingly anxious to obtain information and materials for making the work complete, and shall be grateful if observers will submit specimens of annelids of all kinds for identification, together with observations of their habits.

Hilderic Friend.

Swadlincote, Burton-on-Trent.

Erasmus Darwin on Flying Machines.

Prof. Meldola's reference to Erasmus Darwin's prophecy of flying machines (p. 370) omits the most remarkable proof, as it seems to me, of his insight into the future. The verses which he quotes are from Canto I., lines 289–96, of the "Botanic Garden"; on line 254 there is a note in which occurs the following passage (the italics are mine):—

"As the specific levity of air is too great for the support of great burthens by balloons, there seems no probable method of flying conveniently but by the power of steam, *or some other explosive material*, which another half-century may probably discover."

University College, London. Arthur Platt.

CAUSAL GEOLOGY.[1]

In science there can be no orthodoxy, and consequently there are no heresies. Prof. Schwarz's book will be read and circulated, instead of being burnt as a danger to established modes of thought. It will bring, in consequence, a freshness to those who have repeated, year after year, the same explanations of phenomena in their courses of instruction. They will feel much like the humdrum banker, who thinks that he really understands his business, until his son takes him one evening to the theatre, and he meets for the first time with the ideal villains of finance. The planetesimal hypothesis of Chamberlin is held by the present author to enable "one to build up a system of geology without an appeal to the unknown and the unknowable" (p. v). "Unknowable" is a rash word; but there is a good deal more of the unknown than of the known in the explanations of earth-structure put forward by Prof. Schwarz. We remember a paper of his, in which the former boundaries of continents and oceans were ingeniously deduced from a rock-fragment discovered in a southern isle. The present work includes speculations of a similar order of magnitude, but the underlying facts are marshalled more strategically, and far bigger battalions are brought into the field.

The planetesimal hypothesis, as developed by Prof. Schwarz, leads him to the conception of a cold earth, steadily growing in bulk by the accretion of meteoritic, or, as he prefers to write it, meteoric matter. The phenomena of the surface cannot, then, be caused by shrinkage of the interior, nor can volcanic action be ascribed to general internal heat. Earth-movements (p. 189) are said to develop sufficient heat to vaporise water in the crustal layers affected by them; all this water has crept down by capillary action from the surface, and may form outbursts of steam, shattering the sedimentary rocks around the orifice. If the heat generated is sufficient to melt the sediments, the product, with the water in it, appears as an ordinary upwelling of lava.

From the author's point of view, all gneisses and granites are derived from sediments by metamorphism in dissolving waters, or by actual melting (pp. 40, 221, &c.). The ultrabasic vents of Kimberley and Pretoria, so well known as the diamond-pipes, contain "meteoric matter of the centrosphere" (p. 198), since here faulting was sufficiently profound to melt up the ferriferous masses that underlie the ordinary crust. The faulting is accounted for by the transference of sedimentary matter from one part of the surface to another, the overladen rocks flowing away under the pressure; and we are given to understand that melting, with production of granite domes, or of lava ready to arise in fissures, takes place where water is present, and where the pressure is most intense, instead of where pressure is relieved. A fine instance of revivalism in geology appears on p. 227, where Prof. Schwarz, rejecting Darwin's observations in South Africa, and *lit par lit* injection generally, urges that "thin laminæ of granite substance bedded in between metamorphosed sediments" may result

[1] "Causal Geology." By Prof. E. H. L. Schwarz. Pp. viii+248. (London: Blackie and Son, Ltd., 1910.) Price 7s. 6d. net.

from the sediments "changing into granite in the ultimate expression of metamorphism."

It would be unfair, however, to judge the author's powers of observation from this or by his more startling propositions, such as that of the reconstitution of sand-grains on p. 140. The fact that he has seen so much throughout South Africa, in a country laid bare by nature for the geologist, entitles him to a serious hearing. The emphasis that he lays on the descent of ore-material from the surface (p. 11), and on the ascent of calcium carbonate from below, recalls at once the tropical rains, and the "pans" upon the desiccating surface. But surely, as Mr. Mennell has lately pointed out in his "Petrology," there is abundant evidence of the accumulation of iron-ores under African conditions at the surface. The whole siliceous crust, however, according to Prof. Schwarz, is a residue from the leaching-out and down-sinking of iron and magnesium from the primitive meteoritic matter. The silica was first set free from this matter in a colloidal form which consolidated as chert. Quartz arose only by metamorphic action in the depths (p. 39). When we are told that chert is not crystalline, and when we reflect on the quartz deposited in cavities from solution, as is the case in limestones which retain all their fossils, we cannot help thinking that our author's earlier studies have been temporarily overcast by a cloud of planetesimals. The careless writing of some sentences suggests that the work has been pushed forward with something of the heat of a new gospel. The word "meteorite" is thus missing in the middle of p. 10; cubes of salt are said to be present (p. 57) in the "bubbles in granitic quartz"; to most field-workers the Archæan masses (p. 69) cannot seem "characterised by the enormous development of limestone"; when carbon dioxide is included in an analysis of the air, the omission of argon and its allies can hardly be excused (p. 93) by their "minute proportions"; Fig. A, a lunar area, opposite p. 22, should surely be inverted to agree with its description; and, to come to smaller matters, grammar is imperfect on pp. 3, 131, 145, and 200.

Boulder in Dwyka Conglomerate, Prieska, illustrating lateral flow in rocks under pressure. From "Causal Geology."

Yet we again and again respect Prof. Schwarz's grasp of geological literature, writing as he does in a small South African town, and his preface shows that he is still to be ranked among the inquirers, and not as the apostle of a dogma. Probably we also have been the gainers, if, after reading his well-printed and well-illustrated book, we feel that we know less than before concerning the constitution of the globe.

GRENVILLE A. J. COLE.

THE BRITISH SECTION OF THE BRUSSELS EXHIBITION.

THE importance of a Government department to deal with exhibitions could not have been better exemplified than when the King of the Belgians opened the new British section of the Brussels Exhibition on September 19. Exactly five weeks previously the section which had cost so much in thought, time, and money was reduced to a smoking mass of ruins. For a moment everyone was stunned by the extent of the loss, but within a few hours it had been determined to rebuild the section provided the reply received from previous exhibitors was satisfactory. The replies were not only satisfactory, but almost overwhelming; in fact, more space was applied for than the Commission had at its disposal.

But the rebuilding of the section was only rendered possible by the Belgian Commission placing at the disposal of the British organisers the *Salle des Fêtes*. This building was originally used for holding large congresses and meetings, and had a platform and a sloping auditorium, the side alleys being divided up into reception and cloak rooms. All the internal fittings of this building have been removed, and it has been divided up into courts in a most artistic fashion, the various courts radiating out from a central transept.

The space of the original building was 150,600 square feet; the present space is only 35,500 feet; but this fact made it difficult rather than easy to design and fit up the new section, owing to the large number of exhibitors who desired space. How rare is it for an exhibition to be ready for the opening day, even after months have been spent in collecting the exhibits! But although the work was enormous, the new section arose from the ashes in the space of five weeks, and the whole exhibit, with the exception of one or two cases, was absolutely finished when the King of the Belgians opened it. Not only was the exhibit finished, but the new catalogue, "Catalogue Officiel de la nouvelle Section Britannique," was ready on the same day for distribution. Without the machinery of the committees organised by the Royal Commission of the Board of Trade it would, however, hardly have been possible to have accomplished this feat.

In declaring the new section open, and replying to Sir Arthur Harding, the King said: "Your Excellency has associated the British and Belgian people in the eulogy which you have made in such happy terms of the work of repairing the disaster caused by the fire. Certainly the Belgians have displayed in that work their fine qualities of courage and perseverance which no misfortune can daunt, and I congratulate them upon it highly. But what shall I say of the English—of the Government as of the exhibitors—who, in reconstructing in the space of a few weeks a section as beautiful and interesting as anyone could possibly wish for, have once more shown of what that unconquerable tenacity, the characteristic of the British Empire, is capable. I find no words to express to Your Excellency my admiration and my gratitude."

One of the most interesting exhibits is that of the Thermal Syndicate. The articles are manufactured at the high temperature of the electric arc, and it is of particular interest to notice that even the intense heat of the conflagration had no effect upon the silica ware. In the new section, tubes and pipes which had been through the fire are exhibited alongside of articles freshly manufactured. These tubes have glass fused to them, but, except for slight discoloration, are absolutely uninjured by the ordeal through which they have passed.

Although Messrs. Johnson and Matthey have not been able to exhibit again, it should be mentioned that the transparent silica shown by them in the original section was also in no wise injured by the heat, although much of it was broken by the falling *débris*. The writer found pieces of platinum exhibited by the same firm absolutely embedded in fused glass, which gives a good idea of the intense heat to which everything in the burning building was subjected.

As showing the resource of energy of some of the exhibitors, mention should be made of the pottery exhibit of Mr. Bernard Moore. A large vase is shown which has been designed and manufactured since the fire and bears a commemorative design—a phœnix rising from the flames with the motto *Quod ignis debit incendium abstulit*. The Pilkington Tile and Pottery Co. also shows a commemorative vase. This is of particular interest, because it shows a new lustre which has not been discovered more than three months.

The International Salt Co., Ltd., shows salt purified by a new process. The salt is fused and air blown through it, the impurities separate out, and the pure salt is run off. Whether this process will be able to compete against the older process remains to be seen, but at least it is interesting.

Owing to the exigencies of time and of space, it has not been found possible to instal again completely the very fine display of scientific instruments and of chemical products which was shown in the original section, but the chemical court makes quite a good display. The section, as a whole, is a splendid example of what can be done by organisation and the courage which knows no defeat.

It should be mentioned in closing that the advances due to recent science have been found to be of the utmost value in the cutting and removal of the tangled mass of iron-work which is all that remains of the burnt-out parts of the exhibition. The cutting of even thick girders is done entirely by burning with the oxyhydrogen flame, and it is extremely interesting to notice how rapidly it is possible to work by means of this method.

F. MOLLWO PERKIN.

MATHEMATICS IN AUSTRIA.

AS the result of an educational conference, convened at Vienna in 1908, changes of considerable importance have been made in the curriculum of the secondary schools of Austria. At the instance of the Board of Education, the mathematical syllabus issued in 1909 for the Austrian Gymnasien has been translated into English, and it deserves the thoughtful consideration of all those who are interested in the efficiency of our own educational system. It comes at an opportune moment and forms a useful contribution to all the discussions and experimental investigations of the last few years, which should provide a sound foundation for the work of the International Commission on Mathematical Teaching, which will report to the congress at Cambridge in 1912. We do not propose to examine this pamphlet in detail, but it may be useful to note some of its salient features.

Although in recent years the theoretical has been replaced by the practical in our secondary schools to a degree which many have considered dangerous, it is clear that far more drastic measures have been adopted by the Austrian authorities. The course of arithmetic is limited to multiplication and division of decimals, contracted methods, proportion and interest. There are few who will not admit that the time spent on mixtures, discount, stocks, and the various other specialised arithmetical problems, which occupy so large a space in our text-books, might be employed to far greater advantage. At present only a small proportion of boys ever obtain a working knowledge of the elements of trigonometry and the calculus. Reform in this direction is badly needed, but it is almost impossible for changes to be made in the school curriculum so long as the various examining bodies, and in particular the Oxford and Cambridge joint board and the Civil Service Commissioners, continue to require a standard in arithmetic, which can only be attained by a large expenditure of time. There is much to be said for omitting altogether the arithmetic paper from these examinations, but, if this should be regarded as too extreme a measure, we are profoundly convinced of the desirability of restricting it to simple questions on the laws of the subject; the time thus saved would be devoted to numerical trigonometry, and consequently it would be reasonable to expect from candidates for such examinations as the leaving certificate or army qualifying an elementary practical knowledge of trigonometry. It would be difficult to exaggerate the benefits which would result from such a change as this, and we do not doubt that it will come, although not in the near future.

The next feature of interest is the importance which is attached to the idea of functionality.

"The notion of Function is recognised as the idea which differentiates higher from elementary mathematics, and a full grasp of it is held to be the proper aim of school teaching . . . the habit of looking at variable quantities as varying *continuously* and in obedience to *law* is to be fostered from the beginning."

Experience shows how slow is the growth of appreciation of this conception, but the sphere of its operation is so extensive and its application so stimulating that it well repays the effort required. If the graphical work in algebra is not designed to illustrate this principle, it is reduced to a valueless mechanical operation.

The last noteworthy variation is the combination of plane and solid geometry throughout. The cultivation of the power of thinking in three dimensions receives far more attention on the Continent than in England. Many even of those who win mathematical scholarships at our universities have no knowledge of the rudiments of practical solid geometry. There are signs, however, of change in this direction, and the value of an elementary course on plan and elevation of simple solids is being gradually realised.

Enough has been said to show that the guiding principles of this syllabus are progressive and eminently practical, and the Board of Education have done well to render it accessible.

NOTES.

The Thomas Young lecture of the Optical Society will be delivered in the lecture hall of the Chemical Society this evening by Prof. R. W. Wood, of the Johns Hopkins University, Baltimore, U.S.A. The subjects will be "The Echelette Grating" and "The Mercury Telescope."

Lieut. Filchner, the German explorer, in an address at the meeting of German naturalists and physicians at Königsberg, announced, says Reuter, that the start of his Antarctic expedition could with a certainty be fixed for the spring of 1911. He has agreed with Captain Scott, who starts from the Ross Sea for the Pole, while Lieut. Filchner's base will be the Weddell Sea, that, if the expeditions meet in the centre of the Antarctic, some of Captain Scott's party shall join his and accompany him to the Ross Sea, and that some of his party shall go with Captain Scott to the Weddell Sea.

We learn from the *British Medical Journal* that the fifth International Dairy Congress, which will be held in Stockholm in 1911, offers a prize of 20*l.* for the best essay on the nutritive value of raw milk as compared with that of pasteurised, sterilised, or evaporated milk, determined, at least in part, by experiments made upon infants. In case the raw milk is found to give the better results, it is requested that the *rôle* played by the enzymes of the milk be determined if possible. The papers, which may be written in German, French, or English, and typewritten, should be sent before April 1, 1911, to the Secrétariat-général de la Fédération internationale de Laiterie, 23 rue David Desvachez, Bruxelles, Belgium.

The observatory of the Hampstead Scientific Society is now in full working order. It is equipped with an 8-inch equatorially mounted reflector telescope, which may be used by members of the society on any evening by arrangement with the secretaries, and by the public on Saturday evenings. A special meeting of the astronomical section of the society will be held on October 5, at 8.30 p.m., at Stansfeld House, Prince Arthur Road, Hampstead, when a paper on Saturn will be read. For several successive evenings following the observatory will be devoted to demonstrations on Saturn. Inquiries may be addressed to Mr. P. H. Hepburn, one of the honorary secretaries of the astronomical section, 49 Downshire Hill, Hampstead.

The Marconi Wireless Telegraph Company announces that it has received a Marconigram from the Italian Lloyd steamship *Principessa Mafalda* stating that Mr. Marconi, who was on board, has been successful in obtaining wireless messages from Clifden, Ireland, and Glace Bay, Canada, stations up to a distance of 3500 miles, in broad daylight. A kite was used for the support of the aërial wire on the vessel, and, except for encountering high wind, which stopped kite-flying, Mr. Marconi is confident that a greater distance would have been achieved. The distance easily excels all accomplishments in the reception of wireless messages on shipboard in the daytime, the greatest previous distance at sea being 1750 miles.

The Berlin correspondent of the *Times* announces the death, in his sixty-fourth year, of Prof. Theobald Fischer, professor of geography in the University of Marburg. Prof. Fischer made valuable contributions to the knowledge of the structure of the plateau of the Atlas; and the results of most of his researches are to be found in *Petermann's Mitteilungen* and in the Proceedings of the Hamburg Geographical Society. He was the author of a work on the peninsulas of southern Europe in Kirchhof's "Länderkunde Europas," and of books on the date palm (1881) and the olive (1904).

M. G. Chavez was successful on Friday, September 23, in making a flight with a Blériot monoplane across the Alps from Brigue to Domo d'Ossola, but he had the misfortune to meet with a severe accident when landing, from the effects of which he died on Tuesday, September 27. To traverse by aëroplane a distance of about thirty miles of snow-covered mountain, including the Simplon, which reaches a height of 6600 feet, is a notable achievement, even though it has a sensational aspect. M. Chavez started at 1.30 p.m., and reached Domo d'Ossola at 2.19; over the Simplon Pass he encountered a very high wind, which caused him to take the route over the Gorge of Gondo instead of going by the shorter route over the Mousoera Pass. When quite near the landing place at Domo d'Ossola the wings of the monoplane appear to have broken, and the machine fell to the ground with M. Chavez beneath. Everyone will regret that the remarkable feat of crossing the Alps by aëroplane should have had such a melancholy termination. M. Chavez is the fifteenth airman who has been killed by flying accidents this year.

We record with regret the death, on September 16, of Mr. Hormuzd Rassam, at the age of eighty-four years. Mr. Rassam in 1845 joined Mr. (afterwards Sir) A. H. Layard to assist him in his Assyrian researches. He was sent out again by the trustees of the British Museum in 1849 to take part in Layard's second undertaking, and carried on work for the British Museum until 1854. In 1864 he was selected by the British Government to proceed to Abyssinia to try to persuade King Theodore to release Consul Cameron and other prisoners. Though at first he met with success with King Theodore, he was, after a few months, thrown into prison with the original prisoners, who had been retaken, and he was kept in chains for nearly two years. The occurrences led to the war with Abyssinia in 1868. Mr. Rassam conducted further Assyrian explorations from 1876 to 1882, and during the Turko-Russian war he was sent to Asia Minor, Armenia, and Kurdistan by the British Foreign Office. Among his published works may be mentioned "British Mission to Theodore, King of Abyssinia, with Notices of the Country Traversed from Massowah through the Soudan, the Amhara, and back to Annesly Bay from Magdala," two vols., and "Asshur and the Land of Nimrod."

The second International Congress of Alimentary Hygiene will be held in Brussels on October 4–8. In addition to the usual meetings of sections, the following lectures are included in the provisional programme:—Tuesday, October 4: Prof. Dastre, "The Ultra-violet Rays and their Application to Alimentary Hygiene"; October 5: Prof. Paterno, "The Chemical Sciences"; October 6: M. Bordet, "Hygiene and Bacteriology." Various social functions and visits to the exhibition, to the Colonial Museum, and to the Institut au Parc Leopold have also been arranged. Members and associates (subscription, 20 francs and 10 francs respectively) are admitted free to the Universal Exhibition during the time of the congress. Further information may be obtained of the honorary secretary, Mr. Cecil H. Cribb, 136 Shaftesbury Avenue, London, W.

The annual foray of the mycological section of the Yorkshire Naturalists' Union was held at Sandsend, near Whitby, on September 17–22. The magnificent old woods at Mulgrave, with their deep, well-watered ravines invariably produce a rich fungus flora independent of season, which to a very great extent determines the presence or absence of fungi in less favoured districts. Notwithstanding four previous visits, six agarics new to the British flora were met with, in addition to a species only previously recorded from Jersey. *Mycena flavipes*, a beautiful fungus with a pink cap and a bright yellow stem, was met with in some quantity. This fungus was first recorded as a British species from specimens collected in Mulgrave Woods about twenty-five years ago, and has not been met with elsewhere in this country. A considerable number of rare and interesting British species were also collected. Several parasitic fungi were also noted. The total number of species collected amounted to between four and five hundred. During the evenings, discourses on mycological subjects were given by Mr. Harold Wager, F.R.S., Mr. A. Clarke, Mr. T. Gibbs, and Mr. Geo. Massee. Mr. Cheesman exhibited a collection of Myxogastres collected in the Rocky Mountains, and Mr. A. Clarke exhibited an extensive series of coloured drawings of fungi. Much of the success of the meeting was due to the facilities kindly afforded by the Rev. the Marquis of Normanby.

PROF. FLINDERS PETRIE in *Man* for September records the discovery in the neighbourhood of the Pyramid of Sneferu (B.C. 4600) of a stone tomb dating from a time before the construction of the pyramid, the earliest private tomb in Egypt to which a date can be assigned. This burial is of the highest interest, as it shows that the body was completely unfleshed before it was wrapped in linen. It lies in a sarcophagus of red granite, the oldest stone sarcophagus known. It has long been known that in prehistoric burials the corpse was stripped of the flesh, the bones even being broken to extract the marrow. In the present case each bone was separately wrapped in linen; and the present discovery proves that the dissevering of the skeleton was the custom among the higher classes at the beginning of the Pyramid period.

IN the last progress report of work at Knossos Dr. A. J. Evans records a remarkable discovery of what he calls the "Tomb of the Double Axes," which has produced more definite evidence regarding the sepulchral cult and the conception of the after-world than any grave yet opened in Crete or prehistoric Greece. Here the double axes were socketed in sacral horns of plaster, and it would seem that the tomb, besides being a place of sepulture, was also a chapel, where the protection of the Great Mother of the prehistoric Cretan cult was sought for the shade of the departed warrior, the stone benches round the shrine being probably arranged for some memorial function in which the family took part. Inside the tomb was found a bronze axe, not of the thin ritual type, but a real prehistoric implement, probably used by the workmen at some early reopening of the sepulchral chamber to admit of the presentation of offerings to the dead.

AN interesting recent addition to the Maidstone Museum is a model of the fine dolmen situated at Coldrum, some 2¼ miles north of West Malling. The dolmen itself stands on the edge of a well-marked prehistoric cultivation terrace at the foot of the chalk escarpment and faces east, towards Kits Coty House, which is some six miles distant. It was in this dolmen that Mr. F. J. Bennett recently found some remains of prehistoric man, and it is to Mr. Bennett, assisted by Mr. Filkins, of Maidstone, that the model is due. It is built to scale, the model of each stone having been made and fixed at the site of Coldrum itself, thus ensuring an accurate representation. Mr. Bennett has also had prepared plans of the Coldrum and Addington megaliths, together with a photographic survey of the former and a tracing of the 25-inch map showing additional sarsens, so that visitors to the museum may more clearly understand the relations of the various parts and their surroundings. With so many of our megalithic remains being neglected or wilfully despoiled, it is an urgent necessity that similar models, plans, &c., should be made of the few which still remain intact.

A MEMOIR on "Factors in the Transmission and Prevention of Malaria in the Panama Canal Zone," by Dr. S. T. Darling, in the *Annals of Tropical Medicine and Parasitology*, vol. iv., No. 2, describes a number of very interesting observations and experiments on the development of the parasites of simple and malignant tertian malaria in mosquitoes, and on the infectivity of different species of anopheline mosquitoes in the region in question. *Cellia albimana*, the common white-hind-footed mosquito, a very hardy species, was found to be the most efficient transmitter of malaria, *C. tarsimaculata* scarcely less so; on the other hand, *Arribalzagia malefactor* belies its name, since it was not found possible to infect it. Incidentally, the author comes to a conclusion which will perhaps be a surprise to many—that the characteristic musical note of the mosquito is caused by the vibration of the proboscis, not by the wings in flight.

A RECENT number of the *Philippine Journal of Science* (vol. v., No. 1, Section B) contains seven papers by different investigators on the subject of the etiology of beriberi, together with a report of the discussion which followed the reading of these papers at the first biennial meeting of the Far-Eastern Association of Tropical Medicine, held at Manila in March. It was generally agreed, and a resolution was passed by the meeting to the effect, that "beriberi is associated with the continuous consumption of white (polished) rice as the staple article of diet." Evidence, experimental and otherwise, was brought forward to prove that in the process of polishing the rice the grains are deprived of certain outer layers, the pericarp and sub-pericarpal tissue, which appear to contain some substance or substances essential for the maintenance of the normal metabolism of nerve-tissues. On this view, beriberi is a disorder of metabolism, due to deficiencies of diet. The chief obstacle to the acceptance of this theory, it is pointed out, is that it does not explain the occurrence of beriberi in some tropical countries and its absence in others, such as Ceylon, where white rice is equally the staple diet of the natives. Some experts consider, therefore, that the diet is only the predisposing condition, and that the true cause of the disease has yet to be found.

A SYNOPSIS of the Silurian fossils of the South Yarra district forms the subject of a paper by Mr. F. Chapman, palæontologist to the Melbourne Museum, in the August number of the *Victorian Naturalist*. The presence of an eurypterid of the genus Pterygotus, of the peculiar brittle-star described by the author as a new genus, Gregoriara, and of the bivalve *Cardiola cornucopiae*, is stated to link the fauna with that of the British and Bohemian Silurian.

THE September issue of the *Irish Naturalist* is devoted to a report of the sixth triennial conference and excursion of the Irish Field Club, held at Rosapenna, County Donegal, on July 8–13. Notes on the natural history and archæology of the district are contributed by a number of members of the club, among which reference may be made to Mr. Ussher's announcement of the discovery of five specimens of the humerus of the great auk.

Dr. A. C. Günther, with the assistance of Mr. Tate Regan, has (in the *Journal des Museum Godeffroy*, Heft xvii., Hamburg, 1910) completed the description of the collection of fishes made in the Indian Ocean and South Pacific by Andrew Garrett. Four new species, *Trygon panapensis*, *Tetrodon regani*, *Opichthys macrops*, and *O. garretti*, are described. The report is very beautifully illustrated by twenty coloured plates.

Attention has previously been directed in Nature to the need for uniform orthography of geographical names in Government departments; this need is exemplified by the "Return" of the British Museum for 1910. In 1909 Mrs. J. A. Brooke presented to the museum a series of specimens sent from China by her son, the late Mr. J. W. Brooke, some of which went to Bloomsbury and others to Cromwell Road. Those at Bloomsbury are entered (p. 77) as having been obtained in Szechuan, while those at Cromwell Road are recorded (p. 123) as coming from Sze-chuen.

We have received copies of several papers on human skulls and skeletons and supposed evidence of human work, read by Dr. F. Ameghino before the Congreso Científico Internacional Americano, held at Buenos Aires in July last. In one he describes a skull from a cave in Cuba as a new species, under the name of *Homo cubensis*. Skeletons from the Moro district, on the Atlantic coast of Argentina, are described in a second paper under the name of *H. sinemento*, and stated to be of a more primitive type than the Neanderthal *H. primigenius*. These remains are stated to be of Lower Pampean age; in a third paper the author describes another skeleton, from the Upper Pampean, which is regarded as representing a third species, *H. caputinclinatus*. The other four papers relate to supposed evidence of man's presence in various formations, the oldest of which is classed as Upper Eocene.

To vol. xxviii., pp. 197–239, of the Bulletin of the American Museum of Natural History Dr. R. Broom contributes an important article on the relationship of the Permian reptiles of North America to those of South. After reviewing the leading types of each, he concludes that in the Upper Carboniferous northern South America was the home of a primitive vertebrate fauna from which originated both the North American Pelycosauria and the African Anomodontia (in the wider sense of the term). In the Permian this fauna invaded North America, where it soon became isolated. Early in the same epoch the Brazilian Mesosaurus reached Africa by a land-bridge, and later on appeared other types, which probably developed in the area now occupied by the South Atlantic. When sundered, the North American and African faunas underwent great development in divergent directions, the former undergoing many strange specialisations—notably in vertebral spines—while the latter showed a tendency to a great increase in the size of the limbs. This limb-lengthening, accompanied by the alteration of the phalangeal formula of the toes from 2.3.4.5.4 to 2.3.3.3.3, started the mammalian line of evolution, for directly the more specialised anomodonts raised their bodies above the ground they were well on the way to become mammals. Birds, in fact, "are reptiles that became active on their hind limbs; mammals are reptiles that acquired activity through the development of all four."

An article entitled "Hunting Birds with the Camera," contributed by Mr. W. Bickerton to the October number of the *Royal Magazine*, gives a good idea of the great patience required by anyone who desires to photograph birds. The article is accompanied by several striking illustrations, including two of a reed-warbler feeding a young cuckoo. Mr. Bickerton says that, of all our summer visiting birds, the reed-warbler has its nest used most frequently by the cuckoo to deposit her eggs. He remarks, "In the area I am describing no fewer than seven different eggs of the cuckoo lay each in a different reed-warbler's nest, left there for the latter bird to hatch out."

The second number of the botanical section of the current volume of the Philippine Journal of Science contains the latter portion of the critical enumeration of Philippine Leguminosæ prepared by Mr. E. D. Merrill, a third set of bryological determinations by Dr. V. F. Brotherus, and a short list of indigenous fungi compiled by Messrs. H. and P. Sydow.

An investigation into the causes underlying a serious loss of gooseberry bushes in Cambridgeshire is recorded by Mr. T. F. Brooke and Mr. A. W. Bartlett in *Annales Mycologici* (vol. vii., No. 2). Two fungi fell under suspicion, but definite proof in the shape of infection experiments was only obtained for *Botrytis cinerea*, although good reason is adduced for finding a second cause of disease in *Cystoporina ribis*. The diseases are not in any way connected and distinct macroscopic and microscopic characters are defined for each fungus; further, it is noted that in no case were both fungi discovered on the same plant.

A new and peculiar type of resin collector that has been tried in the pine forests of Florida, U.S.A., is described by Mr. J. S. Woolsey, jun., in the *Indian Forester* (August). The tree is tapped by two small tunnels, about an inch in diameter and five inches long, bored from a common opening or mouth tangentially through the sap wood. The collector consists of two metal caps set at right angles, and connected by a hollow angle piece. One metal cap is fitted over the mouth, while a glass jar, into which the resin flows, is fitted to the other horizontal cap. It is claimed that the method gives an increased yield and a clean gum, and that evaporation is avoided.

Systematic articles are prominent in the latest issue of the *Kew Bulletin* (No. 7), as, in addition to a long series of new species of Protea and other African diagnoses, Mr. J. S. Gamble contributes a second list of new Lauraceæ from the Malayan region, principally additions to the genera Cinnamomum, Alseodaphne, and Notophœbe, and Dr. O. Stapf presents a revision of the Australian plant *Epacris heteronema*. Also Mr. G. Massee describes several new exotic fungi, including a Sphærulina and a Phoma, both discovered on *Welwitschia mirabilis* in Damaraland. More important from an economic aspect is *Eutypa caulivora* (Sphæriaceæ), a parasite collected on rubber trees in Singapore, that kills its host by blocking up the water channels with mycelium.

The Australian Commonwealth Bureau of Meteorology has commenced the issue of a monthly report from January last. It is intended to embody, *inter alia*, discussions on current weather, daily observations at each of the capital cities, and extracts, or brief articles, on matters of general scientific interest, and, judging from the first number, it gives promise of taking a prominent place among the leading weather bulletins. The principal article in the

January number deals with the disastrous flood during that month in the Upper Darling tributaries, owing to abnormally heavy rains, attributed by Mr. H. A. Hunt to the joint action of an anticyclonic area over the southern half, and a monsoonal depression operating in the northern half, of the continent. In the Namoi basin several places recorded more than 12 inches of rain between January 11 and 15, and at Bingara, in the area of the river Gwydir, 19·44 inches were registered, the normal for the whole month being $3\frac{1}{4}$ inches. The report states that, generally speaking, the amount of damage was inestimable, but the deposit left by the subsidence of the water has rendered the soil fertile over a vast area.

We have received copies of several papers which have been published recently by members of the staff of the Reichsanstalt at Charlottenburg, amongst them one on the thermal expansion of metals, by Dr. E. Grüneisen, which appeared in the *Annalen der Physik* for August 5. The first part of the paper deals with the observations of expansion of platinum, palladium, copper, silver, aluminium, iron, nickel, and iridium made previously at the Reichsanstalt by Holborn, Day, Scheel and others, and the second part with observations made by the author on magnesium, zinc, cadmium, antimony, iridium, gold, lead, and bismuth by comparison of the expansion of a bar of each metal with that of a platinum standard bar by a method analogous to the double-mirror method of determining the bending of a beam. With the exception of zinc, cadmium, and possibly tin, the whole of the metals which have regular expansions confirm Thiesen's law that the rate of expansion is proportional to a power of the absolute temperature. The author finds that the power lies between 0·06 and 0·5, and is a periodic function of the atomic weight of the metal.

Engineering for September 23 contains a photograph of submarine "D 1," which is the largest vessel of its class belonging to the British Navy. An interesting development in this vessel consists in the application of wireless telegraphy to submarine work. Successful experiments have been carried out recently with this vessel in Torbay, the crusier *Bonaventure* establishing and maintaining communication with the "D 1" when submerged. The "D 1" replied from below the surface. The installation was tested when the submarine was submerged to a depth just sufficient to keep the periscope above water, *i.e.* about one-half of the telegraphy mast was below water. The possibilities of such a development are considerable, as not only could the actions of submarines be directed by these means from larger vessels, but a flotilla of submarines will be able to use the system for the purpose of communicating among themselves when submerged, their value in naval warfare being thus considerably improved.

The progress of the great Barren Jack dam in Australia is described in the *Engineer* for September 23. This dam will be one of the largest in the world when finished. The design in plan gives a length of 784 feet, curved to a radius of 1200 feet, and a maximum height of 240 feet. The structure is of cyclopean concrete; the base is 163 feet wide and 20 feet high, with vertical sides, and this level has now been reached. The catchment area embraces 5000 square miles, mostly of hard shale formation, and much of it mountainous, which is snow-fed in winter. The maximum depth of water behind the dam will be 224 feet, and the capacity will be 33,380 millions of cubic feet. Nature has furnished a gorge in hills of granite, providing the best site and best materials for a dam, behind which is an unfailing supply of rainfall; a natural 220-mile channel, and, at the proper place, a foundation for a distributing weir. That advantage is now being taken of this almost ready-made but long neglected irrigation opportunity is a matter for congratulation. It is not intended to wait for the completion of the work before putting it to use. The building contract provides for the wall reaching a height of 110 feet in August, 1911, when storage will be started, so as to ensure irrigation in the summer of 1911–12. The remainder of the dam is to be finished in August, 1913.

We have received from Ozonair, Ltd., of 96 Victoria Street, a catalogue of apparatus suitable for laboratory and research work. Four arrangements are described ranging in cost from 15*l.* to 100*l.* for alternating, and from 25*l.* to 110*l.* for direct current, for a complete installation operated from the street mains. It is claimed that the yield of ozone is greater than that of any other generator, and that the purity of the effluent is unapproached.

A report on recent progress in the chemistry of the sugars, by Mr. J. S. Hepburn, appears in the Journal of the Franklin Institute for August. This paper reviews the work of Emil Fischer upon sugars and ferments, describes the synthesis of monoses, disaccharides, and glucosides, and discusses the fermentation of the sugars, the action of the various inverting enzymes, and the lock-and-key theory of enzyme action. The splitting of racemic sugar derivatives into their active components and asymmetric syntheses within the sugar are also considered. References are given to original papers, of which no fewer than seventy-four are by Prof. Emil Fischer and his colleagues or pupils.

A supplement of eighty-four pages to the *Columbia University Quarterly* gives an account of the Charles Frederick Chandler testimonial, presented on the occasion of his retirement from the positions of head of the department of chemistry and dean of the School of Mines of Columbia University. Prof. Chandler has been a college teacher during fifty-four years, and his retirement marked the close of his forty-sixth year of service at Columbia. A bibliography of fifty publications testifies to the fact that his keen interest in pure science was allied with much work of a public and philanthropic kind. His work on behalf of public health in New York was of the utmost value, and the story of his midnight raid upon the cattle stalls of Washington Market, as set forth in the *Columbia Quarterly*, will form a fascinating feature in some future history of municipal cleansing; the ingenious methods by which in the following years he overcame the prejudice of the poorer people against the isolation of small-pox cases is an eloquent testimony to his versatile ability.

Two important crystallographic papers, by Prof. Armstrong and Messrs. Colgate and Rodd, have recently appeared in the Journal of the Chemical Society. The investigation has been in progress since 1892. The work now described includes the crystallographic examination of no fewer than twenty-nine derivatives of the *p*-dihalogenbenzenesulphonic acids; but considerable progress has already been made in the study of the five similar series of isomeric acids in which the two halogens occupy the *ortho* and *meta* positions relatively to one another. The series now described is comparatively simple in its crystallographic properties; almost all the compounds belong to one of the two types of close-packed arrangement which Barlow and Pope have indicated for the benzene molecule, namely, the rhombohedral arrangement, in which (*a*) one parameter has a value slightly below 2·780, or (*b*) two of the parameters are nearly equal. Amongst the sulphonic chlorides and bromides two isomorphous series are seen, the second series being restricted to compounds in which an iodine atom is present; it is noteworthy that the two chloriodobenzenesulphonic chlorides are found in different series, and that one of them was on one occasion obtained in a labile form, the crystals becoming cloudy and opaque when removed from the solvent from which they had separated. This behaviour indicates clearly that certain members of the series are actually dimorphous, and the whole series may therefore be regarded as isodimorphous. Isodimorphism was also detected amongst the anilides and toluides. It is remarkable that two other series, containing the halogen atoms in the *meta* position, which were examined by Dr. E. C. Jee in 1900, proved to be isotrimorphous and isotetramorphous respectively. The completion of the work on these series will be awaited with interest.

A SECOND edition of "A Text-book of Zoology," by Profs. T. Jeffrey Parker and W. A. Haswell, is announced as nearly ready by Messrs. Macmillan and Co., Ltd. The work has been subjected to careful revision throughout; some parts have been to a great extent rewritten, and a considerable number of new illustrations have been added.

OUR ASTRONOMICAL COLUMN.

VELOCITIES AND ACCELERATIONS OF THE EJECTA FROM HALLEY'S COMET.—Profs. Barnard and Lowell and Senor J. Comas Sola all deal with the velocities and accelerations of the matter ejected from the body of Halley's comet, during May and June, in No. 4441 of the *Astronomische Nachrichten* (pp. 11–16).

From measures of photographs taken at the Yerkes Observatory (Y), Honolulu (H), and Beirut (B) on June 6, Prof. Barnard found the velocities of recession, of a well-marked feature in the tail, given in the following table:—

Stations	Interval between photographs	Hourly motion	Recession per second			
			From comet		From sun	
	Hours	′	Miles	km.	Miles	km.
Y–H	4·25	3·60	23·1	37·2	39·7	63·9
Y–B	15·15	5·17	33·1	53·3	49·7	80·0
H–B	10·90	5·78	37·3	59·7	53·9	86·4

These results show a strong acceleration in the mass measured, which was about 1·5° from the head; from the last two photographs this acceleration was about 14 miles (22 km.) per second.

Similar results are obtained by Prof. Lowell from the measures of two photographs taken, with rather less than an hour's interval, on May 23. On these photographs are shown four knots in the tail, at distances varying from 1° 28′ to 6° 15′ from the head, and the measures give for the velocities of the particles composing the knots 13·6, 17·2, 19·7, and 29·7 miles per second respectively, thus showing an acceleration of the velocities as the particles receded further from the head.

Senor Sola, dealing with the velocities of the gaseous globes ejected from the nucleus on June 4, shown on photographs taken on June 4, 6, and 7, finds that between June 4 and 6 the acceleration of these ejecta was 0·148 metre per second, and between June 6 and 7 was 0·248 metre per second.

OBSERVATIONS OF COMETS.—New observations of three comets are published in No. 4441 of the *Astronomische Nachrichten*. A number of observers give positions, determined during August, of Metcalf's comet, 1910*b*, and generally describe it as a faint object, magnitude about 11·0, having a central condensation and a suspicion of a tail.

D'Arrest's comet was observed at the Algiers Observatory on August 26 and 29 and September 1 by M. Gonnessiat. The correction to Leveau's ephemeris was an increasing quantity, and on September 1 had the value −1m. 19·39s., +6′ 16·2″; the comet is described as a diffuse nebulosity of 2′ or 3′ diameter, with a feeble, central condensation of about magnitude 14·5.

With a 9-inch refractor Mr. Innes found that, on August 11 and 12, Halley's comet was a most difficult object, and was, therefore, much fainter than the magnitude (7·4) given in No. 4423 of the *Astronomische Nachrichten*. Observations made between July 26 and August 11 indicate a correction of about −11s. to the ephemeris given in the same place; the ephemeris is nearly correct in δ. When last seen the comet was a nebulous object, of 1′ diameter, showing a slight condensation.

THE SOLAR PHYSICS OBSERVATORY, SOUTH KENSINGTON.—From the report published by the Board of Education, dealing with the work done at the Solar Physics Observatory, South Kensington, during 1909, we learn that spectroheliograms of the solar disc were obtained on 147 days during the year; of the 286 negatives secured, 231 have been selected for the measurement of flocculic areas in pursuance of the scheme for establishing a cooperative daily record of such areas. Fifty-seven photographs showing the calcium prominences at the limb were also secured with the spectroheliograph. Visual observations of the sun were possible on 232 days, and "no spots" was recorded on five occasions. The spectra of 138 spots were observed visually, and show that the lines chiefly affected, in the region F–D, are due to V, Ti, Sc, and Mg, associated with H. A powerful instrument for the photographic recording of sun-spot spectra cannot be used owing to the vibration occasioned by traffic in the vicinity. Work with the 36-inch reflector on Halley's comet and other objects was also restricted by the poor observing conditions. A large number of photographs of stellar spectra were secured with various prismatic cameras, those obtained with a calcite-quartz optical system being employed for the temperature-comparisons of various stars.

THE DETERMINATION OF LONGITUDE.—In an interesting brochure of sixty-two pages, now published as an extract from the journal *L'Horloger*, Dr. Jean Mascart recounts the history of the determination of longitudes, with a special chapter on the invention and development of marine chronometers, and an account of the voyage of the *Flore*, which had for its purpose the actual testing of the different methods of determination, in 1771–2. The brochure is well illustrated with portraits and cuts of historical instruments and their parts, and contains numerous references to the literature of the subject with which it deals.

THE ROYAL COMMISSION ON WELSH MONUMENTS.

THE first report of the commission contains a general account of work already done, and an outline of the work proposed to be done. The first volume of classified information the commission hopes to publish in the course of the present year, in the form of an inventory of monuments in the county of Montgomery.

The task undertaken is truly immense. No type of monument nor available source of information seems to have been overlooked in the outline given. There are, of course, inevitable limitations to be considered, but it is not likely that the work in value and extent will ever be a subject for serious adverse criticism. As, however, the commission's plan of campaign has been published at a time when that plan may be reconsidered in some details before the information collected has been cast into a final form, one may venture to direct attention to a class of facts which is not even mentioned in the report, but which may be shown to be by far the most important within the scope of the inquiry.

The most important documents are the monuments themselves. Whatever facts may be directly elicited from them take precedence of all facts elicited from "finds," folklore, and documentary information. They may be called structural facts, and they are to be regarded as facts irrespective of any theory. So long as such facts may be gathered, as a rule, at every ancient site, there seems to be no valid reason why they should not be treated as of first importance in any examination of ancient monuments. Opinions may differ greatly as to the value of deductions from the facts, but no difference of opinion can possibly justify a policy of turning a deaf ear to the positive testimony of the monuments themselves.

The sharpest distinction should be made between the testimony of a structure and that of any "finds," and the commission's chief object is to make an inventory of structures. Judging a structure by the finds alone, the popular epithet "sepulchral" is often tolerable, but the epithet does not explain the structure even of a hermetically closed cist, which everybody would regard as sepulchral. Now, "grave goods" have been given a place in the commission's schedule, and for that reason alone one would claim recognition of the structural facts. The relation of a burial to the surface soil is particularised, and such details show that the structural facts, in a way, are included in the schedule. The facts I have chiefly in mind are measures, both angular and linear. Some measures of the sort, of course, are given in ordinary reports and plans of monuments, but measures made on the lines of a working theory, based on the sum of knowledge already gained by measurements, must be much more to the point than any measures made with absolutely no theory in view. Even when a working theory is adopted, some technical knowledge is indispensable for making the required measures.

The subject, I understand, has been considered by the commission. Some information bearing on the astronomical inquiry, which I had the honour of submitting at the Cardiff meeting, was accepted. I understand, further, that some arrangements have been, or are being, made for making measures. The report, however, gives us no light on the matter. There is not even a recommendation of the inquiry. We are told what features of ancient churches are to be observed, but not a word about the one feature which usually gives character to the whole, orientation.

If measures of monuments have any meaning—and if they were and likely to remain meaningless, to ignore them would be a reckless accommodation to our ignorance—that meaning must be the vertebral column of any body of information about them. In most, if not all, branches of scientific inquiry measurements take precedence of any other data. If such a commission were appointed to gather anthropological data, is it likely that anthropometry would be given a second place in the inquiry? A similar method for archæological research has been devised in which measurement forms the first and best basis for a classification of monuments, all apart from any theory as to the significance of the measures. To those who are in the habit of regarding measures as constituting the very soul of a monument, the preservation of measures is the best possible preservation of a monument.

One can easily understand why a representative body of archæologists should hesitate a little before giving its endorsement to a line of inquiry which has to make its own way into favour. Probably at a mixed gathering of archæologists a majority might be found in favour of keeping it in abeyance. The commission might justify its silence, if not inaction, in such a matter, to such an audience, by referring to the element of prejudice which unfortunately is not confined to non-scientific bodies. There is, however, no evidence, so far as the commission is concerned, of such a slavish subjection of what should be a free, open, and thorough inquiry to the idiosyncrasies of the human equation. Just as the commission seeks the sympathetic cooperation of the Welsh public in its work, it is to be hoped that a representation of this kind will receive an equally sympathetic treatment by the commission itself.

The task of sifting and sorting the contents of the vast drag-net which the commission has cast over Wales is not an enviable one, but a better master of method in handling such materials could hardly be found than the secretary, Mr. Edward Owen.

John Griffith.

ANNUAL REPORT OF THE GOVERNMENT LABORATORY.

The report of the principal chemist of the Government Laboratory, London, upon the work of the department during the last fiscal year, contains, as usual, a mass of information respecting the chemical examinations and inquiries made for the various branches of the executive. On former occasions we have described the general work of the laboratory in some detail, and will therefore, in the present instance, merely note a few of the many miscellaneous points of interest mentioned in the report.

Conformably to the provisions of the White Phosphorus Matches Prohibition Act, 1908, which came into operation on January 1 this year, a number of samples of imported matches were examined in order to ascertain whether they were free from the white or poisonous form of phosphorus. In only seven instances, however, out of 647, was white phosphorus found to be present. The importation of the matches in these consignments was prohibited. They were but an insignificant proportion of the total matches imported. Only doubtful cases are dealt with in the laboratory, as the absence of white phosphorus is shown in the great majority of cases by simple tests which have been devised for application by the local customs officials. The effect of the Act already has been to stamp out the use of white phosphorus in imported matches; and as regards matches made in the United Kingdom, samples of the paste used for "tipping" have been taken from the factories, but in no case has the use of white phosphorus been detected.

A number of samples of beer and brewing materials were found to contain arsenic in excess of the limits laid down by the Royal Commission on Arsenical Poisoning. One sample of malt contained as much as one-eighth of a grain of arsenic per lb., and the beer brewed from it showed a considerable excess of the poison. The brewers were immediately warned of the danger of allowing such beer to go into consumption. On investigation, the presence of the arsenic was traced to the fuel used for kiln-drying the malt.

Articles of food taken from the canteens on board naval vessels were not in all cases free from objection. Thus, of four samples of "lard," one consisted of cocoa-nut oil, one was considerably adulterated with cotton-seed oil and beef stearine, and the remaining two gave evidence of slight contamination with cotton-seed oil; and out of four samples of condensed milk, one was found to be a "skimmed" product and another was deficient in fat. The general Admiralty supplies, however, were found to be usually satisfactory.

The tendency of makers of foodstuffs to work down to a "standard," when one has been fixed, is exemplified by a remark which the principal chemist makes in regard to the proportion of water in imported colonial butter. Since the fixing of the limit of water at 16 per cent., "the quantity of water in colonial butter, formerly exceptionally low, is now nearer the limit, and occasionally exceeds it." Two samples of imported "pastry margarine" were found to contain solid paraffin, in one case as much as 10 per cent. Amongst miscellaneous samples analysed may be mentioned certain feeding-meals which were examined in connection with alleged poisoning of cattle; in some instances the meal was found to contain Java or Rangoon beans, which, on digestion with water, produce prussic acid through the influence of an enzyme. In another case of cattle poisoning, the food was found to have been contaminated with an arsenic-paste sheep dip.

In connection with lead poisoning in the pottery industry, a large number of samples were examined. From works in which cases of plumbism had occurred, thirty-six specimens of glaze were taken. The proportion of lead oxide in these glazes varied from 12·6 to 47·5 per cent., and it is noteworthy that, with one exception, the lead was almost wholly present as a soluble compound.

Samples of air from certain mines in Scotland were found to be very impure, proportions of carbon dioxide as high as $3\frac{1}{2}$ per cent. being shown, and as much as 16 per cent of methane; whilst the oxygen in one sample had been reduced to $15\frac{1}{2}$ per cent.

Arising out of suspected frauds in connection with claims for old age pensions, the Government chemists were asked if possible to ascertain the date of entries made in family Bibles, old letters, and certificates. In some cases they were able to show, from the nature of the ink employed, that the writing was comparatively recent, and that the entries had been made for the purpose of manufacturing evidence in support of the claim.

The total number of analyses and examinations made during the year at the two main laboratories (Clement's Inn and Custom House) was 170,033, the greater number being in connection with dutiable articles. Legal proceedings were taken in 223 cases for contraventions of revenue laws, and the total amount of fines paid was 2877*l*.

THE ARCHÆOLOGICAL SURVEY OF NUBIA.

THE last Bulletin of the Archæological Survey of Nubia describes excavations in the cemeteries and buildings of the ancient district of Pselchis, which will become submerged when the new Nile barrage is completed. The results are to some degree unsatisfactory, owing to the prevalence, even from ancient times, of the practice of *sebakh*-digging by agriculturists in order to obtain fresh supplies of rich soil to re-fertilise the land, which is periodically covered by a layer of fine sand drifted by the prevailing wind. This results in the destruction of many interesting remains; and treasure hunters have also done much damage, but the operations of the latter can be easily distinguished from the ruder methods adopted by the farmers.

The anatomical reports by Prof. G. Elliot Smith and Dr. D. E. Derry are, as usual, exhaustive, and present much valuable information. They disclose the advance in the Byzantine-Pagan period, between the second and fourth centuries A.D., of a group of negroes from the south with distinctive physical characteristics, customs, and arts. Their occupation of these new settlements was certainly not altogether peaceful, many skeletons showing evidence of death by wounds, and one, in particular, with such extensive cranial injuries that it is difficult to understand how the victim could even for a short time have survived. One of the negresses whose remains were discovered in this cemetery displays an extremely abnormal type of prognathism. While the alveolar index of adult Europeans is 96·2, and that of African negroes 104·4, this specimen gives an index of 123·3, which is little below that of the chimpanzee, 128·8. It would be interesting to identify this abnormal type with that of some modern race; and a clue may be found in the fact that the negroes whose remains were found here practised the custom of filing the teeth, which, with removal of some of the incisors, still prevails among the Masai and some of the Kavirondo Bantus.

It seems to be generally believed that the latter races derived this custom from the Dinka and other allied Nilotic peoples, some of whom may have supplied the individuals whose remains have now, in such strange circumstances, been subjected to scientific examination. The question of the ancient prevalence of tuberculosis is also advanced by the fact that many of these people suffered from spinal disease due to this malady. It must have been common among them, because the high average of cases found in these cemeteries cannot be accounted for by the supposition that this site was used as a sanatorium for this class of disease.

MANGANESE-ORE DEPOSITS.

THE paper referred to below[1] gives an elaborate and interesting account of the occurrence of manganese ore in Sandur, one of the States of the Presidency of Madras; its value lies mainly in the abundance of detail given respecting this one particular occurrence, and it thus lacks the broader economic interest that attaches to that recent admirable memoir dealing with the manganese deposits of the whole of India, "The Manganese-ore Deposits of India," by Dr. L. L. Fermor, Mem. Geol. Surv. India, xxxvii., which appeared at the commencement of the present year, and which has given so much valuable information regarding the occurrence and distribution of this ore. Mr. Ghose gives no figures at all to show the output of manganese from the State of Sandur, and thus avoids directing attention to its relative unimportance; it may therefore be as well to make up here for his shortcomings in this respect:—

Production of manganese ore during 1908 in the State of Sandur, 23,413 tons.

Production of manganese ore during 1908 in the Presidency of Madras, 513,845 tons.

Production of manganese ore during 1908 in the whole of India, 2,584,525 tons.

The production of ore, of which the paper treats, is therefore less than 1 per cent. of the output of India, and may be looked upon as economically negligible; it would accordingly be difficult to justify the concluding sentence of Mr. Ghose's paper, in which he characterises these Sandur deposits as "among the largest and most remarkable manganese-ore deposits of the world." Such exaggeration of language is out of place in a scientific paper, especially seeing that, as a matter of fact, the Sandur deposits are considerably smaller than those of Nagpur or Balaghat, whilst the ore is also apparently of inferior quality. In the same way, the estimates of the probable ore reserves may be dismissed as resting on very slight foundation.

The interest of the paper centres essentially in the geological description of the occurrences, and in the author's views as to their formation, which differ entirely from those put forward by the India Geological Survey authorities. Dr. Fermor looks upon these manganese deposits as having "been formed by the replacement at the surface of Dharwar schists, phyllites, and quartzites" in such a manner as to form a capping approaching to laterite in its character, and he accordingly designates these ores as "*lateroid* replacement masses"; this view appears, moreover, to be endorsed by Sir Thomas Holland. Mr. Ghose, on the other hand, considers that these "deposits primarily owe their origin to sedimentary deposition from magmatic solution. Their economic value has been enhanced by secondary enrichment." It should be noted that he does not use the term "magmatic solution" in the sense in which it has generally been employed by writers on ore deposits, but means in this case hot solutions containing iron and manganese, flowing in horizontal currents over the floor of an ocean.

Apart from all other considerations, it is obvious that these two theories would assign widely different economic values to the ore deposits in question. If the former is correct, the extension of the ore bodies in depth is strictly limited, whereas the latter theory, according to which the deposits are syngenetic, would impose no such limits upon their extension, and the suspicion cannot be avoided that the author's promulgation of his theory may have been unconsciously influenced by his desire to magnify the economic value of ore deposits, in the opening up of which he has taken a leading part. Seeing that the result of future mining operations will demonstrate without doubt which of these two conflicting theories is the correct one, whilst at present decisive evidence is lacking, it is hardly worth while to examine critically the bases upon which they rest, and the question may well be left for the future to settle, it being sufficient to record here that, whether his theories are right or wrong, the author has produced a full and interesting description of this system of deposits, and has thus contributed to our knowledge of the occurrences of ores of manganese.

H. L.

[1] "Manganese-ore Deposits of the Sandur State." By A. Ghose. Excerpt from the Transactions of the Mining and Geological Institute of India, vol. iv., pp. 155–204+21 plates. Part 3, February, 1910.

ZOOLOGICAL WORK IN INDIA.

IN vol. ii., No. 8, of the entomological series of the Memoirs of the Department of Agriculture, the Government entomologist, Mr. H. Maxwell-Lefroy, commences a lavishly illustrated account of the life-history of Indian insects, dealing in this instance with beetles. Hitherto, it is stated, little definite information has been recorded with regard to the life-histories of the beetles of India, and entomologists will therefore welcome the particulars given by the author in the case of eight of the commoner species. In seven out of the eight, the egg, larva, pupa, and imago are illustrated by coloured plates, executed in first-class style by the Calcutta Phototype Company.

Three out of five numbers of the Records of the Indian Museum, recently to hand, contain articles on biting flies and gnats. In the first of these, vol. iv., No. 1, Mr. F. V. Theobald describes certain new genera and species of Culicidæ, typified by specimens in the Indian Museum. It is stated, however, that in the case of the Culices with banded proboscis, some at least of the determinations must be regarded as provisional, since certainty cannot be attained until both sexes have been bred in captivity and the generative organs of the males and the larvæ carefully examined. In No. 3 of the same volume Mr. E. Brunetti records a protest against what he considers unnecessary subdivision and splitting in the Culicidæ, remarking that specialists in the Diptera must regard the present state of affairs as absurd, and that Prof. Williston appears to be the only systematic dipterologist who has attempted to stem the tide. The plea of the unwieldiness of big genera cannot be upheld, it is added, since the systematist is quite accustomed to such genera: a similar protest, it may be mentioned, seems called for in the case of the excessive generic splitting now in vogue in the squirrel and mice family. Mr. Brunetti concludes by stating that the subject will be more fully discussed in the supplement to the catalogue on which he is now engaged.

An article forming part ii. of the fourth volume, by Dr. Annandale, on Indian sand-flies (Phlebotomus), will be read with interest, since not only are these minute insects some of the greatest torments to Europeans in India, but, as may be inferred from the investigations made on their south European representatives, it is practically certain that they are also carriers of certain types of fever.

Finally, in the fourth and last part of vol. iv., Mr. Brunetti publishes a systematic revision of the Oriental blood-sucking flies of the family Muscidæ, with the description of a new genus.

From among a dozen articles in the first and second parts of the fifth volume of the Records, it must suffice to direct attention to one by Dr. R. E. Lloyd, on variation in Indian rats. In a previous paper the author has adduced evidence in favour of discontinuous variation having played a prominent part in the production of races. Individual rats from any particular towns, for instance, sometimes show more or less marked differences from their fellows, and the evidence they afford for discontinuous evolution lies in the manner in which these are distributed among the multitude of whole-coloured specimens. In the present paper it is stated that, among the thousands of normally coloured rats infesting Poona, there is found a colony of about one hundred individuals characterised by the presence of a white breast-patch, these having apparently originated in the city itself. Again, it was found that the rats of Naini Tal differ from the normal type of plains-rat by their shorter tails, longer and greyer fur, and a more or less well-defined white breast-patch. Some rats in the district differ, however, from this type by the under side of the tail being white. Accordingly, we find that in a single limited area there live, under apparently similar conditions, two phases of a widely distributed species, differing from one another solely in one obvious feature, these two phases living apart from each other. Obviously, any explanation as to the origin of the white-tailed phase will apply equally to the case of the white-breasted Poona rats, and the author concludes by endeavouring to explain each instance by the light of the theory of gametic factors. R. L.

THE BRITISH ASSOCIATION AT SHEFFIELD.

SECTION G.

ENGINEERING.

OPENING ADDRESS BY PROF. W. E. DALBY, M.A., M.INST.C.E., PRESIDENT OF THE SECTION.

British Railways: Some Facts and a Few Problems.

It is remarkable how few among us really realise the large part that railways play in our national life. How many of us realise that the capital invested in the railway companies of the United Kingdom is nearly twice the amount of the national debt; that the gross income of the railway companies is within measurable distance of the national income; that to produce this income every inhabitant of the British Islands would have to pay annually 3*l.* per head; that they employ more than six hundred thousand people; and that about eight million tons of coal are burnt annually in the fire-boxes of their locomotives? I hope to place before you in the short time which can be devoted to a presidential address a few facts concerning this great asset of our national life and some problems connected with the recent developments of railway working—problems brought into existence by the steady progress of scientific discovery and the endeavour to apply the new discoveries to improve the service and to increase the comfort of the travelling public.

A great deal of interesting information is to be found in the Railway Returns issued by the Board of Trade. I have plotted some of the figures given, in order to show generally the progress which has been made through the years, and at the same time to exhibit the rates of change of various quantities in comparison with one another.

Consider, in the first place, what the railways have cost the nation. This is represented financially at any instant by the paid-up capital of the companies. The total paid-up capital in 1850 was 240 millions sterling. In 1908 this amount had increased to 1310 millions. The curve marked "Total" in Fig. 1 shows the total paid-up capital plotted against the year. It will be noticed that

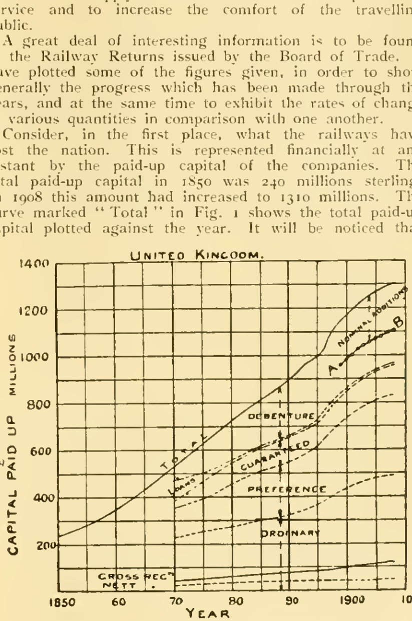


FIG. 1.

the increase per annum is remarkably regular up to about 1896, and is at the rate of not quite 100 millions per annum. After this date the capital increases at a somewhat greater rate, but in 1900 the rate drops with a tendency to a gradually decreasing value. Part of the increase immediately after 1896 is, however, due to nominal additions to the capital. The extent to which this process of watering the stock has been carried is indicated over the period 1898 to 1908 by the curve AB. In the year 1908 the nominal additions to capital amounted to 196 millions of pounds.

Curves are also plotted showing the amounts of the different kinds of stock making up the total. It will be noticed that the ordinary stock is a little more than one-third of the total paid-up capital in 1908, viz. 38 per cent. In 1870 it was about 43 per cent.

The lower curve on the diagram shows the gross receipts, which amounted to 120 millions of pounds in 1908. The dotted line indicates the net revenue after deducting from the total receipts the working expenditure. This, for 1908, was $43\frac{1}{2}$ millions, corresponding to 3·32 per cent. of the total paid-up capital. If the net receipts are reckoned as a percentage of the paid-up capital after deducting the nominal additions, the return is increased to 3·9 per cent. These figures practically represent the average dividend reckoned in the two ways for the year 1908.

Fig. 2 shows by the upper curve the number of miles open for traffic plotted against the year. This curve indicates great activity of construction during the period 1850 to 1870, with a regular but gradually decreasing addition of mileage from year to year afterwards.

At the end of 1908 there were 23,205 miles open, corresponding to 53,669 miles of single track, including sidings. Of this, 85 per cent. was standard 4 feet 8½ inches gauge, 12·3 per cent. 5 feet 3 inches, and 2·2 per cent. 3 feet gauge. The remainder was made up of small mileages of 1 foot 11½ inches, 2 feet 3 inches, 2 feet 4 inches, 2 feet 4½ inches, 2 feet, 2 feet 9 inches, 4 feet, and 4 feet 6 inches gauges.

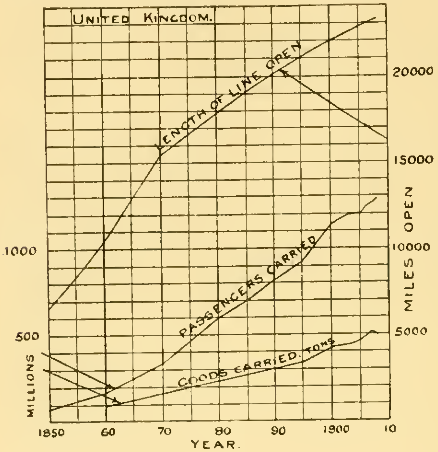


FIG. 2.

The two lower lines of the diagram show, respectively, the number of passengers carried and the tons of goods carried from year to year.

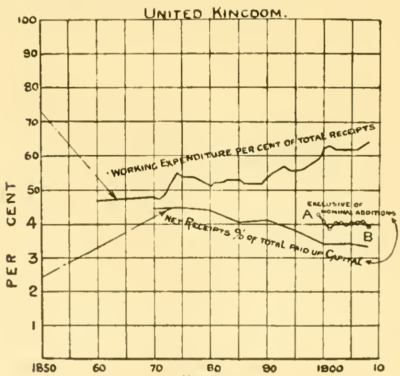


FIG. 3.

The curves of mileage, passengers carried, and goods carried increase regularly with the increase of capital, indicating that up to the present time the possibility of remunerative return on capital invested in railway enterprise in this country is not exhausted. It is true that there is a maximum of goods carried in the year 1907; but the sudden drop in the curve between the years 1907 and 1908 suggests that the drop is only of a temporary character, and there is every reason to believe that the curve will resume its upward tendency with time. In 1908 the railways of the United Kingdom carried 1278 millions of passengers, exclusive of season-ticket holders, and 491 million tons of goods; the quantity of goods carried in 1907 was nearly 515 millions of tons. It is curious that, very approximately, the companies carry per annum one passenger and about 0·4 ton of goods for every pound sterling of paid-up capital.

The proportion of the gross receipts absorbed in carrying out this service is shown by the upper curve of Fig. 3. The proportion has increased, on the whole regularly, from 47 per cent. in 1860 to 64 per cent. in 1908.

The lower curve shows the net receipts as a percentage of the paid-up capital. From 1899 onwards the curve AB shows the net receipts reckoned on the paid-up capital exclusive of the nominal additions. It will be observed that the net receipts have not declined more than half a per cent. since 1870, notwithstanding the increase in working expenditure.

Fig. 4 indicates the cost of working the traffic calculated in terms of the train-mile, no data being available regarding the actual work done as represented by the ton-mile or the passenger-mile. In some respects the train-

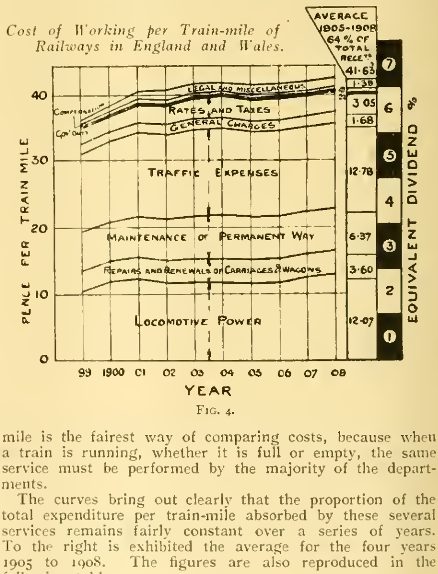


FIG. 4.

mile is the fairest way of comparing costs, because when a train is running, whether it is full or empty, the same service must be performed by the majority of the departments.

The curves bring out clearly that the proportion of the total expenditure per train-mile absorbed by these several services remains fairly constant over a series of years. To the right is exhibited the average for the four years 1905 to 1908. The figures are also reproduced in the following table:—

TABLE I.

Average Working Costs per Train-mile of the Railways in England and Wales taken over the Years 1905 to 1908.

	Pence per train-mile.
Locomotive power	12·07
Repairs and renewals of carriages and waggons	3·60
Maintenance of permanent-way	6·37
Traffic expenses	12·78
General charges	1·68
Rates and taxes	3·05
Government duty	0·22
Compensation	0·47
Legal and miscellaneous	1·39
Total	41·63

Locomotive power absorbs an amount about equal to the traffic expenses; and companies actually pay in rates and taxes a sum nearly equal to the whole amount required to maintain the rolling-stock in an efficient state.

To the right is shown a scale, the divisions of which represent an amount estimated in pence per train-mile corresponding to 1 per cent. of the average dividend. This shows that if the whole of the locomotive power could be obtained for nothing, the average dividend would only be increased by $1\frac{3}{4}$ per cent. Reckoned on the ordinary stock alone, however, the increase would be about three times this amount.

It may be of interest at this stage to compare the financial position and the cost of the working of railways in their earlier days with the state of things now. For this purpose the position of the old London and Birmingham Railway is compared with the position of the London and North-Western Railway, the system into which it has grown. The years selected are 1840 and 1908.

I have taken out the cost per mile of working the traffic of the London and Birmingham Railway from some accounts given in Winshaw's "Railways." The details are grouped somewhat differently in the list just given, but in the main the various items may be compared.

The number of train-miles on the London and Birmingham Railway recorded for the year January to December, 1839, is 714,998. The accounts given are for the year June, 1839, to June, 1840. The mileage record is thus not strictly comparable with the expense account, but it may be regarded as covering the same period with sufficient accuracy for our purpose.

The costs work out as follows:—

TABLE II.

Cost per Train-mile for the Year ending June, 1840, *London and Birmingham Railway.*

	Pence per mile.
Locomotive power	23·2
Maintenance of way	27·2
Traffic expenses, including repairs to waggons	25·9
General charges, including legal charges ...	4·5
Rates and taxes...	4·5
Government duty	7·65
Accident account	0·35
Total	93·30

The receipts amounted to 231*d.* per train-mile. Hence the working expenditure was 40 per cent. of the gross receipts.

The gross receipts for the year ending June 30, 1840, were 687,104*l.*, which, after deducting charges for loans, rents, and depreciation of locomotives, carriages, and waggons, enabled a dividend of $9\frac{1}{4}$ per cent. to be paid on the ordinary stock.

There are two noteworthy facts in these old accounts. First, the allowance for depreciation on the rolling-stock of nearly 4 per cent. of the receipts. Secondly, the fact that the cost of working the traffic is given per ton-mile. This method of estimating the cost of working has gradually fallen into desuetude on British railways. One company only at the present time records ton-mile statistics. Quite recently (in 1909) the committee appointed by the Board of Trade to make inquiries with reference to the form and scope of the accounts and statistical returns rendered by the railway companies under the Railway Regulation Acts have had the question of ton-mile and passenger-mile statistics under consideration. There was considerable difference of opinion concerning the matter, and in the end the committee did not recommend that the return of ton-mile and passenger-mile statistics should be made compulsory on the railway companies.

Returning to the London and Birmingham Railway accounts, the actual figures given by Mr. Bury, the locomotive engineer, were, for the year ending December, 1839:—

Passenger Trains.—Ton-miles, 21,159,796, giving an average of 542,533 ton-miles per engine at 0·86 lb. of coke per ton-mile costing 0·17*d.*

Goods Trains.—17,527,439 ton-miles, giving an average of 584,247 per engine at 0·57 lb. of coke per ton-mile costing 0·11*d.* per ton-mile.

Table III. shows various amounts and quantities in comparison with one another. Beneath the actual figures are placed proportional figures, the London and Birmingham item being in every case denoted by unity.

TABLE III.

Comparison of Capital, Receipts, Miles Open, Train-miles, and Cost of Working between the London and Birmingham Railway for the Year ending June, 1840, *and the London and North-Western Railway for the Year ending December,* 1908.

	Stock and Share Capital.		Loans and Debentures.		Total.	Gross Receipts.
	£	Interest per cent.	£	Interest per cent.	£	£
L. & B. Ry., 1840 . . .	3,125,000	$9\frac{3}{4}$	2,125,900	$4\frac{5}{8}$	5,250,000	687,000
L. & N. W. Ry., 1908 .	85,861,760	5 app. average on all types of stock.	39,175,374	3 average.	125,037,134	15,515,334
L. & B. Ry., 1840 . . .	1		1		1	1
L. & N. W. Ry., 1908 .	27·5		18·4		24	22·6

	Miles Open in Equivalent Single Track.	Train-miles Run.	Receipts per Train-mile.	Cost of Working per Train-mile.	Expenditure to Gross Receipts per cent.
L. & B. Ry., 1840 . .	250	714,998	231 pence	93 pence	40
L. & N. W. Ry., 1908.	5,406	48,732,644	$76\frac{1}{2}$,,	50 ,,	65
L. & B. Ry., 1840 . .	1	1	1	1	1
L. & N. W. Ry., 1908.	21·6	68·3	0·33	0·54	1·62

The comparison brings out some curious facts. For instance, it will be noticed that the gross receipts of the London and North-Western Railway in 1908 were twenty-two and a half times as much as those of the London and Birmingham Railway in 1840, and that the track mileage open was about twenty-two times as great. The money earned per mile of track open is thus practically the same after a lapse of seventy years. To earn the same amount per mile of track open, however, the trains of the London and North-Western Railway had in 1908 to run 68·3 times the number of train-miles that the trains of the London and Birmingham Railway ran in 1840. That is to say, in order to earn a sovereign a London and North-Western train has now to run three times the distance which it was necessary for a London and Birmingham train to run to earn the same amount.

Another point to notice is that although the mileage and the receipts per mile of track open have each increased in the same proportion, yet the capital has increased at a greater rate, being on the total amount twenty-four times as much as in 1840, and the stock and share capital has increased twenty-eight times. So that with the necessity of running three times the train-mileage to obtain the same return per mile of track open, there runs the obligation to pay interest on an ordinary stock which has been increased in a greater proportion than the mileage and in a greater proportion than the earning power of the line. Lower dividends are therefore inevitable. The cost of working per train-mile has decreased gradually to about half its value in 1840, but, at the same time, the receipts per train-mile have dwindled to one-third of the amount in 1840.

These figures show that a more conservative system of financing the railways might have been adopted in the earlier days with advantage. If, when the receipts per train-mile were larger, a proportion of the revenue had been used annually for the construction of new works and for the provision of new rolling-stock, instead of raising fresh capital for everything in the nature of an addition to the railway, the companies would to-day have been in a position to regard with equanimity the increasing cost of working.

It is too late in the day to recover such a strong financial position, but even now on many lines a larger proportion of the revenue could be sunk in the line with great ultimate advantage to the financial position.

The Problem of the Locomotive Department.

During the last twenty years the demand on the locomotive has steadily increased. The demand has been met, though with increasing difficulty, owing to the constructive limitations imposed by the gauge. The transference of a train from one place to another requires that work should be done continuously by the locomotive against the tractive resistance. The size of the locomotive is determined by the rate at which this work is to be done. If T represents the tractive resistance at any instant, and V the speed of the train, then the rate at which work is done is expressed by the product TV. The pull exerted by the locomotive must never be less than the resistance of the whole train considered as a dead load on the worst gradient and curve combination on the road, and it can never be greater than about one-quarter of the total weight on the coupled wheels of the engine.

Again, the tractive pull of the engine may be analysed into two parts—one the pull exerted to increase the speed of the train, the other the pull required to maintain the speed when once it has been reached. For an express train the number of seconds required to attain the journey speed is so small a fraction of the total time interval between the stops that the question of acceleration is not one of much importance. But for a local service where stops are frequent the time required to attain the journey speed from rest is so large a fraction of the time between stops that this consideration dominates the design of the locomotive, and, in fact, makes it desirable to substitute the electric motor for the locomotive in many cases.

An accurate estimate of the rate at which work must be done to run a stated service can only be made if there are given the weight of the vehicles in the train, the weight of the engine, the kind of stock composing the train, the speed and acceleration required at each point of the journey and a section of the road; and, in addition to this, allowance must be made for weather conditions.

A general idea of the problem can, however, be obtained by omitting the consideration of acceleration, gradients, and the unknown factor of weather conditions, considering only the rate at which work must be done to draw a given load at a given speed on the level. Even thus simplified the problem can be solved only approximately, because, although the tractive resistance of a train as a whole is a function of the speed, the tractive resistance per ton of load of the vehicles and per ton of load of the engine differ both in absolute value and in their rates of change for a stated speed, and, further, the ratio between the weight of the vehicles and the weight of the engine is a very variable quantity.

For our purpose, however, it will be sufficiently accurate to assume that the resistance of the whole train, expressed in pounds per ton, is given by the formula

$$T = 5\tfrac{1}{3} + \frac{V^2}{256}.$$

It follows that the horse-power which must be developed at the driving-wheels to maintain a speed of V miles per hour on the level with a train weighing W tons is

$$HP = W\left\{\frac{V}{70} + \frac{V^3}{96{,}000}\right\}.$$

Fig. 5 shows curves of horse-power plotted from this equation for various weights of train. From this diagram a glimpse of the problem confronting locomotive engineers at the present day can readily be obtained.

To illustrate the point, consider the case of the Scotch express on the West Coast route.[1] This is an historic service, and goes away back to 1844, in which year the first train left Euston for Carlisle, travelling by way of Rugby, Leicester, York, and Newcastle, and occupying $15\frac{1}{4}$ hours. It was not until 1847, however, that there was a through service to Edinburgh *via* Berwick.

In September, 1848, the West Coast service for Edinburgh was established by way of Birmingham and Carlisle, the timing being 8 hours 55 minutes to Carlisle, and 12 hours to Edinburgh.

In September, 1863, the starting time from Euston was fixed at 10 a.m., and in 1875 the train ran *via* the Trent Valley between Rugby and Stafford, thus cutting out Birmingham and shortening the journey to Carlisle from 309 miles to 299 miles, the timing being 7 hours 42 minutes to Carlisle, and 10 hours and 25 minutes to Edinburgh. The speed has gradually been increased, and in 1905 the timing was 5 hours 54 minutes to Carlisle, and $8\frac{1}{4}$ hours to Edinburgh. Now the timing is 5 hours 48 minutes to Carlisle, but is still $8\frac{1}{4}$ hours to Edinburgh.

Three specific examples are plotted on the diagram, showing the power requirements in 1864, 1885, and 1903 for this train. Typical trains in 1864, 1885, and 1903 weighed, including engine and tender, 100 tons, 250 tons, and 450 tons respectively. The average speeds were thirty-

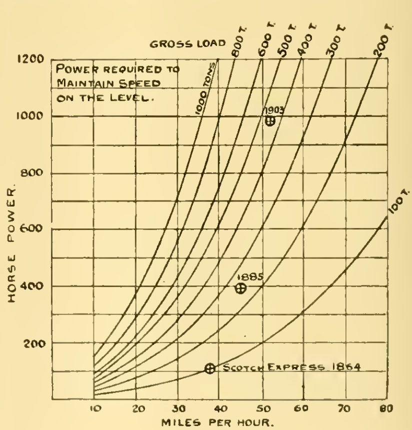


Fig. 5.

eight, forty-five, and fifty-two miles per hour respectively. A glance at the diagram will show that the power required to work this train was about 100 horse-power in 1864, 400 horse-power in 1885, and 1000 horse-power in 1903.

It must not be supposed that the increase in the weight of the train means a proportionate increase in the paying load. Far from it. On a particular day in 1903, when the total weight of the Scotch express was 450 tons approximately, the weight of the vehicles was about 346 tons. There were two dining-cars on the train, and the seating accommodation, exclusive of the seats in the dining-cars, was for 247 passengers, giving an average of 1·4 tons of dead load to be hauled by the engine per passenger, assuming the train to be full. In the days before corridor stock and dining-cars were invented the dead load to be hauled was about a quarter of a ton per passenger for a full train.

In a particular boat special, consisting of two first-class saloons, one second- and third-class vehicles, one first-class dining-car, one second and third-class dining-car, one kitchen-car, and two brake-vans, seating accommodation was provided, exclusive of the dining-cars, for 104 passengers, and the dead load to be hauled averaged 2·72

[1] I am indebted to Mr. Bowen Cooke for particulars of the Scotch Express Service.

tons per passenger. Notwithstanding this increase in the dead load of luxurious accommodation, the fares are now less than in former days on corresponding services. Similar developments have taken place in almost every important service, and new express services are all characterised by heavy trains and high speeds.

Characteristic Energy-curves of Steam Locomotives.

This steadily increasing demand for power necessarily directs attention to the problem, What is the maximum power which can be obtained from a locomotive within the limits of the construction-gauge obtaining on British railways? The answer to this can be found without much ambiguity from a diagram which I have devised, consisting of a set of typical characteristic energy-curves to represent the transference and transformation of energy in a steam locomotive, an example of which is given in Fig. 6. While examining the records of a large number of locomotive trials, I discovered that if the indicated horse-power be plotted against the rate at which heat energy is transferred across the boiler-heating surface the points fall within a straight-line region, providing that the regulator is always full open and that the power is

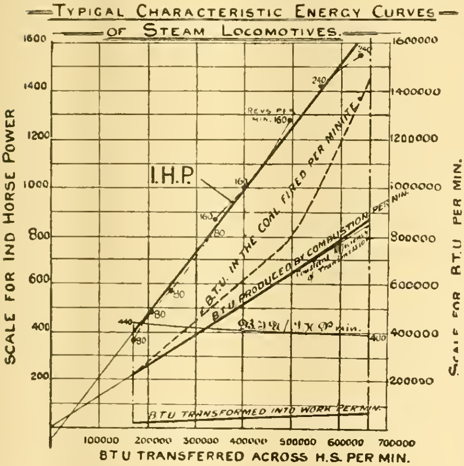


FIG. 6.

regulated by means of the reversing lever—that is to say, by varying the cut-off in the cylinders. It is assumed at the same time, of course, that the boiler-pressure is maintained constant. I have recently drawn a series of characteristic energy-curves for particular engines, and these are published in *Engineering*, August 19 and 26, 1910. A typical set is shown in Fig. 6.

The horizontal scale represents the number of British thermal units transferred across the boiler-heating surface per minute. This quantity is used as an independent variable. Plotted vertically are corresponding horse-powers, each experiment being shown by a black dot on the diagram. The small figures against the dots denote the speed in revolutions of the crank-axle per minute. Experiments at the same speed are linked by a faint chain-dotted line. A glance at the diagram will show at once how nearly all the experiments fall on a straight line, notwithstanding the wide range of speed and power.

The ordinates of the dotted curve just below the I.H.P. curve represent the heat energy in the coal shovelled per minute into the fire-box—that is, the rate at which energy is supplied to the locomotive. The thick line immediately beneath it represents the energy produced by combustion. The vertical distance between these two curves represents energy unproduced, but energy which might have been produced under more favourable conditions of combustion. Some of the unproduced energy passes out of the chimney-top in carbon monoxide gas, but the greater proportion is found in the partially consumed particles of fuel thrown out at the chimney-top in consequence of the fierce draught which must be used to burn the coal in sufficient quantity to produce energy at the rate required. The rate of combustion is measured by the number of pounds of fuel burnt per square foot of grate per hour. In land practice, with natural draft, 20 lb. of coal per square foot of grate per hour is a maximum rate. In a locomotive the rate sometimes reaches 150 lb. per square foot per hour. In the diagram shown the maximum rate is about 120 lb. per square foot, and the dotted curve begins to turn upwards at about 70 lb. per square foot per hour. The vertical distance between the curves shows what has to be paid for high rates of combustion.

I found that in almost every case the curve representing the energy actually produced by combustion differed very little from a straight line, passing through the origin, showing that at all rates of working the efficiency of transmission is approximately constant. That is to say, the proportion of the heat energy actually produced by combustion in the fire-box which passes across the boiler-heating surface per minute is nearly constant, and is therefore independent of the rate of working.

The lowest curve on the diagram represents the rate at which heat energy is transformed into mechanical energy in the cylinders of the locomotive. It seems a small rate in proportion to the rate at which heat energy is supplied to the fire-box, but it is not really so bad as it looks, because the engine actually transformed 60 per cent. of the energy which would have been transformed by a perfect engine working on the Rankine cycle between the same limits of pressure. The engine efficiency is represented in a familiar way by a curve labelled "B.T.H. per I.H.P. minute." It will be seen that the change of efficiency is small, notwithstanding large changes in the indicated horse-power.

The diagram indicates that the indicated horse-power is practically proportional to the rate at which heat is transferred across the boiler-heating surface, and as this is again proportional to the extent of the heating surface, the limit of economical power is reached when the dimensions of the boiler have reached the limits of the construction-gauge, the boiler being provided with a fire-grate of such size that, at maximum rate of working, the rate of combustion falls between 70 and 100 lb. of coal per square foot of grate per hour. A boiler of large heating surface may be made with a small grate, necessitating a high rate of combustion to obtain the required rate of heat-production. Then, although a large power may be obtained, it will not be obtained economically.

Returning now to the consideration of the type of locomotive required for a local service with frequent stops, the problem is to provide an engine which will get into its stride in the least time consistent with the comfort of the passengers. The average speed of a locomotive on local service is low. The greater part of the time is occupied in reaching the journey speed, and the brake must then often be applied for a stop a few moments after the speed has been attained. In some cases the stations are so close together that there is no period between acceleration and retardation. Without going into the details of the calculation, I may say that to start from rest a train weighing, including the engine, 300 tons, and to attain a speed of thirty miles per hour in thirty seconds requires about 1350 indicated horse-power. During the period of acceleration the engine must exert an average tractive pull of nearly fifteen tons.

Mr. James Holden, until recently locomotive engineer of the Great Eastern Railway, built an engine to produce an acceleration of thirty miles per hour in thirty seconds with a gross load of 300 tons. The engine weighed 78 tons, and was supported on ten coupled wheels, each 4 feet 6 inches diameter. There were three high-pressure cylinders, each $18\frac{1}{2}$ inches diameter and 24 inches stroke. A boiler was provided with 3000 square feet of heating surface and a grate of 42 square feet area. Boiler pressure, 200 lb. per square inch. This engine practically reached the limit of the construction-gauge.

An acceleration of thirty miles per hour in thirty seconds is considerably below what may be applied to a passenger without fear of complaint. But it is clear that it is just about as much as a locomotive can do with a train of reasonable weight. Even with a gross load of 300 tons nearly one-third of it is concentrated in the locomotive, leaving only 200 tons to carry paying load. The problem of quick acceleration cannot therefore be properly solved by means of a steam locomotive. But with electric traction the limitations imposed on the locomotive by the construction-gauge and by the strength of the permanent way are swept away.

The equivalent of the boiler-power of a dozen locomotives can be instantaneously applied to the wheels of the electric train, and every axle in the train may become a driving axle. Thus the whole weight of the stock, including the paying load, may be utilised for tractive purposes. If, for instance, the train weighed 200 tons, then a tractive force equal to one-fifth of this, namely, 40 tons, could be exerted on the train, but uniformly distributed between the several wheels, before slipping took place. The problem of quick acceleration is therefore completely solved by the electric motor.

Electric Railways.

December 18, 1890, is memorable in the history of railway enterprise in this country, for on that date the City and South London Railway was opened for traffic, and the trains were worked entirely by electricity, although the original intention was to use the endless cable system of haulage. This line inaugurated a wonderful system of traction on railways, in which independent trains, moving at different speeds at different parts of the line, are all connected by a subtle electric link to the furnaces of one central station.

Since that epoch-marking year electric traction on the railways of this country has made a gradual if somewhat slower extension than anticipated. But electrically operated trains have in one branch of railway working beaten the steam locomotive out of the field, and now reign supreme—that is, in cases, as indicated above, where a quick, frequent service is required over a somewhat short length of road. The superiority of the motor over the steam locomotive, apart from questions of cleanliness, convenience, and comfort, lies in the fact that more power can be conveyed to the train and can be utilised by the motors for the purpose of acceleration than could possibly be supplied by the largest locomotive which could be constructed within the limits of the construction-gauge. There are many other considerations, but this one is fundamental, and determines the issue in many cases.

A few facts relating to the present state of electric railways in the United Kingdom may prove of interest. At the end of 1908 there were in the United Kingdom 204 miles of equivalent single track worked solely by electricity and 200 miles worked mainly by electricity, corresponding to 138 miles of line open for traffic. Of this, 102 miles belong to the tube railways of London and 201 miles to the older system formed by the District and the Metropolitan Railways and their extensions.

It is not an easy matter to ascertain exactly how much capital is invested in these undertakings for the purpose of electric working alone, since some of the lines originally constructed for a steam locomotive service have been converted to electric working. On the converted lines there is the dead weight of capital corresponding to the locomotive power provided before electrification took place. The capital invested in the 102 miles of tube railways in London is a little more than 25,000,000*l.*

The total number of passengers carried (exclusive of season tickets) on the 138 miles of electrical track during the year 1908 was nearly 342 millions, being roughly one-third of the total number of passengers carried on all the railways of England and Wales during the same period.

The average cost of working this traffic is 22·3*d.* per train-mile. This figure includes the service of the lifts, which is presumably returned with the traffic expenses. The charges work out in this way:—

TABLE IV.

Average Working Cost per Train-mile of the Electric Railways worked wholly or mainly by Electricity in England and Wales for the Year 1908.

	Pence per train-mile.
Locomotive power	8·40
Repairs and renewals of carriages and waggons	1·50
Maintenance of permanent way	2·40
Traffic expenses	5·22
General charges	1·52
Rates and taxes	2·36
Government duty	0·088
Compensation	0·116
Legal and miscellaneous	0·75
Total	22·35

The corresponding total receipts were 38·65*d.* per train-mile. The working expenses are thus 58 per cent. of the total receipts. Comparing this with the figures given above for the whole of the lines in England and Wales, it will be seen that the cost for locomotive power on the electric railways appears to be about two-thirds of the cost on steam lines per mile run, the cost for repairs and renewals of carriages and waggons about one-half, and the cost for traffic expenses about one-half.

The two kinds of working are not, however, strictly comparable, as all the conditions of traffic in the two cases are different, and the length of the electric lines is relatively so small that the problems which arise out of the transmission of electric power over long distances are excluded. The traffic expenses and the cost of repairs and renewals of carriages and waggons, general charges, &c., are practically independent of the kind of power used for locomotive purposes, and, moreover, the difference in weight of electric trains and the steam-hauled trains is on the average so great that no comparison can be instituted without ton-mile statistics.[1]

Method of Working.

With two exceptions, the method of working the electrified lines of this country is in the main the same. A third conductor rail is laid on insulators fixed to the ordinary track sleepers, and is maintained throughout the whole of its length at as nearly as possible a pressure of 600 volts, except in a few cases where the pressure is 500 or 550 volts. Collecting shoes sliding along the rails are fixed to the trains, and through them current is supplied to the armatures fixed to or geared with the axles. The current flows through the armatures back to the stations or sub-stations through the running rails, which are bonded for the purpose, or sometimes through a fourth rail carried on insulators fixed to the track sleepers, as in the cases of the District and Metropolitan Railways.

Differences in the equipment arise out of the geographical necessities of the distribution. For a short line the power is produced at a central station, and is distributed by feeders to the conductor rail direct. For longer lines power is produced at higher voltage (11,000 volts in the case of the District Railway), and is then distributed to sub-stations conveniently placed along the line, where it is transformed to a lower voltage, converted to direct current, and then by means of feeders is distributed at 600 volts or thereabouts to the third rail.

In 1908 the Midland Railway Company opened for traffic the electrified line connecting Lancaster, Morecambe, and Heysham. The method of electrification was a departure from the general direct-current practice hitherto applied to electrified lines in this country. Power was supplied to the trains at 6600 volts, single phase, at twenty-five alternations per second, along an overhead conductor. The pressure was reduced by transformers carried on the motor-coach itself, and was then used by single-phase motors. The traffic conditions on this line are simple.

[1] Most valuable information regarding the cost of converting the line between Liverpool and Southport from steam to electric working will be found in Mr. Aspinall's presidential address to the Institution of Mechanical Engineers.

In December, 1909, the electrified portion of the London, Brighton, and South Coast Railway from Victoria, round by Denmark Hill, to London Bridge was opened for traffic. This work marks an epoch in the history of electric traction in England. For the first time the single-phase system was applied to meet the exacting traffic conditions of a London suburban service where the main condition is that the trains should be accelerated rapidly. The system has shown that it can meet all the conditions of the service perfectly. Energy is purchased, and is distributed by overhead conductors direct to the trains at 6000 volts, single phase, at twenty-five alternations per second, where it is used by the single-phase motors after suitable transformation by apparatus carried under the motor carriage. The results of this electrification will be of unusual interest, because not only has the method applied shown itself to be quite suitable for dealing with a stopping traffic where quick acceleration is the dominating condition, but it contains the germ of practicable long-distance electrification. The near future may see the extension of the system to the line between London and Brighton, giving a frequent non-stop service which would bring Brighton in point of time nearer than the suburbs on opposite sides of London are to one another.

Power Signalling.

During the last ten years a considerable number of trial installations of power-signalling apparatus have been made by the railway companies of this country. The electric lines have generally adopted power signalling, and the District Railway has installed a complete system on all its lines and branches.

The term "power signalling" is applied to any equipment in which the actual movements of the points and signals are done by power, the signalman's work being thus reduced to the movement of small light control levers or switches. Of the several systems tried and proposed, three bulk largest in the equipments applied in this country, namely, the all-electric, the low-pressure pneumatic, and the electro-pneumatic systems.

The "all-electric" system is represented by installations of the McKenzie-Holland and Westinghouse system on the Metropolitan and Great Western Railways, by installations of the "Crewe" system on the London and North-Western Railway, and by installations of Siemens Brothers on the Great Western Railway. The general feature of the all-electric system is that the points are operated by motors sunk in a pit by the side of the rails; the signals are pulled off electrically, and all the apparatus is controlled electrically.

The low-pressure pneumatic system is represented by installations on the London and South-Western Railway and the Great Central Railway. The points and signal arms are moved by air compressed to about 20 lb. per square inch, and led to cylinders connected to the points and to the signal arms. The control is also done by means of compressed air, small pipes leading from each air cylinder to the cabin.

The electro-pneumatic system has found most favour in this country up to the present time. The equipment installed includes such notable stations as the Central at Newcastle with 494 levers, and the Glasgow Central with 374 levers, and the whole of the Metropolitan District system of underground railways. In this system an air cylinder is connected to each set of points and to each signal-arm. Air compressed at 65 lb. per square inch is supplied to the cylinders from a main running alongside the railway kept charged by small air-compressors placed at convenient intervals. Each air cylinder is provided with a small three-way air-valve operated by an electromagnet. The movement of each air-valve is controlled electrically from the cabin through the electromagnet associated with it. The system grouped round any one signal-cabin may be regarded as an engine fitted with a large number of cylinders, each working intermittently by compressed air, and where in each the valve-rod has been changed to an electric cable, all the cables being led to a signal-cabin, where the operation of the valves is done by means of an apparatus which is as easily played upon as a piano, with this difference, however, that the notes are mechanically interlocked, so that a signalman cannot play any tune he pleases, but only a tune which permits of safe traffic movement. Moreover, the instrument is so arranged that the movement of the small lever determining the movement of a signal-arm cannot be completed unless the signal-arm actually responds to the intention of the signalman, thus detecting any fault in the connections between the box and the arm.

The obvious advantage of power signalling is the large reduction of physical labour required from the signalman. His energy can be utilised in thinking about the traffic movements rather than in hauling all day at signal levers. One man at a power frame can do the work of three at the ordinary frame. The claims made for power signalling, in addition to the obvious advantage of the reduction of labour, are briefly that the volume of traffic which can be dealt with is largely increased, that the area of ground required for the installation is considerably less than with the ordinary system, with its rodding, bell-crank levers, chains, and pulleys, and that where the conditions are such that power signalling is justified the maintenance cost is less than with a corresponding system of normal equipment.

Automatic Signalling.

Several of the power-signalling installations are automatic in the sense that between signal-cabins on stretches of line where there are no junctions or cross-over roads requiring the movement of points, the movement of the signal arm protecting a section is determined by the passage of the train itself. The most important equipment of this kind is that installed on the group of railways forming the "Underground" system. This includes the District Railway with all its branches. On this line the particular system installed is the electro-pneumatic, modified to be automatic except at junctions. Signal-cabins are placed only at junctions and at places where points require to be operated. The stretch of line to be automatically signalled is divided into sections, and the entrance to each section is guarded by a signal-post. Calling two successive sections A and B, the train as it passes from Section A to Section B must automatically put the signal at the entrance to B to danger, and at the same time must pull off the signal at the entrance to A. These operations require the normal position of the signal-arm to be "off" instead of at danger, as in the usual practice. The position of the arm in this system conveys a direct message to the driver. If "on" he knows that there is a train in the section; if "off" he knows that the section is clear. Each signal-arm is operated by an air motor, as briefly described above, but the cables from the valves are now led to relays at the beginning and end of the section which the signal protects. The contrivance by means of which the train acts as its own signalman is briefly as follows. One rail of the running track is bonded, and is connected to the positive pole of a battery or generator. The opposite rail is divided into sections, each about 300 yards long, bonded, but insulated at each end from the rails of the adjacent sections, and each section is connected to a common negative main through a resistance. A relay is placed at the beginning and at the end of each section, and is connected across from the positive to the negative rail. Current flows and energises the relay, in which condition the relay completes a circuit to the electromagnet operating the admission valve of the air cylinder on the signal-post, air is admitted, and the signal-arm is held off. This is the normal condition at each end of the circuit. When a train enters a section it short-circuits the relays through the wheels and axles, in consequence of which the relays, de-energised, break the circuit to the admission valve, which closes, and allows the air in the cylinder to escape, and the signal-arm, moved by gravity alone, assumes the "on" or danger position. At the same time the short circuit is removed from the section behind directly the train leaves it, the relays are at once energised, the admission valve to the air cylinder on the protecting post of the section is opened, air enters, and the signal is pulled down to the "off" position.

The speed at which traffic can be operated by this system of power signalling is remarkable. At Earl's Court junction box forty trains an hour can be passed each way—that is, eighty per hour—handled by the one signalman in the box. As the train approaches the box, both its approach to the section and its destination must be notified to the signalman. When it is remembered that with ordinary signalling, to take an express train, for example, a signalman hears some twenty-four beats on the gongs in his box, and sends signals to the front and rear box, which give altogether some twenty-four beats on the gongs in these two boxes, forty-eight definite signals in all, for every express train he passes into the section which his signals protect, it will be understood that the system must be profoundly modified to admit such a speed of operation as eighty trains per hour per man. The modification is radical. No gong signals are used at all. There is a small cast-iron box standing opposite the signalman with fifteen small windows in it, each about $1\frac{1}{2}$ inches square. Normally, each window frames a white background. A click in the box announces the approach of a train, and a tablet appears in one of the empty windows showing by code the destination of the train. The signalman presses a plug in the box, a click is heard, and a tablet is seen in a precisely similar apparatus in the next box. When the train passes the man presses another plug, and the tablet disappears.

Four wires run between the signal-boxes along the railway, and by combining the currents along the four wires in various ways fifteen definite signals can be obtained, a number sufficient for the District traffic. Each of the fifteen combinations is arranged to operate one particular tablet in the box. Current from these four wires is tapped off at intermediate stations, and is used to work a train indicator showing the passengers assembled on the platform the destinations of the next three trains. The whole equipment is a triumph of ingenuity and engineering skill, and is a splendid example of the way electricity may be used to improve the railway service, quite apart from its main use in connection with the actual driving of the trains.

The facts and problems I have brought before you will, I think, show the important influence that scientific discovery has had upon our railway systems. Scientific discovery and mechanical ingenuity have reduced the cost of locomotive working to a point undreamt of by the pioneer locomotive builders. Electric railways are the direct fruit of the discoveries of Faraday. The safety of the travelling public was enormously increased by the invention of continuous brakes and by the discovery of the electric telegraph, and is greatly increased by the development of modern methods of signalling; and the comfort of travellers is increased by modern methods of train-lighting, train-warming, and the train kitchen. Inventions of a most ingenious character have from time to time been made in order to furnish a steady and ample light in the carriages. The smoothness of travelling on our main lines is evidence of the thought which has been lavished both on the wheel arrangements of the carriages and on the permanent way. Problems in connection with the continuous brake are many and interesting. Some of the problems of modern signalling would have quite baffled the scientific electrician of a quarter of a century ago. When engineers endeavour to apply the results of scientific discovery they often find themselves confronted by new problems unperceived by the man of science. Together they may find a solution, and thus enlarge the boundaries of knowledge, and at the same time confer a practical advantage on the community. The pure man of science, the practical engineer, act and react on one another both to the advantage of pure science and to the advantage of the national welfare. The future success of our railways depends upon the closer application of scientific principle both to the economic and engineering problems involved in their working, some decrease in unprofitable competition with one another, and a more just appreciation on the part of the State of the part railway companies play in our national well-being.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY W. CROOKE, B.A., PRESIDENT OF THE SECTION.

ONE-AND-THIRTY years have passed since the British Association visited this city. At that time anthropology was in the stage of probation, and was represented by a branch of the section devoted to biology. Since then its progress in popularity and influence has been continuous, and its claims to be regarded as a science, with aims and capabilities in no way inferior to those of longer growth, are now generally admitted. Its advance in this country is largely due to the distinguished occupant of this chair at our last meeting in Sheffield. During the present year Dr. E. B. Tylor has resigned the professorship of anthropology in the University of Oxford. Before this audience it is unnecessary for me to describe in detail the services which this eminent scholar and thinker has rendered to science. His professorial work at Oxford; his unfailing support of the Royal Anthropological Institute and of this section of the British Association; his sympathetic encouragement of a younger generation of workers—these are familiar to all of us. Many of those now engaged in anthropological work at home and abroad date that interest in the study of man, his culture and beliefs, which has given a new pleasure to their lives, from the time when they first became acquainted with his "Primitive Culture" and "Researches into the History of Mankind." These works enjoy the almost unique distinction that, in spite of the constant accumulation of new material to illustrate an advancing science, they still maintain their authority; and this because they are based on a thorough investigation of all the available material and a profound insight into the psychology of man at the earlier stages of culture. He has laid down once for all the broad principles which must always guide the anthropologist: that a familiarity with the principles of the religions of the lower races is as indispensable to the scientific student of theology as a knowledge of the lower forms of life, the structure of mere invertebrate creatures, is to the physiologist. "Few," he assures us, "who will give their minds to master the general principles of savage religion will ever think it ridiculous or the knowledge of it superfluous to the rest of mankind. . . . Nowhere are broad views of historical development more needed than in the study of religion. . . . Scepticism and criticism are the very conditions for the attainment of reasonable belief." I need hardly say that his exposition of the principles of animism, as derived from the subconscious mental phenomena of dreams and waking visions, has given a new impulse and direction to the study of the religion of savage races.

Dr. Tylor, on his retirement from the active work of teaching, carries with him the respectful congratulations and good wishes of the anthropologists here assembled, all of whom join in the hope that the Emeritus Professor may be able to devote some of his well-earned leisure to increasing the series of valuable works for which we are already indebted to him.

In his address from this chair Dr. Tylor remarked that twenty years before that time it was no difficult task to master the available material. "But now," he added, "even the yearly list of new anthropological literature is enough to form a pamphlet, and each capital of Europe has its anthropological society in full work. So far from any finality in anthropological investigation, each new line of argument but opens the way to others behind, while those lines tend as plainly as in the sciences of stricter weight and measure towards the meeting ground of all sciences in the unity of nature."

Since these words were written there has been a never-ceasing supply of fresh literature, which is well represented in the publications of the present year. Every contributor to this science must now be a specialist, because he can with advantage occupy only one tiny corner of the field of humanity; and even then he is never free from a feeling of anxiety lest his humble contribution may have been anticipated by some indefatigable foreign scholar. In short, the attempt to give a general exposition of the sciences devoted to the study of mankind has been replaced by the monograph. Of such studies designed to coordinate and interpret the facts collected by workers in the field we welcome two contributions of special importance.

Prof. J. G. Frazer has given us a monumental treatise on totemism and exogamy, in which, relying largely on new Australian evidence and that collected from Melanesia by Dr. Haddon and his colleagues, Dr. Rivers and Dr. Seligmann, he endeavours to prove that totemism originated in a primitive explanation of the mysteries of conception and childbirth. As contributing causes he discusses the influence of dreams and the theory of the external soul, the latter being occasionally found connected with totemism; and he points out that one function of a totem clan was to provide by methods of mimetic or sympathetic magic a supply of the totem plant or animal on which the existence of the community depends, this function being not metaphysical or based on philanthropic impulse, but on a cool but erroneous calculation of economic interest. He has also cleared the ground by dissociating totemism from exogamy, the latter, as an institution of social life, being, he believes, later in order of time than totemism, and having in some cases accidentally modified the totemic system, while in others it has left that system entirely unaffected. The law of exogamy is, in his opinion, based mainly on a desire to prevent the union of near relations, and on the resulting belief in the sterilising effects of incest upon women in general and edible animals and plants. In dealing with totemism as a factor in the evolution of religion he gives us a much-needed warning that it does not necessarily develop, first into the worship of sacred animals and plants, and afterwards into the cult of anthropomorphic deities with sacred plants and animals for their attributes. In the stage of pure totemism totems are in no sense deities, that is to say, they are not propitiated by prayer and sacrifice; and it is only in Polynesia and Melanesia that there are any indications of a stage of religion evolved from totemism, a conclusion which demolishes much ingenious speculation. It is hardly to be expected that in a field covered by the wrecks of many controversies these views will meet with universal acceptance. But the candour with which he discards many of his own theories, and the infinite labour and learning devoted to the preparation of his elaborate digest, deserve our hearty recognition.

In his treatise on "Primitive Paternity," Mr. E. S. Hartland deals with the problems connected with the relations of the sexes in archaic society. Mother-right he finds to be due not so much to the difficulty of identifying the father as to ignorance of physiological facts; and he supposes that the transition from mother-right to father-right originated not from a recognition of the physical conditions of paternity, but from considerations connected with the devolution of property; as Prof. Frazer states the case, it arises from a general increase in material prosperity leading to the growth of private wealth.

We also record the steady progress of the great "Encyclopædia of Religion and Ethics," under the editorship of Dr. J. Hastings, which promises to provide an admirable digest of the results of recent advances in the fields of comparative religion and ethnology.

It is now admitted by all students of classical literature that the material collected from the lower races is an indispensable aid to the interpretation of the myths, beliefs, and culture of the Greeks and Romans. Most of our universities provide instruction of this kind; and Oxford has opened its doors to a special course of lectures dealing with the relation of anthropology to the classics. One of its most learned mythologists, Dr. L. R. Farnell, when about half-way through his treatise on the cults of the Greek states, admitted the increasing value of the science in elucidating the problems on which he was engaged. Even with this well-advised change of method he has left the field of peasant religion, nature-worship, and magic, which must form the starting-points for the next examination of Greek beliefs, practically unworked. The formation of a Roman Society, working in cooperation with and following the methods which have been adopted by the Society for the Promotion of Hellenic Studies, is a fresh indication of the increasing importance of the work upon which we are engaged.

In the field of archæology Dr. A. J. Evans has commenced the publication of the Minoan records, which open up a new chapter in the early history of the Mediterranean. It is now certain that the origin of our alphabet is not to be found, as De Rougé supposed, in the hieratic script of Egypt, but in the Cretan hieroglyphs; and that the influence of the Phœnicians in its development was less important than has been generally supposed. Before the full harvest of these excavations can be reaped we may have to await the discovery of some bilingual document, like the Rosetta Stone, which will solve the mysteries of the Minoan syllabary.

As regards physical anthropology, the validity of the use of the cephalic index, particularly in discriminating the elements of mixed populations, has been questioned. The recent Hunterian lectures delivered by Prof. A. Keith, as yet published only in the form of a summary, are designed to place these investigations on a more scientific basis. In particular increased attention is being given to the influence of environment in modifying a structure generally so stable as the human skull. Thus it has been ascertained that the immigrant into our towns, by some process of selection or otherwise, develops a longer and narrower head than the countryman. The recent American Commission, under the presidency of Prof. Boas, reports that "racial and physical characteristics do not survive under the new climate and social environment. . . . Children born even a few years after the arrival of their parents show essential differences as compared with their European parentage. . . . Every part of the body is influenced, even the shape of the skull, which has always been considered to be the most permanent hereditary characteristic." Similar results appear from a comparison of the American negro with his African ancestor.

I may here refer briefly to the work on folk-lore. Though in recent years it has not maintained the importance which it at one time secured in the proceedings of this section, we still regard it as an essential branch of the study of man. The Folk-lore Society, after thirty-two years' useful work, finds that much still remains to be done in these islands to secure a complete record of popular beliefs and traditions, many of which are rapidly disappearing. It has therefore formulated a scheme for more systematic investigation in those districts which have hitherto been neglected. A committee including representatives of the two allied sciences is also engaged on the necessary task of revising and defining the terminology of anthropology and folk-lore.

The materials collected by field workers in various regions of the world, and popular accounts of savage religion, customs, and folk-lore continue to arrive in such increasing numbers that the need of a central bureau for the classification of this mass of facts has become increasingly apparent. It is true that we have suffered a set-back, it is to be hoped only temporary, in the rejection of an appeal made to the Prime Minister for a grant-in-aid of the Royal Anthropological Institute. But if we persist in urging our claims to official support the establishment of an Imperial Bureau of Ethnology cannot be long deferred.

One result of this accession of fresh knowledge, largely due to improved methods of research, is to modify some of our conceptions of savage psychology. We now understand that side by side with physical uniformity there may be wide differences arising from varieties of race and environment. It is becoming generally recognised that we can no longer evade the difficulty of interpreting beliefs and usages by referring them to that elusive personality, primitive man. Between the embryonic stage of humanity and the present lie vast periods of time; and no methods of investigation open to us at present offer the hope of successfully bridging this gap in the historical record. To use the words of Prof. Frazer: "It is only in a relative sense, by comparison with civilised men, that we may legitimately describe any living race of savages as primitive." Hence the hypothesis of the unilinear evolution of culture which satisfied an earlier school will no longer bear examination.

Further, not to speak of the artistic endowments of palæolithic man, we find to our surprise that a race like the Australian Arunta, whose lowness in the scale of humanity does not necessarily connote degradation, has worked out with exceptional ability through its tribal council their complex and cumbrous systems of group marriage and totemism. They have developed a cosmogony which postulates the self-existence of the universe; they have reached a belief in reincarnation and transmigration of the soul. So far from their social system being rigid it is readily modified to suit new conditions. They live in peace with neighbouring tribes, and have established the elements of international law. On the moral side, though there is much that is cruel and abhorrent, they are not wanting in kindliness, generosity, gratitude. The savage, in short, is not such an unobservant simpleton as some are inclined to suppose; and any interpretation of his beliefs and usages which ignores this fact is certain to be misleading.

This popularisation of our science has not, however, been universally welcomed. It has been urged with much reason that this overabundance of material tends to encourage an unscientific method, particularly the comparison of isolated facts without due regard to the context of culture to which they are organically related. There is much force in this contention; and probably when the work of this generation comes to be critically reviewed we shall be rightly charged with rashly attempting a synthesis of facts not generically related, with reposing too much confidence in evidence collected in a haphazard fashion, and with losing sight of their historical relations in our quest after survivals. Those who have practical experience of work among savage or semi-savage races understand the difficulty of collecting information on subjects outside the range of their material interests. Only a skilled linguist is able to interpret their hazy religious beliefs. We fail to evolve order from what is and always must be chaotic; we fail to discriminate religion from sociology because both are from the savage point of view identical; and generally it is only the by-products of religion, such as demonology, witchcraft, mythology which reward our search. The most dogmatic among us, when they consider the divergent views of Messrs. Spencer and Gillen and Strehlow, may well hesitate to frame theories about the Arunta.

In the next place it has been objected that the scientific side of anthropology is in danger of being submerged by a flood of amateurism. It is only within recent years that a supply of observers trained in scientific methods has become available. Much of the work in India, the dominions, and other parts of the Empire has been done by amateurs, that is to say, by officers in the service of the Crown, missionaries, or planters, who understand the languages, manners, and prejudices of the people, but have not received the advantage of scientific training. Some of this work is, in its kind, useful; but there seems reason to believe that inquiries conducted by this agency have almost reached their limit. The existing material may be supplemented and corrected by workers of the same class; but from them no important additions to our knowledge can reasonably be expected.

Criticisms such as these have naturally suggested proposals for improving the qualifications of this agency by providing a course of training for public servants before they join their appointments; and excellent arrangements with this object have been made by several of our universities. In addition to this schemes are in the air for the establishment of a School of Oriental Studies in London or of a College for Civilians in Calcutta. We must, however, recollect that the college established by Lord Wellesley at the beginning of the last century with the intention, to use his own words, of promoting among junior officers "an intimate acquaintance with the history, language, customs, and manners of the people of India," failed to meet the aims of its founder. We must also remember that recruits for the Colonial services do not undergo any training in this country; and that in the case of the Covenanted Civil Service of India the period extends only to a single year, during which the candidate is expected to learn the rudiments of at least one Oriental language and to acquire some knowledge of the law and history of India. It seems obvious that this leaves little time for the scientific study of anthropology; and the most that can be expected is to excite in the young official a desire to study the native races and to define the subjects to which his attention may usefully be directed. There is, again, the obvious risk of letting loose the half-trained amateur among savage or semi-savage peoples. He may see a totem in every hedge or expect to meet a corn-spirit on every threshing-floor. He may usurp the functions of the arm-chair anthropologist by adding to his own proper business, which is the collection of facts, an attempt to explain their scientific relations. As a matter of fact, the true anthropologist is born, not made; and no possible course of study can be useful except in the case of a few who possess a natural taste for this kind of work.

Having then practically exhausted our present agency it is incumbent upon us to press upon the Governments throughout the Empire the necessity of entrusting the supervision of ethnographical surveys to specialists. This principle has been recognised in the case of botany, geology, and archæology, and it is high time that it was extended to anthropology. It is the possession of such a trained staff that has enabled the American Government to carry out with success a survey of the natives of the Philippine Islands; and it is gratifying to record that the Canadian legislature, in response to resolutions adopted by this section at the Winnipeg meeting, has recently voted funds to provide the salary of a superintendent of the ethnological survey. We may confidently expect that other Governments throughout the Empire will soon follow this laudable example. These Governments will, of course, continue to collect at each periodical census those statistics and facts of sociology and economics which are required for purposes of administration. But beyond these practical objects there are questions which can be adequately investigated only by specialists.

The duties of such a director will necessarily be threefold: First, to sift, arrange, and coordinate the facts already collected by non-scientific observers; secondly, to initiate and control special investigations, in particular that intensive study of smaller groups within a limited area which, in the case of the survey of the Todas by Dr Rivers, has so largely contributed to our knowledge of that tribe. Such methods not only open out new scientific fields, but, and this is perhaps more important, establish a standard of efficiency which improves later surveys of these or neighbouring races.

The field for inquiry throughout the Empire is so vast that there is ample room for expeditions independent of official patronage. In some respects the private traveller possesses advantages over the official—in his freedom from the bondage of red tape and from the suspicion which inevitably attaches to the servant of Government that his inquiries are conducted with the object of imposing taxation or of introducing some irksome measures of administration. He is always sure to receive the aid of local officers, whose familiarity with the native races must be of the highest value.

The third duty of the director will be to organise in a systematic way the collection of specimens for home and colonial museums. Our ethnographical museums, as a whole, have not reached that standard of efficiency which the importance of the Empire and the needs of training in anthropology obviously require; and our students have to seek in museums at Berlin and other foreign cities for collections illustrative of tribes which have long been subject to British law. It is only necessary to refer to the recent handbook of the ethnographical collections in the British Museum to see that there are wide gaps in the series which might easily be filled by systematic effort. No time is to be lost, because the tragedy of the extinction of the savage is approaching the final act, and our grandchildren will search for him in vain except perhaps in the slums of our greater cities.

Assuming then that in the near future anthropological inquiries will be organised on practical lines, I invite your attention to some special problems in India which deserve intensive study, and which can be solved in no other way. India is a most promising field for such inquiries. Here the student of comparative religion can trace with more precision than is possible in any other part of the Empire the development of animism and the interaction on it of the forces represented by Buddhism, Hinduism, Islam, and Christianity. The anthropologist can observe the most varied types of moral and material culture, from those represented by the heirs of its historic civilisation down to forest and depressed tribes little raised above the level of savagery.

The first question which awaits examination is that of the prehistoric races and their relation to the present population. Unfortunately the materials for this inquiry are still imperfect. The operations of the archæological survey, with the scanty means at its disposal, have rightly been concentrated upon the remains of architecture in stone, which starts from the Buddhist period, and upon the conservation of the splendid buildings which are our inheritance from older ruling powers. The prehistoric materials have been collected by casual workers who were not always careful to record the localities and circumstances of the discovery of their contributions to the local museums. Many links are still wanting, some altogether absent from Indian soil; others which systematic search will doubtless supply. We can realise what the position of prehistoric archæology in Europe would be if the series of Neolithic barrows, the bone carvings of the cave-dwellers, the relics from kitchen-middens and lake dwellings were absent. The caves of central India, it is true, have supplied stone implements and some rude rock paintings. But the secrets of successive hordes of invaders from the north, their forts and dwellings, lie deep in the alluvium, or are still covered by shapeless mounds. Tropical heat and torrential rain, the ravages of treasure-hunters, the practice of cremation have destroyed much of the remains of the dead. The epigraphical evidence is enormously later in date than that from Babylon, Assyria, or Egypt; and the oriental indifference to the past and the growth of a sacred literature written to subserve the interests of a priestly class weaken the value of the historical record.

Further, India possesses as yet no seriation of ceramic types such as that devised by Prof. Flinders Petrie which has enabled him to arrange the Egyptian tombs on scientific principles, or that which Prof. Oscar Montelius has established for the remains of the Bronze Age. Mr. Marshall, the Director of the Archæological Survey, admits that the Indian museums contain few specimens of metal work the age of which is even approximately known.

Though the record of the prehistoric culture is imperfect, we can roughly define its successive stages.

The palæolithic implements have been studied by Mr. A. C. Logan, whose work is useful if only to show the complexity of the problem. Those found in the laterite deposits belong to the later Pleistocene period, and display a technique similar to that of the river-drift series from western Europe. The Eoliths, which have excited such acute controversy, have up to the present not been discovered; and so far as is at present known the palæolithic series from India appears to be of later date than the European. Palæolithic man seems to have occupied the eastern coast of the peninsula, whence he migrated inland, using in turn quartzose, chert, quartzite, limestone, or sandstone for his weapons; that is to say, he seems not to have inhabited those districts which at a later time were seats of neolithic culture. Early man, according to what is perhaps the most reasonable theory, was first specialised in Malaysia, and his northward route is marked by discoveries at Johore and other sites in that region. Thence he possibly passed into India. The other view represents palæolithic man as an immigrant from Europe. At any rate, his occupation of parts of southern India was antecedent to the action of those forces which produced its present form, ere the great rivers had excavated their present channels, and prior to the deposition of the masses of alluvium and gravel which cover the implements which are the only evidence of his existence.

Between the palæolithic and the neolithic races there is a great geological and cultural gap; and no attempt to bridge it has been made except by the suggestion that the missing links may be found in the cave deposits when they undergo examination.

There is reason, however, to believe that the neolithic and the Iron Age cultures were continuous, and that an important element in the present population survives from the neolithic period. Relics of the neolithic are much more widely spread than those of the palæolithic age. They extend all over southern India, the Deccan, and the central or Vindhyan range. Up to the present they are scanty in the Punjab and Bengal; but this may be due to failure to discover or identify them. Mr. Bruce Foote has discovered at various sites in the south factories of neolithic implements associated with wheel-made pottery of a fairly advanced type, showing that the Stone Age has survived side by side with that of metal down to comparatively recent times. The Veddas of Ceylon, the Andamanese, and various tribes on the north-east frontier, in central and southern India, are, or were up to quite recent times, in the Age of Stone. In fact, when we speak of ages of stone or metal we must not regard them as representing division of time but generally continuous phases of culture.

There is no trustworthy evidence for the existence of an Age of Bronze. The single fine implement of this metal which has been discovered is probably, like the artistic vessels from the Nilgiri interments, of foreign origin; and other implements of a less defined type seem to be the result of imperfect metallurgy. This is not the place to discuss the problem of the origin and diffusion of bronze. Babylon, Asia Minor, and China have each been supposed to be a centre of distribution. The Egyptian specimen attributed to the third dynasty, say before the fourth millennium B.C., is believed by Prof. Petrie to be the result of a chance alloy; but the metal certainly appears in Egypt about 1600 B.C., and it is believed to have originated in central Europe, where the Zinnwald of Saxony or the Bohemian mines provided a supply of tin. The absence of a Bronze Age in India has been explained by the scarcity of tin and the impossibility of procuring it from its chief source in the Malay-Burman region, where the mines do not seem to have been worked in ancient times. But another view deserves consideration. Prof. Ridgeway has shown that all the sites where native iron is smelted are those where carboniferous strata and ironstone have been heated by eruptions of basalt; and iron was thus produced by the natural reduction of the ore. In Africa as well as India the absence of the Bronze Age seems to be due to the abundant supplies of iron ores which could be worked by processes simpler than those required in the case of bronze. In India iron may have been independently discovered towards the close of the neolithic period, and iron may have displaced copper without the intervention of bronze.

However this may be, the Copper Age in India, which has been carefully studied by Mr. V. A. Smith, is of great importance. Implements of this metal in the form of flat and bar celts, swords, daggers, harpoon, spear, and arrow heads, with ornaments and a strange figure probably human, have been found at numerous sites in northern India. In western Europe, according to Dr. Munro, the Copper Age was of short duration; but Mr. Smith believes that in India the variety of types indicates a long period of development.

No mention of iron occurs in the Rig-veda; but it appears in the Atharvan, which cannot be dated much later than 1000 B.C. It is now recognised that there is a still obscure stratum of Babylonian influence underlying the Aryan culture; and if, as is generally supposed, the manufacture of iron was established by the Chalybes at the head-waters of the Euphrates, who passed it down the delta, its use may have spread thence among the Indo-Aryans. It certainly appears late in the south Indian dolmen period; and we have the alternatives of believing that it was introduced there by the Dravidian trade with the Persian Gulf, which certainly arose before the seventh century before Christ, or that it was independently discovered by the Dravidians who still extract it in a rude way from the native ores.

The great series of dolmens, circles, and kistvaens which cover the hills and plateaux of the Deccan and the region to the south seem to belong to the Iron Age. Whether the construction of these monuments was due to the migration of the dolmen-building race from northern Africa, or whether the builders were a local people utilising the material on the spot must remain uncertain. The excavations conducted by Mr. Breeks and others disclose tall jars, many-storeyed cylinders of varying diameter, with round or conical bases, fashioned to rest on pottery ring-stands, like the classical amphoræ, or to be imbedded in softer soil. The lids of these vessels are ornamented with rude, grotesque figures of men, animals, or more rarely inanimate objects, depicting the arms, dress, ornaments, and domesticated fauna of the period. It has been suspected that these figurines may be of a date earlier than the implements of iron with which they are associated, and that they were deposited with the dead in a spirit of religious conservatism. At any rate, the costumes and arms represented on the older pottery present no resemblance to those depicted on the later series of dolmens and kistvaens. The pottery also seems to belong to different periods, the larger jars being of a later date than the true funereal urns which are found at a lower level, and contain a few cremated bones, gold ornaments, bronze and iron rings, with beads of glass or agate. These people clearly regarded bronze as an article of luxury, as it appears in the form of ornaments or in the series of splendid vases preserved in the Madras museum. It is difficult to suppose that these were of local origin; more probably they were imported in the course of trade along the western coast or from more distant regions.

Another and equally remarkable phase of culture, combining distinctly savage features with a fairly advanced civilisation, is illustrated by the Adittanalur cemetery in the Tinnevelli district recently excavated by Mr. Rea. Two skulls discovered here are prognathous, suggesting a mixture of the Negrito and Dravidian types. There is no trace of cremation, and in most cases the smallness of the urn openings implies that the corpses were exposed to birds of prey, and that only such bones as could be discovered after removal of the flesh were collected for interment; or, according to another interpretation of the facts, we have an instance of the custom of mourners carrying with them, like the modern Andamanese, the relics of the dead. These interments certainly extended over a long period, neolithic weapons being found in some graves, while in others iron arms were discovered fixed point downwards near the urns, as if they had been thrust into the ground by the mourners. In the richer graves gold frontlets, like those of Mycenae and other Greek interments, were fastened over the forehead of the corpse. These were, like the Greek specimens, of such a flimsy type that they could never have been used in real life. It is a remarkable instance of a survival in custom that at the present day some tribes in this region tie a triangular strip of gold on the forehead of the dead, the import of which, on the analogy of the death masks of Siam, Cambodia, ancient Mexico, and Alaska, we may interpret as an attempt to guard the corpse from the glances of evil spirits while the spirit is on its way to deathland, or to be used in processions of the corpse.

The question remains: To what races may we attribute these successive phases of culture in southern India? The Tamil literature, as interpreted by Bishop Caldwell and Mr. V. Kanakasabhai, shows the existence of an advanced type of archaic culture in this region; but the evidence to connect this with the existing remains is as yet wanting. We may reasonably assume that neolithic man survives in the existing population, because we have no evidence of subsequent extensive migrations, except the much later arrival of Indo-Aryan colonies from the north, and that of the Todas, whom Dr. Rivers satisfactorily identifies with the Nayars and Nambutiri Brahmans of Malabar. The occurrence of a short-headed strain among some tribes in western India probably represents some prehistoric migration by sea or along the coast line from the direction of Baluchistan or the Persian Gulf. The suggestion that it is the result of a Scythian or Hun retreat from northern India in the face of an advancing Aryan movement is not corroborated by any historical evidence, and is in itself improbable. The customs of dolmen and kistvaen burial still persist among some of the present tribes, and they display some reverence for the burial places of their forgotten predecessors. This feeling may, however, be due to the habitual tendency of the Hindu to perform rites of propitiation at places supposed to be the haunts of spirits, and need not necessarily connote racial identity.

The most primitive type identifiable in the population of south India is the Negrito, which appears among the Veddas of Ceylon, and among the Andamanese, who retain the Negrito skin colour and hair, but have acquired, probably from some Mongoloid stock, distinct facial characters. It has been the habit with some writers to exaggerate the Negrito strain in the south. But tribes like the Badagas and Kotas, which have been classed as representative of this type, possess none of the Negrito characters, which appear only among the more primitive Kurumbas, Malayans, Paniyans, and Irulas. In all the modern tribes the distinctive Negrito marks—woolliness of hair, prognathism, lowness of stature, and excessive length of arm—have become modified by miscegenation or the influences of environment.

The resemblances in culture of the Indian Negrito with the cognate races to the east and south-east of the Peninsula are too striking to be accidental. The Kadirs of Madras climb trees like the Bornean Dayaks, clip their teeth like the Jakun of the Malay Peninsula, and wear curiously ornamented hair combs like the Semang of Perak, among whom they serve some obscure magical purpose. The Negrito type deserves special examination in relation to the recent discovery of Pygmies in New Guinea, and the monograph on the Pygmy races in general by Dr. P. W. Schmidt, who regards them as the most archaic human type, from which he supposes the more modern races were developed, not by a process of gradual evolution, but *per saltum*. If there be any force in these speculations he is justified in expressing his conviction that the investigation of the Pygmy races is, at the present moment, one of the weightiest and most urgent, if not the most weighty and most urgent, of the tasks of ethnological and anthropological science.

This Negrito stock was followed and to a considerable extent absorbed by that which is usually designated the Dravidian. The problem of the origin of this race has been obscured by the unhappy adoption of a linguistic term to designate an ethnical group, and its unwarrantable extension to the lower stratum of the population of northern India. At present the authorities are in conflict on this, the most important question of Indian ethnology. One school denies that this people entered India from the north or north-west on the ground that the immigration of a dolichocephalic race from a brachycephalic area is impossible, and insists that the distinction between the so-called Dravidians and Kolarians is linguistic, not physical. The other theory postulates the origin of the Dravidians from the north-west, that of the Kolarians from the north-east; and avoids the difficulty of head form by referring the Dravidians to one of the long-headed races of central or western Asia or north Africa, or by suggesting that their skull form has become modified on Indian soil by environment or miscegenation.

Recent investigations, archaeological or linguistic, throw some new light on this complex problem. Sir T. Holdich, in his recent work "The Gates of India," asserts that Makrán, the sea-board division of Baluchistan, is full of what he calls "Turanian," or Dravidian remains. He explains the position of the Brahui tribe in Baluchistan, on whom the controversy mainly turns, by assuming that while they now call themselves Mingal or Mongal and retain no Dravidian physical characters, the survival of their Dravidian tongue is due to the fact that it is their mother language, preserved by Dravidian women enslaved by Turco-Mongol hordes. Relics of the original Dravidian stock, he suggests, may be found in the Ichthyophagi, or fish-eaters, whom Nearchus, the admiral of Alexander the Great, observed on the Baluchistan coast, living in dwellings made of whale-bones and shells, using arrows and spears of wood hardened in the fire, with claw-like nails and long shaggy hair, a record of the impression made upon the curious Greeks by the first sight of the Indian aborigines.

In the next place, inquiries by Dr. Grierson in the course of the Linguistic Survey prove that what is called the Mon-khmer linguistic family, which preceded the Tibeto-Burmans in the occupation of Burma, at one time prevailed over the whole of Further India, from the Irawadi to the Gulf of Tongking, and extended as far as Assam. To this group the Munda tongue spoken by some hill tribes in Bengal is allied; or, at least, it may be said that languages with a common substratum are now spoken not only in Assam, Burma, Annam, Siam, and Cambodia, but also over the whole of Central India as far west as the Berars. "It is," says Dr. Grierson, "a far cry from Cochin-China to Nimár, and yet, even at the present day, the coincidences between the language of the Korkus of the latter district and the Annamese of Cochin-China are strikingly obvious to any student of language who turns his attention to them. Still further food for reflection is given by the undoubted fact that, on the other side, the Munda languages show clear traces of connection with the speech of the aborigines of Australia." The last assumption has been disputed, and it is unnecessary to discuss this wider ethnical grouping. Though identity of language is a slippery basis on which to found an ethnological theory, it seems obvious that the intrusive wedge of dialects allied to the Mon-Khmer family implies that the Central Indian region was at one time occupied by immigrants who forced their way through the Eastern Himalayan passes, their arrival being antecedent to the migration which introduced the Tai and Tibeto-Burman stocks into Further India.

When the solution of this problem is seriously undertaken under expert guidance, the first step will be to make an exhaustive survey of the group of forest tribes, from the Santáls and Pahárias on the east, passing on to the Kols and Gonds, and ending with the Bhíls on the west. At present our information of the inter-relations of these tribes is fragmentary, and their superficial uniformity does not exclude the possibility that they represent more than one racial element. It will also be necessary to push inquiry beyond the bounds of the Indian Empire, and, like the trigonometrical surveyor, to fix the base line as a datum in India, and extend the triangulation through the borderlands. It is in these regions that the ethnological problems of India await their final solution. Many of these countries are still beyond our reach. Until the survey of the routes converging at Herat, Kabul, or Kandahar is complete, the extent of the influence of the western races—Assyrian, Babylonian, Iranian, Arab, and Greek—cannot be determined. Recent surveys in Tibet have thrown much light on that region, but it is still only very partially examined. In Nepal the suspicious native Government still bars the way to the Buddhist sites in the Tarai and the Nepal valley, and thus a wide chapter in the extension of Hindu influence beyond the mountain range remains incomplete.

The second great problem is the origin and development of caste. We have yet to seek a definition which will cover the complex phases of this institution, and effect a reconcilement between the views of Indian observers who trace it to the clash of races or colours, and that of the sociologists, who lay little stress on race or colour and rely more upon the influence of environment, physical or moral. We must abandon the insular method which treats it only in relation to India, and ignores the analogous grouping of rank and class which was prepotent in Western Europe and elsewhere, and is now slowly losing ground in the face of industrial development. It is by the study of tribes which are on the borderland of Hinduism that we must look for a solution of the problem. The conflict of the Aryan and aboriginal culture, on which the religious and social systems of Hinduism were based, is reproduced in the contact between modern Hinduism and the forest tribes. Since the Hindus are the only members of the Aryan stock among whom we find endogamous groups with exogamous sections, the suggestion of Prof. Frazer that they may have borrowed it from the non-Aryans gains probability. The Dravidians within the Indian totemic area have worked out an elaborate system of their own, which is well described in the recent survey of the Malayans by Mr. F. T. Richards. How far this is connected with their preference for mother-right and their strong family organisation, of a more archaic type than the joint family of the Aryans, is a question which deserves examination. The influence, again, of religion must be considered, and this can be done with the most hopeful results in regions like eastern Bengal, where a people who have only in a very imperfect way adopted Hinduism are now being converted wholesale to Muhammadanism.

Again, when we speak of the tribe in India, we must remember that it assumes at least seven racial types, ranging from the elaborate exogamous groups of the Rajputs to the more archaic form characteristic of the Baloch and Pathán tribes of the western frontier, attached to which are alien sections affiliated by the obligation to join in the common blood-feud, which in process of time develops into a fiction of blood-brotherhood. Thus among the Marri of Baluchistan we can trace the course of evolution: admission to participate in the common blood-feud, admission to participation in a share of the tribal land, and finally admission to kinship in the tribe.

This elasticity of structure has permitted not only the admission of non-Aryan tribes into the Rajput body in modern times, but prepares us to understand how the majority of the Rajputs were created by a similar process of fusion, the new-comers being known as the Gurjaras, who entered India in the train of the Huns in the fifth or sixth centuries of our era. The recognition of this fact, by far the most important contribution made in recent times to the ethnology of India, is due to a group of Bombay scholars, the late Mr. A. M. T. Jackson, whose untimely death at the hand of an assassin we deeply regret, and R. G. and D. R. Bhandarkar. Mr. D. R. Bhandarkar has recently proved that a group of these Gurjara Huns, possibly the tribal priests or genealogists, were admitted first to the rank of Brahmans, and then, by a change of function, of which analogies are found in the older Sanskrit literature, becoming Rajputs, are now represented by the Guhilots, one of the proudest septs. This opens up a new view of tribal and caste development. Now that we can certainly trace the blood of the Huns among the Rajput, Jat, and Gujar tribes, a fresh impulse will be given for the quest of survivals in belief and custom connecting them with their Central Asian kinsfolk.

In what I have said I have preferred to speculate on a problem for work in the future rather than dwell upon the progress which has been already made. In the sphere of religion we have passed the stage when, as Prof. Max Müller said, "the best solvent of the old riddles of mythology is to be found in the etymological analysis of the names of gods and goddesses, heroes and heroines," or when the "disease of language" theory was generally accepted. The position, in fact, has completely changed since Comparative Religion has adopted the methods of Anthropology. The study of myths has given way to that of cults, the former being often only naïve attempts to explain the latter. India offers wide fields for inquiry by these new methods, because it supplies examples of cult in its most varied and instructive phases. The examination of Hinduism, the last existing polytheism of the archaic type, is likely to explain much hitherto obscure in the development of other pantheons. It is no longer possible to refer the complex elements of this or any other group of similar beliefs to a single class of physical concepts. The sun, the dawn, the golden gates of sunset, or the dairy no longer furnish the key which unlocks the secret. It is by the study of the Animism, Shamanism, or Magic of the lower tribes that Hinduism can be interpreted. This analysis shows that behind the myths and legends which shroud the forms of the sectarian gods the dim shape of a Mother goddess appears, at once chthonic or malignant because she gives shelter to the dead, and beneficent because she nurtures the sons of men with the kindly fruits of the earth. Beside her, though his embodiment is much less clearly defined, stands a male deity, her consort, and by a process of magic, mimetic, sympathetic, or homœopathic, their union secures the fertility of the animal and vegetable creation.

Much, however, remains to be done before the problems of this complex polytheism can be fully solved. The action of archaic religions, as has been well said, "takes place in the mysterious twilight of sub-consciousness"; and the foreign observer is trammelled by the elaborate system of tabu with which the Hindu veils the performance of his religious rites. This feeling extends to all classes, and the ceremonial of the jungle shrines is as little open to examination as the *penetralia* of the greater temples. The great army of mendicant friars jealously conceals the secrets of its initiation, rites, and beliefs, and this field of Indian religious life remains practically unworked. Much may be done by the training of a body of native observers who are not subject to the tabu imposed upon the foreigner. Here the difficulty lies in the contempt displayed by the higher educated classes towards the beliefs and usages of the lower tribes. There are some indications that this feeling is passing away, and in recent years much useful ethnological work has been done by native scholars.

The problems of ethnology, so far as they are concerned with the origin of prehistoric races and their relation to the existing population, are more or less academic. Ethnography, which examines the religious, cultural, and industrial conditions of the people, has more practical uses. At the present time it is incumbent upon us to preach, in season and out of season, that the information which it is competent to supply is the true basis of administrative and social reform. If, for example, we were now in possession of the facts which an anthropometrical survey of our home population would supply, many of our social problems would assume a clearer aspect. Such, for instance, are the questions of degeneration due to slum life and malnutrition, the influence of alcoholism on industrial efficiency, the condition of dangerous and sweated industries, and that of the aliens settled in our midst. It is characteristic of the genius of the English people, that while we are not yet prepared to admit the need of such a survey, the provision of medical inspection and relief for children in elementary schools will snon render it inevitable.

This is more clearly the case in those regions where a large native population is controlled by a small European minority. The Negro question in America teaches us a useful lesson, applicable to native races in most parts of the Empire. In India, whenever the Government has made really serious mistakes, the failure has been due to ignorance or disregard of the beliefs or prejudices of the subject people. A little more than a century ago a mutiny of native troops at Vellore was due to injudicious attempts to change a form of headdress which they believed to be a symbol of their religion or caste; ignorance of the condition of the Santáls allowed them to be driven to frenzy by the extortions of moneylenders which culminated in a serious outbreak; the greased cartridges of the Great Mutiny, and the revolt against measures, adopted in defiance of native feeling to check the plague epidemic, teach a similar lesson.

In India at the present time "the old order changeth, yielding place to new"; and at no period in the history of our rule was it more necessary to effect a reconciliation between the foreigner and the native. While the tabus of marriage relations and commensality will for an indefinite period prevent the amalgamation of the races, much of the present disquiet is due to ignorance and misunderstanding on both sides. The religious and social movements now in progress deserve the attentive study of the British people. In religion various attempts are being made to free Hinduism from some of its most obvious corruptions, to harmonise Eastern and Western ideals, and to elevate the former so as to enable them to resist the pressure of the latter. Such is Vedantism, a revival of the ancient pantheistic philosophy, which not only claims supremacy in India, but asserts that its mission is to replace the dying faiths of the Western world. The spread of monotheism, as represented by Bhagavata beliefs, is equally noteworthy; and the effect of the revival of the cults of Ganpati, god of luck, and of Sivaji, the Mahratta hero, on the political situation in the Deccan deserve the most careful consideration.

The social movement is the result of that fermentation which is in progress among the subject peoples in many parts of the world. While the educated Indian claims social equality with the foreigner, he is occupied with a serious problem at his own doors. The degraded castes, popularly called the "untouchables," are revolting against the obloquy which they have long endured at the hands of the higher races. Many of them have sought relief by joining the Christian or Muhammadan communities, and the progress of conversion is so remarkable as to excite the surprise and alarm of the orthodox classes. Measures have been designed to improve their almost intolerable position. It remains to be seen how far any concessions which are likely to satisfy them can be reconciled with the ideals of the caste system.

It is true that the people of India prefer to celebrate many of their religious and social rites free from observation of the foreigner, and that there are forbidden chambers in the Oriental mind which no stranger may enter. But the experience of those best qualified to express an opinion is that a sympathetic interest in the religious and social life of the people, so far from tending to increase the existing tension, is a valuable aid towards the promotion of mutual goodwill and sympathy. Orthodox native States not only show no aversion to ethnographical inquiry, but are themselves actively engaged in such surveys. Even the Rajputs, who ordinarily display little taste for scientific work, are beginning to undertake the collection of the bardic chronicles which embody their tribal folk-lore and traditions.

When the divergencies in the beliefs and institutions of the foreigner and the indigenous races are realised and understood, a compromise must be effected, each side discarding some hereditary prejudices—the Hindu that aversion to the manners and customs of the European which is the chief barrier to the promotion of intercourse between the races; the European that insularity of thought which makes it difficult for him to understand all that is valuable in novel types of belief and culture, as well as that lack of imagination which inclines him to exaggerate what seems to him intolerable in the economical condition, the social organisation and beliefs of races whose environment differs from his own.

Anthropology has thus a practical as well as a scientific side. The needs of inquirers whose interest mainly lies in the investigation of survivals and in the stages of evolution in culture and belief can, as I have endeavoured to show, be met only by the adoption of improved methods of inquiry and a more rigorous dissection of evidence. Unfortunately the inadequate resources of the societies devoted to the study of man, as contrasted with the extent of the sphere of inquiry and the importance of the savage or semi-savage races as factors in the progress of the Empire, prove that the practical value of anthropology is as yet only imperfectly realised. If its progress is to be continuous we must convince the politician that it has an important part to play in the schemes in which he is interested. Thus it is certain that in the near future the relations between the foreigner and the native races will demand the increasing attention of statesmen at home and abroad. Here anthropology has a wide field of action in the examination of the causes which menace the very existence of the savage; of the condition of the mixed races, like the Mulatto or the Eurasian; of the relations of native law and custom to the higher jurisprudence; of the decay of primitive industries in the face of industrial competition. One of its chief tasks must be the examination of the physical and moral condition of the depressed classes of our home population, and the effect of modern systems of education on the mind and body of the child. It will thus be in a position to assist the servants of the State to meet the ever-increasing responsibilities imposed upon them; and it will help to dispel the ignorance and misconceptions which prevail even among the intelligent classes in this country in regard to the condition of the native races, who, by a strange decree of destiny, have been entrusted to their charge. By such practical contributions to the welfare of humanity it will not only secure the popular interest which is a condition of efficiency, but engage the ever-increasing attention of those to whom its scientific side is of paramount importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. ARTHUR HALE has been appointed second demonstrator in the chemical department of the Finsbury Technical College.

AMONG the public introductory lectures to be given at University College (University of London) during October, we notice the following:—October 3, niton: one of the argon series of gases, Sir W. Ramsay; October 4, the origin of scenery, Prof. E. J. Garwood; October 6, the life and times of Sennacherib, Dr. T. G. Pinches; recent investigations into the mental growth of children, Dr. C. Spearman; October 10, climatic control, Prof. L. W. Lyde; instinct, Prof. Carveth Read; October 13, experimental phonetics, Mr. D. Jones.

WE see from the calendar of the day section of the Bradford Technical College for next session that, to meet the growing demands and necessities of the textile and other departments, a block of buildings is in course of erection in close proximity to the present college. The buildings for the textile department, when completed and equipped, will be worthy of the chief centre of the wool industry in this country. The new equipment will be of a complete character, enabling wool to be taken in the fleece and turned out, in conjunction with the dyeing and finishing department, in the dyed and finished state. In connection with this extension of the college, it has been decided to put down a plant for the department of engineering which, although primarily intended for educational purposes, will at the same time serve to supply light and power to the present building, the new extensions, and the school of art. From the point of view of both mechanical and electrical engineering students this will constitute a valuable advance. The whole of the plant has been so designed that any one set may be available for demonstration or experiment without interfering with the supply of current for lighting or power. More extended trials will be carried out during the summer months, when only a small portion of the plant is required for generating purposes. Students will thus have excellent opportunities of obtaining practical instruction in steam and electrical engineering, and of becoming acquainted with the running of a power station.

WITH what thoroughness the more recently established of the provincial universities are performing their new duties is well brought out by an examination of their calendars for the session 1910–11, which is now commencing. The calendar of the University of Leeds, for instance, runs to some six hundred pages, and gives particulars of courses of work for undergraduates wishing to take degrees in arts, science, technology, and medicine, and for other students desirous of studying for special purposes in the laboratories of the University. In the case of the University of Bristol, in addition to the necessary regulations for degrees, diplomas, and certificates, particulars are given of the university work done in associated institutions, of courses to meet particular local needs, and so on. Reference to courses of a special character brings to the mind again the work of the London polytechnics. The prospectus of the Borough Polytechnic Institute for the coming session shows that, in addition to the numerous trade classes held in previous years, special lectures and practice have been arranged in waistcoat-making and trade millinery for women, classes in masonry and lectures on the chemistry and manufacture of food-stuffs, and the analysis of laundry trade materials. At the City of London College the needs of commercial men especially are provided for, and the new syllabus is very strong in classes intended for young men engaged in offices and warehouses. The prospectus of the Belfast Technical Institute shows that, while specialising to some degree in classes intended to train men employed in textile and engineering industries, the authorities have in no way forgotten the needs of other workers. It would be difficult to find an industry in the city in which any considerable number of men and women are engaged that has not been considered in drawing up the scheme of work of the institute.

SOCIETIES AND ACADEMIES.

GLASGOW.

Institute of Metals, September 21.—Donald **Ewen** and Prof. T. **Turner**: The shrinkage of antimony-lead alloys and of the aluminium-zinc alloys during and after solidification. From the investigation of the shrinkage of the brasses it has been suggested that, for an alloy of given composition, a direct proportion exists between the amount of expansion on solidification and the distance of the solidus from the liquidus at this composition on the equilibrium diagram. The results of shrinkage tests on two further series of alloys are included in this paper; they show that the above theory is incapable of general application, and appear to indicate that it obtains only in the case of alloys containing solid solutions.—F. **Johnson**: The effect of silver, bismuth, and aluminium on the mechanical properties of "tough-pitch" copper containing arsenic. Contrary to the general belief, it was found that bismuth *increased* the tensile strength, as did silver also. It was found that silver had little effect upon the toughness of the arsenical copper, which, again by virtue of the presence of arsenic, was tougher than electrolytic copper made under similar conditions. The effect of silver on the hot-working properties was found to be negligible up to 0·3 per cent.; that of bismuth noticeable above 0·02, and serious above 0·05 per cent.; whilst that of aluminium was ruinous at 0·3 per cent. In view of the possibility of modern commercial copper containing other impurities which could modify the limiting proportion allowable of the above-mentioned impurities, it is difficult to fix a limit beyond which they should not occur. It may, however, be safely said that silver occurs in such traces that its presence may be ignored. Its influence will be beneficial rather than harmful. Bismuth should, preferably, be entirely absent, and may be expected to cause trouble in any process of mechanical treatment at a red-heat, if present above 0·01 per cent. As regards the presence of this impurity in the finished material, however, little concern may be felt, as the amount which will render arsenical copper unfit for working hot, will have no serious effects on the mechanical properties of the finished material in the cold.—A. D. **Ross**: Magnetic alloys formed from non-magnetic materials. The paper deals with investigations carried out chiefly on ternary alloys consisting of copper, manganese, and one of the elements aluminium, tin, bismuth, and antimony. All the groups show fair magnetic quality, but the most interesting are the ternary alloys containing respectively aluminium and tin. Some of the former are, under small magnetising forces, much more magnetic than cobalt, and have little coercive force. The tin alloys are less permeable, but exhibit greater hysteresis. Most of the alloys have their magnetic quality improved if they are annealed for a short time at a moderate temperature, 150°–200° C. Prolonged annealing has invariably an adverse effect, the hysteresis loss increasing rapidly with time. The behaviour of the alloys on cooling to the temperature of liquid air is peculiar and characteristic. For low and moderate fields the process results in general in a decided increase in susceptibility, whereas almost all other magnetic materials are rendered less susceptible.

September 22.—G. D. **Bengough** and O. F. **Hudson**: The heat-treatment of brass: Experiments on 70:30 alloy. The authors have studied the general effect of heat-treatment on the mechanical properties of 70:30 brass, and have paid special attention to the question of burning. Bars and wires made by different manufacturers were used in order to ascertain to what extent variations in character of the alloy and size of section influenced the results. The mechanical tests of the bars and wires after they had been annealed for half an hour show, in agreement with the results of previous workers, that the best annealing temperature is between 600° and 700° C. For this time of annealing a temperature within a few degrees of the melting point does not seriously injure 70:30 brass which is free from tin and lead, but, if maintained for a sufficiently long time, a temperature nearly 100° C. lower will burn the brass.—Dr. C. H. **Desch**: Some common defects occurring in alloys. After references to the defective state of our knowledge of the "diseases" of non-ferrous metals and alloys, as compared with that possessed by manufacturers and users of iron and steel, the importance of the equilibrium diagram as a guide in undertaking investigations of this kind is emphasised, and some of its limitations are mentioned. Some of the principal defects observed in non-ferrous alloys are then briefly reviewed, as a basis for discussion.—H. S. **Primrose**: Metallography as an aid to the brass founder. The results of a systematic investigation of the gun-metal castings in a large engineering foundry are discussed in the light of microscopical examination, in addition to the ordinary tensile testing. The reason why metallography is steadily superseding the old methods of judging by fracture is shown by comparison of photomicrographs of the internal structure. The crystalline formation being profoundly influenced by the rate of cooling as well as by the initial casting temperature, the microstructure of test bars, variously cooled and cast at different points, is contrasted to indicate how the best physical tests are got from a perfect interlocking structure. The different causes of blow-holes are described, and their detection by the microscope discussed with reference to micrographs of the various types. How these defects can be obviated or subsequently eliminated is illustrated by examples taken from actual cases.

PARIS.

Academy of Sciences, September 19.—M. Armand Gautier in the chair.—E. **Bertin**: The arrest of steamships either by reversing the engine or by allowing to slow down by friction of the water. With reciprocating engines reversal causes a rapid slowing down, but with steam turbines the reversing effect is much less. Formulæ are worked out for the reduction in velocity both with and without reversed turbines.—M. **Pougnet**: The action of the ultra-violet rays upon plants containing coumarin, and some plants the smell of which is due to the hydrolysis of glucosides. The ultra-violet rays produce the smell rapidly in coumarin plants, and also in plants the odour of which arises from the products of hydrolysis of a glucoside. The action is caused by the cells being killed by the ultra-violet light.—J. **Athanasin**: The functional mechanism of striated and non-striated muscular fibres.—J. **Deprat** and H. **Mansuy**: General stratigraphical results of the geological expedition to Yun-nan.—Ernest **van den**

Broeck and E. A. **Martel**: The conditions of effective filtration of the underground waters in certain chalk formations. In Belgium the crinoidal chalk at the base of the Carboniferous of the Dinant geological basin furnish filtered potable waters in a remarkably constant manner.

NEW SOUTH WALES.

Linnean Society, July 27.—Mr. C. Hedley, president, in the chair.—G. I. **Playfair**: Polymorphism and life-history in the Desmidiaceæ. A number of new forms described.—L. A. **Cotton**: The ore-deposits of Borah Creek, New England, N.S.W. The Borah Creek Mine is situated in the New England district of New South Wales, within two miles of the Gwydir River. The ores contained in the mine are arsenopyrite, zinc blende, chalcopyrite, stannite, and galena. They are very uniformly distributed through the mine, both along the lode and in depth. The order of deposition of the minerals, which form symmetrical zones in the fissure, is arsenopyrite, pyrite, zinc blende, chalcopyrite, stannite, galena, and finally quartz. Comparison with other occurrences indicates the probability of a genetic relationship between the silver-lead deposits and the tin deposits. It is suggested that the Borah Creek deposits have been formed later than the tin deposits by deposition from highly aqueous and siliceous magmatic extractions containing relatively large amounts of metallic sulphides.—T. G. **Sloane**: Revisional notes on Carabidæ (Coleoptera), part iii. The tribes Oodini, Chlæniini, and Sphodrini, as represented in Australia, are reviewed, and the Australian genera of these tribes, as well as the species of every genus found in Australia, are tabulated. Synonymy is dealt with, and six species are described as new (Chlænius, 1 sp.; Anatrichis, 1 sp.; Coptocarpus, 2 spp.; Platynus, 2 spp.). Certain characters not hitherto deemed of importance in classification are discussed.

CAPE TOWN.

Royal Society of South Africa, August 17.—Mr. S. S. Hough, F.R.S., president, in the chair.—H. **Bohle**: The influence of uniformity and contrast on the amount of light required. The author dealt first with the adaptability of the human eye to various daylight illuminations, and gave a new definition of glare. When the eye looks at an illuminant of great intrinsic brilliancy in front of a dark background it tries to do two things at once: to open wide for the dark background and to close up for the intrinsic brilliancy. The author then considered the physiological effects of radiation, explained overheating of the eyes due to excess light absorption, and considered the effects of the ultra-violet rays of modern illuminants and of solar radiation. In addition he treated the effects of light radiation on germs of disease, the destructive action of rays when applied excessively, and finally dealt with the effect which uniformity and the avoidance of contrast in artificial lighting have on the amount of light required. He came to the conclusion that in a room with black walls an illumination of 35 to 40 candle-metres is required, whereas in a place with white ceilings and light walls the amount of light can be reduced to 30 candle-metres. For perfect uniformity in such places, as obtained with inverted lamps, 20 candle-metres give, in the opinion of the author, complete satisfaction. The effects of various lamp-shades on the uniformity of illumination were also shown.

CALCUTTA.

Asiatic Society of Bengal, September 7.—T. H. D. **La Touche**: The Lonar Lake.—B. L. **Chaudhuri**: *Triacanthus weberi*, sp. nov. It is one of the new fishes found widely distributed in the Bay of Bengal by the trawling operation of the *Golden Crown*. In the collection of the Indian Museum there are five species of this interesting genus besides this new one.—J. Coggin **Brown**: A description of a Lisu Jew's harp. The paper describes a Jew's harp which is the favourite musical instrument of the Lisu's, a tribe living in western China. It differs from those described from Assam, and approximates to those found in the Malay Peninsula. It consists of three delicate harps cut out of bamboo, and held upright between the thumb and first finger or between the first and second fingers of the left hand, while the tongues are made to vibrate with the right hand. The mouth acts as the sounding-board. The instrument is used by the young men in their serenades, and forms a part of the orchestra at all their festivals.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts ii. and iii. for 1910, contain the following memoirs communicated to the society:—

May 28.—R. **Courant**: The establishment of the Dirichlet-principle.—M. **Born**: Kinematics of a rigid body in relation to the principle of relativity.—P. **Koebe**: The uniformisation of algebraic curves by means of automorphous functions with imaginary substitution-groups (concluded).—R. **Gans**: The electron-theory of ferromagnetism.—J. K. **Whittemore**: Convex curves.—H. **Bohr** and E. **Landau**: The behaviour of the functions $\zeta(s)$ and $\zeta_{\lambda}(s)$ in the neighbourhood of the straight line $\sigma=1$.

June 11.—F. **Riesz**: Quadratic forms with an infinite number of variables.

The *Business Communications* of the society, part i. for 1910, contains reports on the Samoa Observatory (1909–10), on the progress of the complete edition of Gauss's works, and on subjects for prize dissertations. The obituary notices of F. Kohlrausch, by **Riecke**, and of T. W. Engelmann, by **Verworn**, are included.

CONTENTS.

PAGE
History of Botany 391
Fuels and Furnaces. By Prof. A. McWilliam . . 392
Medical Parasitology. By E. A. M. 393
Popular Astronomy 393
Marine Biological Research in British Seas. By J. J. 394
Our Book Shelf 395
Letters to the Editor:—
British Marine Zoology.—Prof. W. A. Herdman, F.R.S.; Dr. Wm. J. Dakin; Prof. E. W. MacBride, F.R.S. 396
The Spotted Kudu.—R. Lydekker, F.R.S. 396
The Habits of Worms.—Rev. Hilderic Friend . . 397
Erasmus Darwin on Flying Machines.—Arthur Platt 397
Causal Geology. (*Illustrated.*) By Prof. Grenville A. J. Cole 397
The British Section of the Brussels Exhibition. By Dr. F. Mollwo Perkin 398
Mathematics in Austria 399
Notes 400
Our Astronomical Column:—
Velocities and Accelerations of the Ejecta from Halley's Comet 404
Observations of Comets 404
The Solar Physics Observatory, South Kensington . . 404
The Determination of Longitude 404
The Royal Commission on Welsh Monuments. By Rev. John Griffith 404
Annual Report of the Government Laboratory . . 405
The Archæological Survey of Nubia 406
Manganese-ore Deposits. By H. L. 406
Zoological Work in India. By R. L. 406
The British Association at Sheffield.
Section G.—Engineering.—Opening Address by Prof. W. E. Dalby, M.A., M.Inst.C.E., President of the Section 407
Section H.—Anthropology.—Opening Address by W. Crooke, B.A., President of the Section 414
University and Educational Intelligence 420
Societies and Academies 421

THURSDAY, OCTOBER 6, 1910.

THE MAMMALS OF MANITOBA.

Life-histories of Northern Animals: an Account of the Mammals of Manitoba. By Ernest Thompson Seton. Vol. i., Grass-Eaters. Pp. xxx+673. Vol. ii., Flesh-Eaters. Pp. xii+674–1267. (London: Constable and Co., Ltd., 1910.) Price £3 13*s*. 6*d*. net.

SO far as this country is concerned, it is a great pity that Mr. Seton did not include in his admirable life-histories the whole mammalian fauna of North America, as the restriction of the species to those inhabiting a particular area can scarcely fail to be faulty in the eyes of English readers, who will miss such well-known animals as the big-horn sheep, white goat, Columbian black-tailed deer, and the brown bears and caribou of Alaska. It is likewise a matter for regret that the whole of the table of contents is included in the first volume, instead of the portion relating to the Carnivora being reserved for the second. Except this very small modicum of fault-finding, I have nothing but commendation to bestow on these handsome volumes, which, it may be presumed, are an English edition of the work issued last year in America under the same title.

The mammals of Manitoba are fifty-nine in number, and of these the author describes the life-history in his own inimitable manner, and with a wealth of detail that leaves little, if anything, for future field naturalists to record. The great feature of the work is, of course, that it is the result of personal observation and first-hand knowledge, acquired during wanderings extending over a long series of years, and embracing a very large portion of the North American continent. The map of his travels shows, in fact, that Mr. Seton has explored the whole of the United States, from ocean to ocean, so that the red lines which mark his route form a perfect network. Southward he has touched the Mexican border, while northward he has visited Labrador on the east, and on the west has made a single traverse to the heart of the Mackenzie district. And it is these extensive journeys, with the knowledge thereby acquired, that intensifies our regret that he did not see fit to make his work cover the whole North American mammal fauna. In spite of the almost omniscient character of his personal knowledge of the habits and distribution of the animals of which he writes, the author has been at the pains to quote the names of observers by whom special traits were first recorded.

In addition to his well-known power of conveying important scientific information in most attractive and popular language, Mr. Seton enjoys the great advantage of being a skilled artist, so that he is able to present to his readers portraits of the animals in the particular pose which he considers most characteristic and interesting. The amount of labour he has expended on artistic work may be inferred from the fact that the whole of the 560 illustrations were drawn with his own pencil. Such sketches are, in my opinion, infinitely superior to photographs, which too frequently do not bring out the characteristic features which the describer desires to emphasise. That many of these illustrations, if I mistake not, have appeared in other publications, testifies to public appreciation of their artistic merit.

In the space at my disposal it is quite impossible to attempt anything in the way of a critical review of these two bulky quarto volumes, and I shall therefore content myself with noticing some of the author's observations relating to the larger species which appear of special interest.

By far the most characteristic American type of big game is undoubtedly the prongbuck, a species the distributional area of which has been reduced by about one-half, and the numbers of which were estimated by the author in 1900 not to exceed, at most, 100,000, of which half must be in Mexico. And yet from the accounts of travellers of no earlier date than 1868 it seems probable that these graceful antelopes, as they are locally called, actually outnumbered the bison in the days of its prime. Taking the number observed in one particular district as a basis, the author calculates that, on a low estimate, there must have been over 40 millions on the great plains. Since 1900 these antelopes, in spite of reported local increases, have probably suffered a further serious decrease, the number in Wyoming in 1905 being estimated at not more than one-fourth of what it was five years previously.

As regards the extermination of the bison, Mr. Seton, although as a naturalist regretting the event, takes what may be called the practical view of the subject, and declares it to have been absolutely inevitable. The plains were required by the advance of civilisation, and the supporting of vast herds of stupid bison, ready to stampede in an overwhelming mass on the slightest alarm, was not the best use to which they could be put. On the testimony of two independent observers, he asserts that blizzards, especially those of 1871–2 and 1880–1, had a share in the extermination of the bison, one of the two witnesses stating that the Dakota blizzard was more destructive to the herds than the Indians. Since, however, blizzards are only occasional events, Mr. Seton doubts if their destructiveness was equal to that of agencies working with greater regularity.

In concluding this brief notice of a first-class work, it may be noted that the author is a firm believer in the evolution of the mind of man from that of animals below him in the zoological scale.

R. L.

THE CARE OF TREES.

The Care of Trees in Lawn, Street, and Park. By Bernard E. Fernow. Pp. x+392. (New York: Henry Holt and Co., 1910.)

ALTHOUGH there is scarcely a garden or park of any pretensions in this country which does not contain within its boundaries one or more trees particularly valued for their interest, beauty, or associations, how rarely do their owners ever take any steps to keep them in health, and thus prolong their term of years. The care of trees, indeed, more especially those parts in it which may be described as surgical and antiseptic, is an art strangely recent in origin. Some of the practices of still living "tree-doctors" (one may instance the leaving of a stump "to draw the sap" when a branch or limb is sawn off) betray a simple faith curiously reminiscent of the methods of sixteenth-century practitioners on the human frame.

But owners of trees are, on the whole, content to let them run their ordinary course, although nothing is more certain than that by judicious treatment the span of years of many trees may be extended by tens, perhaps hundreds, of years. The value, of course, of many such trees is a purely sentimental one. Yet among individual living things trees seem to link the centuries together more effectually than anything else. What heart is not moved by the sight, and still more by the possession, of a tree under which it is known some famous man of old, or even one's own forbears, sat and mused.

The author of this work is well known to those in his own walk in life, as one of the most eminent and trustworthy authorities on the subject in the United States and Canada. And we may say at once that this book fully bears out his reputation. It is a pleasant change, after wading through much of the ignorant twaddle that is nowadays so plentifully offered to the tree-loving public, to come across a book the author of which has (what, indeed, the unsophisticated might regard as essential) an adequate knowledge of his subject.

Mr. Fernow's object is, briefly, to interest his readers in their trees, to give them some idea of how they grow and do their work, and to give directions for their cultivation and preservation. Much of what he writes is more particularly applicable to the north-eastern United States and the adjacent parts of Canada, where the climatic conditions, especially in relation to tree and shrub growth, are sufficiently dissimilar to our own as to render some modification of his recommendations necessary before they can be adopted here. But his treatise, on the whole, is very well worth study by those interested in the trees and shrubs of English parks and gardens.

We regret that the author thought it necessary to give a sort of recommendation—although certainly a half-hearted one—to the book on pruning written by A. des Cars, nearly fifty years ago. Des Cars' system of pruning is hopelessly discredited by now. As applied to trees grown solely for timber it was out of the question for reasons of cost, and as applied to the purely ornamental trees of gardens, the rigid formality he advocated was absolutely at variance with the tastes of ninety-nine people out of a hundred.

The latter part of this book is taken up with the description of trees and with the consideration of their respective value and treatment. It is somewhat cursorily done, and is the least satisfactory part, in that it is far from free of errors. The horse chestnut, for instance, is not Chinese (p. 250), nor is *Prunus pissardii* Japanese (p. 304). The author has sadly confused the *Pyrus sinensis* of Lindley, a true pear, with the common *Cydonia japonica*, which is, of course, a quince (p. 297). It is a remarkable lapse to recommend rhododendrons for calcareous soils, which, with the exception of one or two species, they abhor (p. 372). The list of "shrubs fit for rock gardens" is strangely inadequate (p. 373). About a dozen plants are mentioned, half of which are absolutely unfitted for any ordinary rock garden, whilst the scores of dainty shrubs, mainly alpine, the neatness of habit and slow growth of which render them peculiarly fitted for such a position, are quite ignored. Errors in spelling, too, are numerous.

In view of the thoughtless and ignorant outcry which is usually set up in the daily Press whenever the removal or thinning, or even lopping, of trees in public places is done, it was a happy thought to quote a letter written by J. R. Lowell to the president of Harvard University in 1863. The following words will bear repeating:—

"Something ought to be done about the trees in the college yard. They remind me always of a young author's first volume of poems; there are too many of 'em and too many of one kind. If they were not planted in such formal rows, they would typify very well John Bull's notion of 'our democracy,' where every tree is its neighbour's enemy, and all turn out scrubs in the end, because none can develop fairly. . . . We want to learn that one fine tree is worth more than any mob of second-rate ones. Do pray take this matter into your own hands—for you know how to love a tree—and give us a modern instance of a wise saw."

THE MAKING OF BEET-SUGAR.

Beet Sugar Making and its Chemical Control. By Y. Nikaido. Pp. xii+354. (Easton, Pa.: The Chemical Publishing Co.; London: Williams and Norgate, Ltd., 1909.) Price 12*s*. 6*d*. net.

THE aim of this work, the author remarks, is to aid those who are starting on a career of beet-sugar manufacture, but who lack systematic training in the technique thereof.

In principle, the production of sugar from beetroots is a simple matter. The sugar and other soluble bodies are extracted from the sliced roots by diffusion in water; the juice thus obtained is purified from acids and other objectionable matter by "defecation" with lime, and after the excess of lime has been removed by treatment with carbonic acid, the liquor is concentrated by evaporation until the sugar crystallises out. Whilst, however, there is nothing complicated about the principle, successful and profitable production depends upon close attention to a number of points in respect of which the chemist's help is needed.

These points Mr. Nikaido describes and explains at length. The essential part of the book is contained in one chapter—the eighth. This is devoted to expounding the "practical operation," *i.e.* management, "of a beet-sugar house." It sets forth the various steps involved, from harvesting the beets to packing the sugar, and gives details of the chemical examinations necessary for the proper control of the processes. The descriptions bear the stamp of practicality, and the value of the book in actual work is enhanced by a series of useful tables. In the last chapter a number of "special analyses" are considered; they relate to methods of testing beetroot seed, to the examination of various materials used in sugar manufacture, and to particular cases of sugar analysis—*e.g.* the determination of raffinose.

The chief criticism suggested, on looking through the volume, is that a disproportionate amount of space is allotted to preliminary and incidental matters. Apart from an appendix of tabular material and the index, the book contains 294 pages. Of these only 120 are devoted to the real object of the work—beet-sugar making and its chemical control. The rest is taken up with accessory description, much of which is merely general elementary chemistry. This would be much better learned from an ordinary textbook. A "theory of the origin of limestone" (p. 40); a description of the metallurgy of iron (p 48), or the chemistry of lead (p. 54); a dissertation on the molecular structure of the hydrocarbons (pp. 61–2): all these are rather out of place in a book devoted to sugar; or, at least, such things should not get the lion's share of the space. Whilst it is legitimate enough to discuss the general chemistry of the sugars, and even perhaps the theory of the polariscope, the rest of the matter in question gives one the impression of being largely "padding."

This apart, the book deals lucidly with the everyday problems of beet-sugar production, and should prove very useful to those for whom it is written.

C. S.

METHODS OF ROCK-ANALYSIS.

Analyse der Silikat- und Karbonatgesteine. By W. F. Hillebrand; translated by E. Wilke-Dörfurt. Zweite Auflage. Pp. xvi + 258. (Leipzig: W. Engelmann, 1910.) Price 6 marks.

The Analysis of Silicate and Carbonate Rocks. A revision of Bulletin 305. By W. F. Hillebrand. Bull. 422, U.S. Geol. Survey. Pp. 239. (Washington: 1910.)

AS a consequence of the modern developments of petrology, accurate chemical analyses of rocks, and of the component minerals of rocks, have become more than ever an urgent desideratum; and it is a fortunate coincidence that there has been at the same time a decided revival of mineral chemistry, so long overshadowed by that of the carbon compounds. Not only is the discovery of new rock-types continually providing fresh material, but also it has to be recognised that the older rock-analyses, admirable in their own time, no longer suffice for the requirements of the present day. The best modern analyses have the advantage of greatly improved methods of separation; and, further, they aim at a much greater thoroughness of treatment, often including estimations of twenty or more constituents, instead of the eight or nine which satisfied Bunsen and Delesse.

In this work a leading part has been taken by the American chemists, and particularly those of the United States Geological Survey. In the last thirteen years four bulletins have been issued giving complete analyses of many American rocks, conducted in the laboratory at Washington. In the first of these, some forty pages were devoted to a discussion of methods of analysis by Dr. Hillebrand. This part, considerably enlarged, was issued as a separate bulletin in 1900, a new edition appearing in 1907; and it is this last which has now been translated into German, with some revision and additions by the author. It has been closely followed by a revised edition of the original, so that the latest advances in this branch of practical chemistry are now accessible equally to German and English readers.

The methods which are here fully and clearly set forth are, in the main, those which the experience of the author and his colleagues has led him to prefer; but alternative methods are often given, especially when the first one requires complicated and costly apparatus. Many of the analytical methods described are, of course, familiar to the working chemist, but the author's matured judgment on their relative merits cannot fail to be of use; and, even apart from this critical discussion, it is a great convenience to have the scattered literature of the subject brought together and presented in systematic shape.

As an illustration of the author's treatment, we may select the estimation of ferrous iron, always a crux in rock-analyses (pp 154–71). First comes a section, added in the present edition, pointing out the important error introduced by oxidation of the material during the process of grinding, and the devices by which this error may at least be minimised. This is followed by a comparison between Mitscherlich's sealed tube method of estimation and the hydrofluoric acid methods; the former is in general to be avoided, on account of the reducing action of sulphides present in the rock. Since, however, Mitscherlich's method is probably the best in those cases where it can safely be used, it is described, with important modifications suggested by experience. The general principle of the hydrofluoric acid method is then set forth, with a discussion of the chief sources of error and of the influence of sulphides, vanadium, and carbonaceous matter on the determination of the ferrous iron. Finally, the author describes the method itself in its various modifications, as advocated by Cooke, Pratt, and Treadwell, respectively.

Twenty years ago the petrologist who did not perform his own chemical analyses felt that he was delegating part of his legitimate task to another. A more exacting standard has made a division of labour, as regards complete rock-analyses, almost inevitable, and Dr. Hillebrand's manual is accordingly addressed to the chemist rather than the petrologist. On the other hand, few of us are in the advantageous position of the United States Geological Survey, which can command the services of six or eight skilled specialists; and it is also to be remembered that one complete analysis demands as much time and labour as, perhaps, three of a less ambitious kind. Some petrologists will be of opinion that there is still a place for rock-analyses, conducted according to the best methods, but including estimations of only a moderate number of constituents.

If the petrologist cannot make his own analyses, he should, none the less, be competent to interpret them with judgment, and we should have been grateful to the author for some guidance in this matter. Everybody knows, for instance, that the silica is likely to be more correctly determined than the alumina, and so in a general way for other constituents; but a summary discussion by a skilled mineral analyst of the probable errors attaching to the several chief constituents of igneous rocks would be very welcome.

A. H.

NEW GEOGRAPHICAL BOOKS.

(1) *Distant Lands. An Elementary Study in Geography.* By H. J. Mackinder. Pp. xvi+296. (London: Geo. Philip and Son, Ltd., n.d.) Price 2s.

(2) *A First Book of Physical Geography.* By W. M. Carey. The First Books of Science Series. Pp. viii+150. (London: Macmillan and Co., Ltd., 1910.) Price 1s. 6d.

(3) *A Physiographical Introduction to Geography.* By Prof. A. J. Herbertson. The Oxford Geographies. Pp. 120. (Oxford: The Clarendon Press, 1910.) Price 1s. 6d.

(4) *Geology.* By Prof. J. W. Gregory. Dent's Scientific Primers. Pp. 140. (London: J. M. Dent and Sons, Ltd., n.d.) Price 1s. net.

(5) *An Economic Atlas.* By J. G. Bartholomew, with an introduction by Prof. L. W. Lyde. Pp. xii+64. (Oxford: The Clarendon Press, 1910.) Price 3s. 6d. net.

(6) *Devonshire.* By F. A. Knight and Louie M. (Knight) Dutton. Cambridge County Geographies. Pp. xii+245. (Cambridge: University Press, 1910.) Price 1s. 6d.

(7) *Dorset.* By A. L. Salmon. Cambridge County Geographies. Pp. ix+154. (Cambridge: University Press, 1910.) Price 1s. 6d.

(8) *Derbyshire.* By H. H. Arnold-Bemrose. Cambridge County Geographies. Pp. x+174. (Cambridge: University Press, 1910.) Price 1s. 6d.

(9) *A Systematic Geography of Asia.* By G. W. Webb. Pp. vi+100. (London: Methuen and Co., Ltd., 1910.) Price 1s.

MR. MACKINDER has now brought his studies in the teaching of geography by means of its correlation with history to a penultimate stage. Approximately half this book (1) deals with history in some form, either with the world-movements of peoples, such as the Magyars or Turks, or with the history of discovery connected with the names of Marco Polo or Cook. There is, as yet, little political geography, all of which is promised in the final volume of the series, and the treatment tends to ignore the possibilities of correlation with other subjects in the school curriculum. Most pupils learn something of the value of coordinates in relation to the fixing of the position of points in space, and provided the problems of latitude and longitude be postponed, their adequate treatment follows as a special case of this method of recording the positions of points; Mr. Mackinder approaches these problems by way of an account of the work of Eratosthenes and of the eclipse of the sun at the battle of Arbela. The book makes an interesting reader, and is profusely illustrated with maps and diagrams, some of which imply a geographical knowledge which the text does not call upon the pupils to utilise.

The beginner in any study should know the technical language in which the phenomena of that subject are described: hence the utility of the three books which represent the physiographic aspect of geography. Mr. Carey (2) brings to his explanation of the terms of physical geography, and of the "principles which underlie and control the development of the physical conditions" of any region, the methods of the successful teacher. He gives a series of practical exercises which familiarise the pupil with the matter to be considered; he then presents the facts in their usual setting, and elucidates the technical terms and the principles, and, finally, asks questions which force the pupil to realise the meaning of the matter studied. The references are usually to parts of the British Isles.

Prof. Herbertson (3) attempts a succinct summary of world geography. The text and the illustrations require the active cooperation of the teacher with the pupil at every step, and thus the work is much more difficult for the pupil than either of the two previously mentioned. For example, Mr. Carey makes the pupil draw an isotherm, and then discusses the interpretation of typical isotherms for the British Isles; Prof. Herbertson deals with world isotherms at once, assuming that the pupil knows how they are made and what they mean. Prof. Herbertson gives a useful concluding chapter on map nets, while there is an appendix containing many revision questions contributed by Miss Kirk.

Prof. Gregory (4) contributes an explanation of the technical terms employed in geology, which should serve as an excellent introductory primer, but there is lacking the apparatus of exercise and question for school use. Probably, of all subjects, geology requires the assistance of an expert who can suggest and advise as to the particular ways in which practical work in the field should be performed, and the beginner, whether school pupil or private student, would be greatly helped were this primer provided with guidance in this direction.

The "Economic Atlas" (5) is a re-issue of the "School Economic Atlas," with slight modifications. Prof. Lyde, in an introduction, limits economic geography to a study of the earth in relation to man, and provides a series of valuable hints as to the study of the maps which follow. In this introduction Prof. Lyde claims that the water-parting between the Atlantic and the Indo-Pacific Oceans divides the world into two fairly equal parts, and in an inset map the water-parting is shown by a black line on a map of the world, having the Pacific Ocean in the middle. There is no suggestion of the internal drainage systems of the continents, nor of the drainage into the Arctic Ocean. A consideration of the map and text, apart from a consideration of these other facts, would probably lead to erroneous conclusions. The introduction and the maps are distinctly valuable, but there are certain difficulties with regard to this method of presenting the facts of geography. In the first place, the statistics given should be averages for a series of years, and diagrams should show the proportions of their various parts; the diagrams relating to the production of cereals, &c., give no statement of the proportions in which the different areas contribute to the total production. Further, maps without some other form of data are apt to be misleading; for example, the traditional English idea of Canada is that it is a producer of wheat. The fact that Canada produces more oats than wheat does not appear from the maps in the atlas. Oats are, curiously enough, omitted from the economic map of the United States and Canada. Similarly, in regard to the maps of minerals, such as iron and coal, it would be distinctly useful if some indication were added as to the areas in which the mineral deposits are being worked; for example, coal and iron are shown in India, but there is no indication that practically the only mining carried on in India is for coal.

The three additions to the Cambridge County Geographies, "Devonshire" (6), "Dorset" (7), and "Derbyshire" (8), are of the already familiar type of descriptive geography which this series illustrates. In "Derbyshire," Mr. Arnold-Bemrose exemplifies one of the best features of the series. He tells the story of the rocks, and shows the relation between these and the surface features, the climate, and the occupations of the people. His facts range from the Derwent Valley water scheme to the life of early man in these islands as inferred from the deposits in the caverns. In the other volumes, the authors deal with the coastal features of the counties and with the changes in the outline of the coast due to sea encroachments. These books are storehouses of facts of many kinds, and will be useful as reference books in school and other libraries. It may be urged that both in the text and in the appendix the statistics should be average values for a series of recent years.

Mr. Webb's "Asia" (8) is systematic but not regional; for example, the existence of the Thar desert is explained out of all connection with the desert belt immediately to the west; again, in the case of Japan, the large proportion of the country which is forested is ignored, and emphasis is laid upon the growth of rice, "for which the climate is specially suitable," and tea. B. C. W.

OUR BOOK SHELF.

Catálogo Sistemático y Descriptivo de las Aves de la República Argentina. By Roberto Dabbene. Tomo Primero. *Anales Museo Nacional de Buenos Aires,* serie 3, vol xi., pp xiv+513+map. (Buenos Aires: 1910.)

In this work, of which the present portion occupies the whole of the serial volume in which it appears, the author proposes to do for the birds of Argentina that which Mr. Ridgway is accomplishing for those of North and Central America. To a great extent the two works will, when completed, cover the whole of the South American avifauna, for, owing to the imperfect information with regard to the zoology of the outlying provinces of the Argentine Republic, Dr. Dabbene has felt himself compelled to include in his catalogue the birds of the south of Brazil, Bolivia, and Paraguay, and of the frontier districts of Chile and Uruguay.

The author has in the main followed the classification adopted in the British Museum "Hand-list of Birds," although for the Passerines he had to rely on the Museum "Catalogue," as the last part of the former work did not reach him in time to be used. This is a pity, as Dr. Sharpe made certain amendments in the arrangement of the orders which might have been advantageously followed. The present volume commences with a general account of the structure of birds, illustrated with text-figures, which, although somewhat crude, serve their purpose well, the whole account being well up to date. Ending with a bibliography, this section is followed by one on the distribution of Argentine birds, which is perhaps the most important part of the whole volume; the geographical ranges of the various species being shown in tabular form. The volume concludes with a somewhat heavy list of addenda and corrigenda (in addition to an extensive list of errata in the preliminary portion), followed by several copious indexes. The systematic part of the work will, it may be presumed, commence in the next volume, and will afford a better criterion for testing the value of the undertaking than is afforded by the one in hand. R. L.

Land and Fresh-water Mollusca of India, &c. By Lieut.-Col. H. H. Godwin-Austen. Vol. ii., part xi. Pp. 239–310; cxviii–cxxxii. plates. (London: Taylor and Francis, 1910.)

Malacologists will gladly welcome a further instalment of this valuable work from the pen of that nestor of Indian conchology, Col. Godwin-Austen. Like the previous part (Nature, vol. lxxvi., 1907, p. 244), this contains further descriptions of forms, some of them new, belonging to the families Zonitidæ and Endodontidæ.

In 1907, as we pointed out, the author transferred the genera Austenia, Girasia, and Cryptosoma from the Heliocarioninæ to the Macrochlamyinæ. Next year, in the "Fauna of India: Mollusca," and now again in the part under notice, these genera reappear in their old position. These changing views are not so much to be wondered at when the extreme difficulty of reducing this complex and puzzling group to order is taken into consideration. Their classification depends on anatomical differences which are by no means so well defined by nature as one could desire. The apparent introduction, however, of one genus into two subfamilies is due to an unfortunate misprint on p. 272, where *Austenia* appears for *Euaustenia.*

All the Endodontidæ described belong to the genus Pupisoma, comprising forms included by the early writers in the genus Pupa.

A reference to the Mauritian species of Macrochlamys (Proc. Malac. Soc., vol. vi., 1905, p. 320), which the author now refers to *M. renitens,* Morelet, concludes the number.

The plates, which are faithful reproductions of the author's vigorous and effective drawings, call as such for commendation.

Jack's Insects. By Edward Selous. With forty-four illustrations by J. A. Shepherd. Pp. xiii+379. (London: Methuen and Co., Ltd., 1910.) Price 6s.

All we need say about this book is that Jack and his sister fall asleep over a book of natural history, and dream that they are talking to the insects, &c., to which it relates.

LETTERS TO THE EDITOR.

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

The Fur Trade.

It is recorded in the "Life of Professor Owen" that on one occasion Lord John Russell sent him a bone, requesting that it might be identified. Owen replied that it was an ordinary ham-bone, pertaining to the genus Sus, and was informed that Lord John had received from President Grant what purported to be a bear's ham, concerning which he had his doubts, hence the inquiry.

It is not improbable that naturalists are occasionally appealed to in a similar manner for judgments on the identity of furs. In these circumstances, they may well be excused if they lack Prof. Owen's assurance, or are found entirely wrong. The mysteries of the fur trade are surely beyond the understanding of even a skilled zoologist; but there is an American publication in which they are revealed to the astonished reader. This is the retail catalogue of Albrecht and Son, of Minnesota. This firm does a very large business, and has no wish to deceive its customers as to the nature of their purchases, and yet cannot get away from the current trade names. Consequently, it publishes a detailed synonymy, some of which has not yet found its way into zoological works. I venture to extract a few items for the instruction and entertainment of those who have not access to the catalogue.

Alaska Bear.—"The best Minnesota Raccoon, coloured a dark brown."

Adelaide Chinchilla.—Australian Opossum.

French Ermine.—"Made from selected skins of the French Coney."

Baltic (*White*) *Fox.*—"The fur of the large Hare of northern Europe."

Iceland White Fox.—"White Thibet Lamb, combed until the hair is straight."

Kamtschatka Fox.—"Trade name of the northern Timber Wolf."

Baltic Lynx.—"This fur is secured from the large Belgian Hare of northern Europe, dyed a jet black."

Finland Lynx.—Australian Wallaby.

Natural Black Marten.—"From the black Marten (commonly known as skunk)."

Russian Marten.—American Opossum.

Russian Mink.—Mongolian Marmot.

Siberian Pony.—Russian Calf.

Inland Seal.—French Coney.

Coast Seal.—"Albrecht coast seal is made from the skins of the French Coney."

But the catalogue itself should be in every zoological library. It contains other items of interest; thus it appears that one may spend the trifling sum of 625 dollars on a muff made of Russian sable. Single skins of this animal are valued as high as 500 dollars when of the best quality.

T. D. A. Cockerell.

University of Colorado, September 11.

An Attempt to Determine the Supposed Change in Weight Accompanying the Radio-active Disintegration of Radium.

Some time ago Mr. Grant and I designed and constructed a micro-balance (Proc. Royal Society, A, vol. lxxxii., p. 580) for the purpose of demonstrating, if possible, the occurrence of a change in weight accompanying the radio-active disintegration of radium.

We have recently been attempting to do this, using 7·5 milligrams of pure radium bromide. It was necessary to have two balances of great sensitiveness in order to carry out our proposed experiment, and the two balances which we have used have each a sensitiveness of $2\cdot5\times10^{-9}$ grams, and for both of them the resting point has not varied by more than 5×10^{-9} gram during several periods of observation varying in length from a week to a month.

The plan of our proposed experiment was as follows. The two balances were mounted side by side in the same balance case in such a way that the images of a fine illuminated slit could be reflected on to the same scale from the mirrors on the two balances.

One of the balances was to serve as a check on the second, which was to be used to determine the weight of the active deposit from the radium. This second balance was of the type B figured in our paper (*loc. cit.*), and was provided with a fine fibre attachment and quartz hook from which could be suspended a piece of fine platinum wire.

A piece of stout platinum wire was passed through the wall of the balance case, and well insulated from it, and by a mechanical contrivance this insulated wire could be brought, when desired, into contact with the wire suspended from one end of the balance beam. By means of this second wire the suspended wire could be raised to a negative potential of five hundred volts.

Through the wall of the balance case were also passed two glass tubes leading to an air-circulating apparatus and to a bubbler containing the solution of radium bromide.

By means of this circulating apparatus the air contained in the balance case could be bubbled continuously through the radium bromide solution, thus keeping it charged with the radium emanation. As this decayed into radium A, the latter in the electric field should be driven to the charged and counterpoised platinum wire and accumulated there, and so its weight determined.

The behaviour of the balance was investigated with the greatest care, and after many disturbing effects had been discovered and eliminated one at a time, it was finally shown that the resting point of both balances was constant for at least a month, when every condition was the same as for the actual experiment with the single exception that the bubbler contained water instead of the radium bromide solution. Thus the following changes in conditions did not affect the resting point by more than $5\cdot0\times10^{-9}$ gram:—(*a*) Releasing and arresting the balance beam; (*b*) touching and jerking the suspended platinum wire; (*c*) starting and stopping the circulation of the air; (*d*) charging and discharging the platinum wire.

The experiment was then started by replacing the water in the bubbler by the solution of radium bromide and the behaviour of the balance again tested, when it was found that the resting point was still unaffected by the operations (*a*), (*b*), and (*c*).

The wire was then charged, and it was expected that this would cause an increase in weight of the order of 10×10^{-9} gram per day, but instead of this an increase of weight of about 30×10^{-7} gram has been found to occur.

Whilst it is not impossible that this increase in weight is due to radio-active changes, it is so much greater than that calculated on the basis of the electrical evidence that the conditions of the experiment require to be re-examined with the greatest care. An explanation that suggests itself to us is the following. With the balance case used by us and described in our paper (*loc. cit.*) the ground joints and flange are necessarily made vacuum tight by some form of lubricant. We have used the so-called rubber grease, which probably distributes vapour of heavy molecular weight throughout the balance case, although its vapour pressure is far too small to be detected by ordinary methods.

It is possible that the ions produced by the emanation and its radio-active products form nuclei for the condensation of this vapour, and that these condensed aggregates are driven with the charged nuclei to the charged and counterpoised platinum wire, there accumulated, and weighed.

The balance case and other apparatus employed is being modified so as to exclude all possibility of condensation of vapour, and it is hoped, when the necessary preliminary study of the behaviour of the instruments has been carried out, to determine whether the large change in weight that has been observed is an accompaniment of the radio-active process or an adventitious effect.

Bertram D. Steele.

The University, Melbourne.

The Habits and Distribution of Scutigera in India.

Beyond the bare fact of its occurrence, but little else seems to have been recorded concerning either the habits or distribution of this remarkable myriapod in India. During the last three years I have come across it on many occasions, and it proves to be very widely distributed in the United Provinces. It occurs from a few hundred feet above sea-level in the plains, at Allahabad, up to nearly 11,000 feet in the Himalayas, having thus a considerable vertical range. I have found it plentiful at Bhowali, among the Himalayan foot-hills of Kumaon, at 5700 feet, and at many other localities in the same district. It occurs at Dhakuri and Dhwali at an elevation of 9000 feet, and also at Phurkia at about 10,300 feet—about five miles below the Pindari glacier. In the neighbouring district of Garhwal I have met with it this year under stones between Badrinath and the village of Mana, situated at the entrance of the pass of the same name into Tibet. The elevation was approximately 10,800 feet, or possibly a little more. How many species are included within this area of distribution I am unable to say, as the Indian forms are at present being worked out by Prof. Silvestri.

Scutigera exhibits a strong dislike to expose itself to daylight and sunshine, and lurks during the daytime in dark places. The commonest situation for finding it is under matting covering the floors of bungalows, or on walls in dark corners, or under stones, &c., out of doors. Sinclair, in vol. v. of the "Cambridge Natural History," states that in Malta Scutigera darts about in the hot sunshine after its prey. In India, so far as my experience goes, it is a nocturnal animal. It is difficult to secure perfect examples, for Scutigera never seems loth to part with one or more of its extremely long and fragile limbs, which are dismembered with extreme readiness. After separation from the body the legs exhibit active muscular contractions for about twenty or thirty seconds. One of its chief enemies in the plains seem to be scorpions, which inhabit very much the same situations. On one occasion a large Buthus was observed to seize a Scutigera by several of its legs with one of its pedipalps. The Scutigera departed in great haste, and made good its escape, leaving several legs behind in the possession of the scorpion. From this occurrence one is led to suggest that the extreme length of the legs of Scutigera may perhaps be an adaptive modification for defensive purposes. When an animal is encompassed by such an armature of appendages it makes it difficult for an enemy to seize it by a more vital part of the body.

From watching the living animal, there seems no doubt that the extremely long and antenna-like hind pair of legs function as sense-organs. Individuals in captivity kept these appendages frequently uplifted and on the move after the same manner as antennæ. A large spider was placed in a vessel along with a Scutigera, and the latter manifested great alarm. The long posterior appendages were kept in constant agitation, apparently to guard against a rear attack, while the antennæ were behaving in the same manner at the opposite end of the body.

A. D. Imms.

Biological Laboratory, Muir College, University of Allahabad, September 5.

Fire Tests with Textiles.

I shall be glad if you will insert the following letter in reference to fire test with textiles, as the conclusions at which I have arrived, after repeated experiments, are so different from those reached by the British Fire Prevention Committee that I feel I cannot allow the assertions of that committee to pass unchallenged. I have over and over again shown publicly and privately, including a demonstration to the members of the Home Office Committee referred to below, that "Non-flam" flannelette is only non-inflammable if it is washed in a certain way. If washed in the manner usually employed by the ordinary housewife, *i.e.* washed with soap and water, and finally wrung out of clear water until all trace of soap has gone, it burns as readily as ordinary cheap flannelette. This fact was testified to by many witnesses besides myself before the Home Office Committee. The manufacturers of "Non-flam" acknowledge this in a letter to me (a letter which was added as a footnote to my evidence before the Departmental Committee on Coroner's Law, second report, p. 42), from which the following are extracts:—"If a piece of Non-flam is washed . . . with plenty of soap to form a good lather, and then rinsed in water, but not beyond the point at which the water on wringing runs a little milky, showing that a little soapy water still remains in the cloth, it will be found to have lost scarcely any of its fire-proof qualities even after repeated washings. . . . You may perhaps ask why we have not issued instructions as to the method of washing to be adopted with Non-flam. . . . It has never been done for two reasons. One is that to issue such instructions would create suspicion. . . . The other reason is that, upon inquiry, we are satisfied that ninety-nine times out of a hundred the method which is followed in the domestic wash could hardly be improved upon. . . . The clothes, after washing, are seldom, if ever, rinsed until no soap is left in them." My contention is that this method of washing is *not* the one employed by the ordinary woman who washes at home. My school nurse made inquiries for me of a dozen mothers as to their method of washing their children's flannelette garments, and, without exception, they all said they finally wrung out of fresh water to get rid of all traces of soap. (The reason for this is, I believe, that if any soap is left in it makes the clothes nasty and sticky.)

I am confident that the 1400 lives annually lost by burning and scalding in this country will only be substantially diminished when fire-guards are compulsory. Eighty-five per cent. of these deaths were proved to be due to the want of a guard. Section 15 of the Children Act, excellent as it is, needs strengthening. It only renders it a penal offence if a child is burnt to death or seriously injured owing to the want of a fire-guard. It does not compel a parent to take reasonable precautions, by the provision of a guard, to prevent this burning.

I shall be most interested to see what conclusions are arrived at by Mr. Gladstone's committee after having heard the evidence of the various witnesses. The final report may be expected shortly.

Leonard Parry.

83 Church Road, Hove, September 28.

Customs at Holy Wells.

It has been suggested that the following information is of sufficient interest to justify insertion in Nature.

Some of your readers doubtless know the Well of St. Cubert, near Crantock, Newquay, and have read the guide-book description of the miraculous cures of infants which used to take place there in old times.

The book on ancient and holy wells in Cornwall, by Mr. Quiller-Couch, gives a full account of the ceremonies which must be observed, and Sir Norman Lockyer quotes them in the chapter on holy wells in "Stonehenge and other Stone Circles."

These authorities seem, however, to be unaware that the help of St. Cubert was sought as late as the latter half of the nineteenth century. When we were at Newquay in 1886, my parents' man-servant, a native of Mawgan, near Newquay, told the other servants that he as a delicate infant had been passed through the hole in the rock of St. Cubert's Well "for luck."

Whether all the proper ceremonies had been observed I cannot say. The servant must have been about eighteen years old in 1886, and he was alive and well in 1898, since which time we have lost sight of him.

Zorah Godden.

Littlewood, Weybridge, September 27.

A Meteorological Phenomenon.

On Monday, September 26, travelling between Etaples and Breteuil, Chemins de Fer du Nord, *en route* to Paris, my family and myself and a friend (five in all) observed the following meteorological phenomenon.

The sun was hidden, but traceable, behind a white mist from 3.30 p.m. until 4.55 p.m. (French time), and on the north and south at a considerable distance through the mist there appeared two arcs of a circular halo, showing on the north colours from red to green, and on the south colours from red to yellow, only the other spectrum colours were absent.

About 4.30 p.m. a dark grey cloud hid the whole phenomenon, but about 4.45 p.m. until the end of the display the grey cloud passed, and the sight was both beautiful and brilliant.

The colour-bands were very wide; the green was the widest and palest, and I only observed it on the northern arc. R. ASHINGTON BULLEN.

Bordeaux, September 28.

RADIUM STANDARDS AND NOMENCLATURE.

THE International Congress of Radiology and Electricity, held at Brussels, September 12th to 15th, afforded an excellent opportunity of discussing several important questions of general interest to workers in radio-activity. The need of a definite radium standard, in which all results should be expressed, has been growing more acute with the increase of accuracy of radio-active measurements. At the present time, scientific results are expressed in many cases in terms of arbitrary radium standards kept in each laboratory, and it has been difficult to be certain of the accuracy or relative value of such standards. Mr. C. E. S. Phillips several years ago pointed out to the Röntgen Society the desirability of adopting a fixed radium standard, and arranged for the preparation of several small radium standards which were compared with the working standard adopted by Rutherford and Boltwood. Duplicates of the latter standard have been used for several years by a number of English, American, and Continental workers.

At the opening meeting, Prof. Rutherford read a report on the desirability of establishing an international radium standard. He pointed out that he had compared by the γ ray method the radium standards used by several important European laboratories, and had found that there was a considerable difference amongst them, amounting in some cases to 20 per cent. It is now possible to measure with considerable precision a number of magnitudes connected with radium; for example, the volume of the emanation, the heating effect, the rate of production of helium, and the rate of emission of α and β particles. The values of each of these quantities is dependent on the accuracy of the radium standard in which the results are expressed. For the comparison of results obtained by workers in different laboratories, it is necessary that they should all be expressed in terms of the same standard. For example, at the present time it is not possible to compare the results obtained on the heat emission of radium by various observers until the radium standards employed have been accurately compared. When once a standard has been adopted, it is relatively a simple matter to determine the radium contents of substandards by the γ ray method or modification of it, without opening the tube containing the radium.

A special international committee was appointed to report to the congress on the best means to be adopted to fix an international radium standard. This committee comprises the following workers in radio-activity representative of a number of countries: Mme. Curie, Debierne, Rutherford, Soddy, Hahn, Geitel, Meyer, Schweidler, Eve, and Boltwood. No doubt representatives of other countries who are prepared to assist in the work will be added later. This committee reported to the congress at its final meeting and their suggestions were adopted by the congress. As a member of the committee, Mme. Curie agreed to prepare a radium standard containing about 20 milligrammes of radium enclosed in a suitable sealed tube. This standard is somewhat large, but the amount was considered necessary on account of the difficulty of weighing small quantities of radium salt with the requisite accuracy. The thanks of all workers in this subject are due to Mme. Curie in undertaking the full responsibility of preparation of a standard, and for the large expenditure of time and labour its preparation will involve. The committee agreed to reimburse Mme. Curie for the cost of the radium and its preparation, after which the standard becomes the property, and is under the control, of the international committee. It was suggested that the standard should be suitably preserved in Paris. The initial cost of preparation of this standard will be somewhat heavy (about 500*l.*), but it is hoped that scientific societies and Governments of various countries will assist in defraying the expenses.

As soon as the primary standard has been prepared, it is proposed to approach through the committee the various national laboratories to ask them to acquire a radium standard accurately determined in terms of the primary standard. In this way it was thought that any Government interested in the question could acquire an accurate radium standard to be used as a basis for standardisation of quantities of radium in use in scientific laboratories, or to be sold commercially. As the primary standard is somewhat large for use in ordinary laboratories, the committee propose to investigate the question of the best method of comparing accurately in terms of the primary standard smaller substandards containing one or two milligrams of radium.

The committee also has under consideration the question of the preparation of very small substandards to be used for the determination of minute quantities of radium and of radium emanation. It is proposed that special investigations be made by the committee to determine the most suitable method of preparation and preservation of such standards. There is at present some uncertainty of how far radium solutions are affected by time in consequence of the tendency of radium to be precipitated out of the solution. No doubt before long it should be possible to secure accurate standard solutions to distribute amongst scientific workers.

In the course of the congress it was suggested that the name Curie, in honour of the late Prof. Curie, should, if possible, be employed for a quantity of radium or of the emanation. This matter was left for the consideration of the standards committee; the latter suggested that the name Curie should be used as a new unit to express the quantity or mass of radium emanation in equilibrium with one gram of radium (element). For example, the amount of emanation in equilibrium with one milligram of radium would be called 1/1000 Curie or one millicurie. The adoption of this unit will avoid much circumlocution, and will prove useful since the radium emanation is now so widely used in all kinds of experiments.

The committee has under consideration the question whether special names should be given to a very small quantity of radium, and also to the emanation in equilibrium with it. For example, the quantity 10^{-12} gram radium seems a natural unit for expression of the radium content of rocks and soils. At the same time, the large amount of investigation on the emanation content of springs and waters may make it desirable to adopt a convenient unit for expression of such quantities.

The committee pointed out that its recommendations were tentative, as all the members of the standards committee were not present at the congress, and had no opportunity of expressing their opinions. It is intended that the preparation of the radium standard should be proceeded with as soon as possible, and it is hoped that the standardisation of sub-standards will be possible before a year has elapsed. Prof. Stefan Meyer, of the University of Vienna, was appointed secretary of the international committee, and all communications relative to standards should be addressed to him.

The question of the nomenclature of radio-active products was informally discussed at the congress. There was a general consensus of opinion that it was not desirable to alter materially the present system of nomenclature, although it was recognised that it is far from perfect. It was felt that the gain to be obtained by a possibly more systematic nomenclature was more than counterbalanced by the confusion that would arise in consequence of a change of names. It was pointed out that the present system of nomenclature was capable of extension to include possible new products. For example, if future investigation should disclose that the product radium C consists of several products these could be named radium C_1, radium C_2, radium C_3, &c., but the term radium C would be used generally to represent the group of products as they normally always occur together. Reference was made to the undesirability of individual workers assuming the right to give new and fancy names to well-known substances.

A number of suggestions in regard to general nomenclature in radio-activity and ionisation were also made to the congress. For example, it is proposed that the term "half-value period" should be used in all cases to represent the term required for a substance to be transformed to half its original value. It is suggested that the terms "induced" and "excited" activity should be abandoned and the term "active deposit" employed in its stead, as reference is usually made to the radio-active matter itself and not to its radiations. There was a good deal of informal discussion amongst members as to the exact use of a number of scientific terms arising in radio-activity and allied subjects. Such discussions are of great importance in preventing unnecessary confusion in nomenclature due to the development of a rapidly growing subject.

A more general account of the meetings and deliberations of the congress, prepared by Dr. Makower, will appear in another issue of Nature.

E. Rutherford.

HEREDITY AT THE CHURCH CONGRESS.

THE discussion on heredity and social responsibility at the meeting of the Church Congress at Cambridge showed clearly the growing appreciation of the importance of biological principles in the study of social phenomena. The debate was opened by a paper by Dr. G. E. Shuttleworth, who dealt with the subject of the feeble-minded, chiefly from the medical point of view. After tracing the history of the different methods of treatment, he pointed out that in the case of most of the feeble-minded "there existed morbid heredity of a strongly transmissive character," and that the only sound process of attacking the problem was to be found in segregating the rising generation of the feeble-minded in industrial colonies, apart from the general community, for in that way alone could the propagation of the evil be prevented by means in harmony with our feelings of humanity.

Mrs. Pinsent, of Birmingham, a member of the Royal Commission on the Feeble-Minded, gave a brilliant address, which was clearly the chief feature of the meeting. She produced the histories of several mentally defective families, in which disease, mental defect, and crime appeared generation after generation. She pointed out the cost of such families to the community, and the appalling waste of social effort involved in their supervision and maintenance. Good and useful families, themselves often with narrow means, were being taxed to support these degenerate folk, until the more efficient restricted their families under the growing economic pressure, and reduced expenditure on maintenance and education. Thus the unfit replaced the fit within our own civilisation and under our own eyes.

The crowded audience was clearly in sympathy with Mrs. Pinsent's view of the situation, and realised the dangers of ignoring any longer the increased chances of reproduction and survival which our modern humanitarian legislation and social action had given to the degenerate classes.

The Bishop of Ripon spoke on the declining birth-rate, and said that, had it appeared in the less worthy elements of society it would have been welcome, but that, as it chiefly affected the better stocks of our race, it was deeply to be deplored. Especially was it disastrous from the point of view of the Empire, which could not hope to stand against other peoples, and especially against the increasing birth-rate, the growing numbers, and the improving organisation of the Eastern nations, unless our empty spaces in the Colonies were filled with men of British race. Marriage ought to be discouraged among the unfit, while the growth of the fit should be encouraged by a higher sense of duty in the homes and an imperial ideal of national life.

Mr. W. C. D. Whetham traced the part played by religion in the sociological development of society, and pointed out that it alone could give a motive strong enough to lead the mass of mankind to prefer the ultimate good of humanity to the immediate advantage of the individual. Hence religion possessed a real biological survival value, as Kidd showed in his book on "Social Evolution." It followed that the National Church had a very great responsibility towards the race. To play its proper part, it must maintain its hold on the efficient families of the nation, and preach the duty of encouraging the rapid reproduction of the good stocks, while limiting the output of those defective in mind or body. The future belongs to those nations whose religious teachers realise this responsibility.

In the general discussion which followed, there was an almost unbroken agreement with the main point of view of the readers of papers. While one speaker thought that only 50 per cent. of mental defect could be traced to heredity, and another emphasised the importance of alcoholism, there was a general consensus of opinion that the country must be awakened to the need of encouraging the growth of good stocks, and that the reproduction of the feeble-minded must be prevented by legislative action.

The general effect of the meeting on the mind of the listener was to produce the belief that the Church Congress, at all events, was ready, in matters of social action, to "think biologically"—surely an encouraging sign.

COCOS-KEELING ATOLL.[1]

THE author, who was for fifteen months medical officer to the cable station at Cocos-Keeling, presents us with an interesting book on that atoll made classical by the researches of Darwin during the voyage of the *Beagle*. The account of the formation and history of the colony is a romance vividly portrayed, but the main interest of the book lies in the author's observations on coral-life and on the processes in operation which can shape an atoll.

The true coral animal (Madreporaria) is a colonial sea-anemone, which continually deposits under itself carbonate of lime, thus raising its seat higher and higher above the bottom. It sits on the surface of the dried coral, such as it is commonly known to us, and in no way presents the features of an Alcyonacean, such as is represented in Fig. 6 of the book. It is peculiarly unfortunate that this figure should have been inserted, since the skeleton of reef corals, with which the author is dealing, consists entirely of dead material. It exposes the writer to the suspicion that he is unacquainted with the real nature of the coral skeleton, and hence largely throws doubt on his really admirable observations on the growth of corals in relation to their environment. These are in no way scientific, but consist of the notes of a painstaking naturalist.

The extraordinary variability in coral skeletons is well known to zoologists, and may aptly be compared to the growth shown by our forest trees in different environments. Reef corals, too, resemble trees in that they are largely dependent for their food on chlorophyll, which is present in minute algæ, living in their digestive cavities. The coloration of most reef corals is largely due to these algæ, and their mode of growth is sympathetic to them in that the coral skeleton is deposited so as to expose the polyps to the maximum amount of light. Such appear to us the ordinary views of zoologists, but our author regards sediment as the main factor to account for the variability of corals; that it is an important subsidiary factor cannot, of course, be denied. Some corals, such as Cœnopsammia, have no algæ, but pigments in granules in their cells; they, of course, are unaffected by light. Yet others probably have similar pigment together with algæ, but our author does not follow out what should be a most profitable line of research.

The statement that corals know "no natural death," does not rest on observation, and is contrary to the few facts we have. No zoologist would consider the rate of growth of corals slow. The observations on the forms of growth of corals are not convincing, since our author does not appear to have examined the zooids to see whether he is really dealing in any genus with one or more species. He is hence not justified in stating that the distribution of atoll corals "is a distribution of types and *not of species*." The observations on the effect of silt suggest research, such as has for some years been undertaken by Wayland Vaughan at the Tortugas; they are not definitive enough to be of much value. Vaughan, by the way, found no great difficulty in transplanting corals.

FIG. 1.—The Lagoon Shore of Pulu Tikus, to show the Sand-piling by a westerly wind. From "Coral and Atolls."

The third part of the book deals with the Cocos-Keeling atoll and its problems, concluding with chapters on the formation of atolls in general. We agree with the author that "it is almost impossible to judge of the method of formation of any atoll not actually visited and examined." The lagoon of Cocos-Keeling is filling up, we are told, both by organic

[1] "Coral and Atolls." By F. Wood-Jones. Pp. xxiii + 392. (London: Lovell, Reeve and Co., Ltd., 1910.) Price 24s. net.

growth within it and by material washed into it over the barrier. It may be so, but it does not justify the statement that "atoll lagoons tend, as a rule, to become smaller and shallower," and there is no attempt by reference to other atolls to justify it. Solution and material swept out by the tides are said to have nothing to do with the formation of the lagoons of atolls. The picture of a high island crumbling to pieces within the calm of an encircling barrier reef appears to our author to be contrary to all natural laws. On what view does he explain Agassiz's wonderful series of photographs of Fijian islands within barrier reefs? "In this (his own) description," he states, "it is assumed throughout that the lagoon is a slightly submerged reef"; why this assumption without evidence? The encircling reef is said to be "a mosaic inlay of coral fragments, cemented together into a solid platform," but there is no evidence that it was ever really examined. It is supposed to have grown up as a platform, and many of its constituent organisms must surely have remained in their growth-positions. A similar platform is found at 13 feet above mean tide level; it is stated that such a platform can only be formed below this level, and its existence is explained as due to elevation.

FIG. 2.—Photograph of a Boulder of Alga-covered Dead Coral Rock, to show the bites of a fish of the genus Scarus. The black line marks the edge of the alga covering not bitten away by the fish. From "Coral and Atolls."

Our author does good service in directing attention to the important effects of sedimentation. Sedimentation banks largely form the foundations of reefs, but "it matters not what the base may be so long as its platform comes within the wind-stirred area." "Any elevation which rises to this plane (the *limiting line of sedimentation*) will furnish the corals with a suitable basis." The depth of this *line* varies. It is entirely a supposititious *line*, and, so far as we can understand, may lie at any depth. Direct investigation on the processes of sedimentation in the ocean is certainly needed.

In conclusion, it cannot be said that Dr. Wood-Jones has much new to tell us. His volume is, however, a very readable one, and most suggestive of lines of research on corals, which might profitably be pursued by more precise methods. His range of investigation and reading were obviously too restricted to enable him to draw conclusions as to the formation of coral reefs in general. The account of the fauna and flora is very good, and the note on Scarus as a coral-feeder interesting. The illustrations of corals and other organisms are good, but a specialist should have been consulted, so that the names of the coral genera might have been inserted. An obvious Actinian (p. 161) would not then have been labelled as an Alcyonarian.

RESEARCHES IN STELLAR PARALLAX.[1]

THE Observatory of Yale College has acquired a deservedly high reputation for the zeal with which the staff has prosecuted the inquiry into stellar parallax and the standard of accuracy consistently maintained. This latest contribution to the subject cannot but enhance that reputation for accuracy, for the results sought do not aim so much at applying the method to fresh instances, as to the re-examination of previous investigations with the view of improving their trustworthiness. Of the stars, the distances of which are here discussed, two-thirds have already been the subject of inquiry at Yale or elsewhere, but on various grounds the results have been regarded with a degree of suspicion that made the repetition of the measures desirable.

The new material falls into two classes, one containing stars having a larger annual proper motion than about $0{\cdot}4''$; the other, selected stars in the Pleiades the observation of which might afford evidence as to the distance of the group as a whole. As the results derived from these Pleiades stars are not regarded as conclusive, and do not enter into the final catalogue, they may be dismissed here. One star gave the value zero, indicating that the Pleiades group is at the same distance as the star; the measures of another assigned the small negative parallax of $-0{\cdot}3''$, "a value that would give a possible limit of systematic error"; while the third series, resulting in the value $+0{\cdot}6''$, suggests that the star does not belong to the group at all, but is nearer to our system, "and this result would seem to be fairly assured." The approximate distance of the Pleiades group still remains a matter of conjecture.

Naturally in a work so long and laborious, difficulties arose in connection with the instrumental and optical equipment, necessitating interruptions in the continuance of the sequences. The most formidable of these was a tendency for the field lens of the eyepiece to work loose, to which inconvenience it is not necessary to refer further, than to express our assurance that the skill and experience of the observers would succeed in effectually removing any traces of systematic error arising from this untoward accident. To show that this confidence is warranted, we may give the final results obtained by the three observers in the case of the Arcturus determination, a star the measures of which have been most scrupulously examined, since for a star of such brilliancy and large proper motion the earlier values of parallax were so suspiciously small, as to suggest that some inherent quality in the star itself, such as colour, or some peculiarity in the observers' method of measuring, had influenced the result. With regard to the detection of

[1] Transactions of the Astronomical Observatory of Yale University Vol. ii., part ii. Parallax Investigations on thirty-five selected stars by Frederic L. Chase, Mason F. Smith, and William L. Elkin (Director). (New Haven: Published by the University, 1910.)

a colour effect in the observations, to which a reference is made in Nature (vol. lxxv., p. 234), further examination has failed to disclose any systematic error attributable to that cause, while the arrangement and discussion of the several series of measures—Dr. Elkin himself made no fewer than seven—exclude the possibility of any personal peculiarity or habit escaping detection. The adopted parallax values for each of the three observers are as follows :—

Observer.	Parallax.	Probable Error.	Probable Error of Single Obn.	No. of Observation.
Elkin ...	+0"·051 ...	±0"·013 ...	±0"·240 ...	126
Chase ...	+0·085 ...	±0·007 ...	±0·127 ...	154
Smith ...	+0·050 ...	±0·011 ...	±0·126 ...	123

After an elaborate system of "weighting," for details of which we must refer to the original paper, the finally adopted value of the parallax of Arcturus is 0·066"±0·006".

The interesting stars 61 Cygni and Groombridge 1830, notwithstanding the repeated attempts that have been made to determine the parallax, are among those stars of which it has been thought desirable to repeat the measures. Without entering into further particulars, it may be said that the results are equally consistent as those obtained in the case of Arcturus, and command equal confidence.

The grand result of the work at Yale, which has occupied the three observers for some years, is to assign a parallax to 200 stars, with an accuracy that we believe has not been attained elsewhere. The three stars in the Pleiades not being included, we have here a catalogue of 197 stars, which Dr. Elkin forms into groups depending on magnitude and proper motion. This table is so small that it can be conveniently given here. It may seem but a modest outcome for so many years of careful and anxious work, but those who appreciate it most will be warmest in their congratulations to Dr. Elkin and his able colleagues on the satisfactory completion of a task of no common difficulty. The table into which so much work is compressed is as follows :—

Proper Motion	0"·00–0"·34	0"·41–0"·54	0"·55–0"·65	0"·66–0"·96	1"·01–7"·07
Mag. 0·0–2·5	+0"·031 (13)	+0"·100 (2)	+0"·113 (3)	... ... (0)	+0"·200 (2)
,, 3·0–5·0	+0·026 (9)	+0·024 (7)	+0·114 (5)	+0·091 (8)	+0·162 (6)
,, 5·1–7·0	−0·010 (7)	+0·034 (14)	+0·064 (16)	+0·036 (20)	+0·111 (8)
,, 7·1–9·0	... ... (0)	+0·040 (23)	+0·032 (23)	+0·018 (19)	+0·128 (12)

The number in brackets after the parallax signifies the number of stars in each group. As Dr. Elkin remarks, "There is, with slight exception, manifest a very decided sequence of values, both with respect to magnitude and size of proper motion, such as one might expect." W. E. P.

THE PERFILOGRAPH.

The perfilograph is an ingenious instrument for recording graphically the undulations of the bottom of a channel in depths up to about six or seven fathoms. It is the invention of Augustus Mercau, an Argentine engineer, by whom a paper was read at Buenos Aires before the Naval Section at the recent meeting of the International American Scientific Congress, in the course of which the instrument was fully described. The principles on which its construction depends and the practical results obtained from its use appear to present some points of interest.

A heavy weight of from 150 to 200 lb. being slowly dragged along the bottom by a wire rope attached to the stern of a steam launch, it is obvious that as the depth changes the inclination of the wire will vary. By an ingenious mechanism, the sine of the angle made by the wire with the horizontal plane is registered graphically in parallel ordinates on a roll of paper, which is slowly unwound by means of clockwork at a rate proportionate to that of the vessel. The lengths of the ordinates, being proportional to the sines of the varying angles, represent the undulations of the bottom referred to the horizontal plane, and are registered on a convenient scale on the paper by means of a system of levers.

The instrument, mounted in the stern of the launch, is placed accurately at a height of 5 feet above the water-line, and the depths are measured from a zero line drawn by a pencil pressing against the roll of paper as it is unwound. The system of levers by which the sines of the angles are registered is connected to a length of tubing of small diameter, through which a thin guiding wire passes. One end of this wire, which is about 50 feet in length, is secured to a spiral spring attached to the weight on the bottom; the other end is led underneath the base of the instrument and secured. The spiral spring yielding to a strain of about 150 lb., the tension on the guiding wire is automatically relieved by throwing the excess of strain on to the towing cable, the length of which is adjusted accordingly. The guiding wire, being thus kept taut by a strain not exceeding 150 lb., the length of tubing through which the wire passes takes up an inclination to the horizontal dependent on the depth of water, and in so doing it actuates the system of levers with which it is connected.

The speed at which the weight can be towed should not exceed three or four knots. There is an arrangement for marking on the paper the instant at which the position of the vessel may be fixed by means of sextant angles. The horizontal scale of the diagram may thus be determined between successive "fixes" by actual observation, independently of the rate at which the paper is being unrolled or the speed at which the vessel may be moving. Unless these two factors remain constant throughout the run, the horizontal scale will be subject to variation. It is desirable therefore to reconstruct the diagram, so far as its horizontal components are concerned, from the data afforded by the "fixes."

The horizontal scale of the diagram is roughly about 1/1000 or about 70 inches to the nautical mile; the vertical scale is about $\frac{1}{4}$ inch to a foot. The instrument has been adopted by the Argentine Hydrographic Service, and has been in constant use for some time past. It is understood that the results are considered quite satisfactory.

An opportunity of witnessing a practical trial was courteously afforded to the present writer by the Argentine naval authorities. The instrument was readily set up and adjusted, and several sectional lines were run across the dredged channel leading to the docks at Buenos Aires. The resulting diagrams over the same section run in opposite directions agreed accurately, and no difficulty whatever was experienced during the trials.

The following advantages have been claimed for the instrument :—(1) Continuity of the section traced; (2) accuracy of results; (3) rapidity as compared with ordinary methods; (4) economy of skilled labour; (5) facility of manipulation; (6) capability of use in circumstances of sea and weather when accurate soundings by the lead could not be obtained.

The trials were carried out in open water with its surface considerably disturbed by a fresh breeze, and afforded a very fair test of the capabilities of the instrument. There is certainly a source of error owing to the motion of the vessel. The section as shown on the diagram is necessarily a combination of effects due to the pitching of the vessel and the actual form of the bottom.

In several of the diagrams the rapid scending of the vessel was noticeable in oscillations to the extent of 2 or even 3 feet; but it was not difficult to draw a mean line which would eliminate the motion with a fair degree of accuracy. Practically the speed of the launch scarcely exceeded that at which she might have proceeded with two leadsmen sounding in the ordinary manner, and the same number of hands are required, although they need not necessarily be skilled leadsmen. Two officers are necessary for fixing the vessel, as they would be in ordinary circumstances.

On a rocky bottom, where dredging has been carried out, the weight would be constantly liable to catch in the inequalities of the bottom, and bring up the boat, thus causing delays and possibly breakage of gear. In such cases, moreover, the usual method of sweeping with an iron bar could not safely be dispensed with, however accurately each separate section might be obtained.

On the whole, it may be said that the advantages to be derived from the invention do not at present seem so clearly pronounced as to make it likely that it would be adopted for use under the conditions usually prevailing in the examination of dredged channels. There might, however, be special circumstances in which it could be used advantageously.

A. M. F.

NOTES.

A monument to Gregor Mendel, the naturalist, who was born at Amsterdam in 1822 and died at Brünn in 1884, was unveiled at the latter place on October 2.

The summer season, comprised by the six months from April to September, can in no sense be considered ideal, although from a meteorological point of view it has not differed very widely from the average. At Greenwich the mean temperature for the six months was 57·0°, which is 0·9° below the average of the past sixty years, but is 0·9° higher than for the corresponding six months in 1909. The warmest month was August, with a mean temperature of 62·2°, and this was followed by a mean of 61·5° in June. May and June were the only two months with the mean temperature in excess of the average. The highest shade temperature during the summer was 82·3°, in June, and there was no other month with a temperature of 80°. The only years since 1841 with a slightly lower absolute maximum summer temperature are 1853, 1862, 1879, and 1882. There were in all only fifty-one days with a temperature of 70° or above, and the only summers with so few warm days are 1860, 1879, and 1888. The most conspicuous month for the absence of warm days was July, when there were only six days with a temperature of 70° or above; this is the smallest number of such warm days in July since the establishment of trustworthy records in 1841. August had twenty days with a temperature of 70° or above, and June follows with seventeen; in September there were only two. The only instances of frost in the shade in the six summer months are two in April and one in May. The aggregate rainfall at Greenwich was 13·60 inches, which is 1·22 inches more than the average of the past sixty years, but is 0·44 inch less than for the corresponding period in 1909. The rainfall was in excess of the average in each month, with the exception of September, when there was a deficiency of 1·47 inches. The wettest summer month was July, with a total measurement of 3·55 inches, which is 1·15 inches more than the normal. In all, rain fell on ninety-two days, but only on three days in September, when the aggregate measurement was 0·72 inch, and on one day the fall was 0·66 inch. The duration of bright sunshine was 966 hours, which is 165 hours fewer than the average, and May is the only month with an excess of sunshine. The sunniest month was May, with a total duration of 219 hours, and the least sunny month was July, with 112 hours' duration, which is 124 hours fewer than the normal. The finest month of the six was undoubtedly September.

Mr. Marconi has informed the Marconi Wireless Telegraph Company that wireless telegraphic messages have been successfully transmitted between Clifden (Galway) and Buenos Aires, a distance of about six thousand miles, without the employment of an intervening relay station. We learn from a note in the *Engineer* for September 30 that the tramp steamer *Nonsuch*, whilst on her voyage from Bombay to Hull and Middlesbrough, was heard at the wireless station at the North Foreland calling her name when she was fifteen miles south of Cape de Gaa, at the south-east corner of Spain, a position distant 940 nautical miles from the North Foreland. This distance, across the obstacle of the whole of France and Spain, and the Pyrenees, is a remarkable range for wireless signals from a ship. The owners received a message through the station at Ushant, sent from the ship off Cape Roca, near Lisbon, no less than 610 nautical miles from Ushant. The *Nonsuch* is the first tramp steamer to be fitted with wireless telegraph.

The council of the Institution of Civil Engineers has made the following awards in respect of papers published in Section ii. of the Proceedings for the session 1909–10:—A Telford gold medal to Major W. W. Harts, U.S. Army (Nashville, Tenn.); a Watt gold medal to Mr. A. Trewby (London); a Crampton prize to Prof. A. H. Gibson and Mr. A. Ryan (Manchester); and Telford premiums to Messrs. W. R. Baldwin-Wiseman (Southampton), O. W. Griffith (London), Dr. W. E. Lilley (Dublin), W. Corin (Sydney), J. A. Saner (Northwich), and F. O. Blackwell (New York). The council has awarded the Indian premium for 1910 to Mr. C. W. Lloyd-Jones (Secunderabad).

The Paris correspondent of the *Times* has reported the death, in his sixty-ninth year, of Prof. Fulgence Raymond, clinical professor of diseases of the nervous system in the University of Paris, and superintendent of the Salpêtrière. Prof. Raymond became known first by a special study on "L'Hémichorée, L'Hémianasthésie, et Les Tremblements Symptomatiques." On the death of his friend and teacher Charcot, in 1894, Raymond was appointed to succeed to the chair of clinical professor of nervous diseases. He was the author of many works on nervous and kindred diseases, and was celebrated for the laboratories of pathological anatomy and physiological psychology which he instituted and superintended at the Salpêtrière. Prof. Raymond was a member of many of the scientific societies of Europe.

The ordinary meetings of the Royal Geographical Society for the winter session will begin on November 7, when Major P. Molesworth Sykes will lecture on his further journeys in Persia. Subsequent meetings have been provisionally arranged as follows:—November 21: some results of the Duke of the Abruzzi's Karakoram expedition, Dr. Filippo de Filippi; December 5: the new geography and its aims, Mr. H. J. Mackinder, M.P.; December 19: the French Antarctic Expedition, 1909–10, Dr. J. B. Charcot; January 16, 1911: the *Michael Sars* North Atlantic deep sea expedition, Sir John Murray and Dr. Hjort. A selection from the following papers may be expected during the session:—Recent explorations in Dutch New Guinea, Dr. H. A. Lorentz; the development of British Central Africa, Sir Alfred Sharpe; recent boundary work in Bolivia, Major P. H. Fawcett; the peoples of the Sudan, Dr. C. G. Seligmann; the geographical conditions affecting the development of Canada, Prof. W. L. Grant; economic geography of the Tyne, Mr. A. J. Sargent; distribution of cotton culture within the British Empire, Mr. J. Howard Reed; researches in the Himalayas, Dr. Arthur Neve; explorations in western and northern Australia, Mr. A. W. Canning.

Mr. C. G. Thorp, 182 St. George's Terrace, Perth, Western Australia, writes:—"I am endeavouring to prove the origin of obsidianites; it has been stated that Mr. Dunn's bubble hypothesis is impossible on account of the occurrence of dumb-bells. I wish to endeavour to make a dumb-bell by the union of the drops of two bubbles. Perhaps one of your readers would help me to the formation of a very viscid fluid that would dry." The inquiry was submitted to Prof. C. V. Boys, who has kindly sent the following reply: "The best mixture for blowing bubbles that will solidify, not exactly dry, is resin containing one-tenth, more or less, of beeswax, melted and blown when fluid. Possibly the addition of Canada balsam would make the mixture more adhesive. No soap and glycerine mixture will make a bubble that will dry."

In a letter entitled "An Undescribed Feather-element," which appeared in Nature of September 15, Mr. F. J. Stubbs described a remarkable feature of the structure of the primary feathers of certain birds, which he said "seems to be hitherto undescribed." Two correspondents have written to point out that the peculiarity in question has been described before. Mr. W. P. Pycraft states that he published an account of the structure seventeen years ago in the pages of *Natural Science* (vol. iii., 1893, p. 197). Prof. R. v. Lendenfeld, of Prague, informs us that "these structures have been studied in my laboratory and carefully described and figured by one of my students, Dr. E. Mascha, in his paper 'Ueber die Schwungfedern' (*Zeitschrift fur wissenschaftliche Zoologie*, vol. lxxvii., 1904, pp. 606–51, nine text figures, Plates 29–31), on p. 614 ff, an English version of which appeared in the Smithsonian Miscellaneous Collections (vol. xlviii., 1905, 30 pp., 15 plates) under the title 'The Structure of Wing Feathers.'"

In *Man* for September Mr. W. E. Hardenburg, in an account of the Indian tribes of the Putumayo River, one of the principal tributaries of the Upper Amazon, describes what he terms a system of "wireless telegraphy" in use among this race. It consists of two logs of hard wood pierced by narrow holes of longitudinal section, burnt out by heated stones. One log is always thicker than the other, producing two grave notes, while the smaller trunk gives out two which are acute. They are hung from the roof timbers, and are beaten with a club tipped with rubber. A code is arranged based upon the differences of tone and the length and number of the blows, so that messages can be exchanged, on a clear day the sound reaching a distance of from 12 to 15 kilometres.

A series of experiments by Messrs. R. M. Yerkes and D. Bloomfield is described in the *Psychological Bulletin* for August, planned to answer the question, Do kittens kill mice instinctively? The experiments decide in the affirmative. They show that "the instinct to kill may manifest itself in the kitten before the end of the first month of life, while the animal is yet feeble and barely able to eat a young mouse." The instinctive reaction, though somewhat variable with individual kittens, is fairly definite in character. It appears quite suddenly, and is aroused by the movement of the mouse, and, after the first reaction, by the smell of the mouse. Usually it develops during the second month of the kitten's life, and does not completely wane during the following two or three months, but "it apparently becomes increasingly difficult to evoke. The practical inference is: allow a kitten to exercise its killing instinct when young if a good mouser is desired." The authors admit the great value of imitation and experience for the killing reactions of kittens, and for the modification and development of these reactions. But the prime object of their experiments is to show that kittens, reared in solitude, seize the mouse, even in the first kill, so that they cannot be bitten by it, and that the visual experience of movement is the primary condition for the initiation of the instinct.

In the Bulletin of the Johns Hopkins Hospital for September Dr. C. L. Minor, of Asheville, N.C., has a paper on the use of the X-ray in the diagnosis of pulmonary tuberculosis. This subject was discussed at the recent annual meeting of the British Medical Association in London (see Nature, August 4). Dr. Minor gives full directions as to the most suitable arrangement of the apparatus and of the dark-room, and as to the positions in which patients should be examined. His paper is chiefly interesting as representing the point of view of a physician in general practice in contrast to that of the X-ray specialist. In his opinion the general practitioner should confine himself to the use of the fluorescent screen, and leave the taking and the interpretation of photographic plates, with the great amount of detail they contain, to the X-ray specialist. He enters fully into the controversy regarding the comparative value of the clinical and the radioscopic methods of diagnosis of phthisis in its earliest stages. Many X-ray specialists, he says, insist that signs of early phthisis are shown by the Röntgen rays before the physician is able to demonstrate them by the ordinary methods of physical diagnosis. In Dr. Minor's opinion this is due to the fact that many clinical physicians are not really expert in the method of physical diagnosis, and that they frequently overlook signs which a more trustworthy diagnostician would have discovered. Dr. Minor's own experience goes to show that there are few cases in which, although distinct shadows are shown by the X-rays, no physical signs can be elicited in the chest. The present writer, however, has frequently had patients sent for examination by thoroughly competent physicians with the statement that no physical signs of lung disease were present. He has then demonstrated to the physician the exact position and extent of the pulmonary lesion, and the physician has thereupon been able, by a careful examination, to detect definite signs at this spot. Dr. Minor directs special attention to the frequency of the discovery of enlarged lymphatic glands in the chest, and he describes the positions in which they are to be found. His conclusions lend further confirmation to the view, now generally accepted as true, that the X-ray examination of the lungs is a very valuable aid to the early diagnosis of pulmonary phthisis.

Dr. P. L. Sclater has contributed to the "Handbook of Jamaica for 1910" a revised list of the birds of Jamaica, based on the one by Messrs. A. and E. Newton in the same publication for 1881. The new list, which is printed separately in pamphlet form, and can be obtained in London of Messrs. H. Sotheran and Co., contains notes on the distribution of the various groups.

THE European hedgehog has been hitherto considered to differ from other species of its genus in the peculiar form and single root of the third upper incisor and upper canine, while it has also been supposed to be characterised by the constant presence and relatively large size of the second upper premolar. From an examination of a large number of specimens, Mr. E. Hollis (*Zoologist* for September) finds, however, that two of these characters are by no means constant. Thus, out of eleven British examples, in only one case was the upper canine single-rooted, while in six instances it was double-rooted, and in the remaining four in a kind of intermediate condition. In the same series the second upper premolar was absent in three instances, rudimentary in one case, and normal in the remainder. From this it is inferred that *Erinaceus europaeus* is in a state of unstable equilibrium in regard to the latter tooth, thereby resembling the Asiatic *E. micropus* and *E. pictus*. Somewhat similar variations were observed in the collection of skulls of the European species in the British Museum, but in no instance was the third upper incisor observed to be double-rooted. A single root to this incisor may therefore still be characteristic of *E. europaeus*.

THE fourth part of the Flora of Glamorgan, dealing with the division Incompletæ of the Dicotyledons, has been recently published. The flora is being prepared under the editorship of Prof. A. H. Trow by a committee, for whom Dr. and Miss Vachell act as secretaries. It is noted that several critical and polymorphic species require more detailed observation and study.

A SECOND report on the Hymeniales of Connecticut, constituting Bulletin No. 15 of the State of Connecticut Geological and Natural History Survey, requires to be taken in conjunction with the preliminary report published as Bulletin No. 3, in which the keys to the genera were given. Analytical keys for the species are supplied in the present bulletin, and are accompanied by excellent illustrations of selected types. Prof. A. E. White, who is responsible for both reports, also provides a good account of some edible species of Agaricaceæ; most of the species are similar to those recommended by British fungologists, but the author is bolder than some authorities in recommending *Lactarius piperatus* and *Cantharellus aurantiacus*.

THE plant formations of East Bolivia, which were briefly outlined and illustrated by Dr. Th. Herzog in a number of the *Vegetationsbilder*, are described at greater length in Engler's *Botanische Jahrbucher* (vol. xliv., part iii.). A well-defined formation is that of the Pantanales, developed near Carumba, in the extreme south-east, which is a fertile virgin forest, consisting largely of deciduous trees with a wealth of lianes. *Piptadenia macrocarpa* is a dominant tree, valued for its timber and astringent bark; *Tecoma Ipe* is another magnificent tree, yielding a durable timber, and *Calcophyllum multiflorum* is also characteristic of the formation. The lianes include *Urvillea laevis*, *Bignonia unguis cati*, and species of Serjania. The author presents a graphic description of the magnificent palm, *Orbignya phalerata*, *Physocalymma scaberrima* (Lythraceæ), and various species of Tecoma, that inhabit the highlands of Velasco, and extols the beauty of the flowering shrubs found on the Cordilleras.

DR. FELIX OSWALD, so well known for his geological map and description of Armenia, has published an account of the tectonic development of the Armenian highlands in *Petermann's Mitteilungen* for 1910 (pp. 8, 70, and 126). The movements that affected the pre-Devonian rocks are obscured by the potency of the Hercynian and Alpine movements. The Alpine uplift was foreshadowed in Armenia by considerable folding in Upper Eocene times, but the resulting land-surface was reduced almost to a peneplain before the great transgression of the Miocene sea. This sea even spread over land that had remained unsubmerged since the opening of the Mesozoic era. Its invasion, however, was soon checked, since in the Upper Miocene epoch the Alpine folding set in, accompanied by great intrusions of ultrabasic rocks. This folding continued long enough to involve the Sarmatian deposits on the south flank of the Caucasian chain. Dr. Oswald, with the aid of a map, explains the grouping of the main lines of folding, and discusses the breaking up of the highlands into elevated plateaus and regions of depression. He regards the volcanic phenomena as manifested along planes of fracture. When these, in Upper Miocene times, reached down to the ultrabasic regions, peridotites rose among the folded rocks. Regions of decreasing basicity have since been drawn on, and only the higher zones are now penetrated, as is evidenced by the recent rhyolitic lavas of the crater of Nimrud.

AN interesting lecture on "Vegetation and Rainfall," recently delivered at Perth, Western Australia, by Dr. A. Morrison, is reported in the *West Australian* of August 4. The author does not deal specially with the distribution of rainfall in the colony, but with the importance of a plentiful water supply and the warmth of the sun on vegetation generally, and on the influence of the latter in preserving the moisture of the soil. On hill-sides, without the protection of vegetation, the natural streams become choked with débris, causing floods and devastation in the country below, but vegetation gives time for water to percolate the soil without displacing it. The cosmic causes of rainfall must be carefully distinguished from local causes, which only modify the precipitation brought from distant parts. Irrigation during the dry season would do much in maintaining the desired moist condition of air and soil, and the plantation of trees would help to make it permanent; but when the settler has cleared the bush for cultivation he sometimes finds that a heavy fall of rain will run off the surface without having time to sink into the ground. The author considers that a large proportion of the country in Western Australia should be left in its original state, clothed with forests.

WE have received a separate copy of Prof. L. Palazzo's paper on his magnetic survey of Sardinia, which appeared last year in *Terrestrial Magnetism and Atmospheric Electricity*. While the eastern side of the island appears to be normal, the western shows great abnormalities which are not due to surface rocks. While the equal vertical force lines run nearly east and west across the island, the equal horizontal force lines, which have the general direction north-east to south-west, are disturbed at points near the middle and north end of the west coast. The isogonic and isoclinic lines show irregularities near the same points. The annual secular changes are:—in west declination, $-4 \cdot 6'$; in inclination, $-1 \cdot 5'$; in horizontal force, $+0 \cdot 00020$ dyne per unit pole.

THE *South African Journal of Science* for June contains an important paper by Dr. D. M. Tomory on modern methods of water purification. The Modder River water, from which Bloemfontein draws its supplies, refuses to settle clear, and cannot be effectively purified by sand filters, which, however, are very soon choked by the suspended clay. A remarkable improvement was effected by precipitating with lime and permanganate, and filtering rapidly through a mechanical filter, the deaths from enteric fever falling from 83 per 10,000 in 1896 and 20 per 10,000 in 1904 to 2·75 per 10,000 in 1908. In view of the necessity of increasing the plant, a tour was made to inspect the chief purification plants both in Europe and in America. England and the northern part of the States do not show many examples of river-waters of the Modder type, and appear to be admirably served by the "fool-proof" method of sand-filtration. But in Egypt and in the southern States the author found many analogous cases in which extraordinary results were achieved by chemical precipitation followed by rapid mechanical filtration. He concludes that the extraordinary rapidity of the mechanical filtration is accompanied by no special risks of pollution when it is used intelligently in conjunction with a chemical precipitation process, and that in the case of non-settling waters, which can only be purified by such a precipitation, the rapid mechanical filtration is decidedly to be preferred on the ground of efficiency combined with economy. The paper will be read with interest by many who have been compelled to limit their observations of water purification to the somewhat uniform conditions which prevail in the water supplies of Great Britain.

The *American Journal of Science* for September contains an account of an important series of researches upon the complexity of tellurium, by Mr. W. R. Flint, of Yale University. The material used amounted to 500 grams of the redistilled metal; a series of five conversions of the basic nitrate $2TeO_2.HNO_3$ into the dioxide gave an atomic weight 127·45, with a maximum error 0·04. The material was fractionated by repeatedly precipitating the dioxide from solutions of the chloride by the addition of a large excess of water. Four precipitations reduced the atomic weight to 126·59, whilst ten precipitations gave the value 124·32 for a fraction amounting to 23 grams. This figure does not necessarily represent the lowest possible value for the atomic weight, but it agrees well with Mendeléeff's prediction that the true value would be 123 to 126, and "is apparently the nearest approach which has yet been made to the true atomic weight of the element tellurium." The fractions less easily hydrolysed by water were also worked up, and yellow to green substances were isolated; these gave negative results when tested for the commoner elements, but gave nearly all the reactions of tellurium, and many perhaps contain an unknown homologue.

The trials of H.M. second-class cruiser *Bristol*, completed on September 27, form the subject of an illustrated article in *Engineering* for September 30. The *Bristol* is the first British ship tried with other than the Parsons type of turbine, her propelling machinery consisting of Curtis turbines of a special character designed by the builders, Messrs. John Brown and Co., of Clydebank. This firm has taken up the Curtis turbine on account of the following reasons:—(1) the potential advantages of acquiring experience with a type of marine turbine capable of using superheated steam, as in land installations; (2) the attainment of economy at low powers, without the disadvantage of very close-fitting parts, and the extremely fine adjustments entailed thereby; and (3) the simplification of the connections and general engine-room arrangement, and also the expectation of attaining higher efficiency by an increase in size of the individual propellers. With characteristic thoroughness, the firm first constructed experimental plant and conducted a lengthy research on several modifications of the Curtis turbine, the results of which are now embodied in the machinery of the *Bristol*. It is a pleasure to record that the result of this policy is that the *Bristol* on her official trials has secured the same mileage per unit of water consumption as has been obtained in the four ships of her class which preceded her, these having Parsons turbines, embodying the inventor's latest improvements at the date of their construction. As this is the first Brown-Curtis installation, even better results may be looked for as the experience of the makers extends.

The syndics of the University Press, Cambridge, have entered into an agreement with the directors of the Chicago University Press to undertake the publication and sale in England and in the British colonies of books issued by the Chicago University Press. This will apply to all future publications and, subject to certain existing arrangements, also to books already published.

The October issue of the quarterly list of second-hand instruments which he has for sale or hire has been published by Mr. C. Baker, of 244 High Holborn, London. The catalogue contains details of 1635 pieces of apparatus, and is concerned with microscopes, surveying and drawing instruments, telescopes, spectroscopic apparatus, as well as instruments for use in the study of most other branches of physics. Messrs. H. F. Angus and Co., 83 Wigmore Street, London, have also sent a copy of their first catalogue of second-hand scientific apparatus and accessories. This department has been added to the business but recently, but the list shows that workers in science will find already a good selection of instruments likely to provide the apparatus of which they may be in search.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in October:—

October 7. 5h. 6m. to 6h. 23m. Moon occults δ Scorpii (mag. 2·5).
,, 10. 11h. 7m. Minimum of Algol (β Persei).
,, 11. Mercury at greatest elongation west and visible as a morning star.
,, 13. 7h. 56m. Minimum of Algol (β Persei).
,, 18–22. Epoch of the October shooting stars (*Orionids*, radiant at $92° + 15°$).
,, 26. 14h. 44m. to 15h. 51m. Moon occults η Leonis (mag. 3·6).
,, 27. 22h. 52m. Venus and Jupiter in conjunction, Venus 0° 11′ N.
,, 29. 13h. 16m. Mercury and Jupiter in conjunction, Mercury 0° 21′ N.

A Bright Meteor.—From a correspondent we have received the following particulars of a bright meteor seen at South Kensington during Monday night, October 3:—Time, 12h. 50m.; approximate path, from 310°, +35°, to 294°, +35°; size, about one-third diameter of moon; duration of flight, about three seconds; no trail; colour, whitish-yellow.

Rediscovery of Brooks's Periodical Comet (1889 V.), 1910*d*.—A telegram from the Kiel Centralstelle announces that Brooks's periodical comet was rediscovered by Messrs. Aitken and Wilson, at the Lick Observatory, on September 28. Its position at 9h. 17·3m. (Lick M.T.) was R.A. = 19h. 47m. 51s., dec. = 28° 8′ 39″ S., which agrees closely with the ephemeris by Prof. Bauschinger mentioned in these columns on September 8. This position lies in Sagittarius about $1\frac{1}{2}°$ south-west of the fifth-magnitude star ω, and is on the meridian about 7.30 p.m.

As the magnitude of the comet is given as 13·0, it is unlikely that observations in these latitudes will be possible for some time, but the southern declination is decreasing, and perihelion passage is not due until January 8, 1911. According to the ephemeris, the comet was at its nearest point to the earth early in August, and its present distance is about 155 million miles.

The Luminosity of Comets.—As a reprint from *Science*, N.S., vol. xxxii., No. 817, we have received a paper in which Mr. W. L. Dudley discusses the causes which produce luminosity in cometary bodies. According to the author's reasoning, luminous comets are simply masses of gaseous matter illuminated by the heavy electric discharges constantly flowing from the sun to each of the planets. The "ionic breeze" thus produced renders the comet luminous, and at the same time brushes matter along with it to form the tail. Should the comet get into such a position as to be under the influence of two planets (kathodes) at the same time, more than one tail is produced by the streams of ions from the sun (anode). The author also offers explanations on this hypothesis for the production of multiple heads, the change of direction which sometimes takes place in the tail, and the polarisation of cometary light.

Coloured Stars between the Pole and 60° N. Declination.—In continuation of previous lists, Herr Krüger now publishes, in No. 4441 of the *Astronomische Nachrichten*, a list of coloured stars which lie between the North Pole and 60° N. declination. The list includes 191 stars, and for each object gives the catalogue numbers, the colour on the Potsdam scale, Herr Krüger's observed colour, on a scale where 0° = white, 10° = red, the magnitude and the spectral type. Ninety-three of the stars lie within the colour-limits WG–G–, and are of the second and third types.

Observations of the Companion of Sirius.—The observations of the companion of Sirius, made with the 40-inch refractor by Prof. Barnard during November 30, 1909, to March 15, are recorded in No. 617 of the *Astronomical Journal*. The values for position-angle and distance, for the mean epoch (1910·106), are 89·09° and 9·07″ respectively.

The Perseid Shower, 1910.—In a note appearing in No. 617 of the *Astronomical Journal* Mr. E. F. Sawyer describes the meteor observations made by him at North Weymouth, Mass., on August 9, 11, 12, and 13. The hourly rates for one observer, covering one-sixth of the visible sky with the centre in Perseus, were 15, 15, 8, and 6 on these respective dates. The meteors generally were bright, and left streaks for one or two seconds; the radiant was found to be at 38·5°, +55·5°.

A Modified Method for Nadir Observations.—In making the ordinary nadir observations, where a bright thread is made to coincide with its reflected image, there is always some little doubt as to when exact coincidence occurs. To obviate this difficulty, Mr. R. M. Stewart suggests a method where the reflected bright image is obliterated by a dark thread. Experiments made with the Ottawa meridian circle show that this method is simple, and gives greater accuracy than the older one. In making the observation, the bright reflected image and the illuminated thread are brought nearly to coincidence as usual, but the eye-piece, or attached plane mirror, is then slightly rotated so that the field becomes dark and the thread invisible, although the reflected image remains bright. A slight motion then causes the dark thread to occult the bright image, and it is stated that this operation can be performed with much greater certainty than can the bringing into exact coincidence two bright lines (Journal R.A.S. Canada, vol. iv., No. 4).

A New Micrometer.—Dr. Doberck describes a new micrometer in No. 4432 of the *Astronomische Nachrichten* made to his specifications by Messrs. Cooke and Son. In this instrument the frame carrying the wires is the only readily movable part, so that there is practically no fear of dragging, and the whole is built very rigidly and strongly, thus obviating any likelihood of derangement.

The errors of the screw, as shown by an investigation involving 4000 settings, are extremely small, the corrections being considerably below the probable errors of setting on stars. The instrument is called the Elizabeth Thompson micrometer.

The Mean Parallax of Tenth-magnitude Stars.—From a number of measures, made during 1907–9, of the Engelhardt companions of Bradley stars, Dr. H. E. Lau finds that the mean parallax of tenth-magnitude stars, taking Campbell's value for the sun's velocity, is 0·0010″; this is smaller than the value found by Comstock. The value derived by Kapteyn's method should be 0·0011″, so that it would appear that these faint stars are not abnormal in constitution, nor is there indicated any marked absorption in space (*Astronomische Nachrichten*, No. 4430).

HALLEY METEORS.

In a communication to Dr. W. J. S. Lockyer, Prof. David Todd, of the Amherst College Observatory, writes as follows:—

"So well established is the Schiaparelli-Newton theory of the connection between comets and meteors, that it is highly important to obtain observations from every possible radiant, in order to ascertain whether there may be any that do not conform to the general law.

"Particularly is it desirable to observe the meteors of the Halley stream. Prof. W. H. Pickering directed attention to the possibility of observing such meteors early last May, when the earth was at its nearest, not to the comet, but to the comet's orbit. Many astronomers kept an outlook for these meteors; and on the night of May 5–6 I made a balloon ascension for this purpose, with a certainty of clear skies, as the spring season had been especially cloudy. However, hardly more meteors than usual on a May night were seen, and none of them appeared traceable to the Halley radiant. Indeed, I had very little expectation of seeing Halley meteors on that occasion, as the region of the cometary orbit then nearest to us was that through which the comet had passed seventy-five years ago.

"Quite different will be the conditions next month. On October 18 the earth is closest to that region of Halley's orbit where the comet passed on March 13–15, 1910, and from which, therefore, it may be expected that many meteors will enter the earth's atmosphere, as the comet has visited that region so recently. Very unfortunately, the moon fulls at just that time, so that all the faintest shooting stars would be lost.

"Probably it will be well to begin the watch as early as October 15, as evidently the meteoric matter in this case is widely scattered along the comet's path."

According to the *Daily Mail* of October 4, a very brilliant meteor is recorded to have been observed at Johannesburg on October 3. Perhaps this may be a forerunner of the swarm referred to by Prof. Todd. The account of this large meteor is as follows:—

"Johannesburg, *Monday*.

"Johannesburg was startled at 8.50 this evening by the largest shooting star or meteor ever seen in the district.

"Its light was equal to that of a naval searchlight at fifty yards' range. The sky was illumined for three minutes, and the streets were as light as if it were day. Natives were terrified, believing that the end of the world was at hand.

"The astronomical observers at the local observatory were nearly blinded. The director of the observatory estimated that the meteor was only 150 miles from the earth. The head of the meteor, he says, was pear-shaped and half the size of the moon in diameter. The tail was straight at first, but afterwards turned towards the south."

THE AUTUMN MEETING OF THE IRON AND STEEL INSTITUTE.

When Buxton was selected as the locality for the autumn meeting of the Iron and Steel Institute doubts were freely expressed as to the suitability of the choice. These doubts proved to be groundless, for the attendance of members was larger than usual, and visits to the Midland Railway works at Derby, the London and North-Western works at Crewe, and to the Staveley Iron Works afforded opportunities for instruction, while the beautiful weather conditions caused the Duke of Devonshire's garden-party at Chatsworth, and other excursions in Derbyshire, to be very successful and enjoyable functions.

From a scientific point of view, the paper which attracted the most attention was that on the theory of hardening carbon steels, by C. A. Edwards, of Manchester. As is well known, metallurgists have long been divided into two camps, the "carbonists" and the "allotropists," and at times much heat has been introduced into the discussions which have taken place. The position advocated by Mr. Edwards is to an extent an intermediate one, as it is based on the assumption of the existence of three allotropic forms of iron, known as α, β, and γ respectively. At the same time, the absolute necessity of carbon for true hardening is maintained. After a clear explanation of the elementary facts connected with the phase rule in its application to alloys in general, and particularly to the iron carbon series, the author concludes that the hardness of carbon steel is due to the retention, by quenching, of the solid solution of carbon, or carbide of iron, in γ iron, and that the β-iron theory, as applied to the explanation of the increased hardness of steel, is untenable. The solid solution of carbon or carbide in γ iron decomposes with slow rates of cooling, and some force must be applied to prevent inversion taking place. The force is mechanical, and is caused by the contraction of the outer shell. There is no constitutional difference between austenite and martensite, the apparent difference being due to the twinning of the γ solid solution as a result of the mechanical pressure.

In the discussion which followed the reading of this paper, Prof. Arnold warmly congratulated the author on his contribution, but contended that more facts were required before generalisations were accepted, and pointed out that the cooling curves as given by himself, and confirmed at Charlottenburg, did not agree with those published by Dr. Carpenter. The latter stated that the difference was not one of observation, but of methods of recording and of interpretation. Prof. Turner asked for evidence of twinning, and suggested that twinning in crystalline rocks or in the brasses was the result of annealing after pressure, but that in the hardening of steels there was no such annealing.

Two papers which also led to an interesting discussion were taken together, and dealt, *inter alia*, with the changes on the length of cast-iron bars when cooling in a sand mould. These papers were entitled "The Influence of Silicon on the Properties of Pure Cast Iron," by A. Hague and Prof. T. Turner, and "Manganese in Cast Iron, and the Volume Changes during Cooling," by H. I. Coe. It was pointed out that in Prof. Turner's original papers on silicon in cast iron, published in 1885, the materials used were relatively impure, and though the results have been confirmed by very extended practical application, it was thought well to start with the purest available materials and to observe the temperature and contraction changes and the microstructure, which had not been examined in the earlier tests. White iron, when free from elements other than carbon, shows only two slight arrests in the rate of contraction, and these correspond with the eutectic and the pearlite points respectively. On adding silicon or manganese, the iron, though still white, expands during and immediately after solidification. With more silicon the carbon is thrown out of solution, and a marked additional expansion occurs. Though much manganese tends to make iron white, about 0·5 per cent. of manganese, in presence of silicon, produces more secondary graphite, and thus lowers the combined carbon. In the manganese series of white iron the expansions form a regular curve with the percentages of manganese, and minima are found corresponding with the existence of four definite carbides. In the grey-iron series the expansions were relatively large, and the pearlite point disappeared suddenly with about 3·5 per cent. of manganese.

In the discussion references were made to the great detail involved in such an inquiry, and to the need of further work and generalisation. In a paper by S. Hilpert and E. Colver-Glauert, sulphurous acid was recommended as an etching agent for metallographic work. The acid is used as a saturated solution of sulphurous acid in water. It should be free from sulphuric acid, and should be diluted with water to about 3 or 4 per cent. of such acid. The time taken is said to vary from seven seconds to one minute. S. Hilpert, of Berlin, submitted a useful note on the preparation of magnetic oxides of iron from aqueous solutions, and stated that the production of Fe_3O_4 from aqueous solution is only possible through the precipitated FeO dissolving in the ammoniacal residue. The true magnetic oxide is Fe_2O_3 in the form of ferric ferrate, and the magnetic properties of Fe_3O_4 have their source in the acid properties of Fe_2O_3.

The remaining papers of a varied programme dealt with briquetting iron ores, electric power and electric steel refining, the Hanyang iron works in China, the production of rolled **H** beams, and experiments on fatigue in metals.

THE GEOLOGICAL CONGRESS AT STOCKHOLM.

The eleventh International Geological Congress in Stockholm from August 17–25 has been generally pronounced by the members to have been one of the most successful yet held. There was an attendance of about 900, including representatives of all European countries except Portugal, of Australia, China, and Japan, and a distinguished contingent from America. The excursions at this congress have been unusually various and instructive, and they were heartily enjoyed, thanks to their skilful organisation and management. Before the meeting there were excursions to Spitsbergen, Lapland, and central Sweden; during it to the Archæan areas and glacial deposits around Stockholm and Upsala, and to the classical Silurian sections at Gothland; and after it to the chief iron fields and areas of geological interest in southern Sweden. The library of guide-books issued for the excursions forms an invaluable summary of the field geology of Sweden. The Swedes as a people are characterised by the thoroughness of their work and the charm of their manners; the foreign visitors return impressed by the excellence of Swedish contributions to geology and with pleasant memories of the hospitable reception from all classes, from the gracious courtesy with which the King and Queen received us in the palace to the smiling welcome of the peasants in the field.

So much work was done at the congress that no adequate account of it can be given in a short notice. Five sections and various commissions and committees met simultaneously.[1] The discussions were sometimes not influential, for they often followed the reading of several disconnected papers, and many of the speeches were rather further contributions to the subject-matter than discussions of the papers that had been submitted.

The first formal meeting of the congress was held on August 18, when the honorary president, H.R.H. Prince Gustave Adolphe, welcomed the congress in a graceful speech, referring to the dependence of mining on geology and the increasing importance of science now that it is devoting more attention to practical questions. The King of Sweden then declared the congress open. Prof. de Geer was installed as president, and gave a lecture on "The Geochronology of the last 12,000 Years." He remarked the complete failure of previous attempts to measure geological time in years, and described his determination of the length of post-glacial time in the Stockholm district. He noticed there that the marine post-glacial clays

[1] For notes on some of the meetings the writer is indebted to Prof. Hobbs, Prof. Cole, and Dr. J. W. Evans.

had been deposited in regular layers, which differ in colour and composition; the same succession is repeated time after time, with layers of varying thickness. He early suspected that each cycle in this series might represent one year's deposition, the layers laid down in the summer being thicker, as the floods then carried most mineral matter to the sea, and being brown owing to oxidisation, the autumnal layers being thinner and also blacker, owing to the higher percentage of organic matter. Near Stockholm there are many small linear moraines, each line of which he thought might be the terminal moraine deposited in one year. After thirty years' work he has discovered, by the correlation of the evidence of the seasonally banded clays, of the northward advance of their successive layers as they followed the receding ice front, of the annual moraines, and of the annual delta deposits laid down at the mouths of glacial rivers, that the retreat of the ice from Scandinavia was more rapid and less ancient than had been thought. The ice covered the site of Stockholm only a few thousand years ago, and withdrew at the rate of 200 metres a year. The latter part of the lecture was abridged, but Prof. de Geer announced that at Ragunda he had found a section which showed the full sequence of clays, from a layer formed in 1796, through a succession of lake clays and a fjord clay, to the seasonally banded clays deposited along the front of the receding ice-sheet; and, according to his determination, the ice receded from Ragunda only 7000 years ago. Prof. de Geer concluded his lecture with expressions of hope that the application of his method would allow of positive proof whether the glaciations of Scandinavia, the British Isles, and North America were synchronous.

Prof. Van Hise then delivered a lecture on "The Influence of Applied Geology and the Mining Industry upon the Economic Development of the World." He confined his lecture to the conservation of natural resources, and considered mainly the cases of iron and coal, as the failure of other metals would involve only minor readjustments. The working of coal and iron on a large scale introduced the industrial revolution of the nineteenth century, and gave commercial supremacy to countries endowed with both minerals. A civilisation can exist without iron; but a man with a wooden plough could till only one-tenth as much as with an iron plough, and hence the exhaustion of iron would mean that countries would support much smaller populations. The supply of high-grade iron ores will not last long in the chief iron-producing countries, but the quantities of low-grade ores are so immense that the total failure of iron ores is practically out of the question. Moreover, much of the iron extracted is available for all time. The coal question is more serious, as fuel when burnt is gone for ever, and the supply is so limited that it cannot last indefinitely. At the present rates of consumption, the coal in Britain and Germany may last from 500 to 1000 years, and the United States has sufficient for 6000 years; but if the consumption continues to increase at its recent rate all the coal in seams that can be worked under existing conditions will be used in 150 years; within 100 years rising prices will force men to turn to other sources of power—natural gas, petroleum, tides, and the sea; these, though all possible sources of power, are too expensive. The only perennial source of cheap power is water. The industrial future lies with countries rich in iron ores and water-power. Scandinavia has both, and it is especially favoured, as its recent glaciation has left so many lake basins, which provide easy water storage and the uniform discharge most suitable for the production of power.

Prof. van Hise made an earnest appeal to men of science to ask how long our natural resources can last, and to protest against needless waste. Primitive man and any philosopher at the beginning of the nineteenth century would have felt confident that natural resources would last indefinitely. But it is now manifest that new principles must apply to the conservation of our mineral supplies, and it is our manifest duty to leave our descendants a fair share, so that they may enjoy the comfort and leisure necessary for the intellectual development by which they can attain the godlike destiny of man.

Iron Ore Supplies.

The question of the iron ore supplies of the world was subsequently considered in a conference opened by the Prime Minister of Sweden, M. Lindman, who declared the conservation of iron ores to be more necessary than of coal, as water supply offers a permanent source of power and heat. He stated the measures adopted by Sweden to limit the export of its high-grade ores; they appear to amount to the future nationalisation of the chief iron mines.

Prof. Sjögren regarded the iron ore reserves as practically inexhaustible, and he added some fresh data to those announced in the report on the iron ore reserves of the world. Estimates received from Mr. Inouye, of Japan, show that the reports as to the unlimited iron ores in China are without adequate foundation. According to Prof. Sjögren, the best idea as to the amount of ore available in the less known regions of the world can be learnt by multiplying the area by a factor obtained by dividing the ore reserves, actual and potential, of Europe, the United States, and Japan, by their total area. On that assumption the ore supply available is 425,000 million tons.

Prof. Beyschlag defended the estimates of German ore supplies prepared for the congress from some recent criticisms, and proposed a commission to secure official evidence as to the ore reserves of the United States and the chief iron-producing countries.

M. de Launay, on the other hand, issued a warning against a serious possible source of loss, which is often disregarded by the advocates of conservation. There are in Europe vast quantities of low-grade ores, distant from supplies of fuel or power, that could not be worked in competition with the high-grade ores of many countries not yet iron-producing. If the European low-grade ores are not used now, in fifty years' time they will probably be useless. M. de Launay claimed, therefore, that under such conditions the sound policy is to accelerate by all means the production of these ores.

Prof. J. F. Kemp also repudiated the fears of an iron famine. He predicted a diminished demand on iron ores, as we are now passing from the age of steel to the age of cement, and also further discoveries of ores, such as that in Cuba, which will probably lead to the establishment of large iron works on the Atlantic coast of America. He insisted that the critical point with iron is not the supply of ore, but the exhaustion of the coking coals. Even if all the heat be supplied by electricity, half a ton of coking coal will still be required for the reduction of a ton of ore.

The only speaker in the discussinn, Prof. J. W. Richards, of Lehigh, also agreed that the danger is with the coking coal, and he suggested a commission on the supplies of this material.

Glacial Erosion.

The first sectional discussion was on glacial erosion, under the chairmanship of M. de Margerie. Papers were contributed by Profs. Högbom, Penck, Davis and Reusch, and Dr. Nordenskjold, and in the discussion speeches were made by Profs. Wahnschaffe, Baltzer, Heim and Salomon, Dr. G. F. Becker, and Dr. Sederholm. Prof. Penck, in an eloquent summary of his paper, explained the evidence which has led him to attribute the main work in the formation of Alpine valleys to the action of ice. Prof. Davis insisted on the importance of the physiographic study of the question, and the comparison of never glaciated mountains, taken as the "norm" of mountain form, with those that have been glaciated: he advocated the formation of cirques by the "plucking" away of the rocks at the head of a valley, until the whole mountain ridge at the head of the valley may be torn away. Prof. Högbom, while advocating the erosive power of ice, remarked the difficulty of explaining some Swedish valleys that had been filled with ice, which had not removed their soft, pre-glacial deposits. Prof. Wahnschaffe referred to cases where ice had covered soft deposits, and had not even shifted boulders lying on them.

Prof. Reusch described the glaciated valleys near Christiania, which he thought were pre-glacial, and contrasted the effect of low-level ice in deepening and moulding valleys with the planing effect of high-level ice.' The powerful influence of pre-glacial structures in determining the course and character of ice-worn valleys was also maintained by Dr. Becker, who attributed the Yosemite and other valleys in the Sierra Nevada to the existence of a vast system of joints, the decomposed rocks along which have been removed by ice. Dr. Nordenskjold insisted that long straight valleys like fjords can only be due to ice erosion.

The adjourned discussion, with Prof. Wahnschaffe in the chair, was opened by Prof. Salomon, of Heidelberg, who remarked that erosion must take place where a glacier presses firmly on the ground; but we must wait for the ice to withdraw before we can study its effects, just as we have to wait for the dissection of a volcano before we can see what has been going on in the depths. He had seen cause to change his mind, and to accept the potency of glaciers as eroding agents, especially where the rock-structures lend themselves to "plucking." Joints in igneous rocks are not always evenly distributed, and thus one part of the same mass may show erosion while another resists. The suggestion of the action of freezing water in the rock-joints under a glacier deserves full consideration. Dr. von Dechy, from his studies in the Caucasus, urged that much seeming erosion was due to the clearing out of previously filled valley floors and of lake basins by glaciers, and by catastrophic glacier-slides. Prof. Wahnschaffe remarked that the Caucasian area was not comparable with that north of the Alps, since no great Piedmont glacier had formed north of the Caucasus. Prof. Heim, in a vigorous speech, said the rock-surfaces were palimpsests of river action and glacier action, and the work of each was thus obscured. While stream action concentrates itself in a portion of the valley floor, a glacier spreads too widely to compare with it in erosive power. So-called "plucked" masses had often merely fallen from above on to the ice, and had come out below. Glaciers have overriden Alpine landslides, but even then without carrying many blocks away. The broad, rounded form of glacier valley floors may even be due to the wandering of a previous stream from side to side within its valley walls. Then comes a glacier, and gives a final touch to the form, overriding the taluses of a previous age at either side.

Prof. Högbom, of Upsala, regarded the great chalk masses, said to have been moved in northern Germany and elsewhere by glacial erosion, as having been prepared by fractures. He compared a great glacier to the overthrust mass in mountain-building, and the ground moraine to the breccia along the thrust plane. Erosion must be greatest under the vertical nose of an advancing glacier, and not much under the glacier as a whole. Prof. E. Stolley, of Brunswick, said the German chalk masses represented genuine plucking and pushing forward. Lakes due to glacial erosion occur even in the North German plain. Prof. Reusch confessed, like Salomon, to having changed his mind. He answered an objection in Heim's speech by showing how a glacier must leave some upstanding masses in its floor, and cannot be expected to plane all equally away. Prof. Penck, on closing the discussion, accepted excavating action of subglacial streams, especially along valley sides, and urged that the only differences between Prof. Heim and himself were now really quantitative.

The Pre-Cambrian Fauna.

The discussion on the sudden appearance of the varied Cambrian fauna showed the firm belief in the evidence of pre-Cambrian life as contended by Prof. Barrois from the graphite of Brittany, by Dr. Sederholm from traces of pre-Cambrian fossils in Finland, and by Prof. Rothpletz from the oolitic pebbles and organic traces in the pre-Cambrian conglomerates of Sweden. The discussion showed a general agreement as to the influence of the absence of carnivorous organisms from the pre-Cambrian seas. Thus, according to Dr. J. W. Evans, creatures then had no need of defensive structures, and according to Dr. R. A. Daly there was, for the same reason, an accumulation of decomposing organic matter in the early seas, and the resultant ammonium carbonate led to the precipitation of the pre-Cambrian limestones; Profs. Sollas and Steinmann both thought that the early organisms had no hard parts, which developed as the organisms became more complex. Prof. Walther suggested that the pre-Cambrian sea consisted of isolated basins, the waters of which differed in chemical composition, and that organisms living in water rich in silica secreted siliceous skeletons, those in water rich in carbonate of lime formed calcareous shells; the phosphatic skeletons of trilobites and some brachiopods were due to life in a sea rich in phosphate, and chitinous shells were developed in fresh-water basins.

In the section on general and regional geology, Dr. Evans exhibited an elaborate and ingenious model to illustrate the movements along the line of the San Andreas fault during the recent Californian earthquake. It is constructed of two sets of flexible wooden strips held together by strings at their common edge; the one part was subjected to slow lateral stresses, and suddenly released from the strain by cutting the strings. Vibrations were thus set up, the amplitudes of which were greatest at the adjacent edges, and a musical note was produced through the friction of metal attachments. Dr. Evans believed the earthquake stresses to be of slow accumulation, the larger vibratory movements after release causing the sensible shocks, the frictional small tremors the sounds.

Prof. Hobbs gave a lecture on "The Fracture Systems of the Earth's Crust," and urged their international investigation, owing to their importance in relation to land sculpture, the course of rivers, the discovery of obscure faults, and earthquake disturbances. Prof. H. F. Reid discussed the results of a recent paper on the California earthquake, and exhibited a model similar in principle, but not in construction, to that of Dr. Evans. Dissent from his views as to the cause of the earthquake was expressed by Prof. Rothpletz, Dr. Oldham, and the chairman (Prof. Hobbs).

An important paper by Prof. Tarr on the advance of glaciers in Alaska as a result of earthquake shaking indicated how the sudden advance and equally sudden subsequent stagnation of many Alaskan glaciers might be accounted for by masses of snow being shaken from the névé regions during the heavy earthquake of 1899. In discussing this paper, Prof. Frech showed how the explanation offered would account for the hitherto inexplicable sudden advances of the glaciers of the Alps.

Dr. H. Stille described the earth movements in the later rocks of north-western Germany, and showed the influence of the Palæozoic areas of the Rhine and the Harz.

Pre-Cambrian Geology.

The petrographic section met on Saturday, in the morning under President van Hise, to consider the principles of pre-Cambrian geology and the cause of regional metamorphism, and in the afternoon under M. Barrois, to discuss pre-Cambrian stratigraphic classification. There were fourteen papers and many speeches. The general result of the morning's discussion was summarised at the close by Prof. Cole as showing the great advance in recent years of the views of Michel-Levy and Barrois as to the formation of crystalline schists by intense granitic injections, which in recent years had been supported by Sederholm in Finland and his own work in Donegal. These views were clearly expressed by a statement of the evidence from Brittany by Prof. Barrois. Prof. Adams opened the discussion by an account of the constant association with the crystalline schists of vast granitic batholites, to which he attributed the metamorphosis. Dr. Sederholm exhibited a map of a Finnish islet on the scale of one-twentieth of natural size, and he described the granitisation of the pre-Cambrian sediments by injection with granite when the adjacent rocks were half melted and plastic. On the other hand, attention was directed to intrusive gneisses elsewhere which had a less metamorphic effect. Thus Prof. U. Grubenmann, of Zurich, contrasted the actions of the gneisses of Scandinavia and Finland with those of the Alps, which had done less in melting the adjacent rocks, but had a greater pneumatolitic effect.

Prof. Coleman described the alteration of conglomerates at Sudbury, Ontario, into rocks that had been mapped as

Laurentian gneisses, and contrasted the slight metamorphism of the Lower Huronian conglomerates of Cobalt with their alteration into gneiss at Michipicoten by infolding with Keewatin batholites.

Dr. Lane stated the three possible sources of the gneissic rocks known as the Laurentian, and from a comparison of the size of their constituents with those of the adjacent rocks concluded that the Laurentians must be due to the ascent of deep-seated fluid material.

In the afternoon meeting various subdivisions of the pre-Cambrian rocks were advocated. Mr. W. G. Miller explained the classification used by the Geological Survey of Ontario, which adopts three main divisions: the Keweenawan for the upper sandstones, the Huronian for the underlying schists, quartzites, &c., and the Laurentian-Keewatin for the basal complex. Prof. Coleman objected to the retention of Laurentian except as a temporary convenience, since the Laurentian are intrusive rocks of various ages. Dr. Sederholm explained the classification he had adopted for Finland and Scandinavia, where the pre-Cambrian system is broken up by great unconformities into divisions, each of which he thought from its thickness must correspond to the groups, and not to the systems, of the post-Cambrian rocks. He objected to the terms previously used, and proposed to call the pre-Cambrian rocks the Progonozoic, and to divide them into three divisions, the Archeo-, Meso-, and Næo-progonozoic.

Another case of supposed Palæozoic schists proving to be pre-Cambrian was described by Prof. J. F. Kemp from evidence displayed during recent work for the New York water supply.

President van Hise supported the threefold division of the pre-Cambrians, and Mr. Fermor the twofold division found more convenient in India, and referred to Sir Thomas Holland's term Purana for the non-foliated pre-Cambrian sediments. Miss Raisin directed attention to the analogous case in the English Midlands, and to Lapworth's term Uriconian for the comparatively unaltered pre-Cambrian volcanic series.

The petrographic section, under the presidency of Dr. Teall, devoted a morning to discussion of the principles of rock classification. Prof. Adams exhibited photographs of the structures he had produced in rocks, including the formation of flaser gabbro or augen gneiss by pressure at temperatures of 450° F. No fresh minerals were produced, but by mechanical movements the material of a massive diabase was rearranged as a gneiss.

Prof. Vogt urged the claim of eutectics as a factor in rock classification. Dr. A. L. Day explained the aims and methods of the researches on mineral formation and stability conducted in the Carnegie Institute, and expressed confidence that their methods could in time be applied to even such complex mixtures as ordinary rocks.

Dr. Whitman Cross defended the quantitative system of rock classification from recent criticisms, and said that the other systems were only less arbitrary in the degree that they were less definite. He referred to Becke's petrographic types—the Atlantic and Pacific—as based on distinctions that could not be sharply defined. Dr. Evans repeated his criticisms on the quantitative system, and the general discussion was continued by Dr. Benett, Prof. Kœnigsberger, and Prof. Tschirwinsky.

Meetings of the other sections were devoted to tectonic geology, especially of Switzerland, to the causes of the Ice age, to polar geology, applied geology, stratigraphy, and palæontology.

At the final meeting it was decided that the next meeting, in 1913, should be in Canada, and the hope expressed that the meeting in 1916 should be in Belgium.

THE THOMAS YOUNG ORATION.

PROF. R. W. WOOD, in delivering the Thomas Young Oration at the Optical Society on Thursday, September 29, described some apparatus with which he has been experimenting recently. The first of these, which he calls the echelette grating, is an instrument occupying a position between the echelon and the ordinary diffraction grating. It is a grating ruled with a crystal of carborundum on gold deposited on copper; the carborundum has the advantage over a diamond point of having perfectly straight sides meeting at an angle of 120°. The spacing is about ten times as coarse as usual. No metal is removed in ruling, but the gold is compressed so as to form ridges and hollows. The sides of these ridges are highly polished and almost optically flat. Such a grating may have various faults, such as having a flat or irregular top to the ridges, or the sides of one groove may be deformed in ruling the next; tests to determine whether the grating is free from faults were described.

A variety of gratings is obtained by altering the position of the crystal in ruling; thus some gratings have their two sides equally inclined to the surface of the plate, and in others there are inequalities in the inclinations of various magnitudes. The gratings thus obtained, with a known form of groove, have been used to determine the causes which throw the greater part of the light of a definite wave-length into one particular spectrum. These gratings bear the same relation to heat waves that the ordinary diffraction grating bears to light waves; thus they are specially suitable for use in investigations into radiant energy, being many times more efficient than prisms of rock salt. Diagrams were shown which demonstrated the greater resolving power of the grating compared with the rock-salt prism. A number of gratings were exhibited, and some of the tests for detecting faults were shown. A demonstration was also given of the ability of these gratings to concentrate the light of a definite colour into a particular spectrum.

Prof. Wood next described his mercury telescope, in which the mirror is a vessel containing mercury, the surface of which is made to assume a steady parabolic form by rotation under gravity. The practical difficulties to be overcome in preventing ripples on the mercury surface due to vibration or to a very slight obliquity in the axis of rotation were described. The mercury vessel is mounted on an axis with two conical bearings, and the whole mount is placed on a stand with levelling screws. To avoid the excessive friction due to conical bearings, the greater part of the weight is taken by a steel ball under the centre of the objective. A magnetic drive was first attempted, but was abandoned in favour of a mechanical connection consisting of half a dozen fine threads of pure elastic, thus any vibrations in the motor are absorbed by the elastic threads. Some star trails taken with the instrument in and out of adjustment were described.

Finally, some photographs of landscapes taken with infra-red light were shown.

THE POLAR ESKIMOS.[1]

ANTHROPOLOGISTS are now beginning to realise the necessity of supplementing the methods of a general ethnographic survey by a more intensive study of smaller groups within limited areas. A good example of this class of investigation is provided by the account of the Polar Eskimos by Dr. H. P. Steensby, who was a member of the expedition commissioned by the Danish Missionary Society in 1909 to establish a station in Greenland.

The tribe known as the Polar Eskimos occupies the west side of the Hayes Peninsula, extending from north-west Greenland towards the west between the Kane Basin in the north and the Melville Sound in the south. At present they number about two hundred souls. Compared with the people of the more southerly west Greenland, they appear to be a different race, the Mongolian type prominent in the latter region being here replaced by that called by Dr. Steensby the Indian. The so-called Mongolian racial characters, the low nose, oblique eyes, flat face, broad and large cheek-bones, are more prominent in the women than in the men. The skull is of the dolichocephalic class. The skin has always a yellowish ground-colour, and the so-called "Mongolian spot" is present in the sacro-lumbar region of children.

Much of the existing culture of the tribe seems to be due to the emigration of a body of their kinsmen from the coasts of North Devon and Ellesmere Land in the early 'sixties, and they present the almost unique condi-

[1] "Contributions to the Ethnology and Anthropogeography of the Polar Eskimos." By Dr. H. P. Steensby. Pp. 253—406. (Copenhagen: Bianco Luno, 1910.)

tion that during the comparatively short period since they came under European observation they have risen from practically the lowest to a comparatively high stage of culture. Kane, who in the early 'fifties first described them, found that they possessed little iron or wood, using sledge-runners of bone and pieces of barrel-hoops as knives. They did not hunt the reindeer, and were ignorant of the use of the bow and arrow; they could not catch salmon, and did not use the kayak. These cultural deficiencies were certainly survivals of their primitive social condition. During the 'sixties, however, they learned from emigrants from the American side of Smith's Sound the art of reindeer hunting, the use of the bow and arrow, skill in salmon catching, and the mode of building kayaks and hunting from them. The leader of this party of foreigners, Kridlarssuark, has now become the legendary culture hero. Finally, in 1891, Peary began his intercourse with them, which enabled them to obtain in exchange for their fox and bear skins the finest American weapons, with the result that the rapid destruction of game will probably soon destroy their main source of livelihood. Even up to the time of Peary's first visit stone knives and axes were in use, and they used to make rude implements with cutting edges of meteoric iron, the source of which was discovered by Peary during a later expedition in 1894. Even now they make their harpoon points of iron with a head-piece of bone, and they work iron with much skill with the files they used for the older material.

A similar course of evolution may be traced in the construction of their houses. In their original home they must have used whale-ribs for the support of the roof. Wood of sufficient span being now not procurable, they have, while retaining the primitive plan, adopted a new device for supporting the roof, planned on the model of the cantilever.

With this modern and fairly advanced culture the Polar Eskimo combines many savage characteristics. He is, says Dr. Steensby, "a confirmed egoist, who knows nothing of disinterestedness. Towards his enemies he is crafty and deceitful; he does not attack them openly, but indulges in back-biting; he will not meet his deadly enemy face to face, but will shoot or harpoon him from behind." They practise a rude form of justice. One man, because he was a notorious liar, was summarily killed by two chiefs, one of whom annexed the wife of the deceased.

We have said enough to show the interest and value of this account of a little known tribe. It is illustrated by characteristic sketches, the work of an Eskimo woman, which in style closely resemble the Bushman drawings recently published under the editorship of Mr. H. Balfour.

THE BRITISH ASSOCIATION AT SHEFFIELD.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY PROF. A. B. MACALLUM, M.A., M.B., PH.D., SC.D., LL.D., F.R.S., PRESIDENT OF THE SECTION.

THE record of investigation of the phenomena of the life of animal and vegetable cells for the last eighty years constitutes a body of knowledge which is of imposing magnitude and of surpassing interest to all who are concerned in the studies that bear on the organic world. The results won during that period will always constitute, as they do now, a worthy memorial of the intense enthusiasm of the scientific spirit which has been a distinguishing feature of the last six decades of the nineteenth century. We are to-day, in consequence of that activity, at a point of view the attainment of which could not have been predicted half a century ago.

This body of knowledge, this lore which we call cytology, is still with all this achievement in one respect an undeveloped science. It is chiefly—nay, almost wholly—concerned with the structural or morphological side of the cell, while of the functional phenomena our knowledge is only of the most general kind, and the reason is not far to seek. What little we know of the physiological side of the cell—as, for example, of cellular secretion, absorption, and nutrition—has only to a very limited extent been the outcome of observations directed to that end. It is in very great part the result of all the inferences and generalisations drawn from the data of morphological research. This knowledge is not the less valuable or the less certain because it has been so won, but simply because of its source and of the method by which we have gained it; it is of a fragmentary character, and therefore less satisfactory in our estimation.

This state of our knowledge has affected—or, to express it more explicitly, has fashioned—our concept of living matter. When we think of the cell it is idealised as a morphological element only. The functional aspect is not ignored; but we know very little about it, and we veil our ignorance by classing its manifestations as vital phenomena.

It is true that in the last twenty years, and more particularly in the last ten, we have gathered something from biochemical research. We know much concerning ferment or catalytic action, of the physical characters of colloids, of the constitution of proteins, and their synthesis in the laboratory promises to be an achievement of the near future. We are also in a position to understand a little more clearly what happens in proteins when, on decomposition in the cell, they yield the waste products, urea, and other metabolites, with carbon dioxide and water. Further, fats can be formed in the laboratory from glycerine and fatty acids, a large number of which have also been synthesised, and a very large majority of the sugars of the aldohexose type have been built up from simpler compounds. These facts indicate that some of the results of the activity of animal and vegetable cells may be paralleled in the laboratory, but that is as far as the resemblance extends. The methods of the laboratory are not as yet those of nature. In the formation of carbohydrates, for example, the chlorophyll-holding cell makes use of processes of the most speedy and effective character, but nothing of these is known to us except that they are quite unlike the processes the laboratory employs in the artificial synthesis of carbohydrates. Nature works unerringly, unfalteringly, with an amazing economy of material and energy, while "our laboratory syntheses are but roundabout ways to the waste sink."

In consequence, it is customary to regard living matter as unique—*sui generis*, as it were, without an analogue or parallel in the inorganic world—and the secrets involved in its actions and activities as insoluble enigmas. Impelled by this view, there are those, also, who postulate as an explanation for all these manifestations the intervention in so-called living matter of a force otherwise and elsewhere unknown, biotic or vital, the action of which is directed, according to the character of the structure through which it operates, to the production of the phenomena in question. Living protoplasm is, in this view, but a mask and a medium for action of the unknown force.

This is an old doctrine, but it has again made headway in recent years owing to the reaction from the enthusiasm which came from the belief that the application of the known laws of physics and chemistry in the study of living matter would explain all its mysteries. A quarter of a century ago hopes were high that the solution of these problems would soon be found in a more profound comprehension of the laws of the physical world. Since then there has been an extraordinary increase in our knowledge of the structure and of the products of the activity of living matter without a corresponding increase in knowledge of the processes involved. The obscurity still involving the latter appears all the greater because of the high lights thrown on the former. Despair, in consequence, has taken the place of hope with some, and the action of a mysterious force is invoked to explain a mystery.

It may be admitted that our methods of investigation are very inadequate, and that our knowledge of the laws of matter, seemingly comprehensive, is not at present profound enough to enable us to solve all the problems involved in the vital phenomena. The greatest factor in the difficulty of their solution, however, has been the fact that there has been a great lack of investigators specially trained, not only in biology, but also in physics and chemistry, for the very purpose of attacking intelligently such problems. The biologists, for want of such a wide training, have emphasised the morphological aspect and the readily observable phenomena of living matter; while the physicist and chemist, knowing little of the morphology of the cell and of its vital manifestations, have been unable to apply satisfactorily the principles of their sciences to an understanding of its processes. The high degree of specialism which certain departments of biology has in recent years developed has made that difficulty greater than it was.

It must also be said that in some instances in which the physicist and chemist attempted to aid in the solution of biological problems the result, on the whole, has not been quite satisfactory. In, for example, the phenomena of osmosis, the application of Arrhenius's theory of ionisation and van 't Hoff's gas theory of solutions promised at first to explain all the processes and the results of diffusion through animal membranes. These theories were supported by such an array of facts from the side of physics and physical chemistry that there appeared to be no question whatever regarding their universal validity, and their application in the study of biological phenomena was urged with acclaim by physical chemists and eagerly welcomed by physiologists. The result in all cases was not what was expected. Diffusion of solutes, according to the theories, should, if the membrane is permeable to them, always be from the fluid where their concentration is high to that in which it is low. This appears to happen in a number of instances in the case of living membranes—or, at least, we may assume that it occurs—but in one signal instance, at least, the very reverse normally obtains. In the kidney, membranes formed of cells constituting the lining of the glomeruli and the renal tubules separate the urine, as it is being formed, from the blood plasma and the lymph circulating through the kidney. Though the excreted fluid is derived from the plasma and lymph, it is usually of much greater osmotic concentration than the latter.

It may be urged that this and other discrepancies are explained by the distribution (or partition) coefficient of the solutes responsible for the greater concentration of the product of excretion, these solutes being more soluble in the excreted medium than in the blood plasma, and distributing or diffusing themselves accordingly. If such a principle is applicable here as an explanation, it may be quite as much so in other physiological cases in which the results are supposedly due only to the forces postulated in the theories of van 't Hoff and Arrhenius. Whether this be so or not, the central fact remains that the enthusiastic hopes with which the theories were applied by physiologists and biologists in the explanation of certain vital phenomena have not been wholly realised.

The result has been a reaction amongst physiologists and biologists which has not been the least contributory of all the causes that have led to the present revival of vitalism.

Another difficulty in accounting for the vital phenomena has been due, until recently, to a lack of knowledge of the physical and chemical properties of colloids and colloidal "solutions." The importance of this knowledge consists in the fact that protoplasm, "the physical basis" of life, consists mainly of colloids and water. Until eleven years ago, what was known regarding colloids was derived chiefly from the researches of Graham (1851–62), Ljubavin (1889), Barus and Schneider (1891), and Linder and Picton (1892–7), who were the pioneers in this line. In 1899 were published the observations of Hardy, through whose investigations very great progress in our knowledge of colloids was made. In 1903 came the invention of the ultramicroscope by Siedentopf and Zsigmondy, by which the suspension character of colloid material in its so-called "solutions" was visually demonstrated. During the last seven years a host of workers have by their investigations greatly extended our knowledge of the physical and chemical properties of colloids, and now the science of Collochemistry bids fair, the more it develops, to play a very important part in all studies bearing on the constitution and properties of living matter.

Then, also, there are the phenomena of surface tension. This force, the nature of which was first indicated by Segner in 1751, and described with more detail by Young in 1804 and Laplace in 1806 in the expositions of their theories of capillarity, was first in 1869 only casually suggested as a factor in vital processes by Engelmann. Since the latter date and until 1892, when Bütschli published his observations on protoplasmic movement, no serious effort was made to utilise the principle of this force in the explanation of vital phenomena. Even to-day, when we know more of the laws of surface tension, it is only introduced as an incidental factor in speculations regarding the origin of protoplasmic movement and muscular contraction, and yet it is, as I shall maintain later on in this address, the most powerful, the most important of all the forces concerned in the life of animal and vegetable cells.

It may be gathered from all that I have advanced here that the chief defect in biological research has been, and is, the failure to apply thoroughly the laws of the physical world in the explanation of vital phenomena. Because of this too much emphasis is placed on the division that is made between the biological and the physical sciences. This division is very largely an artificial one, and it will in all probability be maintained eventually only as a convenience in the classification of the sciences. The biologist and physiologist have to deal with problems in which a wide range of knowledge is necessary for their adequate treatment; and, if the individual investigator has not a very extensive training in the physical sciences, it is impossible for him to have at his command all the facts bearing on the subject of his research, unless the problem involved be a very narrow one. The lack of this wide knowledge of the physical sciences tends to specialism, and, as the specialism is ever growing, it will produce a serious situation eventually, for it will develop a condition in the scientific world in which coordination of effort and a broad outlook will be much more difficult than is the case now.

This growing defect in the biological sciences can only be lessened by the insistence of those in charge of advanced courses in biological and physiological laboratories that only those whose training is of a very wide character should be allowed to take up research. It is, perhaps, futile to expect that such a rule will ever be enforced, for in the keen competition between universities for young teachers who have made some reputation for original investigation there may not be too close a scrutiny of the qualifications of those who offer themselves for post-graduate courses. There is, further, the difficulty that the heads of scientific departments are not desirous of limiting the output of new knowledge from their laboratories by insisting on the wider training for the men of science who are in the process of developing as students of research.

It is perhaps true, also, that there still remains a great deal unobserved or unrecorded in the fields of biology, physiology, and biochemistry, in the investigation of all of which a broad training is not specially required to give good service; and that, further, this condition will obtain for one or two decades still. It is quite as certain, however, that the returns from such service will tend to diminish in number and value, and, if the coming generation of workers is not recruited from a systematically and broadly trained class of students, a period of comparative sterility may supervene.

As it is to-day, there are few who devote themselves to the direct study of the chemical and physical properties of the cell, the fundamental unit of living matter. There are, of course, many who are concerned with the morphology of the cell, and who employ in their studies the methods of hardening and staining which have been of very great service in revealing the structural as well as the superficial chemical properties of the cell. On the facts so gained views are based which deal with the chemistry of the cell, and which are more or less widely accepted, but the results and generalisations drawn from them give us but little insight into the chemical constitution of the cell. We recognise in the morphologists' chromatin a substance which has only in a most general way an individuality, while the inclusions in the nucleus and the cytoplasm, on the distinction by staining of which great emphasis is laid, can only in a most superficial way be classified chemically.

The results of digestion experiments on the cell structures are also open to objection. The action of pepsin and hydrochloric acid must depend very largely on the accessibility of the material the character of which is to be determined. If there are membranes protecting cellular elements, pepsin, which is a colloid, if it diffuses at all, must in some cases, at least, penetrate them with difficulty. In Spirogyra, for example, the external membrane, formed of a thick layer of cellulose, is impermeable to pepsin, but not to the acid, and, in consequence, the changes which occur in it during peptic digestion are due to the acid alone. Even in the cell the periphery of which is not protected by a membrane, the insoluble colloid material at the surface serves as a barrier to the free entrance of the pepsin. It is, however, more particularly in the action on the nucleus and its contents that peptic digestion fails to give results which can be regarded as free from objection. Here is a membrane which during life serves to keep out of the nucleus, not only all inorganic salts, but also all organic compounds, except chiefly those of the class of nucleo-proteins. That such a membrane may, when the organism is dead, be permeable to pepsin is at least open to question, and in consequence what we see in the nucleus after the cell has been acted on by pepsin and hydrochloric acid cannot be adduced as evidence of its chemical or even of its morphological character.

The results of digestive experiments on cells are, therefore, misleading. What may from them appear as nucleo-protein may be anything but that, while, if the pepsin penetrates as readily as the acid, there should be left, not nucleo-protein, but pure nucleic acid, which should not stain at all.

The objections which I now urge against the conclusions drawn from the results of digestion experiments have developed out of my own observations on yeast cells, diatoms, Spirogyra, and especially the blue-green algæ. The latter are, as is Spirogyra, encased in a membrane which is an effective barrier to all colloids. When, therefore, threads of Oscillaria are subjected to the action of artificial gastric juice, a certain diminution in volume is observed owing to the dissolving power of the hydrochloric acid, and an alteration of the staining power of certain structures is found to obtain; but the pepsin has nothing to do with these, as may be determined by examination of control preparations treated with a solution of hydrochloric acid alone.

It is thus seen how slender is our knowledge of the chemistry of cells derived from staining methods and from digestion experiments. That, however, has not been the worst result of our confidence in our methods. It has led cytologists to rely on these methods alone, to leave undeveloped others which might have thrown great light on the chemical constitution of the cell, and which might have enabled us to understand a little more clearly the causation of some of the vital phenomena.

It was the futility of some of the old methods that led me, twenty years ago, to attack the chemistry of the cell from what appeared to me a correctly chemical point of view. It seemed to me then, and it appears as true now, that a diligent search for decisive chemical reactions would yield results of the very greatest importance. In the interval I have been able to accomplish only a small fraction of what I hoped to do, but I think the results have justified the view that, if there had been many investigators in this line instead of only a very few, the science of Cytochemistry would play a larger part in the solution of the problems of cell physiology than it does now.

The methods and the results are, as I have said, meagre, but they show distinctly indeed that the inorganic salts are not diffused uniformly throughout the cell, that in vegetable cells they are rigidly localised, while in animal cells, except those devoted to absorption and excretion, they are confined to specified areas in the cell. Their localisation, except in the case of inorganic salts of iron, is not due to the formation of precipitates, but rather to a condition which is the result of the action of surface tension. This seems to me to be the only explanation for the remarkable distribution, for example, of potash salts in vegetable cells. We know that, except in the chloroplatinate of potassium and in the hexanitrite of potassium, sodium and cobalt, potassium salts form no precipitates; and yet, in the cytoplasm of vegetable cells, the potassium is so localised at a few points as to appear at first as if it were in the form of a precipitate. In normal active cells of Spirogyra it is massed along the edge of the chromotophor, while in the mesophylic cells of leaves it is condensed in masses of the cytoplasm, which are by no means conspicuous in ordinary preparations of these cells.

This effect of surface tension in localising the distribution of inorganic salts at points in the cytoplasm would explain the distribution of potassium in motor structures. In striated muscle the element is abundant in amount, and is confined to the dim bands in the normal conditions. In Vorticella, apart from a minute quantity present at a point in the cytoplasm, it is found in very noticeable amounts in the contractile stalk, while in the holotrichate infusoria (Paramæcium) it is in very intimate association with the basal elements of the cilia in the ectosarc. This, indeed, would seem to indicate that the distribution of the potassium is closely associated with contraction, and, therefore, with the production of energy in contractile tissues. The condensation of potassium at a point may, of course, be a result of a combination with portions of the cytoplasm, but we have no knowledge of the occurrence of such compounds; and, further, the presence of such does not explain anything or account for the liberation of energy in motor contraction. On the other hand, the action of surface tension would explain, not only the localisation of the potassium, but also the liberation of the energy.

In vessels holding fluids, the latter, in relation to surface tension, have two surfaces, one free, in contact with the air, and known as the air-water surface, the other that in contact with the wall of the containing vessel (glass). In the latter the tension is lower than in the former. When an inorganic compound—a salt, for example—is dissolved in the fluid it increases the tension at the air-water surface, but its dilution is much greater here than in any other part of the fluid, while at the other surface its concentration is greatest. In the latter case the condition is of the nature of adsorption. The condensation on that portion of the surface where the tension is least is responsible for what we find when a solution of a coloured salt, as, *e.g.*, potassium permanganate, is driven through a layer of dry sand. If the latter is of some considerable thickness, the fluid as it passes out is colourless. The air-solution surface tension is higher than the tension of each of the solution-sand surfaces, on which, therefore, the permanganate condenses or is adsorbed. The same phenomenon is observed when a long strip of filter paper is allowed to hang with its lower end in contact with a moderately dilute solution of a copper salt. The solution is imbibed by the filter paper, and it ascends a certain distance in a couple of minutes, when it may be found that the uppermost portion of the moist area is free from even a trace of copper salt.

If, on the other hand, an organic compound—as, for instance, one of the bile salts—instead of an inorganic compound is dissolved in the fluid, the surface tension of the air-water surface is reduced, and in consequence the bile salt is concentrated at that surface, while in the remainder of the fluid, and particularly in that portion of it in contact with the wall of the vessel, the concentration is reduced.

The distribution of a salt in such a fluid, whether it lowers surface tension or increases it, is due to the action of a law which may be expressed in words to the effect that the concentration in a system is so adjusted as to reduce the energy at any point to a minimum.

Our knowledge of this action of inorganic and organic substances on the surface tension in a fluid, and of the differences in their concentrations throughout the latter, was contained in the results of the observations on gas mixtures by J. Willard Gibbs, published in 1878. The principle as applied to solutions was independently discovered by J. J. Thomson in 1887. It is known as the Gibbs' principle, although the current enunciations of it contain the more extended observations of Thomson. As formulated usually it is more briefly given, and its essential points may be rendered in the statement *that when a substance on solution in a fluid lowers the surface tension of the latter, the concentration of the solute is greater in the surface layer than elsewhere in the solution; but when the substance dissolved raises the surface tension of the fluid, the concentration of the solute is least in the surface layers of the solution.*

It is thus seen how in a system like that of a drop of water with different contact surfaces the surface tension is affected, and how this alters the distribution of solutes. It is further to be noted that for most organic solutes the action in this respect is the very reverse of that of inorganic salts. Consequently, in a living cell which contains both inorganic and organic solutes, and in which there are portions of different composition and density, the equilibrium may be subject to disturbance constantly through an alteration of the surface tension at any point. Such a disturbance may be found in a drop of an emulsion of olive oil and potassium carbonate in the well-known experiments of Bütschli. When the emulsion is appropriately prepared, a minute drop of it, after it is surrounded with water, will creep under the cover-glass in an amœboid fashion for hours, and the movement will be more marked and rapid when the temperature is raised to 40° to 50° C. All the phenomena manifested are due to a lowering of the surface tension at a point on the surface, as a result of which there is protrusion there of the contents of the drop, accompanied, Bütschli holds, by streaming cyclic currents in the remainder of the mass.

Surface tension also, according to J. Traube, is all-important in osmosis, and he holds that it is the solution pressure (*Haftdruck*) of a substance which determines the velocity of the osmotic movement and the direction and force of the osmotic pressure. The solution pressure of a substance is measured by the effect that substance exercises when dissolved on the surface tension of its solution, or, to put it in Traube's own way, the more a substance lowers or raises the surface tension of a solvent (water), the less or greater is the solution pressure (*Haftdruck*) of that substance. This solution pressure, Traube further holds, is the only force controlling osmosis through a membrane, and he rejects completely the bombardment effect on the septum postulated in the van 't Hoff theory of osmosis.

The question as to the nature of the factors concerned in osmosis must remain undecided until the facts have been more fully studied from the physiological point of view, but enough is now known to indicate that surface tension plays at least a part in it, and the omission of all consideration of it as a factor is not by any means a negligible defect in the van 't Hoff theory of osmosis.

The occurrence of variations in surface tension in the individual cells of an organ or tissue is difficult to demonstrate directly. We have no methods for that purpose, and, in consequence, one must depend on indirect ways to reveal whether such variations exist. The most effective of these is to determine the distribution of organic solutes and of inorganic salts in the cell. The demonstration of the former is at present difficult, or even in some cases impossible. The occurrence of soaps, which are amongst the most effective agents in lowering surface tension, may be revealed without difficulty microchemically, as may also neutral fats, but we have as yet no delicate microchemical tests for sugars, urea, and other nitrogenous metabolites, and in consequence the part they play, if any, in altering the surface tension in different kinds of cells, is unknown. Further research may, however, result in discovering methods of revealing their occurrence microchemically in the cell. We are in a like difficulty with regard to sodium, the distribution of which we can determine microchemically in its chief compounds, the chloride and phosphate, only after the exclusion of potassium, calcium, and magnesium. We have, on the other hand, very sensitive reactions for potassium, iron, calcium, haloid chlorine, and phosphoric acid, and with methods based on these reactions it is possible to localise the majority of the inorganic elements which occur in the living cell.

By the use of these methods we can indirectly determine the occurrence of differences in surface tension in a cell. This determination is based on the deduction from the Gibbs-Thomson principle that, where in a cell an inorganic element or compound is concentrated, the surface tension at the point is lower than it is elsewhere in the cell. If, for example, it is concentrated on one wall of a cell, the surface tension there is less than on the remaining surfaces or walls of the cell. The thickness of this layer must vary with the osmotic concentration in the cell, with the specific composition of the colloid material of the cytoplasm and with the activity of the cell, but it should not exceed a few hundredths of a milimetre (0·02–0·04 mm.), while it might be very much less in an animal cell the greatest diameter of which does not exceed 20 μ.

Numerous examples of such localisation may be observed in the confervoid protophyta. In Ulothrix, ordinarily, there is usually a remarkable condensation of the potassium at the ends of the cell on each transverse wall. The surface tension, on the basis of the deduction from the Gibbs-Thomson principle, should be, in all these cases, high on the lateral walls and low on those surfaces adjoining the transverse septa.

The use of this deduction may be extended. There are in cells various inclusions the composition of which gives them a different surface tension from that prevailing in the external limiting area of the cell. Further, the limiting portion of the cytoplasm in contact with these inclusions must have surface tension also. When, therefore, we find by microchemical means that a condensation of an inorganic element or compound obtains immediately within or without an inclusion, we may conclude that there, as compared with the external surface of the cell, the surface tension is low. It may be urged that the condensation is due to adsorption only; but this objection cannot hold, for in the Gibbs-Thomson phenomena the localisation of the solute at a part of the surface as the result of high tension elsewhere of the solution is, in all probability, due to adsorption, and is indeed so regarded.[1]

It is in this way that we can explain the remarkable localisation of potassium in the cytoplasm at the margins of the chromatophor in Spirogyra, and also the extraordinary quantities of potassium held in or on the inclusions in the mesophyllic cells of leaves. In infusoria (Vorticella, Paramœcium) the potassium present, apart from that in the stalk or ectosarc, is confined to one or more small granules or masses in the cytoplasm.

How important a factor this is in clearing the active portion of the cytoplasm of compounds which might hamper its action, a little consideration will show. In plants, very large quantities of salts are carried to the leaves by the sap from the roots, and among these salts those of potassium are the most abundant as a rule. Reaching the leaves, these salts do not return, and in consequence during the functional life of the leaves they accumulate in the mesophyllic cells in very large quantities, which, if they were not localised as described in the cell, would affect the whole cytoplasm and alter its action.

Enough has been advanced here to indicate that surface tension is not a minor feature in cell life. I would go even farther than this, and venture to say that the energy evolved in muscular contraction, that also involved in secretion and excretion, the force concerned in the phenomena of nuclear and cell division, and that force also engaged by the nerve cell in the production of a nerve impulse, are but manifestations of surface tension. On this view the living cell is but a machine, an engine, for transforming potential into kinetic and other forms of energy through or by changes in its surface energy.

To present an ample defence of all the parts of the thesis just advanced is more than I propose to do in this address. That would take more time than is customarily allowed on such an occasion, and I have, in consequence, decided to confine my observations to outlines of the points as specified.

It is not a new view that surface tension is the source of the muscular contraction. As already stated, the first to apply the explanation of this force as a factor in cellular movement was Engelmann in 1869, who advanced the view that those changes in shape of cells which are classed as contractile are all due to that force which is concerned in the rounding of a drop of fluid. The same view was expressed by Rindfleisch in 1880, and by Berthold

[1] See Freundlich, "Kapillarchemie," p. 50, 1909.

in 1886, who explained the protoplasmic streaming in cells as arising in local changes of surface tension between the fluid plasma and the cell sap, but he held that the movement and streaming of Amœbæ and Plasmodiæ are not to be referred to the same causes as operate in the protoplasmic streaming in plant cells. Quincke in 1888 applied the principle of surface tension in explaining all protoplasmic movement. In his view the force operates, as in the distribution of a drop of oil on water, in spreading protoplasm, which contains oils and soaps, over surfaces in which the tension is greater, and as soap is constantly being formed, the layer containing it, having a low tension on the surface in contact with water, will as constantly keep moving, and as a result pull the protoplasm with it. The movement of the latter thus generated will be continuous, and constitute protoplasmic streaming. In a similar way Bütschli explains the movement of a drop of soap emulsion, the layer of soap at a point on the surface of the spherule dissolving in the water and causing there a low tension and a streaming of the water from that point over the surface of the drop. This produces a corresponding movement in the drop at its periphery and a return central or axial stream directed to the point on the surface where the solution of the soap occurred and where now a protrusion of the mass takes place resembling a pseudopodium. In this manner, Bütschli holds, the contractile movements of Amœbæ are brought about. In these the chylema or fluid of the foam-like structure in the protoplasm is alkaline, it contains fatty acids, and, in consequence, soaps are present which, through rupture of the superficial vesicles of the foam-like structure at a point, are discharged on the free surface and produce there the diminution of surface tension that calls forth currents, internal and external, like those which occur in the case of the drop of oil emulsion.

The first to suggest that surface tension is a factor in muscular contraction was D'Arsonval, but it was Imbert who, in 1897, directly applied the principle in explanation of the contractility of smooth and striated muscle fibre. In his view the primary conditions are different in the former from what obtain in the latter. In smooth muscle fibre the extension is determined, not by any force inside it, but by external force such as may distend the organ (intestine, bladder, and arteries) in the wall of which it is found. The "stimulus" which causes the contraction increases the surface tension between the surface of the fibre and the surrounding fluid, and this of itself has the effect of making the fibre tend to become more spherical or shorter and thicker, which change in shape does occur during contraction. He did not, however, explain how the excitation altered the surface tension, except to say that its effect on surface tension is like that of electricity, with which the nerve impulse presents some analogy. In striated fibre, on the other hand, the discs constituting the light and dim bands have each a longitudinal diameter which is an effect of its surface tension, and this causes extension of the fibre during rest. When a nerve impulse reaches the fibre the surface tension of the discs is altered, and there results a deformation of each involving a shortening of its longitudinal axis, and thus a shortening of the whole fibre.

According to Bernstein, in both smooth and striated muscle fibre there is, in addition to surface tension, an elastic force residing in the material composing the fibre which, according to the conditions, sometimes opposes and sometimes assists the surface tension. The result is that in the muscle fibre at rest the surface must exceed somewhat that of the fibre in contraction. In both conditions the sum of the two forces, surface tension and elasticity, must be zero. In contraction the surface tension increases, and with it the elasticity also. Taken as a whole, this would not explain the large force generated in contraction, for the energy liberated would be the product of the surface tension and the amount representing the diminution of the surface due to the contraction. As the latter is very small the product is much below the amount of energy in the form of work done actually manifested. To get over this difficulty, Bernstein postulates that in muscle fibres, whether smooth or striated, there are fibrils surrounded by sarcoplasma, and that each fibril is formed of a number of cylinders or biaxial ellipsoids singly disposed in the course of the fibril, but separated from each other by elastic material and surrounded by sarcoplasma. Between the ellipsoids and the sarcoplasma there is considerable surface tension which prevents mixture of the substances constituting both. The excitation through the nerve impulse causes an increase of surface tension in these ellipsoids, and they become more spherical. In consequence, the decrease in surface of all the ellipsoids constituting a fibril is much greater than if the fibril were to be affected as an individual unit only by an increase of surface tension, and thus the surface energy developed would be correspondingly greater. The ellipsoids, Bernstein explains, are not to be confused with the discs, singly and doubly refractive in striated fibre; for these, he holds, are not concerned in the generation of the contraction, but with the processes that make for rapidity of contraction. The extension of a muscle after contraction is due to the elastic reaction of the substance between the ellipsoids in the fibrils. Bernstein further holds that fibrils of this character occur in the protoplasm of Amœbæ, in the stalk of Vorticella, and in the ectoplasma of Stentor, and this explains their contractility.

It may be said in criticism of Bernstein's view that his ellipsoids are from their very nature non-demonstrable structures, and, therefore, must always remain as postulated elements only. Further, it may be pointed out that he attributes too small a part to surface tension in the lengthening of the fibre after contraction, and that the elasticity which muscle appears to possess is, in the last analysis, but a result of its surface tension.

As regards Quincke's explanation of protoplasmic movement and streaming, as well as of muscular contraction, Bütschli has shown that it is based on a mistaken view of the structure of the cell in Chara and other plant forms in which protoplasmic streaming occurs. Bütschli's own hypothesis, however, is defective in that it postulates a current in the fluid medium just outside the Amœba and backward over its surface, the existence of which Berthold denies, and Bütschli himself has been unable to demonstrate, even with the aid of fine carmine powder in the fluid. He did, indeed, observe a streaming in the water about a creeping Pelomyxa, but the current was in the opposite direction to that demanded by his hypothesis. Further, his failure to demonstrate the occurrence of the postulated backflow in the water about the contracting or moving mass of an Amœba or a Pelomyxa makes it difficult to accept the hypothesis he advanced to explain that backflow, namely, that rupture of peripheral vesicles (*Waben*) of the protoplasm occurs with a consequent discharge of their contents (proteins, oils, and soaps) into the surrounding fluid. Surface tension, further, on this hypothesis, would be an uncertain and wasteful factor in the life of the cell. On *a priori* grounds, also, it would seem improbable that this force should be generated outside instead of inside the cell.

One common defect of all these views is that they made only a limited application of the principle of surface tension. This was because some of its phenomena were unknown, and especially those illustrating the Gibbs-Thomson principle. With its aid and with the knowledge of the distribution of inorganic constituents in animal and vegetable cells that microchemistry gives us we can make a more extended application of surface tension as a factor in cellular life than was possible ten years ago.

In regard to muscle fibre this is particularly true, and microchemistry has been of considerable service here. From the analyses of the inorganic constituents of striated muscle in vertebrates made by J. Katz and others we know that potassium is extraordinarily abundant therein, ranging from three and a half in the dog to more than fourteen times in the pike the amount of sodium present. How the potassium salt is distributed in the fibre was unknown before 1904, in which year, by the use of a method, which I had discovered, of demonstrating the potassium microchemically, the element was found localised in the dim bands. Later and more extended observations suggested that in the dim band itself, when the muscle fibre is at rest, the potassium is not uniformly distributed, and it was found to be the case in the wing muscles of certain of the Insecta—as, for example, the scavenger beetles—in which the bands are broad and conspicuous enough to permit ready observation on this score. In these the potassium salt was found to be localised in the zones of each dim band adjacent to each light band. Subsequently Miss M. L. Menten, working in my laboratory and using the same microchemical method, found the potassium similarly limited in its distribution in the muscle fibres of a number of other insects. She determined, also, that the chlorides and phosphates have a like distribution in these structures, and it is consequently probable that sodium, calcium, and magnesium have the same localisation.

Macdonald has also made investigations on the distribution of potassium in the muscle fibre of the frog, crab, and lobster, using for this purpose the hexanitrite reagent. He holds, as a result of his observations, that the element in the uncontracted fibril is limited to the sarcoplasm in the immediate neighbourhood of the singly refractive substance, while it is abundantly present in the central portion of each sarcomere of the contracted fibril—that is, in the doubly refractive material. I am not inclined to question the former point, as I have not investigated the microchemistry of the muscle in the crab and lobster, and my only criticism would be directed against placing too great reliance on the results obtained in the case of frog's muscle. The latter is only very slowly penetrated by the hexanitrite reagent, and, apparently because of this, alterations in the distribution of the salts occur; and, as I have observed, the potassium may be limited to the dim bands of one part of the contracted fibre and may be found in the light bands of another part of the same. In the wing muscles of insects in the uncontracted condition such disconcerting results are not so readily obtained, owing, it would seem, to the readiness with which the fibrils may be isolated and the almost immediate penetration of them by the reagent. Here there is no doubt about the occurrence of the element in the zones of the dim band immediately adjacent to the light bands.

Whether the potassium in the resting fibre is in the sarcoplasm or in the sarcostyle I would hesitate to say. It may be as Macdonald claims; but I find it difficult to apply in microchemical studies of muscle fibre the concepts of its more minute structure gained from merely stained preparations. Because of this difficulty I have refrained from using here, as localising designations, other expressions than "light bands" and "dim bands." The latter undoubtedly include some sarcoplasm, but in the case of the resting fibre I am certain only of the presence of potassium, as described, in the dim band regarded as an individual part, and not as a composite structure.

Now, on applying the Gibbs-Thomson principle enunciated above, this distribution would seem to indicate that in the dim band of a fibril the surface tension is greatest on its lateral walls, in consequence of which the potassium salts are concentrated in the vicinity of the remaining surfaces, *i.e.* those limiting the light bands. This explanation would seem to be confirmed by the observations I made on the contracted fibrils of the wing muscles of a scavenger beetle. In these the potassium was found uniformly distributed throughout each dim band, which, instead of being cylindrical in shape as in the resting element, is provided with a convexly curved lateral wall, and therefore with a smaller surface than the mass of the dim band has when at rest. This contour suggests that the surface tension on the lateral wall is lessened to an amount below that of either terminal surface, followed by a redistribution of the potassium salt to restore the equilibrium thus disturbed. The consequent shortening of the dim bands of the fibrils would account for the contraction of the muscle.

How the surface tension of the lateral wall of the dim band is lessened in contraction is a question which can only be answered after much more is known of the nature of the nerve impulse as it reaches the muscle fibril, and of the part played by the energy set free in the combustion process in the dim bands. It may be that electrical polarisation, as a result of the arrival of the nerve impulse, develops on the surface of the lateral wall, and as a consequence of which its surface tension is diminished. The energy so lost appears as work, and it is replaced by energy, one may suppose, derived from the combustion of the material in the dim band. In this case the disturbance of surface tension would be primary, while the combustion process would be secondary, in the order of time. In support of this explanation may be cited the fact that the current of action in muscle precedes in time the contraction itself—that is, the electrical response of the stimulus occurs in the latent period and immediately before the contraction begins.

It may, however, be postulated, on the other hand, that the chemical changes occur in those parts of the dim band immediately adjacent to the light bands, and as a result the tension of the terminal surfaces may be increased, this resulting in the shortening of the longitudinal axis of the dim band and the displacement laterally of the contents. This would imply that the energy of muscle contraction comes primarily from that set free in the combustion process, and not indirectly as involved in the former explanation.

Whatever may be the cause of the alteration in surface tension, there would seem to be no question of the latter. The very alteration in shape of the dim band in contraction makes it imperative to believe that surface tension is concerned. The redistribution of the potassium which takes place as described in the contracting fibrils of the wing muscles of the scavenger beetle can be explained in no other way than through the alteration of surface tension.

In the smooth muscle fibre potassium is also present and in close association throughout with the membrane. When a fresh preparation of smooth muscle is treated so as to demonstrate the presence of potassium, the latter is shown in the form of a granular precipitate of hexanitrite of sodium, potassium, and cobalt in the cement substance between the membranes of the fibres. In the smooth muscle fibres in the walls of the arteries in the frog the precipitate in the cement material is abundant, and its disposition suggests that it plays some part in the *rôle* of contraction. Inside of the membrane potassium occurs, but in very minute quantities, which, with the cobalt sulphide method, gives a just perceptible dark shade to the cytoplasm as a whole. Microchemical tests for the chlorides and phosphates indicate that the cytoplasm is almost wholly free from them, and consequently there is very little inorganic material inside of the fibre. Chlorides and phosphates, but more particularly the former, are abundant in the cement material, and their localisation here would seem to indicate that the potassium of the same distribution is combined chiefly as chloride.

In smooth muscle fibre, then, the potassium is distributed very differently from what it is in striated fibre, and on first thought it seemed difficult to postulate that the contraction could be due to alterations of surface tension. This, however, would appear to be the most feasible explanation, for the potassium salts in the cement substance might be supposed to shift their position under the influence of electrical force so as to reach the interior of the membranes of the fibres, in which case the surface tension of the latter would be immediately increased, and the fibre itself would in consequence at once begin to contract. The slowness with which this shifting into, or absorption by, the membrane of the potassium salts would take place would also account for the long latent period of contraction in smooth muscle.

It is of interest here to note that the potassium ions have the highest ionic mobility (transport number) of all the elements of the kationic class, except hydrogen, which are found to occur in connection with living matter. Its value in this respect is half again as great as that of sodium, one-eighth greater than that of calcium, and one-seventh greater than that of magnesium. This high migration velocity of potassium ions would make the element of special service in rapid changes of surface tension.

Loew has pointed out that potassium in the condensation processes of the synthesis of organic compounds has a catalytic value different from that of sodium. For example, ethyl aldehyde is condensed with potassium salts to aldol, with sodium salts to crotonic aldehyde (Kopf and Michael). Potassium is, but sodium is not, effective in the condensation of carbon monoxide. When phenol is fused with potassium salts condensation products like diphenol are produced, but when sodium salts are used the products are dioxybenzol and phloroglucin (Barth). It is, therefore, not improbable that potassium, along with those properties which come from its ionic mobility, has a special value in the metabolism of the dim bands of striated muscle fibre and in the condensation synthesis which characterise the chromatophors of protophyta (Spirogyra, Zygnema).

With the use of this method of determining differences in surface tension in cells it is possible, in some cases at least, to ascertain whether this force plays a part in both secretion and excretion, and evidence in favour of this view can be found in the pancreatic cells of the rabbit, guinea-pig, and in the renal cells of the frog. In the pancreatic cells there is an extraordinary condensation of potassium salts in the cytoplasm of each cell adjacent to the lumen of the tubule, and during all the phases of activity—except, it would appear, that of the co-called "resting stage"—potassium salts occur in, and are wholly confined to, this part of each cell. It is difficult to say whether they pass into the lumen with the secretion and their place taken by more from the blood-stream and lymph, but the important point is that the condensation of potassium salts immediately adjacent to the lumen seems to indicate a lessened surface tension on the lumen surface of the cell.

According to Stoklasa,[1] the pancreas of the pig is much richer in potassium than in sodium, the dried material containing 2·09 per cent. of potassium and 0·28 per cent. of sodium, while the values for the dried material of ox muscle are, as he determined them, 1·82 and 0·26 per cent. respectively. It is significant that in the pancreas this large amount of potassium should be localised as described.

In the renal cells of vertebrates there is usually a considerable amount of potassium salts distributed throughout the cytoplasm. These cells are always active in the elimination of the element from the blood, and it is in consequence not possible to determine whether there are differences in surface tension in them. Under certain conditions, however, these can be demonstrated. In the frogs which have been kept in the laboratory tanks throughout the winter, and in the blood of which the inorganic salts have been, because of the long period of inanition, reduced to almost hypotonic proportions, the renal cells are very largely free from potassium. When it is present it is usually diffused throughout the cytoplasm. If now a few cubic centimetres of a decinormal solution of potassium chloride be injected into the dorsal lymph sacs of one of these frogs, and after twenty minutes the animal is killed, appropriate treatment, with the cobalt reagent, of a thin section of the fresh kidney made by the carbon dioxide freezing method, reveals in the cells of certain of the tubules a condensation of potassium salts in the cytoplasm immediately adjacent to the wall of the lumen. There is also a very slight diffuse reaction throughout the remainder of the cytoplasm, except in that part immediately adjacent to the external boundary of the tubule. In these cells the potassium injected into the lymph circulation is being excreted, and the condensation of the element at or near the surface of the lumen is evidence that there the tension is less than at the other extremity of the cell.

These facts are in their significance in line with some observations that I have made on the absorption of soluble salts by the intestinal mucosa in the guinea-pig. When the "peptonate" of iron was administered in the food of the animal it was not unusual to find that in the epithelial cells of the villi the iron salt was distributed through the cytoplasm, but its concentration, as a rule, was greatest in the cytoplasm adjacent to the inner surface of the cell, from which it diffused into the underlying tissue. Here also, inferentially, surface tension is lower than elsewhere in the cell.

It would perhaps be unwise to form final conclusions at this stage in the progress of the investigation of the subject, but the results so far gained tempt one to adopt as a working hypothesis *that in the secreting or the excreting cell lower surface tension exists at its secreting or excreting surface than at any other point on the cell surface.* How this low surface tension is caused or maintained it is impossible to say, but, whatever the solution of the question may be, it is important to note that we must postulate the participation of this force in renal excretion in order to explain the formation of urines of high concentration. These have a high osmotic pressure, as measured by the depression of the freezing point, while the osmotic pressure of the blood plasma determined in the same way is low. On the principle of osmosis alone, as it is currently understood, this result is inexplicable, for the kinetic energy, as required in the gas theory of solutions, should not be greater, though it might be less, in the urine than in the blood. It is manifest that in the formation of concentrated urines energy is expended. We know also from the investigations of Barcroft and Brodie that the kidney during diuresis absorbs much more oxygen per gram weight than the body generally, and that, assuming it is used in the combustion of a proteid, a very large amount of energy is set free, very much more, indeed, than is necessary. It has also been observed that a portion of the energy set free is found in a higher temperature in the excretion than obtains in the blood itself circulating through the kidney. This large expenditure of energy is, probably, a result of the physiological adaptation of the principle of the "factor of safety," which, as Meltzer has pointed out, occurs in other organs of the body.

In cell and nuclear division surface tension operates as a force, the action of which cannot be completely understood until we know more of the part played by the centrosomes and centrosphere. That this force takes part in cell reproduction has already been suggested by Brailsford Robertson. He has devised an ingenious experiment to illustrate its action. If a thread moistened with a solution of a base is laid across a drop of oil in which is dissolved some free fatty acid, the drop divides along the line of the thread. When the latter is moistened with soap the drop divides in the same way and in the same plane. The soap formed in one case and present in the other, it is explained, lowers the surface tension in the equatorial plane of the drop, and this diminution results in streaming movement away from that plane which bring about the division. He suggests that in cell division there is a liberation of soaps in the plane of division which set up streaming movements from that plane towards the poles, and terminating in the division of the cytoplasm of the cell.

I have observed in the cells of Zygnema about to divide a remarkable condensation of potassium in the plane of division. In the "resting" cell of this Alga the potassium is, as a rule, more abundant in the cytoplasm near the transverse walls of the thread, and only traces of the element are to be found along the line of future division of the cell. But immediately after division has taken place the potassium is concentrated in the plane of division. This would seem to indicate that surface tension in the plane of division is, as postulated by the deduction from the Gibbs-Thomson principle, lower than it is on the longitudinal surface, and lower, especially, than it is on the previously formed transverse septa of the thread.

One must not, however, draw from this the conclusion that in all dividing cells surface tension is lower in the plane of division than it is elsewhere on the surface of the dividing structure. All that it means is that in the dividing cell of Zygnema the condition already exists along the plane of division, which subsequently makes for low surface tension in the cell membrane immediately adjacent to each transverse septum in the confervoid thread. If the evidence of low surface tension vanished immediately after division was complete, then it might be held that it determined the division. As it is, the low surface tension in this case is the result, and not the cause, of the division.

This conclusion is corroborated by the results of observations on the cells of the ovules of Lilium and Tulipa. The potassium salts in these are found condensed in minute masses throughout the cytoplasm. When division is about to begin the salts are shifted to the peripheral zone of the cytoplasm, and when the nuclear membrane disappears not a trace of potassium is now

[1] Stoklasa gave the values in K_2O and Na_2O.

found in the neighbourhood of the free chromosomes, a condition which continues until after nuclear division is complete. The absence of potassium, the most abundant basic element in the cytoplasm, would indicate that soaps are not present, and appropriate treatment of such cells, hardened in formaline only, with scarlet red demonstrates that fats, including lecithins, are absent also. This would seem to show that high instead of low surface tension prevails about the nucleus during division. During the "resting" condition of the nucleus this high tension is maintained, for, except in very rare cases, and these of doubtful character, there is no condensation of inorganic salts in the neighbourhood or on the surface of the nuclear membrane. It is also to be noted that the nucleus, with exceptions, the majority of which are found in the Protozoa, is of spherical shape, which also postulates that high surface tension obtains either in the cytoplasmic layer about the nucleus or in the nuclear membrane itself. It may also be suggested that high surface tension, and not the physical impermeability of the nuclear membrane, is the reason why the nucleus is, as I have often stated, wholly free from inorganic constituents.

It does not follow from all this that surface tension has nothing to do with cell division. If, as Brailsford Robertson holds, surface tension is lowered in the plane of division, then the internal streaming movement of the cytoplasm of each half of the cell should be towards that plane, and, in consequence, not separation, but fusion of the two halves would result. The lipoids and soaps would, indeed, spread superficially on the two parts from the equatorial plane towards the two poles, and, according to the Gibbs-Thomson principle, they would not distribute themselves through the cytoplasm in the plane of division, except as a result of the formation of a septum in that plane. In other words, the septum has first to exist in order to allow the soaps and lipoids to distribute themselves in a streaming movement over its two faces. In Brailsford Robertson's experiment this septum is provided in the thread. If, on the other hand, surface tension is higher about the nucleus in and immediately adjacent to the future plane of division, then constriction of the nucleus in that plane will take place accompanied or preceded by an internal streaming movement in each half towards its pole, and a consequent traction effect on the chromosomes which are thus removed from the equatorial plane. When nuclear division is complete, then a higher surface tension on the cell itself limited to the plane of division would bring about there a separation of the two halves, a consequent condensation on each side of that plane of the substances producing the low tension elsewhere, and thereby also the formation of the two membranes in that plane.

In support of this explanation of the action of surface tension as a factor in division I have endeavoured to ascertain if, as a result of the Gibbs-Thomson principle, there is a condensation of potassium salts in the cytoplasm at the poles of a dividing cell, that is, where surface tension, according to my view, is low. The difficulty one meets here is that, in the higher plant forms, cells preparing to divide appear to be much less rich in potassium than those in the "resting" stage, and under this condition it is not easy to get unambiguous results, while in animal cells potassium may even in the resting cell be very minute in quantity, as, for example, in Vorticella, in which, apart from the contractile stalk, it is limited to one or two minute flecks in the cytoplasm. Instances of potassium-holding cells undergoing division are, however, found in the spermatogonia of higher vertebrates (rabbit, guinea-pig), and in these the potassium is gathered in the form of a minute and thin cap-like layer at each pole of the dividing cell.

This of itself would appear to show that surface tension is less in the neighbourhood of the poles than at the equator of the dividing cell; but I am not inclined to regard the fact as conclusive, and a very large number of observations to that end must be made before certainty can be attained. I am, nevertheless, convinced that it is only in this way that we can finally determine whether differences of surface tension in dividing cells account, as I believe they do, for all the phenomena of cell division. The difficulties to be encountered in such an investigation are, as experience has shown me, much greater than are to be overcome in efforts to study surface tension in cells under other conditions, but I am in hopes that what I am now advancing will influence a number of workers to take up research in microchemistry along this line.

I must now discuss surface tension in nerve cells and nerve fibres. I have stated earlier in this address that I hold that the force concerned in the production of the nerve impulse by the nerve cell is surface tension. The very fact that in the repair of a divided nerve fibre the renewal of the peripheral portion of the axon occurs through a movement—a flowing outward, as it were—of the soft colloid material from the central portion of the divided fibre is, in itself, a strong indication that surface tension is low here and high on the cell body itself. This fact does not stand alone. I pointed out six years ago that potassium salt is abundant along the course of the axon and apparently on its exterior surface, while it is present but in traces in the nerve cell itself. In the latter chlorides also are present only in traces, and therefore sodium, if present, is there in more minute quantities, while haloid chlorine is abundant in the axon. Macdonald has also made observations as to the occurrence of potassium along the course of the axon, and has in the main confirmed mine. We differ only as to mode of the distribution of the element in the axon, and the manner in which it is held in the substance of the latter; but, whichever of the two views may be correct, it does not affect what I am now advancing. Extensive condensation or adsorption of potassium salts in or along the course of the axon, while the nerve cell itself is very largely free from them, can have but one explanation on the basis of the Gibbs-Thomson principle, and that explanation is that surface tension on the nerve cell itself must be high while it is low on or in its axon.

The conclusions that follow from this are not far to seek. We know that an electrical displacement or disturbance of ever so slight a character occurring at a point on the surface of a drop lowers correspondingly the surface tension at that point. What a nerve impulse fundamentally involves we are not certain, but we do know that it is always accompanied by, if not constituted of, a change of electrical potential, which is as rapidly transmitted as is the impulse. When this change of potential is transmitted along an axon through its synaptic terminals to another cell, the surface tension of the latter must be lowered to a degree corresponding to the magnitude of the electrical disturbance produced, and, in consequence, a slight displacement of the potassium ions would occur at each point in succession along the course of its axon. This displacement of the ions as it proceeded would produce a change of electrical potential, and thus account for the current of action. The displacement of the ions in the axon would last as long as the alteration of surface tension which gave rise to it, and this would comprehend not more than a very minute fraction of a second. Consequently, many such variations in the surface tension of the body of the nerve cell would occur in a second; and, as the physical change concerned would involve only the very surface layer of the cell, a minimum of fatigue would result in the cell, while little or none would develop in the axon.

It may be pointed out that in medullated nerve fibres the lipoid-holding sheath, in close contact as it is with the axon, must of necessity maintain on the course of the latter a surface tension low as compared with that on the nerve cell itself, which, as the synaptic relations of other nerve cells with it postulate, is not closely invested with an enveloping membrane. In non-medullated nerve fibres the simple enveloping sheath may function in the same manner, and probably, if it is not rich in lipoid material, in a less marked degree.

What further is involved in all this, what other conclusions follow from these observations, I must leave unexplained. It suffices that I have indicated the main points of the subject, the philosophical significance of which will appear to those who will pursue it beyond the point where I leave it.

In bringing this address to a close, I am well aware of the fact that my treatment of the subjects discussed has not been as adequate as their character would warrant.

The position which I occupy imposes limits, and there enters also the personal factor to account in part for the failure to achieve the result at which I aimed. But there is, besides, the idea that in applying the laws of surface tension in the explanation of vital phenomena I am proceeding along a path into the unknown which has been as yet only in a most general way marked out by pioneer investigators, and in consequence, to avoid mistakes, I have been constrained to exercise caution, and to repress the desire to make larger ventures from the imperfectly beaten main road. Perhaps, after all, I may have fallen into error, and I must therefore be prepared to recall or to revise some of the views which I have advanced here should they ultimately be found wanting. That, however, as I reassure myself, is the true attitude to take. It is a far cry to certainty. As Duclaux has aptly put it, the reason why Science advances is that it is never sure of anything. Thus I justify my effort of to-day.

Notwithstanding this inadequate treatment of the subject of surface tension in relation to cellular processes, I hope I have made it in some measure clear that the same force which shapes the raindrop is an all-important factor in the causation of vital phenomena. Some of the latter may not thereby be explained. We do not as yet know all that is concerned in the physical state of solutions. The fact, ascertained by Rona and Michaelis, that certain sugars, which neither lower nor appreciably raise surface tension in their solutions, condense or are adsorbed on the surface of a solution system, is an indication that there are at least some problems with a bearing on vital phenomena yet to solve. Nevertheless, what we have gained from our knowledge of the laws of surface tension constitutes a distinct step in advance, and a more extended application of the Gibbs-Thomson principle may throw light on the causation of other vital phenomena. To that end a greatly developed science of microchemistry is necessary. This should supply the stimulus to enthusiasm in the search for reactions that will enable us to locate with great precision in the living cell the constituents, inorganic and organic, which affect its physical state and thereby influence its activity.

Literature.

Barcroft and Brodie, *Journ. of Physiol.*, vol. xxxii., p. 18; vol. xxxiii., p. 52.

Bernstein, *Arch. fur die ges. Physiol.*, vol. lxxxv., p. 271.

Berthold, "Studien über Protoplasmamechanik," Leipzig, 1886.

Bütschli, "Untersuchungen über Mikroskopische Schäume," Leipzig, 1892.

Engelmann, *Arch. fur die ges. Physiol.*, vol. ii., 1869.

Willard Gibbs, Trans. Conn. Acad. of Sciences, 1878; also "Thermodynamische Studien," Leipzig, 1892, p. 321.

Imbert, *Arch. de Physiol.*, 5ième ser., vol. ix., p. 289.

A. B. Macallum, *Journ. of Physiol.*, vol. xxxii., p. 95, 1905.

M. L. Menten, Trans. Canadian Inst., vol. viii., 1908; also "University of Toronto Studies," Physiological Series No. 7.

J. S. Macdonald, Proc. Roy. Soc., B, vol. lxxvi., p. 322, 1905; also *Quart. Journ. of Exp. Physiol.*, vol. ii., No. 1, 1909.

Quincke, *Ann. der Physik und Chemie*, N.F. vol. xxxv., p. 580, 1888.

T. Brailsford Robertson, Bull. Physiol. Laboratory, University of California, 1909.

J. Stoklasa, *Zeit. fur physiol. Chem.*, vol. lxii., p. 47.

J. J. Thomson, "Application of Dynamics to Physics and Chemistry," 1888.

J. Traube, *Arch. fur die ges. Physiol.*, vols. c. and cxxiii.

SECTION K.

BOTANY.

Opening Address by Prof. James W. H. Trail, M.A., M.D., F.R.S., President of the Section.

The honour conferred in the election to be President for the year of the Botanical Section of the British Association imposes the duty of preparing an address. I trust that my selection of a subject will not be attributed by anyone to a want of appreciation of the worth and importance of certain sides of botanical research to which I shall have less occasion to refer. These have been eloquently supported by former Presidents, and I take this opportunity to express the thanks I owe for the benefit received from their contributions to the advancement of the science of botany. They have told us of the advance in departments of which they could speak as leaders in research, and I do not venture to follow in their steps. My subject is from a field in which I have often experienced the hindrances of which I shall have to speak, both in personal work and still more as a teacher of students, familiar with the many difficulties that impede the path of those who would gladly give of their best, but find the difficulties for a time almost insurmountable, and who are too frequently unable to spare the time or labour to allow of their undertaking scientific investigations that they might well accomplish, and in which they would find keen pleasure under other conditions. Those whose tastes lie in the direction of studying plants in the field rather than in the laboratory are apt to find themselves hampered seriously if they seek to become acquainted with the plants of their own vicinity; and, if they wish to undertake investigations in the hope of doing what they can to advance botanical science, they may find it scarcely possible to ascertain what has been already done and recorded by others.

For a time the knowledge of plants was too much confined to the ability to name them according to the system in vogue and to a knowledge of their uses, real or imagined. The undue importance attached to this side of the study, even by so great a leader as Linnæus, naturally led to a reaction as the value of other aspects of botany came to be realised, and as improvements in the instruments and methods of research opened up new fields of study. The science has gained much by the reaction; but there is danger of swinging to the other extreme and of failing to recognise the need to become well acquainted with plants in their natural surroundings. The opportunities for study in the laboratory are so great and so much more under control, and the materials are so abundant and of so much interest, that there is for many botanists a temptation to limit themselves to such work, or at least to regard work in the field as subordinate to it and of little value. It is scarcely necessary to point out that each side is insufficient alone. Yet some find more pleasure in the one side, and do well to make it their chief study; while they should recognise the value of the other also, and learn from it.

It is especially on behalf of the work in the field that I now wish to plead. There are few paths more likely to prove attractive to most students. The study of the plants in their natural environments will lead to an understanding of their nature as living beings, of their relations to one another and to other environments, of the stimuli to which they respond, and of the struggle for existence that results in the survival of certain forms and the disappearance of others. In this way also will be gained a conception of the true meaning and place of classification as an indispensable instrument for accurate determination and record, and not as an end in itself. To one that has once gained a true insight into the pleasure and worth of such studies, collections made for the sake of mere possession or lists of species discovered in a locality will not suffice. Many questions will arise which will prove a constant source of new interest. From such studies a deep and growing love for botany has in not a few cases arisen.

The British flora has interested me for upwards of forty years, and has occupied much of my attention during that time—not only as desirous to aid by my own efforts to extend our knowledge of it, but also, as a teacher, seeking to assist my students to become able to do their parts also, and making use of the materials within reach to enable me to help them. Thus our present knowledge of the plants of our own country has become known to me, and the difficulties of acquiring that knowledge have also become known through both my own experience and those of my students. The nature of the hindrances and difficulties that at present bar the way has also become familiar, as well as the steps to be taken to clear some of them away and to make the path less difficult to those who come after us; and I have also gained a fairly good acquaintance with the means at the command of students of the floras of other countries, so as to have a standard for comparison in the estimate to be formed of the condition of matters in our own country.

In how far is the present provision for the study of the flora of the British Islands sufficient and satisfactory?

I venture to hope that the subject will be regarded as among those for the consideration of which the British Association was formed, and that a favourable view will be taken of the conclusions which I take this opportunity to lay before you. What, then, is the present provision for the study of our plants? Since the days of Morrison and Ray there have been many workers, especially during the past century; and an extensive literature has grown up, in the form both of books and of papers, the latter more or less comprehensive, in the scientific journals and in the transactions of societies. These papers contain much that is of great value; but, owing to the absence of any classified index, most of the information in it is beyond the reach of anyone, except at the expenditure of much time and labour. The constantly increasing accumulation of new publications makes the need for a classified index always more urgent; for the mass of literature is at present one of the greatest obstacles to the undertaking of new investigations, because of the uncertainty whether they may not have been already undertaken and overlooked through want of time or opportunity to search the mass exhaustively.

While the early writers of descriptive floras sought to include every species of plant known to occur in Britain, this has not been attempted during the past seventy or eighty years, and instead of one great work we now have monographs of the greater groups, such as Babington's "Manual" and Hooker's "Student's Flora" of the vascular plants, Braithwaite's "Mossflora," &c. Local floras still, in a good many cases, aim at including all plants known to grow apparently wild in the districts to which they refer; but they are often little more than lists of species and varieties and of localities in which these have been found. In some, however, there are descriptions of new forms and notes of general value, which are apt to be overlooked because of the place in which they appear.

The early works were necessarily not critical in their treatment of closely allied species and varieties, but they are valuable as giving evidence of what plants were supposed to be native in England when they were published. Even the works that were issued after Linnæus had established the binominal nomenclature for a time related almost wholly to England. Sibbald in "Scotia Illustrata" (1684) enumerated the plants believed by him to be native in Scotland, and of those then cultivated. Between his book and Lightfoot's "Flora Scotia," published in 1777, very little relating to the flora of Scotland appeared. Irish plants were still later in being carefully studied.

The floras of Hudson, Withering, Lightfoot, and Smith, all of which include all species of known British plants, follow the Linnæan classification and nomenclature in so far as the authors were able to identify the Linnæan species in the British flora. "English Botany," begun in 1795, with plates by Sowerby and text by Smith, was a work of the first rank in its aim of figuring all British plants and in the excellence of the plates; but it shared the defect of certain other great floras in the plates being prepared and issued as the plants could be procured, and thus being without order. Its cost also necessarily put it beyond the reach of most botanists, except those that had the advantage of access to it in some large library. A second edition, issued at a lower price, and with the plants arranged on the Linnæan system, was inferior to the first, in the plates being only partially coloured and in having the text much curtailed. The so-called third edition of the "English Botany," issued 1868–86, is a new work so far as the text is concerned, that being the work of Dr. Boswell Syme, who made it worthily representative of its subject; but the plates, with few exceptions, are reissues of those of the first edition, less perfect as impressions and far less carefully coloured; and this applies with still greater force to a reissue of the third edition a few years ago. This edition, moreover, included only the vascular plants and Characeæ. As this is the only large and fully illustrated British flora that has been attempted, it is almost needless to add that in this respect provision for the study of the flora of our islands is far behind that of certain other countries, and very notably behind that made in the "Flora danica."

Turning next to the provision of less costly aids to the study of British plants, we have manuals of most of the larger groups. The vascular plants are treated of in numerous works, including a considerable number of illustrated books in recent years, inexpensive but insufficient for any but the most elementary students. Fitch's outline illustrations to Bentham's "Handbook to the British Flora," supplemented by W. G. Smith, were issued in a separate volume in 1887, which is still the best for use in the inexpensive works of this kind. Babington's "Manual," on its first appearance in 1843, was gladly welcomed as embodying the result of careful and continued researches by its author into the relations of British plants to their nearest relatives on the Continent of Europe; and each successive issue up to the eighth in 1881 received the careful revision of the author, and contained additions and modifications. In 1904 a ninth edition was edited, after the author's death, by H. and J. Groves; but, though the editors included notes left by Prof. Babington prepared for a new edition, they were "unable to make alterations in the treatment of some of the critical genera which might perhaps have been desirable." The "Student's Flora of the British Islands," by Sir J. D. Hooker, issued in 1870, took the place of the well-known "British Flora" (1830, and in subsequent editions until the eighth in 1860, the last three being issued in collaboration by Sir W. J. Hooker and Prof. Walker-Arnott). The third edition of the "Student's Flora" appeared in 1884, and there has been none since. Mr. F. N. Williams's "Prodromus Floræ Britannicæ," begun in 1901, of which less than one-half has yet appeared, though a work of much value and authority, is scarcely calculated for the assistance of the ordinary student; and Mr. Druce's new edition of Hayward's "Botanist's Pocket Book" "is intended merely to enable the botanist in the field to name his specimens approximately, and to refresh the memory of the more advanced worker." In all the books that are intended for the use of British botanists, apart from one or two recently issued local floras, the classification is still that in use in the middle of last century, even to the extent in the most of them of retaining Coniferæ as a division of Dicotyledones. Apart from this, the critical study of British plants has led to the detection of numerous previously unobserved and unnamed forms, which find no place in the "Student's Flora," and are only in part noticed in the recent edition of the "Manual."

The "Lists" of vascular plants of the British flora that have recently been issued by Messrs. Rendle and Britten, by Mr. Druce, and as the tenth edition of the "London Catalogue of British Plants," are all important documents for the study of the British flora; but they illustrate very forcibly certain of the difficulties that beset the path of the student eager to gain a knowledge of the plants of his native land. In these lists he finds it scarcely possible to gain a clear idea of how far the species and varieties of the one correspond with those of the other, owing to the diversities of the names employed. It would be a great boon to others, as well as to students, were a full synonymic list prepared to show clearly the equivalence of the names where those for the same species or variety differ in the different lists and manuals. Probably in time an agreement will be generally arrived at regarding the names to be accepted, but that desirable consummation seems hardly yet in sight. Meantime, the most useful step seems to be to show in how far there is agreement in fact under the different names.

Among the Cryptogams certain groups have fared better than the higher plants as regards both their later treatment and their more adequate illustration by modern methods and standards. Several works of great value have dealt with the mosses, the latest being Braithwaite's "British Moss-flora," completed in 1899. The Sphagna were also treated by Braithwaite in 1880, and are to be the subject of a monograph in the Ray Society's series. The liverworts have been the subject also of several monographs, of which Pearson's is the fullest.

Among the Thallophyta, certain groups have been more satisfactorily treated than others—*e.g.* the Discomycetes, the Uredineæ and Ustilagineæ, the Myxomycetes, and certain others among the fungi, and the Desmidiaceæ among the algæ; but the Thallophyta as a whole are much in need of thorough revision to place them on a footing either satisfactory or comparable to their treatment in other countries.

Of the Thallophyta, many more of the smaller species will probably be discovered within our islands when close search is made, if we may judge by the much more numerous forms already recorded in certain groups abroad, and which almost certainly exist here also; but among the higher plants it is not likely that many additional species will be discovered as native, yet even among these some will probably be found. It is, however, rather in the direction of fuller investigation of the distribution and tendencies to variation within our islands that results of interest are likely to be obtained.

The labours of H. C. Watson gave a very great stimulus to the study of the distribution of the flora in England and Scotland, and the work he set on foot has been taken up and much extended by numerous botanists in all parts of the British Islands. It is largely owing to such work and to the critical study of the flora necessary for its prosecution that so many additions have been made to the forms previously known as British. Many local works have been issued in recent years, often of a very high standard of excellence. Besides these larger works, scientific periodicals and transactions of field clubs and other societies teem with records, some of them very brief, while others are of such size and compass that they might have been issued as separate books. A few of both the books and papers are little more than mere lists of names of species and varieties observed in a locality during a brief visit; but usually there is an attempt at least to distinguish the native or well-established aliens from the mere casuals, if these are mentioned at all. In respect of aliens or plants that owe their presence in a district to man's aid, intentional or involuntary, their treatment is on no settled basis. Every flora admits without question species that are certainly of alien origin, even such weeds of cultivated ground as disappear when cultivation is given up, as may be verified in too many localities in some parts of our country. Yet other species are not admitted, though they may be met with here and there well established, and at least as likely to perpetuate their species in the new home as are some native species.

Comparatively few writers seek to analyse the floras of the districts treated of with a view to determine whence each species came and how, its relation to man, whether assisted by him in its arrival directly or indirectly, whether favoured or harmfully affected by him, its relations to its environment—especially to other species of plants and to animals, and other questions that suggest themselves when such inquiries are entered on. It is very desirable that a careful and exhaustive revision of the British flora should be made on these and similar lines. In such a revision it is not less desirable that each species should be represented by a good series of specimens, and that these should be compared with similar series from other localities within our islands, and from those countries from which it is believed that the species originally was sprung. Such careful comparison would probably supply important evidence of forms being evolved in the new environments, differing to a recognisable degree from the ancestral types, and tending to become more marked in the more distant and longer isolated localities. An excellent example of this is afforded by the productive results of the very careful investigation of the Shetland flora by the late Mr. W. H. Beeby.

Within recent years excellent work has been done in the study of plant associations, but the reports on these studies are dispersed in various journals (often not botanical), and are apt to be overlooked by, or to remain unknown to, many to whom they would be helpful. The same is true in large measure of the very valuable reports of work done on plant-remains from peat-mosses, from lake deposits, and from other recent geological formations, researches that have cast such light on the past history of many species as British plants, and have proved their long abode in this country. Mr. Clement Reid's "Origin of the British Flora," though published in 1899, has already (by the work of himself and others) been largely added to, and the rate of progress is likely to become still more rapid. Among the fruits and seeds recorded from inter-glacial and even from pre-glacial deposits are some the presence of which could scarcely have been anticipated, *e.g.* *Hypecoum procumbens*, in Suffolk. Some of the colonists, or aliens now almost confined to ground under cultivation, have been recorded from deposits that suggest an early immigration into the British Islands. While much remains to be discovered, it is desirable that what is already established should find a place in the manuals of British botany.

Apart from the descriptive and topographical works and papers on our flora, there is a serious lack of information gained from the study of our British plants. Although a few types have received fuller study, we have little to compare with the work done in other countries on the structure and histology of our plants, on the effects of environment, on their relations to other species and to animals, and on other aspects of the science to which attention should be directed. On these matters, as on a good many others, we gain most of what information can be had, not from British sources, but from the literature of other countries, though it is not wise to assume that what is true elsewhere is equally true here. It is as well, perhaps, that for the present such subjects should find scanty reference in the manuals in ordinary use; but, when trustworthy information has been gained within the British Islands, under the conditions prevailing here, these topics should certainly not be passed over in silence. Students of the British flora have as yet no such works of reference as Raunkjaer's book on the Monocotyledons of Denmark or the admirable "Lebensgeschichte der Blütenpflanzen Mitteleuropas," at present being issued by Drs. Kirchner, Loew, and Schröter.

In a complete survey of the British botany there must be included the successive floras of the earlier geological formations, though they cannot as yet be brought into correlation with the recent or existing floras. In the brilliant progress made recently in this field of study our country and the British Association are worthily represented.

The present provision for the study of the British flora and the means that should be made use of for its extension appear to be these:—

Much excellent work has already been accomplished and put on record towards the investigation of the flora, but much of that store of information is in danger of being overlooked and forgotten or lost, owing to the absence of means to direct attention to where it may be found. A careful revision of what has been done and a systematic subject-index to its stores are urgently required.

The systematic works treating of the flora are in great part not fully representative of the knowledge already possessed, and require to be brought up to date or to be replaced by others.

Great difficulty is caused by the absence of an authoritative synonymic list that would show so far as possible the equivalence of the names employed in the various manuals and lists. There is much reason to wish that uniformity in the use of names of species and varieties should be arrived at, and a representative committee might assist to that end; but, in the meantime, a good synonymic list would be a most helpful step towards relieving a very pressing obstacle to progress.

There is need for a careful analysis of the flora with the view of determining those species that owe their presence here to man's aid, intentional or unconscious; and the inquiry should be directed to ascertain the periods and methods of introduction, any tendencies to become modified in their new homes, their subsequent relations with man, and their influence on the native flora, whether direct or by modifying habitats, as shown by *Lupinus nootkatensis* in the valleys of rivers in Scotland.

Those species that there is reason to regard as not having been introduced by man should be investigated as regards their probable origins and the periods and methods of immigration, evidence from fossil deposits of the period during which they have existed in this country, their constancy or liability to show change during this period, their resemblance to or differences from the types in the countries from which they are believed to have been derived, or the likelihood of their having originated by mutation or by slow change within the British Islands, and their relation to man's influence on them (usually harmful, but occasionally helpful) as affecting their distribution and permanence.

The topographical distribution, though so much has been done in this field during the past sixty or seventy years, still requires careful investigation to determine, not merely that species have been observed in certain districts, but their relative frequency, their relations to man (natives of one part of our country are often aliens in other parts), whether increasing or diminishing, altitudes, habitats, &c. From such a careful topographical survey much should be learned of the conditions that favour or hinder the success of species, of the evolution of new forms and their relation to parent types in distribution, especially in the more isolated districts and islands, and of other biological problems of great interest. A most useful aid towards the preparation of topographical records would be afforded by the issue at a small price of outline maps, so as to allow of a separate map being employed for recording the distribution of each form.

A careful study of the flora is also required from the point of view of structure and development, with comparison of the results obtained here with those of workers in other countries where the same or closely allied species and varieties occur. It is also needed in respect of the relations between the plants and animals of our islands, both as observed here and in comparison with the already extensive records of a similar kind in other countries. On such topics as pollination, distribution of seeds, and injuries inflicted by animals and galls produced by animals or plants we have still to make use very largely of the information gained abroad; and the same holds good with regard to the diseases of plants.

While "English Botany" in its first edition was deservedly regarded as a work of the first rank among floras, it has long been defective as representing our present knowledge of British plants, and it has not been succeeded by any work of nearly equal rank, while other countries now have their great floras of a type in advance of it. There is need for a great work worthy of our country, amply illustrated so as to show, not only the habit of the species and varieties, but also the distinctive characters and the more important biological features of each. Such a flora would probably require to be in the form of monographs by specialists, issued as each could be prepared, but as part of a well-planned whole. It should give for each plant far more than is contained in even the best of our existing British floras. Means of identification must be provided in the description, with emphasised diagnostic characters; but there should also be the necessary synonymy, a summary of topographical distribution, notes on man's influence upon distribution, abundance, &c., on any biological or other point of interest in structure or relations to habitat, environment, associated animals or plants, diseases, &c. Local names, uses, and folklore should also be included; and for this the need is all the greater, because much of such old lore is rapidly being forgotten and tends to be lost. In a national flora there should be included an account of the successive floras of former periods, and, so far as possible, the changes that can be traced in the existing flora from its earliest records to the time of issue should be recorded.

A flora of this kind would not only afford the fullest possible information with regard to the plant world of the British Islands at the date of issue, but would form a standard with which it could be compared at later periods, so as to permit of changes in it being recognised and measured. In the meanwhile, the production of such a flora can be regarded only as an aim towards which to press on, but which cannot be attained until much has been done. But while the fulfilment must be left to others, we can do something to help it on by trying to remove difficulties from the way, and to bring together materials that may be used in its construction.

I have sought to direct attention to the difficulties that I have experienced and to directions in which progress could be made at once, and to provision which should be made for the advancement of the study of the British flora with as little delay as possible. There is, I feel assured, the means of making far more rapid and satisfactory progress towards the goal than has yet been accomplished. Many persons are interested in the subject, and would gladly give their aid if they knew in what way to employ it to the best purpose. As a nation we are apt to trust to individual rather than to combined efforts, and to waste much time and labour in consequence, with discouragement of many who would gladly share the labour in a scheme in which definite parts of the work could be undertaken by them.

I believe that a well-organised botanical survey of the British Islands would give results of great scientific value, and that there is need for it. I believe, also, that means exist to permit of its being carried through. There is no ground to expect that it will be undertaken on the same terms as the Geological Survey. A biological survey must be accomplished by voluntary effort, with possibly some help towards meeting necessary expenses of equipment from funds which are available for assistance in scientific research. Is such a survey not an object fully in accord with the objects for which the British Association exists? In the belief that it is so, I ask you to consider whether such a survey should not be undertaken; and, if you approve the proposal, I further ask that a committee be appointed to report on what steps should be taken towards organising such a survey, and preparing materials for a national flora of the British Islands.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—On Saturday last, October 1, Dr. Mason, the outgoing Vice-Chancellor, announced in his valedictory address to the Senate two munificent benefactions which have recently been offered to the University. The Drapers' Company, which has already done so much for the Agricultural School, has offered a sum of 22,000*l.* towards the cost of erecting a new physiological laboratory on the Downing site, and a further sum of 1000*l.* for fittings. The proposed new laboratory for psychophysics, the cost of which has been collected by Dr. C. S. Myers, will, it is hoped, be erected in the close neighbourhood of the proposed building for physiology.

Since the foundation of the Schröder chair for German, the Cambridge Association has been turning its attention to the further endowment of the teaching of English. Through the instrumentality of Lord Esher, one of their members, Sir Harold Harmsworth became interested in the project, and he has very generously offered to endow a chair of English language and literature by presenting the University with 20,000*l.* The professor is to be called the King Edward VII. professor, and will be elected by the Crown.

The next combined examination for sixty-seven entrance scholarships and a large number of exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 6, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Forms of application for admission to the examination may be obtained at the respective colleges.

THE Child Study Society has arranged a number of lectures and discussions on the recreational activities of children, to be delivered at the Royal Sanitary Institute between now and Christmas. The programme includes the following subjects:—October 13: Some first results of an investigation into the play interests of English elementary-school children, Miss Alice Ravenhill; October 27: games and toys for children under eight, Miss Clara E. Grant; November 3: story of some children's games, Mrs. Lawrence Gomme; November 17: the origin of certain games and toys, Dr. A. C. Haddon, F.R.S.; November 24: philosophy of boys' games, Mr. Felix Clay; December 1: the child's inheritance, Dr. C. W. Saleeby.

The sixty-second session of the Bedford College for Women begins to-day. The college was founded in 1849 by Mrs. Elizabeth Jesser Reid, with the intention of offering to women the opportunity of a liberal education in the higher branches of knowledge. The number of students has increased steadily. We notice from the current calendar of the college that in 1889 the number of students was 145, in 1899 226, and in 1909 357. It will be remembered that the institution is now one of the constituent colleges of the University of London, and prepares its students for degrees in arts, science, and medicine. It is hoped that the new buildings of the college at York Gate, Regent's Park—which will provide accommodation for from 400 to 500 students, with residence for about a quarter of the number—will be ready for occupation in 1912.

The new chemical and physiological laboratories for the University of Bristol are now complete, and were opened for students this week. The formal opening will take place on November 15 by Lord Winterstoke, Chancellor of the University. The new chemical department consists of thirty rooms and laboratories, and contains working places for two hundred students. The main laboratory is capable of accommodating eighty students working at one time. The laboratories have been wired for electrical experiments and so on, and heavy currents from the city supply are available for electro-metallurgical and physico-chemical investigations. Smaller laboratories, specially designed and equipped for physical, organic, biological, and photographic chemistry, have been provided. The department of physiology is arranged to accommodate fifty students. The main lecture theatre has seats for about 120, and is served by a preparation room, store, and museum, all on the same floor. Chemical physiology is taught in a special laboratory. Optical work, photography, and gas analysis are allotted a fine room, to which is attached a well-ventilated dark-room of ample size. Experimental physiology has its own laboratory, and histology is housed in one of the finest rooms in the building, with north light, weaving-shed roof, and a gallery over. There is also a demonstration theatre, built on the model of the operating theatre of a hospital. Research is amply provided for: there is a room for the preparation of electrometer and other records by photography, and a fine suite of rooms apart from the teaching laboratories. Incubator room, constant temperature room, and cold store are also provided. Altogether, between twenty and thirty rooms are comprised in the department, and they are thoroughly convenient and up-to-date. It is noteworthy that nearly 50,000*l*. has been expended on these additions.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 26.—M. Bouchard in the chair.—The president announced the death of Mme. Pasteur.—M. **Darboux** presented vol. xiv. of the *Travaux et Mémoires du Bureau international*, containing a full account of the measurements of the exact volume of the kilogram of water. Three different methods have been employed, and the mean of the closely concordant results gives 1·000027 cubic decimetres as the volume of the kilogram of water at 4° C. and under normal atmospheric pressure.—A. **Laveran**: The treatment of different trypanosomiases by arsenic and antimony emetic. The compound used was obtained in large crystals by crystallising together under certain conditions aniline-arsenyl-tartrate and aniline-antimonyl-tartrate. Details of the methods and dosage are given. Fifteen guinea-pigs infected with *T. evansi*, *T. gambiense*, *T. dimorphon*, or by *T. congolense* were cured. In four of these cases there was a relapse, which was cured by a second treatment. The possibilities of application to the human subject are discussed.—R. **Bourgeois**: The comparison of two astronomical pendulums with the aid of electrical signals transmitted by a submarine cable of great length. A Thomson siphon recorder was modified in a manner to suit this work. The method will be used to determine the difference of time between Brest and Dakar, a distance of about 4500 kilometres.—A. **Demoulin**: The families of Lamé composed of surfaces possessing singular points.—Gaston **Darboux**: Remarks on the preceding communication.—Carl **Störmer**: The canonical forms of the general equations of motion of a particle in a magnetic field and an electric field superposed.—H. **Truc** and C. **Fleig**: Experimental ocular action of the dust on tarred roads. Dust from tarred roads is shown experimentally to be capable of provoking much more serious eye troubles than dust from untreated roads, and the smaller the lapse of time since the road has been tarred the more serious are the lesions produced.—H. **Guillemard** and G. **Regnier**: Observations on animal calorimetry made on Mt. Blanc. Increase of altitude has no sensible effect on the body temperature, but there is a marked increase in the amount of heat evolved by the body as the altitude increases, amounting to more than 30 per cent. between Chamonix and the summit of Mt. Blanc. A discussion of the results leads to the conclusion that protection against the cold is the best way of combating mountain sickness.—Charles **Nicolle** and E. **Conseil**: Properties of the serum of convalescents and animals cured of exanthematic typhus. Serum collected from the ninth to the fourteenth day of convalescence has well-marked preventive and curative properties against the disease. The curative effects disappear if the serum is collected later.—Joseph **Roussel**: The mode of formation of tricalcium phosphate in Algeria and Tunis.

CONTENTS.

PAGE
The Mammals of Manitoba. By R. L. 423
The Care of Trees 423
The Making of Beet-sugar. By C. S. 424
Methods of Rock-analysis. By A. H. 425
New Geographical Books. By B. C. W. 426
Our Book Shelf 427
Letters to the Editor:—
The Fur Trade.—Prof. T. D. A. Cockerell 428
An Attempt to Determine the Supposed Change in Weight Accompanying the Radio-active Disintegration of Radium.—Dr. Bertram D. Steele . . 428
The Habits and Distribution of Scutigera in India.—A. D. Imms 429
Fire Tests with Textiles.—Leonard Parry 429
Customs at Holy Wells.—Zorah Godden 429
A Meteorological Phenomenon.—Rev. R. Ashington Bullen 429
Radium Standards and Nomenclature.—Prof. E. Rutherford, F.R.S. 430
Heredity at the Church Congress 431
Cocos-Keeling Atoll. (*Illustrated.*) 432
Researches in Stellar Parallax. By W. E. P. . . 433
The Perfilograph. By A. M. F. 434
Notes 435
Our Astronomical Column:—
Astronomical Occurrences in October 438
A Bright Meteor 438
Rediscovery of Brooks's Periodical Comet (1889 V.), 1910*d* 438
The Luminosity of Comets 439
Coloured Stars between the Pole and 60° N. Declination 439
Observations of the Companion of Sirius 439
The Perseid Shower, 1910 439
A Modified Method for Nadir Observations . . . 439
A New Micrometer 439
The Mean Parallax of Tenth-magnitude Stars . . . 439
Halley Meteors 439
The Autumn Meeting of the Iron and Steel Institute 440
The Geological Congress at Stockholm . . . 440
The Thomas Young Oration 443
The Polar Eskimos 443
The British Association at Sheffield.
Section I.—Physiology.—Opening Address by Prof. A. B. Macallum, M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., President of the Section . 444
Section K.—Botany.—Opening Address by Prof. James W. H. Trail, M.A., M.D., F.R.S., President of the Section 452
University and Educational Intelligence 455
Societies and Academies 456

THURSDAY, OCTOBER 13, 1910.

THE HISTORY OF PHYSICS.

Geschichtstafeln der Physik. By Prof. Felix Auerbach. Pp. v + 150. (Leipzig: J. Ambr. Barth, 1910.) 4 mk.

PROF. AUERBACH has embodied in this little book of 150 pages upon the chief discoveries in physics the result of notes made during many years for his personal use, in preparation for lectures. It consists of three parts: part i. (110 pages) is a chronological list of the main steps in the development of physics, with the year and the name of the discoverer, but without citing either the authority or the reference by which the discovery is fixed, and extending down to the year 1900. Part ii. (17 pages), a list of selected works, monographs, treatises, and text-books, with their authors, also to the year 1900. Part iii. (5 pages) is a selected list of leading physicists, except those still living, with their years of birth and death. There is also an alphabetical index of names.

Doubtless such a list will be found convenient for reference—much more convenient, for example, than Darmstaedter's recent "Handbuch zur Geschichte der Naturwissenschaften und der Technik," which is a more ambitious work It also covers the ground much more fully than Prof. Lehfeldt's list published in 1894 by the Physical Society.

A good idea of its nature and scope will be gathered by the following selection of the entries about the successive steps in photography.

1311, Camera obscura; Levi ben Gerson.
1505, Improved camera obscura; Lionardo da Vinci.
1556, Blackening of silver chloride by sunlight; Fabricius.
1558, Improved camera obscura; Porta.
1728, Action of light on silver compounds; J. H. Schulze.
1757, Copying of silhouettes on silver chloride paper; Beccaria.
1777, Photochemical reduction of silver; Scheele.
1777, Violet rays are photographically most active; Scheele.
1782, Colour sensitiveness of the silver compounds; Senebier.
1801, The strongest chemical action lies in the ultra-violet; Ritter.
1802, Production of light-images on silver chloride paper in the camera obscura; Davy.
1802, Photographic silver nitrate silhouettes; Wedgewood.
1810, Photochemical production of colours by coloured illumination; Seebeck.
1816, First permanent and printable photographic plates; Niepce.
1826, Discovery of silver bromide and its sensitiveness to light; Balard.
1833, Invention of the actinometer; Herschel.
1837, Production of the first plates with silver iodide, and developed by mercury vapour; Daguerre.
1838, Achromatic landscape-lens; Chevalier.
1839, Production of the first negatives copyable upon paper; Talbot.
1840, Foundation of microphotography; Donné.
1840, Portrait-objective for photography; Petzval.
1842, First useful photographs of the solar spectrum; E. Becquerel and Draper.
1842, Printing-out process with iron salts; Herschel.
1843, Discovery of gold-toning of photograms; Fizeau.
1847, First photographs on albuminised plates; Niepce de St. Victor.
1850, Introduction of gelatine into photography; Poitevin.
1851, Wet collodion process for photography; Archer.
1852, Chrome-gelatine process for photography; Talbot.
&c., &c., &c.

The subsequent steps are narrated in similar detail; but, strangely enough, the name of Sir Joseph Swan is entirely omitted from the list. Similar lists might be adduced in every branch of physics. As might be expected from Prof. Auerbach, the list in acoustics is particularly complete, while those in optics and in magnetism are scarcely less so.

The omission of all references to authorities renders criticism difficult; because the critic, even where he is fairly certain that some error exists, has no means of learning what the compiler of the list relies upon for his statement. Thus the author credits Wilcke, in 1757, with the introduction of the conception of electric resistance; he attributes to Scoresby, in 1827, the discovery of the destruction of magnetism by glowing heat; he credits to Hankel, in 1848, the suggestion of the hot-wire galvanometer. One would wish to know the authorities for these statements. There are several inexplicable omissions: Du Bois Reymond's discovery of non-polarisable electrodes is not mentioned; Shelford Bidwell and George F. FitzGerald are unknown to the author as having achieved anything in physics; Barrett's discovery of recalescence is ignored, as is Osmond's work in the same field. Earnshaw's discovery of the dependence of the velocity of sound on its intensity is unnoticed. Lord Kelvin's publication in 1855 of the doctrine of available energy is not referred to. Osborne Reynolds's work on dilatancy is not mentioned. The foundation of crystallometry is attributed to Weiss in 1813; all reference to the work in that direction of Wollaston, of Haüy, and even of Steno being omitted! In several cases the dates need revision. Thus, Maxwell's electromagnetic theory of light is given as 1871, several years too late. A reference to Dr. Gilbert, who died in 1603, is given as 1630. The first research to register the curves of alternating electric currents is attributed to Colley in 1885; Joubert has dropped out, even from the index. Aitken's classical observations on dust nuclei are not recorded. Lord Kelvin's mariner's compass is dated back to 1868, though only patented in 1876. Foucault's use of gas retort carbon for electric light pencils certainly dates back before 1850; but here it is given as 1866. These blemishes can easily be removed when a second edition is called for—as it ought to be before long.

PSYCHIATRY AND PSYCHOTHERAPY.

(1) *A Text-book of Mental Diseases.* By Prof. Eugenio Tanzi. Authorised translation from the Italian by Dr. W. Ford Robertson and Dr. T. C. MacKenzie. Pp. xvi+803. (London: Rebman, Ltd., 1909.) Price 24*s.* net.

(2) *Psychotherapy.* By Prof. Hugo Münsterberg. Pp. xi+401. (London: T. Fisher Unwin, 1909.) Price 8*s.* 6*d.* net.

THESE two books appeared towards the end of last year, the one being a thoroughly up-to-date work on psychology, normal and morbid, and the other dealing with the psychical treatment of disease, especially of mental disorder.

(1) Prof. Tanzi's book has already been published in Italy for nearly five years and from the first has been recognised as a standard work on mental diseases. It begins with a study of the seat of the psychical processes and considers seriatim the data of physiology and experimental anatomy, embryology, pathology and normal anatomy. Then follows a discourse on the causation of mental diseases, and there is a chapter on the morbid anatomy of the brain, microscopical and macroscopical, in respect of mental diseases. About 150 pages are devoted to psychology of a practical kind, under the headings of sensibility ("sensation" would have been a better translation), ideation, sentiment, movements and other external reactions. This last chapter is really a disquisition on the conduct of the insane and deals with anomalies of the will, of the instincts, of emotional expression and of speech and writing. The classification adopted is mainly that of Kraepelin, but the author does not follow that authority with any slavish rigidity.

It will seem curious to English physicians to find the study of mental diseases beginning with that of pellagra, but it will not be forgotten that this disease plays almost as large a *rôle* in some parts of Italy as general paralysis does in this country.

Many will object to the use of the term "amentia" in the sense of acute confusional insanity or acute hallucinatory insanity; but this is the sense in which the word has been used on the Continent ever since the days of Meynert, whereas in this country "amentia" means idiocy or imbecility. The term maniacal-depressive insanity does not appear; but melancholia, periodic melancholia, periodic mania, and circular insanity are discussed under the heading of "the affective psychoses."

Paranoia is more clearly defined and receives fuller consideration than we have seen in any other text-book. The author divides paranoiacs into those with abstract delusions (mattoids) and those with an ego-centric delusion (the querulants, the persecuted, the erotic and the ambitious). Under these various headings there are interesting references to the history of the Middle Ages and to the peculiarities of certain primitive races. There are also some very full accounts of individual cases of paranoia.

The chapter on constitutional immorality is well worth reading. Prof. Tanzi takes a broad view of the subject, and criticises the penal law on the one hand and the narrow views of some of his own countrymen on the other. He rightly condemns stigmatising a person as a criminal merely because he possesses a certain number of the physical stigmata of degeneration, such as a Darwinian ear, plagiocephaly, hexadactylism, &c.

There is a full and excellent index. The book is well illustrated and got up, and there are 132 figures which materially assist the reader in understanding the text.

(2) Prof. Münsterberg divides his book into three parts, the first being on the "Psychological Basis of Psychotherapy," the second on the "Practical Work of Psychotherapy," and the third on the "'Place' of Psychotherapy."

Part i. seems rather unnecessary to anybody who has studied psychology before and, to the practical physician, part iii. will appear rather redundant, as it deals with the relation of psychotherapy to the church, &c. The essential section of the book is part ii., and this will be found exceedingly interesting. It treats of the conditions in which psychotherapy is likely to be of use, general and special methods, and of mental and bodily symptoms. The special methods discussed are suggestion, hypnotism, side-tracking and psycho-analysis.

The methods of psycho-analysis are beginning to be well understood in this country, although they have not yet reached the popularity they have in Austria, where the name of Freud, the propounder of its principles, has become a household word. Freud and his followers hold that by the psycho-analytic method they are able to discover in a patient some long-forgotten memory, and that in their discovery they bring to the surface a source of mental irritation, thus removing from the mind a foreign body in the same way as a surgeon picks a thorn from the finger. English physicians are disinclined to regard the method in this light; they consider that the proceeding is rather one of suggestion to the patient. The patient lies on a sofa whilst the operator sits at his head and reels off a series of words to which the patient is required to fit associated ideas; and the operator subsequently, from the study of the patient's associations, evolves some incident in his past history. This he relates to the patient, and hey, presto! recovery. The same result, however, may be quite well attained by taking a careful history of the patient's past life. Psycho-analysis is most suited for hysterical patients, but Münsterberg recommends it for cases of psychasthenia.

Side-tracking is a somewhat different principle which, however, may be used in conjunction with psycho-analysis. Patients suffering from psychasthenia are obsessed with some thought which they are unable to dispel. By psycho-analytic methods the physician searches for an origin of the obsession and then, by devices of various kinds (side-tracking), he diverts the patient's thoughts from the original incident into different channels. To take an example, a man found that he had developed a tendency to hesitate when walking in the street, and was unable to cure himself. Münsterberg was consulted, and found that on a certain occasion when the patient was running to catch a tram he suddenly saw almost immediately before him a big hole dug out for laying gas pipes. He was able to stop himself quickly enough to avoid falling into the hole, but he had a strong emotional shock from the experience. Münsterberg persuaded him under slight hypnosis to think himself once more in the situation of his run for the car, but, as soon as he reached the hole, to jump over it. He went through this motor feature on ten successive days with increasing energy, and from that time the trouble disappeared.

Both books make a very useful addition to the libraries of people interested in the subjects with which they deal.

COMMERCIAL GEOGRAPHY.

Physical and Commercial Geography. By Profs. H. E. Gregory, A. G. Keller, and A. L. Bishop. Pp. viii+469. (London: Ginn and Co., n.d.) Price 12s. 6d.

THE aim of this work is stated to be "to infuse orderliness and sequence into the chaotic data and statistics of trade," and this the authors regard as constituting "a new departure."

The question whether their work constitutes a new departure or not is, however, one of comparatively small importance. We may at least admit that the attempt to carry out this aim in their "own chosen way" is new, and we may add that that way is a good way, and, on the whole, admirably followed. We feel sure that no student or teacher of commercial geography could fail to profit greatly by the perusal of this work, and, above all, of its more general sections.

The work is divided into three parts, each of which, we are told, belongs essentially to one of the three authors, though they have a joint responsibility for the outline and general character of treatment. The first part is entitled "The Natural Environment," the second "The Relation of Man to Natural Conditions," and the third "The Geography of Trade." It is in the first two sections that the aim of the work as above indicated, the tracing of the influence in the moulding of trade of what "might be called the environmental (or geographical) factors," is kept most consistently in view, and with the most satisfactory results.

The third part of the work is the most disappointing. Here the geographical point of view is much less prominent. In it, the authors say, their treatment is "Topical, a short monograph upon each preeminent article of commerce occurring under the general politico-geographical section which leads in the production or use of the article in question."

But in some of the most important cases little or no attempt is made to show what, if any, geographical influences have been at work to help in creating that importance. Emphasis is laid on the remarkable lead which Great Britain takes in the cotton industry and in transmarine carriage; but the question whether geographical circumstances have had anything to do with this in either case is not even raised. There is very little comment on the seats of manufacturing industry in the United States. There is a reference to water-power in certain cases, and coal, iron, and limestone, as determining the localisation of the iron industries of Pittsburg and the Birmingham districts, but little else. The reason for this apparently is the attaching an exaggerated degree of importance to sources of power as localising manufacturing industries, and overlooking the importance of the relation to labour supply and the market. When the latter relations are kept in view it may be shown that the fact that so few important manufacturing towns in the United States are situated on the coalfields is as much due to geographical causes as the fact that in England and Germany so many are.

RESTORATIONS OF EXTINCT ANIMALS.

Extinct Monsters and Creatures of Other Days; a Popular Account of Some of the Larger Forms of Ancient Animal Life. By the Rev. H. N. Hutchinson. New and enlarged edition. Pp. xxxiii+329. (London: Chapman and Hall, Ltd., 1910.) Price 10s. 6d. net.

SINCE the author of this volume was the first to recognise that the larger extinct animals of former ages presented a promising field for a popular work showing what these creatures probably looked like in life, he thoroughly deserved success in his attempt to fill a gap in literature, and we have therefore great pleasure in congratulating him on the appearance of a second edition. In the volume now before us, Mr. Hutchinson has combined his original two works in one, with some condensation of the old matter, and with the addition of a large quantity of new material, both in the shape of text and illustrations, in order to bring it abreast of modern palæontology. Since 1892 and 1894, the respective dates of publication of "Extinct Monsters" and "Creatures of Other Days," vertebrate palæontology has indeed made vast strides, as is especially noticeable in the case of the anomodont reptiles and the proboscideans, and the author appears to have discharged the difficult task of bringing the work up-to-date in a satisfactory and interesting manner. From first to last the volume is thoroughly readable, and it is to be hoped that it may aid in dissipating the ignorance still so prevalent with regard to the relative ages of the mammoth and the iguanodon.

In referring to the iguanodon as a smooth-skinned reptile, and then giving a plate of it clad in crocodile-like armour, the author appears to display inconsistency; and in the plate of Ceratosaurus the individuals in the background are depicted with relatively larger fore-limbs than the one in front. Reference might also have been made to the evidence in favour of an elephant-like pose of the bones afforded by the figure of an undisturbed limb of Diplodocus; and recent researches indicate that the restoration of Stegosaurus with a double row of plates is incorrect. A few improvements might also be suggested in the text, as, for instance, on p. 169, where it is stated that the teeth of Claosaurus resemble those of Hadrosaurus, without any clue being given as to the nature of the latter. Misprints and typographical inaccuracies are singularly few, although we notice Jakutsh on plate xliii., and Yakutsk in the first note on p. 276. The book is thoroughly deserving of a large sale. R. L.

HINTS FOR THE GARDEN.

(1) *The Carnation Year Book*, 1910. Edited by J. S. Brunton. The official organ of the Perpetual Flowering Carnation Society. Pp. 53. Price 1*s.*

(2) *Gardening Difficulties Solved. Expert Answers to Amateurs' Questions.* Edited by H. H. Thomas. Pp. 160. (London: Cassell and Co., Ltd., 1910.) Price 1*s.* net.

(3) *Leitfaden für gärtnerische Pflanzenzuchtung.* By M. Löbner. Pp. vii+160. (Jena: Gustav Fischer, 1909.) Price 1.50 marks.

(4) *Wild Flowers and How to Identify Them.* By H. Friend. Pp. 64. (London: Robert Culley, 1910.) Price 1*s.* net.

THE popularity of the carnation as a florist's flower has already been enhanced by the spread of the American or perpetual flowering carnation, and will become more so as the qualities of this type are more generally recognised. Originally raised in France where they were known as "remontants," their value was not realised until American growers took up their cultivation with excellent results. Only within the last decade have British horticulturists entered the field, but sufficient growers were found in 1906 to form the society which offers the "Carnation Year Book" (1) as its official organ. One important object of the society is to undertake the registration of new varieties; about a dozen have so far been registered, including the already famous Britannia and Mrs. H. Burnett, as compared with about 800 recognised by the corresponding American society. The volume contains several short articles, of which the most interesting deal with cultivation and hybridisation.

(2) Amateur gardeners do not lack opportunities for obtaining assistance in their difficulties, as all the gardening papers are prepared to supply expert advice. The brochure edited by Mr. Thomas has been collated from replies to correspondents inserted in the columns of the *Gardener*. The questions cover a wide field, so that, although they are grouped in sections, it is a small chance that any specific matter for which the book is consulted will be mentioned therein. So far as it goes, the information is sound and practical, and some practical hints are conveyed in the illustrations.

(3) The perusal of Herr Löbner's book has afforded much pleasure and instruction, as it provides a successful combination of scientific teaching and practical experience. The book consists of a general part dealing with the acquisition of new plants by selection, hybridisation, importation, grafting, and sports—here limited to vegetative anomalies—and a special part in which the origin of specific novelties is treated. It is only possible in the limited space to note that the author discusses seed-fixation, the means of getting seed from double flowers, fertile and infertile hybrids, and the keeping qualities of pollen. In the latter part no section is more interesting than that on roses which includes some account of the author's experience.

(4) The arrangement for identifying British plants offered by Mr. Friend is, to all intents and purposes, the Linnean system, with the omission of many genera; species are only cited for eight genera, and then partially. The notes on season, habitat, and structure provide but little help towards identification, especially as no clear definition is given for some of the technical terms, *e.g.* fruit, bract, and stipule; further, there is a singular confusion on p. 32 of bulb and root, corm and tuber.

OUR BOOK SHELF.

The Telegraphic Transmission of Photographs. By T. Thorne Baker. Pp. xi+146. (London: Constable and Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

THOSE who look at the illustrated papers, and especially readers of *The Daily Mirror*, are aware that the telegraphic transmission of photographs has already entered the commercial stage, and if the results are not yet all that can be desired it will generally be admitted that they reach a high standard of merit considering the very numerous difficulties that have had to be surmounted. This little book from the pen of Mr. Thorne Baker, who has been carrying out the work for *The Daily Mirror* during the last two-and-a-half years, is consequently very welcome.

A brief historical survey of the earlier work is given, and a more detailed account of the later work of Prof. Korn, M. Belin, and the author, which has resulted in the development of systems of actual commercial value. One is impressed throughout by the number of small difficulties which have had to be overcome by persevering experiment, and it is evident that the present state of the art owes its perfection considerably to the development of the kindred arts of photography and reproduction without which the advances on the purely electrical side would have been of slight avail. Problems such as this, though theoretically simple of solution, present great difficulties on account of the amount of technical skill and knowledge of a number of different subjects that is required.

The book is well written and illustrated. A good deal will only be understood by the technical reader fairly well equipped with electrical knowledge, but there is sufficient simple description to enable the non-technical reader to acquire a very fair idea of the whole subject. Some of the phototelegrams which are reproduced are excellent, especially when looked at from a sufficient distance to render the "grain" indistinct, and the two sketches transmitted by wireless telegraphy, though poor in themselves, afford evidence of still further possibilities of development.

M. S.

Liste des Observatoires Magnétiques et des Observatoires Séismologiques. By E. Merlin and O. Somville. Pp. x+192. (Brussels: Havez, Rue de Louvain, 112, 1910.)

To those who seek to establish definite relationships between solar and terrestrial phenomena, the multiplication of well-distributed stations equipped for the observation of terrestrial magnetism and earth movements is a hopeful sign. Hitherto, one of the grave difficulties encountered in such researches has been the paucity of trustworthy and continuous data for sufficiently long periods.

The list now published leads us to hope that a future generation may be more fortunate, for here we find some 220 observatories, of which at least eighty are devoted to the study of terrestrial magnetism and electricity.

The usefulness of such a list has been proved, in principle, by the publication of a similar list of astronomical observatories in 1907, and the Royal Observatory of Belgium, under the auspices of which both were prepared and published, is to be congratulated upon having performed an exceedingly useful, if tedious, duty.

As any attempt to separate magnetism and seismology would have led to needless duplication and confusion, the arrangement is purely alphabetical. For each station are given the geographical position, the altitude, the nature of the ground on which the observatory stands, the publications wherein the results appear, the names of the staff, a brief history of the observatory, and the nature and distance of any disturbing elements, such as tramways, &c., and, finally, a description of the instruments and the special researches to which they are dedicated. Other lists show the continental and national distribution of the two kinds of observatories, and, alphabetically, the names of the observers.

Such a list was to have been prepared by the International Commission for Terrestrial Magnetism, but the project failed; the data then collected, however, have been placed at the service of the compilers of the present work, and have proved very useful.

W. E. R.

An Inconsistent Preliminary Objection against Positivism. By Prof. Robert Ardigo. Translated by Emilio Gavirati. Pp. 52. (Cambridge: W. Heffer and Sons, Ltd., 1910.) Price 1s. net.

THIS pamphlet, by the veteran leader of Italian positivism, is issued in translation by a devoted admirer and disciple who wishes to find an English helper in the translation and publication of other works by the "great master." Its argument is directed against those opponents who, on behalf of modern idealism, contend that in positivism there is to be found this fundamental fault—namely, that, according to the method which the positivist has prescribed to himself, the subject ought, in his system, to become an object which cannot have, therefore, any of the characteristics belonging to subjectiveness. Prof. Ardigo, as St. George to the dragon of metaphysics, develops a subtle and closely reasoned argument for a positivist treatment of psychology, criticising the positions associated with the names of Bergson and Boutroux. He is also careful to show that positivism differs widely from materialism, with which there is—very naturally—a tendency to confound it. The substance of this pamphlet is contained in the second part of volume x. of Ardigo's "Philosophical Works."

Analytical Chemistry. By Prof. F. P. Treadwell. Authorised translation from the German by William T. Hall. Vol. ii. Quantitative Analysis. Second edition. Pp. x+787. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 17s. net.

A REVIEW of the first edition of Mr. Hall's translation of Prof. Treadwell's work on quantitative analysis was published in NATURE of August 11, 1904 (vol. lxx., p. 341). In the present issue certain additions have been made which are not found in the German text, and the main part of the work has been compared with the fourth German edition.

Students' Life and Work in the University of Cambridge. Two lectures by Prof. Karl Breul. Revised edition. Pp. 60. (Cambridge: Bowes and Bowes, 1910.) Price 1s. net.

THE two lectures delivered by Prof. Karl Breul to the students attending the University Extension summer meeting in 1908 give an interesting and informative account of the life and work of Cambridge undergraduates. In the revised edition a few corrections and additions have been made.

LETTERS TO THE EDITOR.

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

Early Burial Customs in Egypt.

ALL who are interested in the serious attempts that are being made to reconstruct the real history of ancient Egypt and to sift established truth from wild conjecture must deplore Prof. Flinders Petrie's attempt (see NATURE of September 29, p. 401) to revivify the corpse of a belief in the supposition that the archaic Egyptians were in the habit of cutting up their dead, a view which has been so effectually hanged, drawn, and quartered during the last ten years.

When Prof. Petrie states (*op. cit.*, p. 401, quoted from *Man*, September) that "it has long been known that in prehistoric burials the corpse was stripped of its flesh, the bones even being broken to extract the marrow," he should have written that he and M. de Morgan had *stated* that the prehistoric Egyptians dissected the bodies of their dead. But, even though Profs. Maspero, Sayce, Wiedemann, and Lortet repeated these or similar statements (Sayce and Lortet invoking the aid of birds of prey to do the bone-cleaning!), the experience gained by other excavators has totally shattered and destroyed every scrap of evidence that could lend any support to the belief in the reality of such practices.

In 1896 Prof. Petrie ("Naqada and Ballas," p. 32) attempted to explain the disturbed condition of the skeletons found in many archaic Egyptian graves by saying "*that bodies were sometimes—with all respect—cut up and partly eaten*"!

Four years later Dr. George A. Reisner proved that such disturbances of the bones as Prof. Petrie mentioned were the result of the operations of grave-plunderers (see the Egyptian Exploration Fund's Archæological Report for 1900–1, p. 25); and every year since then this explanation has been proved to be true in every case where disturbances have been found amongst many thousands of burials of all ages and in every part of Egypt and Nubia, which have been submitted to the most thorough and critical examination, not only by Dr. Reisner himself, but also of many independent witnesses. The evidence referring to Nubia is set forth *in extenso* in the First Annual Report of the Archæological Survey of Nubia, which is being published in Cairo this month. During my ten years' association with Dr. Reisner, my collaborators in the anatomical branch of the work and I have examined and made notes on the remains of more than 15,000 human beings buried in the Nile Valley, and we have not seen a single case which afforded any evidence whatsoever of the practices postulated by Prof. Petrie.

Secondary burials, of course, occurred in ancient Egypt: but they were exceedingly rare, probably more so than in modern England. Perhaps some archæologist of the next millennium will find infinitely more evidence in English graveyards of the twentieth century in support of speculations on our "customs of mutilation of corpses and cannibalism" than Prof. Petrie has been able to gather in Egypt.

It would, indeed, be a matter for astonishment if such a people as the ancient Egyptians, whose respect for their dead is proverbial, did not attempt to restore to order the graves of relatives that had been desecrated by grave-plunderers. The surprising thing is not that we find instances of reburial, but that they are so exceedingly rare.

During the Græco-Roman period in Egypt and Nubia, when the decadence of the art of mummification had definitely begun, it often happened that bodies handed over to the embalmers were treated in such a careless manner that they fell to pieces in an early stage of the process, and had to be rebuilt—sometimes with limb-bones reversed, leg-bones as skeletons for arms, portions of other skeletons introduced, and often foreign materials added. This "faking" of mummies is described in detail in the forthcoming Report of the Archæological Survey of Nubia.

Would it be unreasonable to suppose that in the early experimental stages of the art of embalming—corresponding to the epoch with which Prof. Petrie is dealing—similar failures may have occurred, and that such a condition, for example, as Prof. Petrie has described from Deshasheh, where the fibula was upside down (see "Deshasheh," 1898, Pl. xxxvii.), would receive a natural explanation? Such cases are so exceedingly rare that it is idle to quote them as representing the "custom" of the country.

Apart from these rare exceptional cases of secondary burial and embalmers' "faking," all the disturbances of the bones of unplundered graves result from (1) the operation of the force of gravity on bodies falling into decomposition, and (2) the occasional action of rodents moving small bones. That this is so has been conclusively demonstrated by Dr. Reisner in the minute and critical examination of many thousands of burials in Egypt and Nubia. Thus there are very precise and definite reasons for discarding Prof. Petrie's fantastic speculations, and for accepting in their stead the simple and perfectly obvious explanation of the disturbed state of the skeleton in many graves, which he who runs may read.

The phrase "the bones even being broken to extract the marrow" (*op. cit.*, Nature, p. 401) calls for some further comment. Does it mean that Prof. Petrie is reaffirming his former statement of a belief in the practice of cannibalism (already quoted)? Can he point to one single case where the bones of a prehistoric Egyptian have been broken *post-mortem*, except by grave-plunderers, excavators, or the natural forces of the denudation of the soil and the disintegration of organic matter?

In "Naqada and Ballas," p. 32, Prof. Petrie referred to the forcible scooping out of the marrow as an evidence of cannibalism; but that statement was clearly inspired by his lack of familiarity with the normal medullary cavity of a human long bone and its relation to the cancellous tissue at the ends. But he added, further, that "there were grooves left by gnawing on the bones"—a sure sign of anthropophagy! Dr. Fouquet, who examined M. de Morgan's material of a similar nature, also saw these grooves, but called them "syphilitic ulcers."

Two years ago (*Lancet*, August 22, 1908, p. 521) I was able to demonstrate that the bones of many pre-dynastic Egyptians were certainly gnawed, but neither by man nor the spirochæte: the damage was inflicted by small necrophilous beetles. Although Prof. Petrie no longer refers to these signs of gnawing, he still speaks of the prehistoric Egyptian breaking human bones "to extract the marrow," *i.e.* presumably to eat it. The whole evidence afforded by excavations in Egypt goes to prove that this statement is pure fiction.

G. Elliot Smith.

The University of Manchester, October 1.

British Marine Zoology.

"The proof of the pudding is in the eating," and surely Prof. MacBride will admit that whether a biological station is or is not suitable for research must be decided, not by the expensiveness of the equipment, but by observing whether research is being carried on there.

That one station is ten times as large and expensive as another is no advantage and no credit to it unless it is also ten times as efficient. That it is only in such an establishment that Prof. MacBride can "bring research to a successful issue" is, of course, an important personal record, but it might be unsafe to generalise from one such observation.

I am sorry not to be able to agree with Prof. MacBride in the distinctions he draws between the stations equipped for research and others; and I cannot avoid a doubt as to whether he has personal knowledge of the smaller stations of this country.

W. A. Herdman.

October 1.

I shall gratify Prof. Herdman's curiosity so far as to say that I have worked at more than one small station in this country.

I fully agree that "the proof of the pudding is in the eating," and I am content to leave it to the judgment of my fellow-zoologists whether in reviewing the work done at the various zoological stations in this country Plymouth has not justified its superior equipment by the superiority of the original work, both as to quantity and quality, which has been accomplished there.

E. W. MacBride.

Hormones in Relation to Inheritance.

With reference to my presidential address to Section D of the British Association, of which a full report appeared in Nature of September 22, I must rectify an omission by pointing out that the theory of the possible influence of hormones in inheritance was first enunciated by Mr. J. T. Cunningham in a paper in the *Archiv für Entwicklungsmechanik*, vol. xxvi., 1908, entitled "The Heredity of Secondary Sexual Characters in Relation to Hormones, a Theory of the Heredity of Somatogenic Characters." It was through inadvertence that the reference to Mr. Cunningham's paper was not printed in the copies of the address distributed at the meeting at Sheffield.

Gilbert C. Bourne.

Savile House, Oxford, October 4.

Pwdre Ser.

My friend Mr. Frank Darwin has sent me the following additional information respecting the *Pwdre Ser.*

"The 'Treasury of Botany' says that Nostoc is called 'Falling Stars,' and quotes Dryden (no reference)—

'And lest our leap from the sky prove too far,
We slide on the back of a new falling star,
And drop from above
In a jelly of love.'

"The note is signed M. J. B. = Berkeley, so it may be trusted so far as that it really refers to Nostoc."

T. McKenny Hughes.

Ravensworth, Brooklands Avenue, Cambridge, September 30.

Unemployed Laboratory Assistants.

A number of lads who have been employed as laboratory monitors in secondary schools, and whom the London County Council are unable to retain in their service beyond the age of sixteen years, have been referred to us by the London County Council with the view of our placing them. Some of them we have already been able to place in suitable employment, but there are still one or two on our books for whom we seek situations.

They all have an elementary knowledge of physics and chemistry. Some have learned glass-blowing and bending, and a few of the applicants have already passed the Board of Education examination in Chemistry (Stage I.). If any readers of Nature would like to have further particulars of these boys, I should be glad to supply them with information.

Godfrey E. Reiss (*Hon. Sec.*).

Apprenticeship and Skilled Employment Association, 36 Denison House, 296 Vauxhall Bridge Road, London, S.W., October 5.

THE INTERNATIONAL UNION FOR COOPERATION IN SOLAR RESEARCH.

THIS union held a very successful meeting—the fourth since its foundation—on Mount Wilson Observatory, California, during the last week of September, when there was an assembly of nearly forty European astronomers and physicists, who had crossed the Atlantic for the meeting, and many more American men of science. England was represented, among others, by Sir Joseph Larmor, Profs. Newall, Turner, Fowler, and Mr. Dyson. The gathering, representative as it was of all nations actively engaged in solar work, would have been even more so if a number of those who had signified their intention of being present had not at the last moment been prevented by illness or other causes from attending. Among them were Sir David Gill, Dr. Lockyer, Profs. Righi and Violle. To the great regret of everyone present, Prof. Hale was prevented by bad health, brought on through overwork, from taking part in the discussions. Together with Mrs. Hale, he received his guests at a garden-party at their home in Pasadena, and was able to come up to the observatory on the first day of the meeting, but on the advice of his doctor he returned to Pasadena, after delivering a short address on the general work of the conference.

As regards the results of the meeting, the first place must be given to the extremely satisfactory report of the committee on the determination of standard wave-lengths. The requirements of modern spectroscopic research having rendered all previous measurements obsolete, even for purposes which only require relative values, the Solar Union set itself the task of preparing new tables. The direct comparison between the wave-lengths of the red cadmium line with the standard metre carried out by Fabry and Pérot gave a result practically identical with that of Michelson, so that already three years ago its numerical value could be definitely adopted. Taking this line to be the primary standard, a sufficient number of iron lines had next to be compared with it, so that they might serve in subsequent work as secondary standards, with an accuracy hardly, if at all, inferior to that of the primary. This work was undertaken independently in three different laboratories by Fabry and Buisson, at Marseilles, by Eversheim under Kayser at Bonn, and by Pfungst under Ames at Baltimore. The numbers obtained agree so well that we are now already in possession of a large number of lines with accurately known wave-lengths. How accurately? Using the Angström (10^{-8} cms.) as unit, the average differences of the three independent determinations only amount to about three or four in the third decimal place, which means less than one part in a million. The few cases where the differences are somewhat greater are easily explained by a deficiency in the homogeneity of the lines, except in a small region in the orange.

The secondary standards are now sufficiently close together to serve as fixed points for interpolations, when gratings are used, and it is intended to proceed immediately with the further determination of tertiary standards so near to each other, that even with a prismatic dispersion every observer will have at his command a system of lines on which he can depend entirely for comparison or interpolation. In the orange region referred to, some barium lines will have to be added, and the total length of spectrum dealt with, which extends from λ 4282 to λ 6494, will before long be substantially increased on the red side. In order to avoid confusion between the new and old determinations, the now adopted unit will be known as the "international Angström" (I.A.). If the Solar Union had done nothing else than this work on wave-lengths, it would have justified its existence.

We next note the report of the committee on the investigation of sun-spot spectra, which was presented by Prof. Fowler. Its work is sufficiently indicated by the following recommendations, which were adopted by the meeting:—

(1) That, notwithstanding the progress of photographic work, visual observations of spot spectra should be continued, and that the committee should be re-appointed to continue the organisation of this work.

(2) That in view of our increased knowledge of spot spectra, the committee should be authorised to prepare and circulate a revised and extended scheme of visual observations.

(3) That it is desirable that, for the use of visual observers, the separate sections of the new photographic map of the sun-spot spectrum should not exceed 60 centimetres in length, and should be on a scale of 5 mm. to the Ångström.

Another committee dealt with spectroheliograph work, and here also we may confine ourselves to quoting the more important resolutions:—

(1) That daily photographs of the calcium flocculi be continued by the co-operating observatories.

(2) That provision be made, if possible, for the measurement of the photographs.

(3) That the desirability of utilising large spectroheliographs of high dispersion for the study of the upper layers of the solar atmosphere is recognised by the committee.

A report on the spectroheliograph work carried on at South Kensington was sent in by Sir Norman Lockyer, and will be printed in the transactions of the union, as also a discussion of solar phenomena as revealed by the spectroheliograph, which was presented by M. Deslandres.

An important, but from the nature of things somewhat slowly progressing, committee deals with the study of solar radiation. Its work has been seriously retarded by the lamented death of Knut Angström, whose pyrheliometer had been adopted by the union as standard instrument, and who had undertaken personally to standardise all pyrheliometers sent out from Upsala. Latterly serious defects in the constancy of the indications of the instrument have shown themselves, and unless a ready means is found to keep an accurate log of their changes by frequent comparison with some standard radiator, the union will be forced to modify its previous decision. Mr. Abbott presented the report of the committee, and gave an account of his own important work on solar radiations, which has revealed some fluctuations in the amount of heat and light which enters our atmosphere. These fluctuations, which frequently amount to 5 or 6 per cent., may still be due to uncorrected influences of atmospheric absorption, and Mr. Abbott laid stress on the importance of establishing an independent station in a locality where the atmospheric conditions are favourable, so that simultaneous observations can be carried out, at least in two places, and atmospheric inequalities still further eliminated.

It remains to record an important alteration in the constitution of the union, which has decided to extend its scope, and include astrophysics in the range of its activity. In voting for the change, the members of the union were fully aware of the importance of their decision. It was pointed out by several speakers that the union exposed itself to the danger of undertaking more than could be managed, and that before long the primary object of the union might be swamped by the additional problems now introduced. But, on the other hand, everybody recognised that the distinction between the sun and a star was an artificial and accidental one, and that the study of one was a necessary complement to the study of the other. The danger of being overwhelmed by the additional subjects is not great, because only a few well-defined portions of astrophysics are adapted for investigation by international cooperation. At the conclusion of an interesting discussion, the vote went unanimously in favour of the change. A beginning of the new order of things was made at once, and a committee was appointed, with Prof. E. Pickering as chairman, to discuss the possibility of coming to an agreement on the classification of stellar spectra.

The next meeting of the union will be held at Bonn in the year 1913.

Arthur Schuster.

POPULAR BOOKS ON BIOLOGICAL SUBJECTS.[1]

(1) THE first of these books forms vol. iv. of the handsomely got-up and well-illustrated "Science in Modern Life." The first eighty-eight pages are a continuation of the account of botany begun in the previous volume, and deal with geographical distribution as influenced by climate, &c., followed by a general systematic survey of the vegetable kingdom. So much of the space is filled by illustrations (usually very good) that the letterpress is exceedingly condensed, and makes the style rather that of an encyclopædia than of a book to be read, but the substance is good.

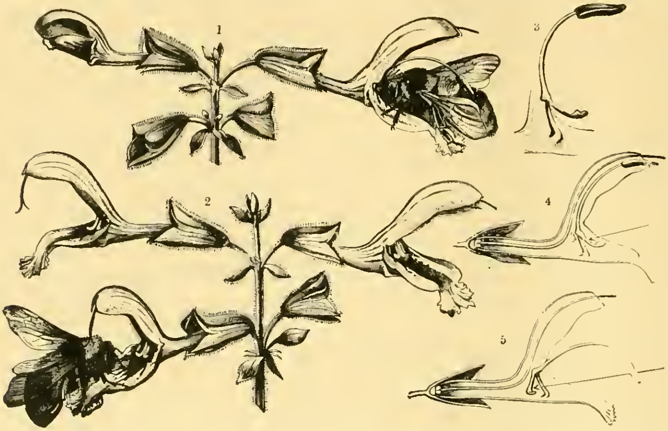


FIG. 1.—Transference of pollen to the bodies of insects by means of mechanism of the percussive type. (1) Part of an inflorescence of *Salvia glutinosa*; the right-hand flower is being visited by a humble-bee, and the pollen-covered anther is in the act of striking the insect's back. (2) Another part of the same inflorescence with three open flowers in different stages of development: the lower flower on the left-hand side is being visited by a humble-bee which carries on its back pollen from a younger flower and is rubbing it off on to the deflexed stigma. (3) A stamen of *Salvia glutinosa* with rocking connective. (4) Longitudinal section through a flower of the same plant. The arrow indicates the direction in which humble-bees advance towards the interior of the flower. (5) Same section; the lower arm of the connective lever is pushed backward, and in consequence the pollen-covered anther at the end of the other arm of the lever is deflexed.—From "Science in Modern Life."

The section on zoology (114 pages) includes six pages on the history of the science, and ten on a general survey of the animal kingdom, and these are so much condensed as to be almost meaningless without further reading. The remainder is devoted to an account of the evolution of animals as revealed by their fossil remains. In this way descriptions are given of all the chief orders of animals, but short diagnostic descriptions of groups, sometimes with no illustration, convey little definite impression to the reader, and the general effect is distinctly disappointing. The physiological side of zoology, in which its relation with "modern life" is perhaps closest, is not dealt with.

The pages devoted to fisheries are the most readable in the volume. The style is necessarily very concise, but the author succeeds in picking out the salient features and in making the subject interesting. The volume is provided with a full list of contents, but no index.

(2) "A Bush Calendar" consists of a series of articles on nature in the neighbourhood of Sydney, reprinted from the *Sydney Morning Herald*. They are pleasantly written descriptions of the birds, flowers, &c., seen, with observations on their habits and haunts; and although to most English readers the names will not convey any clear idea, to those living in that part of Australia it should be a useful little book. It is illustrated with pretty photographs, and for each month a list is given of the flowers, migrant birds, and nests which may be found. An Englishman is at once struck with the fact that there is no month in which some bird does not breed. One small blemish is that generic names should be written with initial capitals.

(3) "Nature Studies by Night and Day" does not claim originality, and consists of a series of disconnected chapters on well-worn subjects—the opening and closing of flowers, protective coloration, the sundew, &c. The photographs are not very well repro-

FIG. 2.—Tadpole before the emergence of the fourth limb.—From "Nature Studies by Night and Day."

[1] (1) "Science in Modern Life." A Survey of Scientific Development, Discovery and Invention, and their Relations to Human Progress and Industry. Vol. iv. Edited by Prof. J. R. Ainsworth Davis; Botany (continued), by J. M. F. Drummond; Zoology, by Prof. J. R. Ainsworth Davis; and Science and the Sea Fisheries, by Dr. J. Travis Jenkins. Pp. x+236. (London: Gresham Publishing Co., n.d.)
(2) "A Bush Calendar." By Amy E. Mack (Mrs. L. Harrison). Pp. vi+109. (Sydney: Angus and Robinson, Ltd.; London: Australian Book Company, 1909.) Price 3s. 6d. net.
(3) "Nature Studies by Night and Day." By F. C. Snell. Pp. 319. (London: T. Fisher Unwin, n.d.) Price 2s.
(4) "Insect Wonderland." By Constance M. Foot. Pp. xi+196. (London: Methuen and Co., 1910.) Price 3s. 6d. net.
(5) "The Landscape Beautiful." A Study of the Utility of the Natural Landscape; Its Relation to Human Life and Happiness, with the Application of these Principles in Landscape Gardening, and in Art in General. By F. A. Waugh. Pp. 336. (New York: Orange Judd Co., 1910.)
(6) "Bees for Profit and Pleasure." By H. Geary. Farm and Garden Handbooks. Edited by T. W. Sanders. Pp. 114. (London: W. H. and L. Collingridge, n.d.) Price 1s. net.

duced; perhaps the most interesting is that of a tadpole with three legs, the right front limb not yet having emerged from the opercular fold. A book which might interest a novice in "nature-study."

(4) In "Insect Wonderland" the author endeavours to interest little children in the natural history of insects by conversations between insects and flowers, birds, &c., to which the insects describe their life and habits. It may be doubted whether this method is really more attractive to children than straightforward accounts, if written simply and easily, but in any case, it is unfortunate to write of *Mr.* Bee when the individual speaking is a worker, or of the orange-tip butterfly as "she," when the orange colour is confined to the male. The flowers and insects described as talking together also are not all to be found at the same season. Otherwise the descriptions are clear and good; the illustrations are pretty, but not always easy to understand.

(5) "The Landscape Beautiful" is written by an American "landscape architect," to encourage the appreciation of beauty in nature and in gardens. The first five chapters ("Essays") are in praise of natural beauty in its broader aspects, followed by a chapter to prove that landscape gardening is entitled to a place among the fine arts, since it combines all the objects and technical difficulties of painting and sculpture. This subject is amplified in the succeeding chapters, which deal especially with American landscape gardening, and the need for a greater appreciation of beauty and care for its preservation by the American people. The concluding chapter on "Some Practical Applications," describing the methods used or suggested by the author for encouraging the study of natural beauty in schools is particularly interesting, and might well be read by teachers of "nature-study." The book is pleasantly written and illustrated by very pretty photographs by members of "The Postal Photographic Club."

(6) "Bees for Profit and Pleasure" is a practical handbook to bee-keeping, written by an expert on the subject. It points out the advantages of keeping bees either for pleasure or as a supplementary source of income, gives a clear, concise account of their natural history and habits, and a good account of the various kinds of hives and other apparatus, with prices, but in some places the mention of apparatus not described until later in the book might cause some difficulty to the beginner. The instructions for successful management are straightforward and interesting, and the book is provided with an index.

THE GEOLOGY AND ARCHÆOLOGY OF ORANGIA.[1]

THIS work is the fourth of a series containing the author's personal observations and conclusions on the economic geology and archæology of South Africa. The present volume is devoted to Orangia, where the author has resided in practice as a mining engineer; his work gave him excellent opportunities for observation and research, and he has used his chances with admirable industry and judgment.

The first chapters are devoted mainly to the geology of Orangia, which is of less interest, owing to its monotonous uniformity, than that of any other South African State. Most of the country is occupied by rocks belonging to the Karoo system. The granitic mass of Vredeport outcrops near the northern frontier, and is surrounded by a belt of rocks corresponding to those of the Rand goldfield, which is situated further to the north. The extension of the Rand series under the Karoo has been proved by the bores recently made under the superintendence of Mr. A. R. Sawyer, and some of the results revealed by those boring operations are stated in the work. Mr. Johnson gives a short account of the diamond-bearing pipes of northern Orangia; he describes especially the Roberts-Victor Mine, of which he was for some time the mining engineer. This mine, among other points of interest, has yielded an eclogite boulder containing diamonds, which has been described by Dr. Corstorphine. The first such occurrence was found in the Newlands Mine at Kimberley, and is well known from the classical paper by Prof. Bonney. Mr. Johnson rejects the view that the eclogite was the original matrix of the diamond, and his conclusion is supported by the results of Mr. Gardner Williams's elaborate test, which proved by testing a large number that these boulders at Kimberley are barren of diamonds. He adopts the conclusions that the kimberlite, the igneous rock that fills the diamond-bearing pipes, is due to the intrusion of a magma at a comparatively low temperature.

Representation of Zebra, Hippotragus, and Quagga pecked and engraved on rock, Biesjesfontein. (Scale ⅛.) Reduced from "Geological and Archæological Notes on Orangia."

Mr. Johnson's archæological contributions include figures and descriptions of many rock paintings, of which one is here reproduced; the figures show no new general results, but they are interesting additions to those previously recorded. They are cruder than many of those found in South Africa, as shown by the exaggerated steatopygy in one of the figures. Mr. Johnson has diligently collected stone implements at many localities in Orangia, and investigated the sites of many ancient settlements. At one site he collected 700 stone implements from a small area in a short time. Mr. Johnson's most original archæological contribution is the claim that the stone implements belong to two separate periods, which he compares with the Acheulian and Solutrian of Europe. In some localities he found his Acheulic type—a common form of which he calls amygdaliths—below the alluvium and the Solutrian above it. The author candidly remarks at the end of his discussion of this question that his observations may merely prove that some of his Acheulic are older than some of his Solutric implements. This caution appears justified, as the results stated are not quite convincing, and more details as to the depths at which the implements were found would be useful.

In his agricultural notes the author directs attention to the great progress that has been made in Orangia by the adoption of the methods often known as "dry farming," which have long been used by farmers on our chalk downs. They have only recently been adopted in South Africa, where they have already

[1] "Geological and Archæological Notes on Orangia." By J. P. Johnson. Pp. vi+102. (London: Longmans and Co., 1910.) Price 10s.

proved remarkably successful; Mr. Johnson reports that the rainfall for the ten years' records at Kimberley, Kronstad, and Bloemfontein are respectively 20·4, 27·1, and 25·2 inches; so the climate would not be regarded as arid in Australia, where wheat cultivation has long been undertaken in areas with a rainfall of as low as fourteen inches. Most of the rain in South Africa falls in the six summer months, and its amount is sufficient to justify Mr. Johnson's confidence as to the future agricultural prosperity of the State.

J. W. G.

SPORT ON THE MOORS AND BROADS.[1]

SO far as I am aware, Messrs. Malcolm and Maxwell are the first to present the public with a concise, authentic, and at the same time highly interesting account of the rise and expansion of modern grouse-shooting in the North—a sport which they rightly declare to have been rendered accessible to English sportsmen as a whole by the development of railways. In our own days the steadily increasing demand for well-stocked moors produced by these means has given rise to great improvements in the care and cult of the moors, themselves coupled with a large extension of the area devoted to grouse; and this, in turn, has added very considerably to the financial prosperity of many parts of North Britain. How enormous is the value of Scottish and Yorkshire moors is told in the second chapter of the volume by Mr. Malcolm, who also discourses, with the confidence of an authority, on the management of moors, the connection between grouse and heather, and grouse disease. At one time it was hoped that the number of grouse on a moor might be largely augmented by suitable treatment, but it is now ascertained that there is a limit to this. In view of the prospect of a second edition, Mr. Malcolm's attention may be directed to a couple of obvious grammatical errors on the latter part of the second page.

The last six chapters are from the pen of Captain Maxwell, who discourses pleasantly on ancient and modern grouse-shooting, with a couple of chapters devoted to blackcock and ptarmigan. In urging the need for an extension of the close season in the case of blackcock, the author ought to enlist the support and sympathy of true sportsmen, since it is a crying shame that half-fledged "cheapers" should, as is so often the case, be shot in August. It is also satisfactory to find Captain Maxwell remarking that grouse-driving has resulted in a more or less indifference to natural history and wood-craft on the part of the modern sportsman, who thereby falls far behind his grandfather, to whom such knowledge was essential.

Coot and Great Crested Grebe on their Nests. From "Life and Sport on the Norfolk Broads.

In commending the united efforts of the two authors, I must not omit a word of praise for the 16 coloured reproductions of sketches of Scottish game-birds and scenery, by Mr. C. Whymper, which add so greatly to the attraction of the volume.

Mr. Ready, the author of the second volume mentioned above, is a born "Broadsman," having been brought up in a rectory in the heart of the broad-country, where forty years ago no railway had penetrated, while a visit to Norwich entailed an eighteen-mile journey by coach. Those early days of the author's life can be recalled only in memory, for the penetration of the district by the railway has altered its primitive character in many ways, although the charm of the more secluded portions of the Broads cannot, fortunately, be destroyed.

1 "Grouse and Grouse Moors." By George Malcolm and Aymer Maxwell. Illustrated by Charles Whymper. Pp. viii+286. (London: A. and C. Black, 1910). Price 7s. 6d. net.
"Life and Sport on the Norfolk Broads in the Golden Days." By Oliver G. Ready. Pp. xvi.+249. (London: T. Werner Laurie, n.d.) Price 7s. 6d. net.

That one who knows and loves his subject so thoroughly as does the author of this volume should furnish a mine of information about the Broads, is only what might be expected; but Mr. Ready is also possessed of a pleasant and readable style, although it may be noted that on the very first page he writes "Peninsular" when he means "Peninsula." Perhaps the three most interesting chapters out of the twelve which form the volume are those on birds' nests and fishing; and attention may be specially dir cted to the account of the nests of the great grebe—locally known as loon—and the buzzard, the former being illustrated by an excellent reproduction from a photograph. In the chapters on fishing much space is devoted to eels and eel-spearing; and it may be noted that in the author's opinion the old-fashioned spear on which eels were impaled is less cruel than the modern weapon in which they merely become entangled between the prongs. For while the former meant death, the latter allows a number of mangled fish to escape.

The illustrations, in addition to the one of the grebe, depict broadland scenery, Wrexham Hall and Church, various implements connected with eel-fishing, and other local subjects.

R. L.

DR. JOHN PEILE.

The death of the Master of Christ's College, Cambridge, has removed from the University a striking figure, and from the college over which for twenty-three years he presided so successfully a great master. Dr. Peile came of a well-known Cumberland family. His father was Mr. Williamson Peile, of Whitehaven, a geologist of repute. The late master was born in 1838, and was educated at Repton, whence he proceeded to Christ's College in 1856.

Dr. Peile had a distinguished university career, being bracketed Senior Classic in 1860, and winning the Craven Scholarship the year before, and being bracketed Chancellor's Classical Medallist in 1860. Soon after taking his degree, he became a fellow and lecturer of his college, and in 1870 he began his most successful career as a college tutor. This lasted until 1884, in which year he was elected reader in comparative philology in the University. In 1887 he succeeded Dr. Swainson as master of the college, and four years later, becoming vice-chancellor, he resigned his readership.

Dr. Peile took a large part in university matters. He was always on the side of progress, and, together with Henry Jackson and Henry Sidgwick, led many of the movements which have done much to advance learning in all its aspects at Cambridge during the last forty years. He was for an unprecedented time a member of the council of the Senate, and he took a foremost part in the movement for granting degrees to women, for the abolition of compulsory Greek, for the further provision of university buildings for science and other subjects, in the work of University Extension, and in the rearrangement of triposes and other examinations. He was in university affairs and politics a Liberal in the best sense of the word. His lifelong work in the cause of the higher education of women was recognised in the early "nineties," when he succeeded the late Prof. Adams as chairman of the council of Newnham College; and it was a great pleasure to him and to his wife to learn that the new building, opened only this term, was to be called the Peile building.

Dr. Peile's services to philology were those of the teacher rather than the discoverer. He was one of the first to introduce the study into England, and his manual of comparative philology and the little primer long held the ground practically unchallenged. These books showed a touch of taste and literary charm which are not often found in comparative philologists, perhaps rarely in any branch of science. When Brugmann's "Grundriss" summed up the results of twenty years' brilliant discoveries, Peile's books ceased to be useful, though they could not cease to be interesting. He never revised them. All through the period of transition, however, he was keeping abreast of the new discoveries, and acting on them. He brought a critical mind to bear on these; he took nothing on authority, and very often suggested a way of his own to meet the case. What struck the hearer was his humorous common sense. He had a sense of the fitness of things that kept him from pedantry. And the dullest details were illuminated by some chance remark, as when he lectured on the moods, he said one day, "Now you have Delbrück's view and my view; but I confess that I feel some misgiving when I see that we prove two contrary theories by the same examples." The lectures on comparative syntax probably contained his most original work. These were never published. Peile's infectious enthusiasm never failed to influence his hearers, and the impression is still quite strong after a quarter of a century.

In his own college, Dr. Peile was singularly successful in promoting the study of science in its widest sense. Christ's, which was the first college to award open scholarships in the natural sciences, has ever since maintained a high standard in science. Amongst Dr. Peile's pupils were the late Prof. Marshall Ward and the late Prof. H. Newell Martin, Prof. S. H. Vines, Prof. E. W. Hobson, Dr. W. J. Sell, Dr. H. J. H. Fenton, Prof. Liversidge, Prof. Percy Gardner the president of Queen's College, Dr. Rouse, Prof. J. G. Adami, Dr. A. C. Haddon, Prof. E. W. Brown, of Yale University, Prof. Graham Kerr, Dr. E. A. T. W. Budge, Dr. C. A. Barber, Dr. A. W. Rogers, of the South African Geological Survey, Prof. I. Gollancz, Mr. A. Hutchinson, Mr. R. H. Rastall, Mr. A. W. Clayden, Dr. F. H. A. Marshall, Prof. Gwynne-Vaughan, Mr. C. Warburton, and many others who are holding up the lamp of science in all its forms in many parts of the world.

The master was an untiring worker, and devoted his energies, which were great, whole-heartedly to the services of the University and of his college. During his mastership, Christ's College has been greatly enlarged, and to a great extent rebuilt. The chapel and the hall have been decorated by the late Mr. Bodley, and the same architect rebuilt and rearranged the library. A third court has been opened up, and contains a handsome building, with sets of students' rooms, and a more recently constructed pile of lecture-rooms erected at the time of the quatercentenary of the college. John Peile was a wise counsellor, a loyal colleague, absolutely unselfish and unself-seeking. He has left an impress on his University and on his college which can never be effaced.

NOTES.

By the bequest of the late Mr. F. Tendron, for many years chairman of the St. John Del Rey Mining Company, the trustees of the British Museum have recently acquired a few choice mineral specimens. Conspicuous among them is a magnificent, and probably unique, crystal of pyrrhotite, measuring as much as fourteen centimetres across. The suite also includes smaller specimens of pyrrhotite, two specimens of the rare mineral chalmersite, some well-crystallised gold, &c.

The States of the South African Union have decided to present to His Majesty the King a representative collection of living specimens of the wild animals of the country, and arrangements are already in progress for bringing together the collection and transporting it to England. The latter part of the task will be under the superintendence of the Zoological Society of London, in whose menagerie it is hoped that the whole collection will be ready for exhibition next summer, under the title of the King's African Collection.

It is announced in *Science* that the original laboratory of Liebig in Giessen is to be purchased and preserved as a memorial to the eminent chemist. An anonymous donor has guaranteed 3000*l*. for this purpose.

We notice with deep regret the announcement that Mr. J. W. Clark, who until quite recently held the post of Registrary of the University of Cambridge, died on Monday, October 10, at seventy-seven years of age.

The death is announced of Prof. W. H. Niles, Meredith professor of geology at the Massachusetts Institute of Technology. Prof. Niles was appointed to the chair in 1871, and was known for his contributions to geology.

The death is announced, at fifty-five years of age, of Dr. F. W. D. Fraser, formerly professor of anatomy and physiology at the Imperial University of Osaka, Japan; and also of Mr. A. H. Stokes, until recently Chief Inspector of Mines in the Midland district, at sixty-eight years of age.

We record with regret the death, on October 5 at Eastbourne, of Mr. Cecil H. Leaf, known for his studies of cancer. Mr. Leaf was in 1900 appointed to the staff of the Cancer Hospital, and at the time of his death was one of the senior surgeons of this institution. He was the author of numerous important surgical works on cancer of the breast, diseases of the rectum, experiments with chloroform, and other subjects.

Prof. A. Vambéry, the well-known Orientalist, completed on Sunday his fiftieth year of membership of the Hungarian Academy of Sciences. In honour of the occasion the society presented him with a jubilee diploma on Monday, October 10. The *Times* correspondent at Vienna states that in the course of the day Prof. Vambéry received congratulatory visits from a large number of Hungarian men of science and others, as well as telegrams of congratulation from learned bodies and friends in England and America. A subscription has been opened for the purpose of founding a Vambéry scholarship in philology.

We notice with regret the death of M. Maurice Lévy, who became a member of the Paris Academy of Sciences in 1883, when he took the place vacated by Bresse. M. Lévy was born at Ribeauvillé in Alsace in 1838. After studying at the École Polytechnique he entered the corps des Ponts et Chaussées, becoming eventually inspector-general. In 1885 he succeeded Serret as professor of mechanics in the Collège de France. His work was chiefly connected with mechanics and mathematical physics. His best known mathematical researches were on elasticity, hydrodynamics, action at a distance, and conservation of energy.

The Berlin correspondent of the *Times* has announced the death, on October 5 at Charlottenburg, of Prof. Ernst von Leyden in his seventy-eighth year. In 1865 Leyden was appointed professor at the University and director of the Klinik at Königsberg. In 1872 he was sent in the same capacity to the newly founded university at Strassburg. Four years later he succeeded Traube at Berlin, where he continued to work until 1907, when he retired. Leyden was the author of a work on the diseases of the spinal cord and of other medical books. He was a corresponding member of various foreign medical societies, and amongst other distinctions he received a patent of hereditary nobility.

The death is announced of Mr. John Roche Dakyns, who for thirty-four years was attached to the Geological Survey. He was born in St. Vincent, West Indies, on January 31, 1836, and died at Beddgelert on September 27. After joining the Geological Survey in 1862 he was actively engaged for twenty-two years in Yorkshire and the bordering counties of Derbyshire, Lancashire, and Westmorland; for ten years he was occupied in mapping the central Highland rocks in the counties of Perth, Stirling, and Dumbarton, and he was engaged during two years in the neighbourhood of Abergavenny before he retired from the public service in 1896. He was part author of numerous memoirs of the Geological Survey, and he contributed papers, mainly on Carboniferous and igneous rocks, and on Pleistocene deposits, to the Geological Society, the *Geological Magazine*, and the Yorkshire Geological and Polytechnic Society.

The lecture list of the London Institution for the session 1910–11 includes the following subjects:—Secrets in a pebble-beach, Cecil Carus-Wilson; malaria, Major Ronald Ross, F.R.S.; smoke and its prevention, Prof. Vivian B. Lewis; autumn and winter, the web of life, F. Martin-Duncan; Cretan discoveries, David G. Hogarth; the art of aviation, R. W. A. Brewer; life and work of Lord Kelvin, Prof. S. P. Thompson, F.R.S.; and the art of Palaeolithic man, Dr. A. C. Haddon, F.R.S.

In connection with the London County Council's work of indicating the houses in London which have been the residences of distinguished persons, a tablet has been affixed to No. 4 Marlborough Place, St. John's Wood, N.W., where at one time Huxley lived. Huxley moved into the house in 1872, and lived there nearly twenty years. Most of his letters in London were written at Marlborough Place, and a picture of the house appears in his "Life and Letters."

A copy of the list of the zoological gardens of the world in September, compiled by Capt. S. S. Flower, of the Zoological Gardens, Giza, Egypt, has been received. The list includes the names of 104 such gardens in existence at the date specified, as well as references to many others now closed or in process of formation. The oldest of the gardens appears to be the Schönbrunn in Vienna, founded in 1752; the zoological garden in Madrid was opened in 1774, and that in the Jardin des Plantes in Paris was inaugurated in 1793. The gardens in Regent's Park date back to 1828. Two collections have been opened this year, one in Munich and the other in the Edgbaston Gardens, Birmingham.

Prof. Raymond McFarland, of Middlebury College, Vermont, has just returned from a two months' tour of exploration, during which he penetrated into parts of western Labrador never previously visited by a white man. During the first part of his journey, from Lake St. John to the Mistassini post of the Hudson Bay Company, he was accompanied by two colleagues, Profs. T. C. Brown and P. N. Swett. His companions then left him in order to make magnetic observations and to study geological formations along the Fiel Axe and Chief Rivers. Prof. McFarland, with a single Indian guide, then travelled a hundred miles further north, visiting hitherto unexplored regions to the east and north of Grand Lake, Mistassini, and climbing the Porcupine range of mountains. The three explorers are well satisfied with the results of their expedition, having brought back many valuable geographical and geological data.

Prof. E. Fugger, of Salzburg, one of the explorers of the newly discovered ice-cave near Obertraun, in the Hallstadt region of Upper Austria, has favoured us with the following particulars relating to it. The opening is visible from Obertraun, and lies 1600 metres above the sea in the back wall of a cirque between the Mittagkogel and the Hirschberg. A low, narrow passage leads into a hall 10 metres high, the floor of which is covered with ice, bright and clean as a mirror. A cone of ice rises nearly to the roof. After a steep descent of 25 metres an ice-lined cathedral is entered, measuring 40 metres from floor to roof. The floor is strewn with blocks of ice 4 to 7 m. high, the walls are thickly coated with ice, and an ice-pyramid rises here also almost to the roof. A ridge of ice, running in the direction of the length of this cave, leads upwards from it into a gigantic ice-grotto, containing superb needle-like groups of ice-crystals. From a conspicuous group, styled "Monte Cristallo," a stream of clear ice stretches eastward for more than 100 m., leading up to a cross-passage. The right-hand passage is free from ice, and a tooth of *Ursus spelaeus* was found in it. It can be followed into another large hall 100 m. long, 50 m. wide, and 25 m. high, with a castle-like mass of ice rising from its floor. An ice-chasm has now to be scrambled down to an imposing doorway of ice, from which a very narrow passage, 20 m. long, leads into a hall 200 m. long and at least 30 m. high. This hall is free from ice, and breaks up into a series of tunnels, in some of which water-worn pebbles indicate the course of an ancient stream. The total length of the series of caves is 2000 metres. Where ice prevails, the temperature is from 0° to 1° C., while it rises to 5° C. in the portions free from ice.

Under the title of "Byways in the Caucasus," in *Travel and Exploration* for September, Colonel C. E. de la Poer Beresford gives a graphic account of a tour through a region which was the scene of some of the hardest fighting in the great struggle between the Russians and the tribesmen. He describes Gergebil, which was attacked by Vorontzoff in June, 1847, when held by the Murids under Shamil; Gunib, the famous fortress into which Shamil retired in 1857 after waging war against the Russians for twenty-five years; Akhoulgo, like "Edinburgh Castle with another higher rock covering Scott's and Wallace's monuments, rivers rushing round their bases, and a connecting ridge between the rock and Arthur's Seat." He commends the system by which the Russians have reduced these stubborn mountaineers to subjection to the notice of British officers now engaged in the task of subduing the frontier tribes like the Afridis and Waziris.

In the twentieth Bulletin of the Sleeping Sickness Bureau the records of fifty cases of sleeping sickness in Europeans are tabulated and discussed. Of these cases, forty-five were men, five women; nineteen came from the Belgian Congo, fourteen from the French Congo, and four from Uganda. "Of the fifty patients, thirty are known to be dead, eleven survive, and the fate of the remaining nine is uncertain. Of the thirty, fourteen lived a year or more after trypanosomes were discovered, and four two years or more. Of these, one lived three and a quarter years and one six years." One of the survivors, infected probably in 1900, but possibly earlier, is considered to have made a real recovery, and there are grounds for hope that at least four other cases have done the like. Full clinical details of the cases and their treatment are given. The case that is regarded as cured was treated with Fowler's solution.

The *Journal of Hygiene* (vol. x., No. 2) contains a memoir by Miss Harriette Chick on "The Process of Disinfection by Chemical Agencies and Hot Water," giving the results of experiments with phenol on *Bacillus typhosus*, *B. coli communis*, and *Staphylococcus pyogenes aureus*, and with hot water on the same three species and on *Bacillus pestis* and *B. paratyphosus*. It is concluded that "disinfection is an orderly time-process, which may be considered analogous with a chemical reaction." "The fact that the individuals [in a culture of bacteria] do not die all at once, but at a rate proportional to the concentration of the survivors at a given moment, is to be attributed to temporary and rhythmical changes in resistance which, by analogy with chemical processes, may be supposed to be due to temporary energy changes of the constituent proteins."

In the Launceston *Examiner* of August 23 Mr. H. H. Scott records the discovery of a skeleton of Diprotodon in the Smithton district, this being the first record of the occurrence of the genus in Tasmania. The species is presumed to be identical with the Australian *D. australis*.

According to their reports for 1909, all the five museums of the Cape of Good Hope have suffered from shortness of funds, largely owing to the policy of economy rendered necessary by the present state of the colonial finances. In the case of the South African Museum, lack of space for exhibition purposes and the numerical inadequacy of the staff have likewise hindered progress. The director of this institution states that, in his opinion, the time has come for prohibiting the export from South Africa of ethnological and anthropological relics. The plea for the prohibition is based on the systematic manner in which such objects have of late years been exploited, and the high prices paid for them.

The August number of the Journal of the South African Ornithologists' Union contains the report of the migration committee for 1908–9. Eight records of the arrival of storks, either singly or in parties, are chronicled, from which it appears that December is the month when most of these birds reach Cape Colony, although the period of immigration lasts from September to January. In a separate communication Mr. Haagner states that four storks marked by the Vogelwarte Rositten and five by the Royal Hungarian Central Ornithological Bureau have been taken in South Africa, but adds that many more records must be secured before full knowledge of the migration of these can be obtained. Mr. Seebohm, for instance, was of opinion that the birds which travelled farthest north of the equator likewise flew farthest south, but another observer has suggested the reverse of this. Only one record of the movements of the cuckoo is mentioned, this being a departure in the middle of March. No reference is made to a query which recently appeared in the *Field* as to whether cuckoos ever utter their characteristic note in South Africa.

A noteworthy paper by Dr. M. Nowikoff appears in the August number of the *Zeitschrift für wissenschaftliche Zoologie* (Bd. 96, Heft 1) on the structure, development, and significance of the parietal eye of saurians. The author's investigations were conducted chiefly upon species of Lacerta and Anguis. The parietal or pineal eye in these genera agrees closely in histological structure with that of Sphenodon, but the author finds that it is innervated from the right habenular ganglion, and not from the left as Dendy has shown to be the case in the Tuatara. He now adopts the view that the pineal eye and epiphysis are dislocated members of one and the same pair of sense-organs, serially homologous with the lateral eyes, as Dendy has also maintained in the cases of Sphenodon and Geotria. He suggests that, inasmuch as the pineal eye is well developed in small and unprotected lizards, it is, though incapable of image-formation, probably still of service in giving notice of the approach of an enemy flying in the air when the lizards are sleeping in the sun with their paired eyes closed.

WE have recently had an opportunity of seeing at work the large new microtome brought out by the Cambridge Scientific Instrument Company. It is designed to cut flat sections up to 150×120 mm., the thickness of which can be varied by 0·002 mm., the maximum thickness of the section being 0·06 mm. The sliding carriage, in which the object, embedded in paraffin or celloidin, is held, is moved backwards and forwards on plane guides by a handle working through levers. The object is fed upwards by a ratchet turning a toothed wheel, and an arrangement similar to that found in the well-known rocking microtome of this company is adopted to lower the object-holder on the return stroke, so as to prevent the object fouling the knife. The knife can be very securely clamped either at right angles to the direction of movement of the object, when the latter is embedded in paraffin, or at an oblique angle when cutting celloidin. Arrangements are provided for changing the inclination of the cutting edge of the knife, and there is a small angular scale on the knife-holders, so that the angle found most suitable when cutting a particular object can be easily noted and repeated. The strength and rigidity of the instrument are striking features, but the care and attention devoted to the details of construction are no less evident, the device just mentioned, for reading off the angle of the knife, being an example of the useful details which will be greatly appreciated by the operator. We have seen a number of sections, cut by this microtome, of various tissues which can be cut only with some difficulty, which demonstrate the capabilities of the instrument, and we can recommend it to those whose work necessitates the preparation of large flat sections of material containing cartilage, decalcified bone, and other resistant tissues.

A SMALL pamphlet on the cultivation of mushrooms, of which Mr. R. L. Castle is the author, has been published in the series of "One and All" garden books. It can be recommended as a practical and authoritative guide.

A LIST of varieties of sweet peas classified according to colour has been prepared by the National Sweet Pea Society, and is published in the *Gardener's Chronicle* (October 8). It is described as an up-to-date selection of varieties in commerce, and comprises sixty-three varieties grouped in twenty-five classes; the first item in each class is that which produced flowers most true to colour in the society's trials. The society has also issued a list of varieties "too-much-alike" with the intention of allowing only one out of each colour group to be shown on a competition stand. Further, the society is taking steps to arrange for the registration of new varieties.

A COLLECTION of plants obtained by Mr. G. Nakhara in the southern half of the island of Saghalien is described by Mr. G. Koidzumi in the Journal of the College of Science, University of Tokyo (vol. xxvii., art. 13). It provides a supplement to the list of plants collected and determined by Dr. Fr. Schmidt in 1868, to which it adds about fifty species—one, *Cirsium Mamiyanum*, being new to science—and raises the total number of ferns and flowering plants to three hundred. A dozen species are limited to the Ochotsk region, including an Abies and a Picea. The special features of the flora are a predominance of the families Compositæ and Rosaceæ, and the small proportion (3 : 2) of species to genera.

ON the subject of tree plantations in Inverness-shire Mr. W. Dallimore places on record in the *Kew Bulletin* (No. 7) some useful data regarding cost and the species that have given good results on different estates. The area planted on the Ardverikie Estate since 1873 exceeds 10,000 acres, for which 34,000,000 plants have been required. Scots pine, larch, and spruce have been most extensively planted; the pine and larch have grown well on dry ground at altitudes exceeding 900 feet, while the spruce has succeeded better on wet ground, but *Abies nobilis* has, on the whole, proved more vigorous than any of the three. The cost of planting, including fencing, is given at 3*l.* 12*s.* per acre. Interest attaches to a note regarding a larch forest on the Invergarry Estate that at an early stage was condemned on account of the larch disease, but was spared at the urgent request of the forester in charge, and has now developed perfectly clean, straight trees.

THE issue of the *Geographical Journal* for October includes the paper on the land of the Incas, read before the society by Sir Clements R. Markham, K.C.B., F.R.S.; the paper provides a graphic account of southern Peru and part of the north of Bolivia, with their variety of climates, geographical features, and products. The land of the Incas extends from the water-parting of the maritime Cordillera to that of the eastern Andes, and from the gorges through which the rivers force their way into the Amazonian plain to the Knot of Vilcañonota, where the two Andean chains unite. The paper gives interesting glimpses at the Tiahuanacu ruins of unknown history, and shows how intimate is the author's knowledge of this part of South America. In the same issue appears Major G. F. A. Whitlock's paper on the Yola-Cross River Boundary Commission, Southern Nigeria, from which some idea can be obtained of the difficulties of accurate surveying in little known countries. Mr. Edward A. Martin gives an exhaustive account of further experiments he has made on dew-ponds. He has come to the conclusion that very rarely does dew ever form on the surface of ponds, and rarely on the puddled margins. He holds that if we continue to use the term dew-pond we must remember that the word must be used in the widest sense as including any form of condensation out of the atmosphere. Rain appears to be the all-important replenisher of these as of all other ponds which are not fed by springs.

THE application of the method of correlation to investigations of the connection between meteorological elements at different places promises to be a fruitful, though somewhat laborious, method of approaching the problem of seasonal forecasts. In a note in Bulletin 4, 1910, of the Central Meteorological Observatory of Japan, Dr. T. Okada has correlated the mean monthly pressures and temperatures for some places in the Far East. He finds that at Zikawei (Shanghai) the coefficient of correlation between pressure and temperature in December is $-0{\cdot}764 \pm 0{\cdot}050$. Taking pressure at Zikawei and temperature at Nagasaki, 500 miles distant, he finds for the value of the coefficient -0.044 ± 0.076. Thus high pressure at Zikawei is accompanied by low temperature, not only there, but also at Nagasaki. Again, taking pressure at Zikawei and rainfall at Keelung, in northern Formosa, 450 miles distant, he finds for the value of the coefficient 0.925 ± 0.037. Thus when pressure is high at Zikawei in winter rainy weather in northern Formosa may be confidently predicted. The paper includes diagrams, in which the relationships can be distinguished, but the definite numerical index furnished by the correlation supplies the meteorologist with much more satisfactory means of comparing the similarity with that for other places and of using the results in more extended researches.

INTEREST in the diurnal variations of the meteorological elements has been stimulated of late years by the addition to our knowledge of the analysed results of wind velocity for certain representative places, and by the difficulty of bringing into dynamical relation with each other the results for pressure, temperature, and wind. In Bulletin 4, 1910, of the Central Meteorological Observatory of Japan, Y. Tsuiji discusses the daily variation of wind and the displacement of the air at Nagasaki. After analysing the variation into its harmonic components, he attempts to connect it with the variation of pressure gradient deduced from the mean hourly values of pressure at the three stations Nagasaki, Fukuoka, and Kumamoto. He concludes that the phases of the variation of the components of wind are almost identical with those of the variation of the corresponding components of pressure gradient. Apart from any effect due to the earth's rotation, it would be expected that these phases would differ by 90°, and although the nearness of Nagasaki to latitude 30° might account for the identity in the phases for the diurnal wave, it is unlikely that the effect in the semi-diurnal wave can be attributed to such a cause. The author does not attempt to explain the anomaly. An examination and recalculation of some of the results shows that time is to be measured from 1 a.m. in the expressions given for the harmonic components, although it is stated that it is measured from midnight. Thus the diagram (Fig. 5) showing the diurnal and semi-diurnal waves is seen to be wrong by a comparison of the sum of the deviations at noon taken from the diagram with the actual values given in Table I. The fact that the phases of the diurnal term in the south and east components of velocity are almost exactly equal, while those for the semi-diurnal wave differ by 40° only, shows that convection is the predominating factor in determining the diurnal variation, and exercises a considerable influence on the semi-diurnal wave.

IN a paper which appeared in vol. xxxii. of the *Annalen der Physik* Dr. M. Knudsen, of the University of Copenhagen, describes an absolute manometer for the measurement of gas pressures not greater than a few thousandths of a millimetre of mercury. It depends on the measurement of the force of repulsion between two plates at different temperatures immersed in the gas, when their distance apart is extremely small compared with the mean free path of the molecules of the gas. This repulsion the author shows is equal in dynes per square centimetre to half the product of the pressure of the gas by the excess of the square root of the ratio of the two absolute temperatures of the plates over unity. The instrument consists of a polished copper plate, which is supported with its surfaces vertical by a thin platinum wire. Opposite part of one surface is the polished end of a fixed copper cylinder, the temperature of which can be raised above that of the suspended plate and the case of the instrument by sending an electric current through a platinum wire wound on it. The rotation of the moving plate about its suspension is determined by means of a mirror attached to the plate, and thermometers give the temperatures of plate and cylinder.

PROF. PATERNO, of the University of Rome, has given an account in the *Revue scientifique* of August 20 of some recent work on colloidal solutions, arising out of an early observation that tannic acid, which behaves as a colloid and produces no osmotic or cryoscopic effects in water, behaves in the normal way as a crystalloid when dissolved in acetic acid. The aqueous solution is a deep brown, although the tannic acid separating from it is white, and the solution in acetic acid is only yellowish. Observations by the ebullioscopic method indicated that the Grignard reagent, magnesium ethiodide, probably exists as a colloid in its ethereal solutions. Several alkaloids were found to dissolve in ether without raising its boiling point, whilst the alcoholic solutions showed a normal elevation.

IN an article in the *American Architect* for September 28 Prof. William H. Goodyear analyses the report of the Pisa Commission on the Leaning Tower, and brings forward evidence to show that the figures of the commission are in error. Prof. Goodyear maintains that the tower has moved 30 centimetres more than the commission has supposed, and that this movement had taken place before the date of De Fleury's "Monuments de Pise" in 1859. The actual movement, he says, has been one of 50 cm., not of 20; but this movement, which was probably caused by the earthquake of 1846, certainly occurred before 1859. Prof. Goodyear also challenges other results published by the commission. Thus the commission's supposed rate of inclination per metre in 1829 is $86\frac{1}{2}$ mm.; the article gives the real average rate as 84 mm. The supposed present rate of inclination per metre is announced by the commission as 92 mm.; here it is said to be really $94\frac{1}{2}$ mm. in 1859. The commission announces 20 cm. additional inclination between 1829 and 1910. There was really, it is said, 50 cm. additional inclination before 1859. The commission announces the rate of increase per metre between 1829 and 1910 as being $5\frac{1}{2}$ mm. Therefore, says Prof. Goodyear, if the supposed increase of 20 cm. be divided by the rate of increase per metre, we ought to obtain the axial height on which the increase was figured, viz. the axial height of the tower. "But when this division is made, the resulting axial height is only 36·36 m., which is the axial height, according to Cresy and Taylor, of the six stories above the first, thus leaving the entire lower story, which is nearly one-fourth of the axial height, out of the computation."

AN illustrated article on the Portsmouth water works appears in *Engineering* for October 7. The borough of Portsmouth has recently put into commission a new system of filter-beds and covered service reservoirs. The new works are situated at Farlington, on the side of Portsdown Hill, distant five miles from Portsmouth. The water supply comes from chalk springs at Havant and Bedhampton, where pumping-stations are situated. The water is delivered through three rising mains to the filter-beds, from which, after passing through the service reservoirs, it gravitates to the town. Previous to the construction of the new works, the water was delivered from the pumping-stations to two open service reservoirs on Portsdown Hill; these are now covered, and form part of the reconstructed scheme. It was the practice under the old conditions to deliver the water in an unfiltered state from the open service reservoirs to the town. The raw water is normally excellent, owing doubtless to the underground chalk through which it passes, but discoloration occasionally occurs during wet weather following a period of drought. Ferro-concrete on the Hennebique system has been employed largely on the new constructional work.

In this month's *Aeronautics* appears an announcement to the effect that, recognising the importance of flying from a military point of view, that journal offers to present a complete aëroplane to the first suitable officer of the army who applies for it and is willing to try his best to become proficient with it.

In the article on "Mathematics in Austria," in NATURE of September 29, mention was made of arithmetic papers set by the Civil Service Commissioners and other examining bodies. The writer asks us to say that his allusion to the Civil Service Commissioners was due to his belief that they regulated the Army Qualifying as well as the Army Competitive examination. He has since found that the former is conducted by the "Army Qualifying Board." His reference, therefore, to the Civil Service Commissioners was incorrect.

A TRANSLATION into German by Prof. Julius Ruska of Prof. W. H. Hobbs's book on "Earthquakes" has been published by Messrs. Quelle and Meyer, of Leipzig. A review of the original volume was published in the issue of NATURE for March 26, 1908 (vol. lxxvii., p. 481). The price of the German work is 6.60 marks.

OUR ASTRONOMICAL COLUMN.

ANNOUNCEMENT OF A NOVA.—A circular received from the Kiel Centralstelle states that in a telegram from Cambridge, Mass., received on October 5, it is announced that a new star in Sagittarius has been discovered by Mrs. Fleming on a plate taken on May 31·831 (G.M.T.). This object, Nova Sagittarii No. 2, was then bright enough to be visible in a small telescope, and its position is $\alpha=17$h. 52m. 15s., $\delta=27^\circ$ 32·2′ south, about 7m. west and 3° north of the third-magnitude star γ Sagittarii; like most other objects of its class, this nova lies in, or very near to, the Milky Way.

It is interesting to recall that Nova Sagittarii No. 1 was also discovered by Mrs. Fleming on a photograph taken at Arequipa on March 8, 1898, but was not detected until March, 1899.

TIME OF THE SOLAR TRANSIT OF HALLEY'S COMET.—The examination of various solar photographs for traces of Halley's comet during its transit of the solar disc on May 18 has hitherto been somewhat indefinite, because the exact times of ingress and egress were not certainly known. Figures which should permit of more definitive examinations are now given in No. 616 of the *Astronomical Journal*; they are as follows:—

	G.M.T. h. m.		
Ingress	15 40	...	Angle 279°
Least distance between centres .	16 9	...	Comet 3′ 15″ N.
Egress	16 39	...	Angle 76°

OBSERVATIONS OF COMET 1910*a*.—In a Bulletin of the Catania Academy of Natural Science, just received, Prof. Riccò discusses the observations of comet 1910*a*, visual, photographic, and spectroscopic, made at the Catania Observatory during January and February. After describing the visual and spectroscopic results, Prof. Riccò directs special attention to the greater similarity of the visual and photographic images in this comet than in several which immediately preceded it, due to the greater proportion of yellow radiations. He also suggests that the appearance of the three "hydrocarbon" and one yellow band, when the comet was near perihelion, is in accordance with Hasselberg's experiment with a Geissler tube containing hydrocarbon and sodium vapours. With the tube cool, only the hydrocarbon bands showed in the spectrum, but when it was heated the sodium band was seen to be relatively strong.

It is stated in the *Observatory* (No. 427) that whilst the object observed by M. Sykora (NATURE, September 8, p. 322) was in the right position-angle, it was considerably too far from the centre of the disc.

ARABIAN ASTRONOMICAL INSTRUMENTS.—Vol. xli. (1909) of the *Sitzungsberichte der Physikalisch-Medizinischen Sozietät in Erlangen* contains No. 18 of Prof. E. Wiedemann's contributions to the history of science, which deals with some of the astronomical instruments of the Arabs (53 pp.). Chapter i. gives descriptions of the astrolabe and the quadrant, founded on two writings by Al Birûni in the Royal Library of Berlin. Chapter ii. gives a review of the trigonometry of the Arabs and its application to problems arising from the use of the gnomon ("determination of the shadow"). Chapter iii. contains an account (chiefly from Al Birûni) of the use of the astrolabe in surveying. The paper is of special interest on account of the many extracts it gives from unpublished manuscripts, and makes us hope that some further details may yet be brought to light about the instruments used in the great observatories at Cairo, Merâgha and elsewhere, as to which our knowledge is very imperfect.

NEW EPHEMERIDES FOR SATURN, URANUS, AND NEPTUNE.—For some time it has been a known fact that the observed positions of the three outermost planets showed considerable discordance with Leverrier's tables. In No. 427 of the *Observatory* Dr. Downing directs attention to the advance made by the compilers of the *Connaissance des Temps* in publishing, for 1912, ephemerides based on Gaillot's "Tables Rectifiées" instead of Leverrier's tables. A comparison of the respective corrections shows that an important step in advance, in the calculation of accurate ephemerides of the major planets, has been made.

IRREGULARITIES IN THE MOTION OF ALGOL'S SATELLITE.—In the October number of the *Bulletin de la Société astronomique de France* M. Enzo Mora shows that, according to observations made in 1908, 1909, and 1910, the relative motion of the satellite of Algol has been subject to an extraordinary perturbation. Comparisons made between the brightness of Algol and that of ϵ Persei, within about 40 minutes of the minimum of the former, indicate departures from the normal of the time of minimum ranging from 0 to 26 minutes. The latter figure is somewhat uncertain and unique, but the difference cannot be traced to observational error; prior to 1909 the departure from normal had never exceeded 6 minutes. The perturbative action of other satellites is suggested as a possible cause of these irregularities.

THE CAMBRIDGE OBSERVATORY.—The annual report of the work done at the Cambridge Observatory during the year ended May 18 is divided into two sections, in the former of which Sir Robert Ball gives an account of the general observations. From this we learn that the results of the investigations into the constant of aberration and the variation of latitude, made by Mr. Cookson during 1905–7, are being prepared for press by Mr. Stratton, while the manuscript photographic catalogue of 6000 stars, observed at eleven observatories during the Eros campaign, has now been completed by Mr. Hinks.

In the second part Prof. Newall describes the work done in the astrophysical department. The radial velocities of certain red stars, of which many show fluctuations of brightness with long periods of variation, are being investigated by Mr. Stratton. It is with regret that we note that some difficulty is being experienced in obtaining a perfect 12-inch objective, of 60 feet focal length, for use in the solar observations.

OBSERVATIONS OF NEPTUNE'S SATELLITE.—The observations of Neptune's satellite, made by Prof. Barnard with the 40-inch refractor during 1900–10, are published in No. 617 of the *Astronomical Journal*. A magnifying power of 700 was usually employed, but the satellite was frequently found to be an extremely difficult object; the recorded magnitudes range from 13·0 to 14·5.

SOME RECENT STUDIES OF FOSSIL PLANTS.

WHEN, many years hence, a history of the study of fossil plants during the first decade of the twentieth century is being elaborated, it will be found that two discoveries, announced in 1903 and 1906 respectively, will stand out as particularly far-reaching in their "after effects." These contributions will be found to rank in importance with any that may be cited in the whole range of the previous history of the study of palæobotany.

In 1903, Oliver and Scott showed that Lyginodendron, a well-known fern-like plant of the Carboniferous period, was in reality a seed plant. Within the next two years a number of similar discoveries were made in the case of several other genera, though since 1905 no further contributions of a like nature have been published. The identification, however, in that year of the male organs of Lyginodendron, which we owe to Dr. Kidston, completed our knowledge of that genus.

In 1906, Dr. Wieland, in his handsome volume on the "American Fossil Cycads," brought home to us, with a vividness which left little to be desired, the amphisporangiate nature of the cone of the Mesozoic genus Bennettites, or Cycadeoidea, as the Americans prefer to call it.

As Wieland himself foresaw, this discovery has thrown light on the phylogeny of the Angiosperms and Gnetales,[1] two groups hitherto of obscure affinities. These contributions have been already reviewed in NATURE[2] at some length, and it is therefore not proposed to discuss them further here.

A very extensive series, amounting to several hundreds, of memoirs, both large and small, have also been published on various palæobotanical subjects within the last ten years. The results there contained all contribute to our knowledge in one direction or another, but these directions are so varied, and often so disconnected, that it will only be possible to notice a few of them very briefly in a concise review such as the present. Further, the selection here made will be chiefly confined to those which have appeared during the last four years, and especially to those dealing with petrified material.

The true Ferns of the past have recently received considerable attention. It is now recognised that the ancient Ferns of the Palæozoic period, for which the name Primofilices has been suggested, differed in certain important respects from the Mesozoic, Tertiary, and recent Leptosporangiatæ. The latter appear to have sprung from the Primofilices, during the latter portion of the Permian period, and it would seem that, very soon after the initiation of the group, it differentiated in a fan-like manner into a number of families, many of which are still represented to-day. The Osmundaceæ, for instance, which of all the Leptosporangiate ferns stand nearest to the archaic stock, the Primofilices, were in existence in Upper Permian times.

This fact is emphasised by the recent studies of Kidston and Gwynne-Vaughan,[3] on the anatomy of a number of Osmundaceous stems from the Permian, Mesozoic, and Tertiary rocks. Three of these memoirs have appeared, and a fourth has been added since this review was written. This work is especially interesting, for not only is our knowledge of petrified plant remains from the rocks of these periods extremely scanty, but the study of the structure of these ancient representatives of the family has thrown light on the ancestral history of certain structural peculiarities met with in living ferns, especially the origin of the adaxially curved leaf trace.[4] The primitively solid, protostelic nature of the stem cylinder of the ancient Osmundaceæ is emphasised, and the evolution of the stele in this group is no longer a matter of theory, but of fact.

Our knowledge of the Primofilices has also recently advanced rapidly. A full account of this group will be found in the new edition of Scott's "Studies in Fossil Botany" (chapter ix.). Dr. Paul Bertrand, in his "Études sur la Fronde des Zygoptéridées," a handsomely illustrated volume published last year, has traced the course of evolution of the petiolar stele of members of this group. In this connection Mr. Gordon's paper on the structure of the stem and petiole of *Diplolabis roemeri* (Solms) from the Calciferous Sandstone of Scotland, which is shortly to appear in the Transactions of the Royal Society of Edinburgh, will be found of interest as carrying further broad conclusions of a similar, if not identical, character.

So far as the other Palæozoic groups are concerned, attention has recently been devoted almost entirely to the Lycopods. The Sigillarias, which until a short time ago remained the one important genus of the anatomy of which we knew very little, especially as regards the numerous species which possessed ribbed stems (Eu-Sigillariæ), have now been studied in detail. The structure of the stele closely resembles that of other Palæozoic Lycopods, especially Lepidophloios, the chief distinguishing features being found in the cortical tissues and leaf-bases. The anatomy of the cone scars is now known.[1] It has been found that, in certain species of ribbed Sigillariæ, the leaf-trace, when traversing the leaf-base and the lower part of the leaf, possesses a double xylem strand[2] (Fig. 2). The ribbing of the stem appears to be quite independent of the leaf-bases. The external features of three species of ribbed Sigillarias have now been correlated with their internal structure.

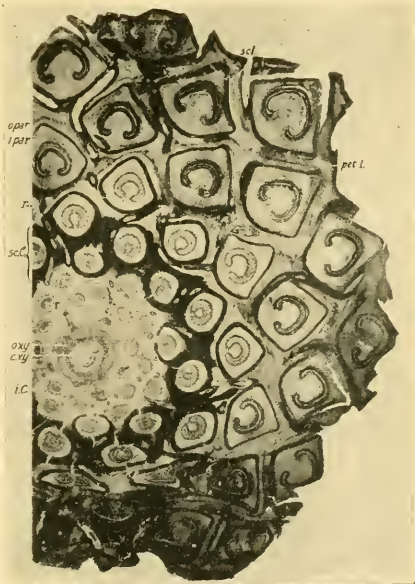


FIG. 1.—*Thamnopteris Schlechtendallii*, an Osmundaceous stem from the Upper Permian of Russia. A transverse section showing *o.xy*, outer xylem ring; *c.xy*, central xylem; *i.C*, inner cortex; *sc C.* sclerotic outer cortex; *i.par*, inner parenchyma of petiole; *o.par*, outer parenchyma of petiole; *scl.* sclerotic ring of petiole; *r.*, root. Reduced after Kidston and Gwynne-Vaughan.

The Sigillarias, like the Lepidodendrons, were large forest trees, often 100 feet or more in height. Herbaceous members of the group appear to have been comparatively rare, and until recently have been little known. Halle[3]

[1] See Arber and Parkin, Proc. Linn. Soc. Bot., vol. xxxviii., p. 29, 1907, and Annals of Bot., vol. xxii., p. 489, 1908.

[2] See NATURE, vol. lxxi., p. 68, 1904; and p. 426, 1905; vol. lxxv., p. 329, 1907; vol lxxvi., p. 113, 1907.

[3] Kidston and Gwynne-Vaughan, Trans. Roy. Soc., Edinburgh, vol. xlv., p. 759, 1907; vol. xlvi., pp. 213. 651, 1908–9.

[4] Gwynne-Vaughan and Kidston, Proc. Roy. Soc. Edinburgh, vol. xxviii., p. 433, 1908

[1] Kidston, Trans. Roy. Soc. Edinburgh, vol. xli., p. 533, 1905; Proc. Roy. Soc. Edinburgh, vol. xxvii., p. 207, 1907.

[2] Arber and Thomas, Phil. Trans. Royal Soc. B, vol. cc., p. 133, 1908; Ann. of Bot., vol. xxiii., p. 513, 1909.

[3] Halle, Arkiv. för Botanik (Stockholm), vol. vii., No. 5, 1907; and *ibid.*, vol. vii., No. 7, 1908.

has, however, figured several impressions of herbaceous Lycopods from the Palæozoic and Mesozoic rocks, some of which appear to be similar in habit to the recent Lycopodium, and others to Seloginella. The latter have dimorphic leaves, and in some cases the sporangia are aggregated into stroboli, while, in at least one species, they are borne in the axils of foliage leaves, a very interesting feature in comparison with the modern Selaginellas. Zeiller, in his fine memoir, "Bassin houiller et permien de Blanzy et du Creusot" (1906), has figured, among other very interesting impressions, a Selaginellites, in which the leaves are arranged in the same manner as in the recent tetrastichous Selaginellas. The heterosporous cones contain a large number of megaspores in the megasporangia, another interesting feature unknown in the modern representatives of the group.

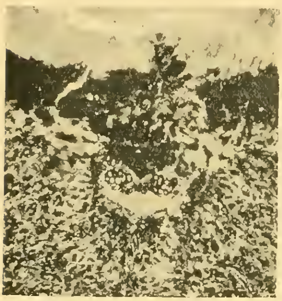


FIG. 2.—Tangential section through the leaf-base of *Sigillaria scutellata*, Brongn., showing the two xylem groups. After Arber and Thomas.

These specimens, however, are mere impressions. Fortunately, however, Miss Benson [1] has recently extended our knowledge of these plants by describing the anatomy and fructification of *Miadesmia membranacea*, Bertr., the first instance in which we have any information as to the structure of a *herbaceous* Palæozoic Lycopod. The fructification of this plant proves to be a primitive seed-like organ, recalling Lepidocarpon among fossils, and Isoetes among living plants.

Numerous other memoirs on Palæozoic Lycopods have also appeared, which it is impossible to discuss here. Among these may be mentioned Prof. Weiss's [2] description of a Stigmaria with centripetal wood, Mr. Watson's [3] discovery of the cone of *Bothrodendron mundum* (Will.), and Mr. David White's [4] *Archaeosigillaria primaeva*, an interesting impression from the Devonian rocks of New York State.

Although, as has been stated, no further attributions of seeds to the Palæozoic fern-like plants or Pteridospermeæ have been made during the last few years,[5] our knowledge of this group has been extended in other directions. Scott [6] has described a new stem, *Sutcliffia insignis*, Scott, a member of the Medulloseæ, characterised by concentric petiolar bundles, and a stem of very simple structure with a single main stele; a unique case of dialystely without siphonostely.

The structure of isolated seeds of pteridospermous affinity has also received attention, Scott and Maslen's [7] studies of Trigonocarpus, of which the first part has appeared, and Oliver's [8] memoir on *Physostoma elegans*, Will., being notable contributions in this direction.

Turning next to the studies of Mesozoic plants, Wieland's elucidation of the cone of Bennettites, to which we have already alluded, has been followed by the very important discoveries by Nathorst [9] of the male organs of Williamsonia, Anomozamites (now called Wielandiella), and several other genera of Triassic or

[1] Benson, Phil. Trans. Roy. Soc. B, vol cxcix., p 409, 1908.
[2] Weiss, Ann. of Bot, vol. xxii, p. 221, 1908.
[3] Watson, Mem. and Proc. Manchester Lit. and Phil. Soc., vol. lii., No. 3, 1908.
[4] White, New York State Mus. Bull. cvii., p. 327, 1907.
[5] Nathorst has shown that the fructifications figured by Arber as *Carbolithus Nathorsti* (Ann. of Bot, vol. xxii., p. 57, 1908) are not seeds.
[6] Scott, Trans. Linn. Soc. Lond., Ser. 2, Bot., vol. vii., p. 45, 1906.
[7] Scott and Maslen, Ann of Bot., vol. xxi, p. 89, 1907.
[8] Oliver, Ann. of Bot., vol. xxiii., p. 73, 1909.
[9] Nathorst, K. Svenska Vetenskap. Akad. Handl., vol. xlv., No. 4, 1909.

Jurassic age, also belonging to the Bennettitales. Nathorst's specimens were impressions and not petrifactions, but by means of his new methods for studying carbonised impressions [1] he has been extremely successful in obtaining, from mere impressions, information which, until a few years ago, would have been regarded as quite impossible.

Nathorst finds that the flowers of Williamsonia, unlike those of Bennettites, are unisexual, a very important point. The male sporophylls (Fig. 3) were arranged in a whorl, and were fourteen or fifteen in number. They were united laterally for nearly half their length. The microsporangia were borne on the inner side of the sporophyll on segments which were somewhat divided. The male organs may be of a similar nature to the extraordinary "male-fronds" of Bennettites, but in Williamsonia they are very greatly reduced.

In Wielandiella, however, the cones are amphisporangiate, and the male sporophylls are still more reduced, and form a palisade-like ring near the base of the cone. The cone was markedly protogynous (Fig. 4).

The fact that the male sporophylls of some members of the Bennettitales have now been found, which are very much reduced as compared with those of Bennettites itself—an event which was confidently expected to occur—has an important bearing on the question of the origin of the Angiospermous stamen.[2]

Wieland [3] has also recently described a male flower of a Williamsonia, which does not, apparently, agree exactly with that discovered by Nathorst in Yorkshire last summer. On this specimen Wieland has founded a theory of the phylogeny of the Gamopetalæ, which, however, will probably not meet with general acceptance.

Mesozoic plants are now attracting a more considerable share of attention than they have in the past. The great drawback to studies of this nature has always been the absence of petrified material. Impressions alone are available, though there has been no lack of large, isolated stems or trunks of Gymnospermous or Angiospermous affinity in certain deposits belonging to this period. Such petrifactions, however, do not tell us very much, and we have hitherto failed to find plant-bearing concretions, similar to

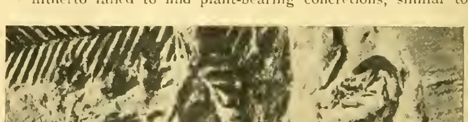


FIG. 3.—The Male Flower of *Williamsonia spectabilis*, Nathorst, from the Lower Oolite of Whitby, Yorkshire. After Nathorst.

the coal-balls of the English Carboniferous rocks, with their wealth of fragments of leaves, cones, or other organs, from which so much can be ascertained, both from an anatomical and a phylogenetic standpoint. Stopes and Fujii [4] have now, however, discovered such concretions in the Upper

[1] Nathorst, Arkiv. für Botanik, vol. vii., No. 4, 1907; K. Svenska Vetenskap. Akad. Handl., vol. xliii., No. 6, 1908. See also Bather, Geol. Mag., Dec. v., vol. iv., p. 437, 1907; vol. v., p. 454, 1908.
[2] See Arber and Parkin, *ante*.
[3] Wieland, Bot. Gaz., vol. xlviii., p. 427, 1909.
[4] Stopes and Fujii, Phil. Trans. Roy. Soc. B, vol. cci., p. 1, 1910.

Cretaceous of Japan, which in several respects appear to be quite analogous to our English coal-balls. In their paper published a few months ago, they describe a varied series of fossil plants from these nodules, such as the sporangia of a fern of Schizæaceous affinities, a leaf, Niponophyllum, with parallel nerves, several stems and cones of Gymnosperms, especially Yezonia, a trunk in which the wood consists of thick- and thin-walled tracheids arranged on the same radii, and which is regarded as a representative of a new family of Coniferæ. Among the Angiospermous remains are woods allied to the Saururaceæ, to the Juglandaceæ, the Sabiaceæ, and Cupuliferæ. But perhaps the most interesting specimen is that discussed as being a flower of Liliaceous affinity, and termed *Cretovarium japonicum* (Fig. 5). This is regarded by the authors as the first fossil flower known in the petrified state. It is described as a trilocular ovary with axile placentation, though the ovules are absent.

FIG. 4.—The amphisporangoic cone of *Wielandiella angustifolia*, Nathorst, from the Rhætic of Sweden. (1) The axis with the "palisade-ring" of male sporophylls below. (2) The ring of male sporophylls enlarged. After Nathorst.

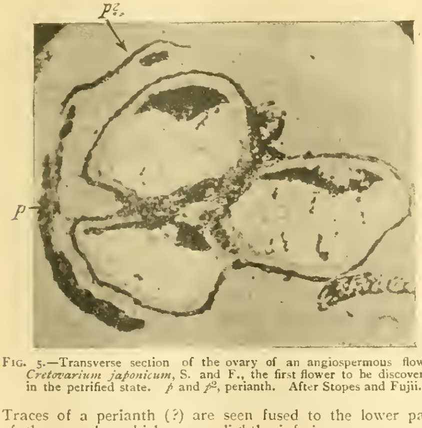


FIG. 5.—Transverse section of the ovary of an angiospermous flower *Cretovarium japonicum*, S. and F., the first flower to be discovered in the petrified state. p and p^2, perianth. After Stopes and Fujii.

Traces of a perianth (?) are seen fused to the lower part of the carpels, which were slightly inferior.

E. A. N. A.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

Edward Arnold.—The Development of British Forestry, A. C. Forbes, illustrated. *Constable and Co., Ltd.*—To Work a Grass Holding at a Living Profit and the Cheap Cottage Problem, H. B. M. Buchanan. *Duckworth and Co.*—Agricultural Bacteriology: Theoretical and Practical, Prof. J. Percival. *John Murray*.—The Feeding of Crops and Stock, A. D. Hall, F.R.S. *Kegan Paul and Co., Ltd.*—Weeds of the Farm and Garden, Prof. L. H. Pammel, illustrated; Commercial Fertilisers, Dr. L. L. Van Slyke; Field and Garden Peas, G. C. Seavey, illustrated; Profitable Stock Raising, C. A. Shamel; Profitable Poultry Production, M. G. Kains; Farm Crops, C. W. Burkett.

ANTHROPOLOGY.

Macmillan and Co., Ltd.—The Golden Bough: a Study in Magic and Religion, Dr. J. G. Frazer, third edition, in five parts: Part i., The Magic Art and the Evolution of Kings; Part ii., The Perils of the Soul and the Doctrine of Taboo; Along the Old North Trail: or Life, Legends and Religion of the Blackfeet Indians, W. McClintock, illustrated. *John Murray*.—The Castes and Tribes of Eastern India, Sir H. Risley; Shans at Home: their Customs, Habits of Life, Industries, Folk-lore, Mrs. L. Milne, with two chapters on Shan History and Literature by the Rev. W. W. Cochrane, illustrated. *Swan Sonnenschein and Co., Ltd.*—Bushman Folk-lore, L. C. Lloyd, with a preface by Dr. G. McCall Theal, illustrated; The Native Races of South Africa, the late G. W. Stow, edited by Dr. G. M. Theal, illustrated. *Watts and Co.*—History of Anthropology, Dr. A. C. Haddon, F.R.S., illustrated.

BIOLOGY.

Edward Arnold.—Hereditary Characters, C. E. Walker; Practical Photomicrography, J. E. Barnard, illustrated; A Gamekeeper's Note-book, O. Jones and M. Woodward, illustrated; Fly-leaves from a Fisherman's Diary, Capt. G. E. Sharp, illustrated. *John Bale, Sons and Danielsson, Ltd.*—A new edition of Lectures on Biology, Dr. C. Thesing, translated by W. R. Boelter. *G. Bell and Sons, Ltd.*—The Inherent Law of Life: a New Theory of Life and of Disease, F. Kleinschrod, translated and edited by L. C. Appel; A Text-book of Plant Physiology, Prof. F. W. Keeble, illustrated. *A. and C. Black*.—First Principles of Heredity, S. Herbert, illustrated. *W. Blackwood and Sons*.—The Elements of British Forestry, J. Nisbet. *Cambridge University Press*.—The Coming of Evolution, Prof. J. W. Judd, C.B., F.R.S.; Heredity, L. Doncaster; Plant-Animals, Prof. F. W. Keeble. *W. and R. Chambers, Ltd.*—Britain's Birds and their Nests, A. L. Thomson, illustrated. *J. M. Dent and Sons, Ltd.*—Physiology, Prof. Sherrington, F.R.S.; Zoology, Prof. Herdman, F.R.S.; Mendelism, Dr. Drinkwater, illustrated; The Book of the Animal Kingdom (Mammals), W. P. Westell, illustrated; Orchids for Everyone, C. H. Curtis, illustrated. *Duckworth and Co.*—Toy Dogs and their Ancestors, Hon. Mrs. N. Lytton, illustrated. *Dulau and Co., Ltd.*—The Influence of Parental Occupation and Home Conditions on the Physique of the Offspring, E. M. Elderton; On the Marriage of First Cousins, E. M. Elderton. *C. Griffin and Co., Ltd.*—New editions of Micro-organisms and Fermentation, A. Jörgensen, translated by S. H. Davies, illustrated; Open-air Studies in Botany: Sketches of British Wild Flowers in their Homes, R. Lloyd Praeger, illustrated. *Gurney and Jackson*.—A History of British Mammals, G. E. H. Barrett-Hamilton, 24 parts, illustrated. *T. C. and E. C. Jack*.—Present-day Gardening, edited by R. H. Pearson: Carnations and Pinks, T. H. Cook, J. Douglas, and J. F. M'Leod; Rhododendrons and Azaleas, W. Watson; Lilies, A. Grove; Orchids, J. O'Brien; Roses, H. E. Molyneux; and volumes on Annuals, Apples and Pears, Cucumbers, Melons, Tomatoes, &c., illustrated. *Longmans and Co.*—Lives of the Fur Folk: the Biographies of Redpad the Fox, Fluff-button the Rabbit, Grimalkin the "Gone Wild" Cat, Stubbs the Badger, M. D. Haviland, illustrated; The Essentials of Morbid Histology, Dr. A. S. Grünbaum, illustrated. *Macmillan and Co., Ltd.*—The Age of Mammals, Prof. H. F. Osborn, illustrated; Text-book of Human Physiology, Dr. L. Luciani, translated by Frances A. Welby, and edited by Dr. M. Camis, with a preface by Prof. J. N. Langley, F.R.S., illustrated, in 4 vols., vol. i. *The Methodist Publishing House*.—Sunbeam's River: a Child's Nature Story Book, N. Parsons, illustrated; In Nature's Nursery, S. N. Sedgwick, illustrated; The Boy's Book of Angling and Rambling, W. J. Claxton, illustrated. *Methuen and Co.*, *Ltd.*—Preliminary Physiology, W. Narramore. *John Murray.*—The Genus Rosa, E. Willmott, illustrated. *Kegan Paul and Co., Ltd.*—Biology, Rev. E. Wasmann, illustrated; The Problem of Evolution, Rev. E. Wasmann. *Swan Sonnenschein and Co., Ltd.* Plant Life: a Manual of Botany for Schools, Prof. E. Warming, translated by E. Rehling and E. M. Thomas, illustrated. *Witherby and Co.*—The Home-life of a Spoonbill, a Stork, and a Heron, B. Beetham, illustrated; The Birds of Australia, G. M. Mathews, illustrated; Liverworts, British and Foreign, Sir Edward Fry, G.C.B., F.R.S.

Chemistry.

Edward Arnold.—An Introduction to Bacteriological and Enzyme Chemistry, Dr. G. J. Fowler, illustrated. *A. and C. Black.*—Chemical Analysis, Qualitative and Quantitative: a Text-book for Technical Schools and Colleges, G. G. Gardiner, vol. i. *C. Griffin and Co., Ltd.*—A new edition of Dairy Chemistry, for Dairy Managers, Chemists, and Analysts, H. D. Richmond, illustrated; and a new edition of Chemistry for Engineers, B. Blount and A. G. Bloxam, illustrated. *Longmans and Co.*—Lectures on the Chemistry of Paints, Dr. J. N. Friend; An Elementary Chemistry for Mining Students, L. T. O'Shea. *Methuen and Co., Ltd.*—A Short History of Chemistry, T. P. Hilditch. *Mills and Boon, Ltd.*—A First School Chemistry, F. M. Oldham. *Kegan Paul and Co., Ltd.*—Crystals, Dr. A. E. H. Tutton, illustrated. *Williams and Norgate.*—A new edition of The Chemist's Pocket Manual: a Practical Handbook containing Tables, Formulas, Calculations, Information, Physical and Analytical Methods for the Use of Chemists, Chemical Engineers, Assayers, Manufacturers, and Others, R. K. Meade.

Engineering.

Edward Arnold.—The Practical Design of Motor-cars, J. Gunn, illustrated; Cement, Dr. C. H. Desch, illustrated; Modern Methods of Water Purification, J. Don and J. Chisholm, illustrated. *Cassell and Co., Ltd.*—Electrical Engineering, H. H. Simmons, illustrated. *Constable and Co., Ltd.*—Solenoids, Electromagnets and Electromagnetic Windings, C. Underhill, illustrated; The Encyclopædia of Municipal and Sanitary Engineering, edited by W. H. Maxwell and J. T. Brown, illustrated; A Treatise on Testing for Engineers, Part i., Materials, C. A. Smith; The Construction and Working of Internal-combustion Engines, being a Practical Manual for Gas-engine Designers, Repairers and Users, R. E. Mathot, translated by W. A. Tookey, illustrated; Electric Furnaces and their Industrial Application, J. Wright, illustrated; Irrigation Works: a Course of Lectures delivered at Oxford under the Auspices of the Common University Fund, N. F. Mackenzie; The Practical Design of Irrigation Works, W. G. Bligh, illustrated; Gas Engines, W. J. Marshall and H. R. Sankey. *C. Griffin and Co., Ltd.*—Transformers, Profs. H. Bohle and D. Robertson, illustrated; Electric Crane Construction, C. V. Hill, illustrated; The Design and Construction of Ships, Prof. J. H. Biles, vol. ii.; Modern Methods of Sewage Purification, G. B. Kershaw, illustrated; A Manual of Civil Engineering Practice, Specially Arranged for the Use of Municipal and County Engineers, F. N. Taylor, illustrated; and new editions of A Text-book on Gas, Oil, and Air Engines, vol. ii., B. Donkin, revised by T. G. Smith, with new chapters by Prof. Burstall, illustrated; Mechanical Engineering for Beginners, R. S. M'Laren, illustrated. *Crosby Lockwood and Son.*—The Modern Manufacture of Portland Cement, P. C. H. West, in 3 vols., vol. i., dealing with "Machinery and Kilns," illustrated; Drying Machinery and Practice: a Handbook on the Theory and Practice of Drying and Desiccating, with Classified Description of Installations, Machinery, and Apparatus, including also a Glossary of Technical Terms and Bibliography, T. G. Marlow, illustrated. *Whittaker and Co.*—The Steam Turbine: its Principles of Design and Construction, R. Kennedy; The Practical Design of Reinforced Concrete Beams and Columns, W. N. Twelvetrees; The Modern Practice of Coal Mining, D. Burns and G. L. Kerr, part iv.; Electric Wiring Diagrams, W. P. Maycock; Elementary Telegraphy, H. W. Pendry; and a new edition of Electric Wiring, Fittings, Switches and Lamps—Electric Circuits, W. P. Maycock.

Geography and Travel.

D. Appleton and Co.—Up the Orinoco and Down the Magdalena, H. J. Mozans, illustrated. *Edward Arnold.*—Unexplored Spain, A. Chapman and W. J. Buck, illustrated; Twenty Years in the Himalaya, Major the Hon. C. G. Bruce, M.V.O., illustrated; Recollections of an Old Mountaineer, W. Larden, illustrated. *Cambridge University Press.*—Worcestershire, L. J. Wills; East London, G. F. Bosworth; West London, G. F. Bosworth; Cumberland, Dr. J. E. Marr, F.R.S.; Huntingdonshire, Rev. W. M. Noble; Berkshire, H. W. Monckton; The Isle of Man, Rev. J. Quine; Ayrshire, J. Foster; Fifeshire, E. S. Valentine (Cambridge County Geographies). *Cassell and Co., Ltd.*—In the Heart of Africa, the Duke of Mecklenburg, illustrated. *Constable and Co., Ltd.*—From Haussaland to Egypt, Dr. K. Kumm, illustrated; Across the Roof of the World: being an Account of Travel, Exploration and Sport on the Pamirs and in Chinese Turkestan, Mongolia and Siberia, Lieut. B. T. Etherton, illustrated; The Call of the Snowy Hispar: a Narrative of Exploration and Mountaineering on the Northern Frontier of India, Dr. W. H. and Mrs. Workman, illustrated; Adventure, Sport and Travel in the Tibetan Steppes: an Account of the Travels of C. H. Mears and J. A. Brooke, edited by W. N. Fergusson. *W. Heinemann.*—Hunting Camps in Wood and Wilderness, H. H. Prichard, illustrated; A Voice from the Congo, H. Ward, illustrated; Amurath to Amurath, G. Lowthian Bell. *Hodder and Stoughton.*—The North Pole, Commander R. E. Peary, illustrated. *Hutchinson and Co.*—The New New Guinea, B. Grimshaw, illustrated; Somaliland, A. Hamilton, illustrated; Sixty Years' Travel and Adventure in the Lands of the Far East, J. D. Ross, illustrated. *Macmillan and Co., Ltd.*—Overland to India: a Popular Narrative of a Journey from Trebizond to Quetta, Dr. Sven Hedin, 2 vols., illustrated; The Glory of the Shia World: the Tale of a Pilgrimage, translated and edited from a Persian manuscript by Major P. M. Sykes, C.M.G., assisted by Khan Bahadur Ahmad Din Khan, illustrated; Highways and Byways of the Rocky Mountains, C. Johnson, illustrated; Through Khurasan and Central Asia: a Book of Literary and Historic Research, A. V. W. Jackson, illustrated; The Great White North, Mrs. H. S. Wright, illustrated; Cuba: the Country and the People, I. A. Wright, illustrated; Pompeii, described by W. M. Mackenzie, illustrated. *John Murray.*—The Excavations of Gezer, 1902–5 and 1907–9, Prof. R. A. S. Macalister, illustrated; India and Tibet: being a History of the Relations which have subsisted between the Two Countries from the Time of Warren Hastings to the Present Year, together with a Particular Account of the Mission to Lhasa of 1904, Colonel Sir F. Younghusband, illustrated. *Smith, Elder and Co.*—The Incas of Peru, Sir Clements R. Markham, K.C.B., F.R.S., illustrated; a new edition of Chota Nagpore, F. B. Bradley-Birt, illustrated. *Watts and Co.*—The History of Geography, Dr. J. S. Keltie.

Geology.

Edward Arnold.—A Text-book of Geology, P. Lake and R. H. Rastall, illustrated. *Cambridge University Press.*—The Natural History of Coal, E. A. N. Arber. *J. M. Dent and Sons, Ltd.*—Geology, Prof. J. W. Gregory, F.R.S. *C. Griffin and Co., Ltd.*—Geology for Engineers, Major Sorsbie, illustrated; A Bibliography of the Mineral Wealth and Geology of China, C. Y. Wang. *Longmans and Co.*—The Prehistoric Period in South Africa, J. P. Johnson, illustrated. *Watts and Co.*—The History of Geology, H. B. Woodward, F.R.S.

Mathematical and Physical Science.

D. Appleton and Co.—A High School Course in Physics, F. R. Gorton, illustrated. *A. and C. Black.*—Practical Physics: a Text-book for Technical Schools and Colleges, A. McLean, vol. i. *Cambridge University Press.*—Scientific Papers, Sir G. H. Darwin, K.C.B., F.R.S., vol. iv.; The Collected Mathematical Papers of James Joseph Sylvester, F.R.S., vol. iv.; The Calculus for Beginners,

J. W. Mercer; Practical Measurements, A. W. Siddons and A. Vassall; Clouds, C. T. R. Wilson, F.R.S.; Aviation, A. Ferguson. *Cassell and Co., Ltd.*—Practical Electricity, the late Prof. Ayrton, F.R.S., and Prof. T. Mather, F.R.S. *C. Griffin and Co., Ltd.*—Physico-chemical Tables, J. Castell-Evans, vol. ii., Chemical Physics, Pure and Analytical Chemistry; and a new edition of General Physics: being vol. i. of an Elementary Text-book of Physics, Dr. R. W. Stewart, illustrated. *Longmans and Co.*—Physical, Chemical and Mathematical Tables, G. W. C. Kaye and Prof. T. H. Laby; A School Course of Heat, R. H. Scarlett; Bird Flight as the Basis of Human Flight, O. Lilienthal, translated by A. W. Isenthal, illustrated; Anharmonic Coordinates, Lieut.-Col. H. W. L. Hime. *Macmillan and Co., Ltd.*—Crystallography and Practical Crystal Measurement, Dr. A. E. H. Tutton, F.R.S., illustrated; Elementary Dynamics, Prof. A. Gray, F.R.S. *Mills and Boon, Ltd.*—A New School Geometry, R. Deakin; Practical Mathematics, W. E. Harrison, illustrated; A Practical Course in First Year Physics, E. T. Bucknell. *G. Philip and Son, Ltd.*—A new edition of Popular Guide to the Heavens, Sir R. S. Ball, F.R.S. *G. P. Putnam's Sons.*—Astronomy in a Nutshell, G. P. Serviss, illustrated; A Beginner's Star-book, K. McKready, illustrated. *Whittaker and Co.*—Elementary Aëronautics, A. P. Thurston.

MEDICAL SCIENCE.

D. Appleton and Co.—Nutrition and Dietetics, W. S. Hall; Text-book of Bacteriology, P. Hanson Hiss, jun., and H. Zinsser; Symptomatic and Regional Therapeutics, G. H. Hoxie; Surgical Diagnosis, A. B. Johnson, 3 vols., illustrated; Plastic and Cosmetic Surgery, F. S. Kolle, illustrated; Principles of Therapeutics, A. Manquat, translated by M. S. Gabriel; Clinical Symptomatology, A. Pick and A. Hecht, translated by K. K. Koessler, with special reference to the Life Threatening Symptoms and their Treatment; A Text-book in Psychotherapy: including the History of the Use of Mental Influence, Directly and Indirectly, in Healing and in the Principles for the Application of Energies derived from the Mind to the Treatment of Disease, J. J. Walsh; Conquest of Disease through Animal Experimentation, J. P. Warbasse. *Baillière, Tindall and Cox.*—Medical Supervision in Schools: being an Account of the Systems at Work in Great Britain, Switzerland, Germany, Canada, and the United States, Dr. E. M. Steven, illustrated; Hæmoglobinuria, Dr. A. E. L. Charpentier; Veterinary Parasitology, R. H. Smythe; and new editions of Military Hygiene, Lieut.-Col. R. Caldwell, illustrated; Physiological Principles in Treatment, Dr. W. L. Brown; Manual of Physiology, with Practical Exercises, Prof. G. N. Stewart, illustrated. *John Bale, Sons and Danielsson, Ltd.*—The Diseases of China, including Formosa and Korea, Drs. W. H. Jefferys and J. L. Maxwell, illustrated; Amœbic or Tropical Dysentery: its Complications and Treatment, Dr. W. C. Brown; Reports from the Clinical and Research Laboratories, St. George's Hospital, London, 1910. *A. and C. Black.*—A new edition of Text-book of Operative Surgery, Dr. T. Kocher, translated by Dr. H. J. Stiles, illustrated. *J. and A. Churchill.*—A Manual of Skin Diseases, Dr. J. H. Sequeira, illustrated; and new editions of The Principles and Practice of Medical Jurisprudence, edited by Dr. F. J. Smith, 2 vols.; Serum and Vaccine Therapy, Bacterial Therapeutics and Prophylaxis Bacterial Diagnostic Agents, Prof. R. T. Hewlett, illustrated; The Microscopical Examination of Foods and Drugs, Prof. H. G. Greenish, illustrated. *Constable and Co., Ltd.* Primitive Psychotherapy and Quackery, Dr. R. M. Lawrence. *C. Griffin and Co., Ltd.*—Transactions of the Medico-Legal Society for the Year 1909–1910, edited by D. Cotes-Preedy, assisted by W. A. Brend. *T. C. and E. C. Jack.*—The Bacillus of Long Life: a Manual of the Soured Milk Industry, L. M. Douglas, illustrated. *John Lane.*—The Rheumatic Diseases, Dr. J. O. Symes; Hysteria and Neurasthenia, Dr. J. M. Clarke; X-Rays in General Practice, Capt. A. E. Walter; A Short Practice of Aural Surgery: for the Use of Students and Practitioners, Dr. J. A. Jones. *Longmans and Co.*—Dental Surgery and Pathology, J. F. Colyer, being the third edition of Diseases and Injuries of the Teeth, by Morton Smale and J. F. Colyer, illustrated; Sanitary Law in Question and Answer, C. Porter. *Macmillan and Co., Ltd.*—New editions of A System of Medicine, by Many Writers, edited by Sir Clifford Allbutt, K.C.B., and Dr. H. D. Rolleston, vol. viii., Diseases of the Brain and Mental Diseases; Deformities: a Treatise on Orthopædic Surgery, intended for Practitioners and Advanced Students, A. H. Tubby, 2 vols., illustrated. *Methuen and Co., Ltd.*—Methuen's Health Readers, vol. i., C. J. Thomas. *G. P. Putnam's Sons.*—The History of Medicine, Philosophical and Critical, D. A. Gorton, 2 vols., illustrated; and new editions of Dust and its Dangers, T. M. Prudden, illustrated; and The Story of Bacteria and their Relations to Health and Disease, T. M. Prudden. *The Walter Scott Publishing Co., Ltd.*—Elements of Physiology, Prof. Osborne; Eating for Health, Dr. Abramowski.

TECHNOLOGY.

G. Bell and Sons, Ltd.—Exercises in Metal-work: for Trade Preparatory Schools, A. J. Kersey. *Constable and Co., Ltd.*—Textiles, A. F. Barker, with chapters on The Mercerised and Artificial Fibres, The Dyeing of Textile Materials, Silk Throwing and Spinning, The Cotton Industry and the Linen Industry, illustrated; Wood Pulp, C. F. Cross, E. J. Bevan, and R. W. Sindall. *C. Griffin and Co., Ltd.*—The Principles and Practice of Textile Printing, Dr. E. Knecht and J. B. Fothergill; The Principles of Bleaching and Finishing, S. R. Trotman and E. L. Thorp, illustrated; Tests for Coal-tar Colours in Aniline Lakes, G. Zerr, translated by Dr. C. Mayer; and new editions of The Metallurgy of Steel, F. W. Harbord, with section on The Mechanical Treatment of Steel, by J. W. Hall, illustrated; The Art of the Goldsmith and Jeweller: a Manual on the Manipulation of Gold and the Manufacture of Personal Ornaments, T. B. Wigley, assisted by J. H. Stansbie, illustrated; Lectures on Iron-founding, Prof. T. Turner, illustrated. *Sir Isaac Pitman and Sons, Ltd.*—Rubber: from the Raw Material to the Finished Product, H. P. Stevens; Sugar: Cane and Beet, G. Martineau, illustrated; Oil: Animal, Vegetable, Essential and Mineral, C. A. Mitchell, illustrated; The World's Commercial Products: a Descriptive Account of the Economic Plants of the World and of their Commercial Uses, W. G. Freeman and S. E. Chandler, in parts, illustrated. *Whittaker and Co.*—A new edition of Colour in Woven Design, Prof. R. Beaumont.

MISCELLANEOUS.

D. Appleton and Co.—The Psychology of Reasoning, Prof. W. B. Pillsbury. *Cambridge University Press.*—Experimental Psychology, Dr. C. S. Myers; eleventh edition of the Encyclopædia Britannica, 28 vols. *Chapman and Hall, Ltd.*—The World of Life: a Manifestation of Creative Power, Directive Mind, and Ultimate Purpose, Dr. A. R. Wallace, F.R.S. *Chatto and Windus.*—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, L. W. King, illustrated; vol. ii., History of Babylon from the Foundation of the Monarchy, about B.C. 2000, until the Conquest of Babylon by Cyrus, B.C. 539; vol. iii., A History of Assyria from the Earliest Period until the Fall of Nineveh before the Medes, B.C. 606. *Wells Gardner and Co., Ltd.*—The Natural History Museum, W. P. Pycraft, illustrated. *C. Griffin and Co., Ltd.*—An Introduction to the Theory of Statistics, G. U. Yule: The Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland, compiled from Official Sources, twenty-seventh annual issue. *H. Holt and Co. (New York).*—Leading American Men of Science, edited by Prof. D. S. Jordan. Biographies and critical estimates of the work of Benjamin Thompson, Count Rumford, by E. E. Slosson; Alexander Wilson, by W. Stone; John James Audubon, by W. Stone; Benjamin Silliman, by D. C. Gilman; Joseph Henry, by S. Newcomb; Louis Agassiz, by C. F. Holder; Jeffries Wyman, by B. G. Wilder; Asa Gray, by J. M. Coulter; James Dwight Dana, by W. N. Rice; Spencer Fullerton Baird, by C. F. Holder; Othniel Charles Marsh, by G. B. Grinnell; Edward Drinker Cope, by M. Benjamin; Josiah Willard Gibbs, by E. E. Slosson; Simon Newcomb, by M. Benjamin; George Brown Goode, by D. S. Jordan; Henry Augustus Rowland, by I. Remsen; William Keith

Brooks, by E. A. Andrews. *Hutchinson and Co.*—Photography (Concise Knowledge Library), edited by H. P. Maskell and others; The Wonders of the World, in parts, illustrated. *Crosby Lockwood and Son.*—Short Specifications of Materials, Labour, and Goods for Works Connected with Building, J. Cubitt; Houses, Villas, and Bungalows for Britishers and Americans Abroad, G. G. Samson. *Longmans and Co.*—A History of the Cavendish Laboratory, Cambridge, Various Writers, illustrated. *Macmillan and Co., Ltd.*—Tennyson as a Student and Poet of Nature, Sir Norman Lockyer, K.C.B., F.R.S., and W. L. Lockyer, with an introduction and notes; The Conservation of Natural Resources in the United States, C. R. Van Hise, illustrated. *John Murray.*—British Weights and Measures, as described in the Laws of England from Anglo-Saxon Times, Col. Sir C. M. Watson. *Kegan Paul and Co., Ltd.*—Educational Psychology, Prof. E. L. Thorndike. *Swan Sonnenschein and Co., Ltd.*—A translation of Hegel's Phenomenology of Mind, J. B. Baillie, 2 vols.; Thought and Things: a Study of the Development and Meaning of Thought or Genetic Logic, Prof. J. M. Baldwin, vol. iii., Real Logic; Matter and Memory, H. Bergson, translated under the author's supervision by N. M. Paul; Adolescence, J. W. Slaughter; Physiological Psychology, Prof. W. Wundt, a translation of the fifth and wholly rewritten German edition by Prof. E. B. Titchener, in 3 vols., vol. ii., illustrated; and new editions of The History of Æsthetic, Dr. B. Bosanquet; Riddles of the Sphinx: a Study in the Philosophy of Humanism, Dr. F. C. S. Schiller; Darwinism and the Humanities, Prof. J. M. Baldwin (Ethical Library). *Williams and Norgate.*—A popular edition of Herbert Spencer's First Principles, 2 vols.

THE INTERNATIONAL CONGRESS ON RADIOLOGY AND ELECTRICITY.

THE second congress on radiology and electricity was held at Brussels on September 13–15. That two congresses have already been held to consider questions relating to radio-activity and allied subjects affords evidence of the rapid progress in this branch of science of recent years; but that some five hundred workers in physics and medicine should have assembled to discuss the bearing of modern electrical theory and radio-activity upon the various investigations on which they are engaged is a striking proof of the influence which these new ideas have exercised on the progress of science. It is now universally felt to be desirable, if not necessary, that those engaged on investigations in radio-activity in different parts of the world should have occasional opportunities of meeting each other, and perhaps one of the most important results of the recent congress has been the formation of an influential international committee to arrange the time and place of subsequent congresses. The continuation at regular intervals of meetings such as the one which has just taken place is therefore now assured, and thanks are due to the Belgian men of science and to the Belgian Government, under the patronage of which the congress was held, for organising the two successful meetings, the first at Liége in 1905 and the second at Brussels this year. It may be added that the meeting was rendered the more successful and pleasant by the hospitality offered to members by the town of Brussels. In this connection may be mentioned the reception at the Bourse and at the Town Hall by the Municipality, and also the admirable performance at the Théâtre Royal de la Monnaie, at which members were invited to be present.

The work of the congress began on Tuesday, September 13, with a meeting at the Palais des Fêtes in the exhibition grounds, when members assembled to hear an address by the president, Prof. de Heen, on æther and matter. The large gathering included eminent men of science from all parts of the world. The opening meeting finished, members dispersed to spend the remainder of the morning in the exhibition, after which they reassembled in the buildings of the Free University for a meeting which proved of exceptional interest. The proceedings began with a discussion, opened by Prof. Rutherford, on the question of fixing a suitable nomenclature in radio-activity and of establishing radio-active standards adapted to the requirements of quantitative measurements to be made for physical and medical purposes. After a short discussion it was decided that the matter could best be settled by a small committee acquainted with the needs of the different branches of the subject, and that this committee should meet and report to the congress the results of their deliberations at a subsequent meeting. The report of the committee is of such special interest that it is not possible to deal adequately with it within the limits of this article, but a full account of the recommendations was given by Prof. Rutherford in NATURE of October 6. While the necessary arrangements were being made for the formation of this committee the president called upon Madame Curie to give an account of the recent experiments made in Paris to isolate metallic radium. It will be remembered that this metal has hitherto not been separated from its salts, although a radium amalgam was obtained some years ago by Coehn. The beautiful experiments described by Madame Curie, resulting in the isolation of metallic radium, must be regarded as a triumph in chemical manipulation when it is remembered that, in addition to the fact that on account of its chemical properties radium is difficult to isolate, the operations had to be carried out with minute quantities of material in such a way as to avoid loss of the precious substance during the process. These experiments should remove all possible doubt that radium is, in fact, an element belonging to the same group of metals as barium.

After some other communications the meeting adjourned until the following day, when the congress met in three sections to deal with the large number of papers on the physical and medical aspect of radiology. The work of the physical section was of great interest. It began with a lecture, remarkable for the clear and vivid style of its delivery, by M. Perrin, who described his experiments on Brownian movement and their bearing on the determination of atomic magnitudes, followed by a review of the present position of our knowledge of these matters. Dr. Hahn next gave an account of the method of preparation of some highly active samples of radiothorium and mesothorium, of which specimens were shown. The phosphorescent effects produced by them on a zinc-sulphide screen could be clearly seen from all parts of the lecture-room, and there can be no doubt that these products, which are now to be had from Messrs. Knöffler and Co., of Berlin, will prove of great use for many purposes as an alternative to radium. Mr. Soddy followed with a description of the results of his work on the rate of production of helium from a Portuguese specimen of autunite. From his experiments it is possible to assign limits between which must lie the "life" of ionium, that stable product discovered by Boltwood, and known to be the parent of radium.

The papers which remained to be read on the last day were so numerous that it was found necessary at the last moment to subdivide the meeting further, and a separate section was quickly formed under the presidency of Prof. Rutherford for the discussion of purely radio-active questions. A number of important papers on various subjects were read. The proceedings were opened by Prof. Bragg with a discussion of the nature of the γ rays, in which he showed how it is possible to assign a "range" to the path of β rays in different metals on the assumption that the γ rays are material particles, and that the ionisation produced by them is due to β rays produced in their path. The paper was immediately succeeded by one by Prof. Barkla, who explained how each element submitted to a stream of homogeneous X-rays emits several beams of homogeneous X-rays characteristic of the element. Each homogeneous radiation was excited by a primary radiation of greater penetrating power according to Stokes's law for fluorescence, so that it was possible to draw a close comparison between light and X-rays in this respect. Dr. Hahn then gave an account of his experiments with Dr. Baeyer on the magnetic deflection of β rays. Photographs were shown indicating that the deflected rays from a single radio-active product gave rise to definite lines on the photographic plate, showing that during the decay of radio-active substances, just as for the α particle, the β particles leave the atom with a velocity characteristic of the particular product. The question of the recoil of radio-active matter during the expulsion of an α particle was next discussed by Dr. Makower. Experiments made by Dr. Russ, Mr. Evans, and himself on the electric and magnetic deflection of radium B when it recoils made it possible to determine the charge carried by the atoms of radium B, and to determine its atomic weight. The results showed that the atomic weight had approximately the value to be expected on the disintegration theory of radio-active changes. M. Wertenstein followed with a description of his work on the absorption by air of radium B when it recoils. Dr. Kovarik then gave a short account of his investigations on the absorption and scattering of β rays. It was shown how entirely erroneous results might be obtained in determining the absorption of β rays by matter unless certain precautions were taken in making the measurements. Dr. Kleeman next brought before the meeting some theoretical considerations regarding the absorption of α, β, and γ rays in passing through matter, after which M. Moulin described his interesting experiments on the saturation currents obtained in air ionised by α rays when the electric field is inclined at different angles to the trajectories of the rays.

It has only been possible to deal even shortly in this article with the papers on radio-activity, which formed perhaps the most important part of the work of the congress; but communications were presented on almost all branches of modern physics, amongst which some of the most interesting may be mentioned. Dr. Conway gave a paper on the theory of electronic conduction; Prof. Becquerel described his experiments on magneto-optic phenomena in crystals; Prof. Wien discussed the existence of positive and negative ions in canal rays; Prof. Arrhenius dealt with the solubility of the active deposit of actinium; Prof. Weiss spoke of molecular magnetic fields; and Prof. Exner gave a description of the new Radium Institute at Vienna.

The papers read before the biological section of the congress were so decidedly medical in character that an account of them would scarcely be of interest to readers of Nature. W. M.

THE OPENING OF THE MEDICAL SESSION.

THE custom of opening the winter session, the commencement of the medical year, at the medical schools with addresses has much to commend it. The attention of the public is directed to the work, scientific and charitable, of the great hospitals; if the address is delivered by a layman, the lay views on medical education and things medical are expressed, often with advantage; if by a medical man, the students hear words of wisdom culled from a ripe experience.

In the absence of the chairman, Prince Francis of Teck, the gathering at the Middlesex Hospital was presided over by Lord Grenfell, and the address was delivered by Lord Kitchener, who naturally dealt with the relation of medicine to the army and with army medical organisation. He directed attention to the improved sanitary condition of the army and to the vast field still remaining for research. As regards India, he said:—"That scourge of the army—enteric fever—is now at last definitely yielding to improved sanitary methods and to the system of inoculation which has recently become almost universal. Enteric will before long, I feel sure, join the formerly dreaded cholera in total banishment from our barracks. To bring home to you the measure of success which has attended their work in India, I need only point out that during the last ten years the ratio of 'constantly sick, invalided, and deaths' has been reduced by no less than 50 per cent. But there still remains in that country a vast field for your energies and painstaking research."

As regards army medical organisation, Lord Kitchener pointed out that the training which turns out competent medical men for civil work is quite inadequate in equipping medical officers for the special needs of the army in war time.

At St. Mary's Hospital Sir Arthur Conan Doyle gave an address to the students on "The Romance of Medicine." After relating some of his medical experiences in his early days, he pointed out that "there were, perhaps, some dangers which came from a medical training, but there was a great post-graduate course called life, and in that course one learnt to correct these weaknesses. One was an undue materialism. He was educated in a materialistic age, before psychical research, scientific hypnotism, telepathy, and other such agencies emphasised the possibilities which lie outside the things that we can see, handle, and explain. They looked upon mind and spirit as secretions from the brain in the same way as bile was a secretion of the liver. Brain centres explained everything, and if you could find and stimulate the centre of holiness you would produce a saint—but if your electrode slipped and you got on to the centre of brutality, you would evolve a Bill Sikes. That was, roughly, the point of view of the more advanced spirits among them."

In the concluding portion of his address Sir Conan Doyle dealt with medicine and history and some of the modern developments of medicine, particularly the *rôle* of opsonins. The starting point of the opsonin investigation was when it was shown that a white corpuscle taken out of the blood plasma would not digest microbes, and would only renew its activities when it was moistened with that fluid. This experiment showed that in that fluid there was suspended some invisible stuff which increased the activity of the white corpuscle, and made it devour microbes—some sort of sauce, in fact, which made the microbes more attractive to it. This substance was named opsonin. It had been found that, normally, opsonins are present in fixed quantity, but that in microbial infections the opsonins are generally diminished in amount. By the injection of dead microbes the activity of the white blood corpuscles is stimulated, more opsonin is formed, and the disease process tends to be cured.

At Charing Cross Hospital the Huxley memorial lecture constituted the opening address, and was delivered by Dr. Mott, F.R.S., the subject being "The Hereditary Aspects of Nervous and Mental Diseases." He remarked that in certain nervous diseases it is generally recognised that heredity plays a part, but these are due to characteristic morphological defects. As regards insanity, there are few alienist physicians who do not hold a strong belief in hereditary causation. The matter is now being investigated statistically, and a report will shortly be published. Consanguinity does not appear to produce insanity or nervous disease provided both stocks are free from taint. Chronic alcoholism figures largely in the pedigrees of patients admitted to asylums, but the idea that a desire for alcohol is transmitted from parent to offspring is erroneous—what is transmitted is lack of will power and moral sense.

The Dean of Salisbury delivered the address at University College Hospital. He emphasised the importance of complete development in a sound education. An address on "Woman's Sphere in Medicine" was given by Mr. E. W. Roughton at the London School of Medicine for Women. Mr. Roughton said that there were cogent reasons why there should be a female section of the profession. So far as he was able to judge, in suitability, adaptability and other characters, and in intellectual capacity, women would compare equally with men in the profession. There were, of course, some divergences between the sexes; women, for instance, did not, as a rule, seem to be so handy as men in looking after pieces of mechanism.

At the London Hospital Dr. Robert Hutchison gave the annual "Schorstein" lecture to the students of the medical school, the subject being "Congenital Pyloric Stenosis." Prof. Marett Tims delivered the address at the Royal Veterinary College. He pointed out the growing importance of biology with regard to the problems of medical and veterinary science, and suggested the establishment of a bureau at the Royal Veterinary College for the collection of statistics, the working out of all questions of inheritance in animals, not only the inheritance of disease, but also of data desirable from the point of view of the breeder, especially in the question of horse-breeding.

Prof. Howard Marsh, master of Downing College, Cambridge, distributed the prizes in the University of Leeds. In his address he dealt with the problems of medical education. He said that as medicine had now become a department of biology, its pursuit necessarily demanded a sound acquaintance with the broad principles of those departments of biological science with which it was intimately connected, the foundations on which it rested, chemistry, anatomy, physiology, and pathology. The difficulty which the student experienced was to keep pace with his subjects. With the average man the whole business had, from the first, been hopeless. He thought that a conference of those interested in medical education might be useful.

THE BERLIN UNIVERSITY CENTENARY.

The celebration of the hundredth anniversary of the foundation of the University of Berlin began on Monday with a reception of the representatives of universities and other bodies and a torchlight procession of students. The principal ceremony was held on Tuesday in the new Great Hall of the University. The Emperor and Empress, with the Prussian Princes and a brilliant retinue, attended, and his Majesty delivered an address. The festivities will be continued until Thursday night. A Reuter message from Berlin states that all the German and the principal foreign universities of the world are represented by special delegates. The representatives appointed by British universities are (in alphabetical order):—Aberdeen, Principal G. A. Smith; Cambridge, Sir J. J. Thomson; Cape Town, Prof. Marais; Dublin, Prof. Mahaffy; Durham, Vice-Chancellor Dr. Jevons; Edinburgh, Prof. H. J. Eggeling and Sir W. Turner; Glasgow, Principal Macalister; London, Sir H. E. Roscoe and Sir W. Ramsay; Melbourne, Prof. Masson; Montreal, Lord Strathcona; Oxford, Mr. R. W. Macan, the Master of University; Toronto, Prof. McCurdy. The British Academy is represented by Lord Reay; the Royal Society by Sir Joseph Larmor; and the University of Paris by M. Henri Poincaré.

Reuter's correspondent remarked on Monday:—"The patriotic aspect of the fêtes will be more strongly marked than is usual in the case of academic celebrations. The decision to found a university in Berlin was taken while the capital was still in the occupation of French troops, when Prussia's national fortunes were at their lowest ebb. It is now a matter of justifiable pride to the Germans that in those disastrous days there was still courage and energy enough in Prussia to set coolly about the task of rebuilding the intellectual and educational life of the country and giving it a national centre. Since then Berlin University has grown with the growth of Prussia and Germany, and a glance at its records from the handful of professors and the few scores of students who attended the opening winter term of 1810 to the 500 professors and lecturers and the 12,000 students who now throng the University buildings, provides no bad barometer by which to gauge the marvellous progress of Prussia and Germany during the past century."

We hope to give in a later issue an account of the celebration, by one of the delegates attending it. The issues of the *Morning Post* for October 11 and 12 contain particulars of the opening functions, and two valuable leading articles in which German thoroughness and system in educational and scientific work are described. From the latter issue we reprint some interesting extracts from the German Emperor's address.

The German Emperor on Knowledge and Research.

Since the day of its foundation, the destiny of the Friedrich Wilhelm University has been most intimately bound up with that of the Prussian and German Fatherland. When my forefather King Frederick William the Third summoned it into existence, now a hundred years ago, his object was to restore to the State with intellectual what it had lost in physical forces. The University of Berlin was thus born of the same creative spirit from which Prussia's regeneration sprang. This spirit, which raised up Prussia and Germany, and which lived in Fichte, Schleiermacher, Savigny, and their friends, made the University in the course of years the centre of intellectual and scientific life in the Fatherland. The University of Berlin was at first, it is true, far from being a *Universitas Literarum* as conceived by Wilhelm von Humboldt, but it has approached ever nearer to this ideal. A stronghold of the sciences, it has to-day an international importance reaching far beyond the frontiers of Prussia and Germany. This is manifested outwardly in the interchange of teachers and auditors. Working in common with the other universities of the country, it constitutes now the general teaching establishment which it was intended to be by its founders.

Humboldt's great plan demands side by side with the Academy of Sciences and with the University independent research institutions as integral parts of a whole scientific organism. The foundation of such institutions has not kept pace in Prussia with the development of the universities, and this deficiency, especially in our natural scientific equipment, becomes ever more keenly felt in consequence of the mighty advancement of the sciences. We need institutions which, outside the compass of the universities, shall serve solely for research. It appears to me to be the sacred task of the present time to summon such institutions into life at the earliest possible moment, and I consider it my patriotic duty to solicit universal interest in the undertaking. This great aim requires large means, and can be attained only if all circles interested in the progress of science and the welfare of the Fatherland are ready to cooperate in fulfilling this most important task and in making sacrifices for it.

I should like, therefore, to bring before everybody's eyes and lay at everybody's heart this new aim with the fervent exhortation: "Tua res agitur." I hope and firmly trust that the work will succeed, for, although the plan has been made known only in a narrow circle, enthusiastic expressions of concurrence have already reached me from various parts of the country, and the very considerable sum of between nine and ten million marks [between 450,000*l.* and 500,000*l.*] have been placed at the disposal of the enterprise. I feel it a cordial necessity to express my warmest thanks from this place to the self-sacrificing givers. In order to ensure the permanent furtherance of the enterprise, it is my wish to found under my protectorate and name a society which shall make it its task to establish and maintain research institutions. To this society I will gladly transfer the funds offered me. That State help will not be wanting to institutions about to be established my Government will take care.

I have one other wish for the University to take with it into the new century. May it in faithful remembrance of the time of its origin preserve its Prussian-German character. Science, it is true, is the common good of the whole civilised world, and its achievements no longer halt before any boundary line. And yet—as each nation must preserve its own peculiarity if it wishes to maintain an independent existence, and its value for the whole—may the "Alma Mater Berolinensis" always remain conscious of the fact that she is a German university. As heretofore, may it also be in all the future the seat of German manners and customs and of the German nature. . . . May, therefore, the University also henceforward hold the splendid privilege of cultivating the true science which, as Humboldt admirably says, comes from the interior and is planted in the interior which remoulds and creates the character. Let her do this with noble freedom which gives laws to itself and in that intense feeling of being the trustee of a treasure which is bestowed on all mankind. "Communis hominum thesaurus situs est in magnis veritatibus." All truth, however, is from God, and His spirit rests on every work that springs from truth and strives after truth. May this spirit of truth also fill you students; may it penetrate my dear University in its entire efficacy. Then will its old age be as its youth, and it will continue to be the town on a hill to which the nations make pilgrimage, and the ornament and safeguard of the Fatherland.

THE BRITISH ASSOCIATION AT SHEFFIELD.

SECTION L.

EDUCATIONAL SCIENCE.

Opening Address by Principal H. A. Miers, M.A., D.Sc., F.R.S., President of the Section.

To preside over this Section is to incur a responsibility which I confess somewhat alarms me; for the President may, by virtue of his temporary office, be regarded as speaking with authority on the subjects with which he deals.

Now, it is my desire to speak about University education, and for this purpose I must say something of school education; but I would have it understood that I really know little about the actual conduct of modern school teaching. One may read books which describe how it should be conducted, but this is a very different thing from seeing and hearing the teacher in his class; and I fear that personal recollections of what teaching in preparatory and public schools was like from thirty to forty years ago do not qualify one to pose as an intelligent critic of the methods which now prevail.

Human nature, however, has not changed much in the last forty years, and if, in considering the relations between University and school education, I can confine myself to general principles, based upon the difference between boys and men, I trust that I may not go far wrong.

I propose first to consider some general relations between teachers and their pupils, and then explain what, in my opinion, should be the change in the method of teaching, or at any rate in the attitude of teacher to pupil, which should take place when the scene changes from school to University.

First as to general relations between teachers and their pupils.

Educational systems necessarily prescribe the same methods for different teachers, and, being made for the mass, ignore the individual. But happily, in spite of the attempts to formulate methods of instruction and to make precise systems, there are many, and those perhaps some of the most successful, in the army of earnest school teachers who are elaborating their own methods.

Now among all the changes and varieties of system and curriculum there is one factor which remains permanent and which is universally confessed to be of paramount importance—the individuality of the teacher and his personal influence upon the pupil. It is therefore a healthy sign when school teachers who have been trained on one system begin to develop their own methods, for in this they are asserting their individuality and strengthening that personal influence which is the real mainspring of all successful education.

Personal influence is, of course, not only a matter of intellectual attainments; it appears to me, however, that at the present time so much is made of the duty of schools to aim at the formation of character that there is an unfortunate tendency to regard this duty as something distinct from the other functions of a master, and as independent of intellectual qualifications. Among the first qualities now demanded of a master in a public school for boys are manliness, athletic skill, and a hearty and healthy personality, and these are often regarded as compensating for some lack of intellectual equipment. I suspect that there is a similar tendency in schools for girls. And yet I think it will be found that the only permanent personal influence is really wielded by teachers who exercise it through intellectual channels, and that those who acquire intellectual authority will generally succeed in training the characters as well as the minds of their pupils.

On the other hand, the master who is not up to the proper intellectual standard will soon be found out by his cleverer pupils, and will lose influence, whatever may be the personal charm of his character.

The formation of character, so far as it can be distinguished from intellectual training, is largely worked out by the boys themselves in any public school in which healthy tradition and a sound moral atmosphere are maintained, although it is true that these traditions depend upon the character and personality of the teachers.

The educational value of the personal and intimate association with one and the same teacher throughout the school or University career is officially recognised in the tutorial system at Eton, Oxford, and Cambridge. It has generally led to excellent results, provided that the tutor possesses the right qualities and that pupil and tutor do not happen to be two incompatible personalities; but the results may be well-nigh disastrous where there happens to be antagonism between the two, or where the tutor does not realise his opportunities and responsibilities. I have known some tutors who only excited a distaste for learning in their pupils, and others who entirely neglected or abused the high trust which had been committed to them; but far more, I am glad to say, who have not only exercised the most profound influence for good on their better and cleverer pupils, but also inspired intellectual interest in the most unpromising of them. Although such a tutorial system does not enter fully into the scheme of other schools and Universities, and therefore a student does not usually remain long under any one teacher, it must be within the experience of most persons to have come for a time at least under the influence of a teacher who has inspired real enthusiasm for learning and from whose lips the instruction, that might from others have been a trial, has become an intellectual treat.

It is given to comparatively few to exert this powerful and subtle influence in a high degree, for it is a gift confined to a few rare natures. All the more important is it, therefore, to ensure that an effective personal influence may play its part in the intercourse between ordinary teachers and ordinary pupils in the customary routine of school and University life.

How, then, is the proper personal and sympathetic relation to be established between teacher and pupil, so that the individuality of the one may call out the character and the effort of the other? Those who inquire of their earliest school reminiscences will probably recollect that the teachers who obtained a real hold upon them did so by virtue of the power which they possessed of arousing their intellectual interest. I would ask you for a moment to analyse the character of this interest.

In the young child I believe that it will be found to be mainly that of novelty: with him "this way and that dividing the swift mind," sustained thought, or even sustained attention, has not yet become possible; the inquisitive and acquisitive faculties are strong; and every new impression awakens the interest by its novelty quite apart from its purpose. You have only to watch and see how impossible it is for a young child to keep its attention fixed even upon a game such as cricket or football to realise how still more difficult it is to keep his attention fixed upon an intellectual purpose.

To quite young children, except to those who are unfortunately precocious, even an impending examination is not a permanent object of anxiety.

Now contrast the aimless interest which can be aroused in any young child's mind by the pleasure of a new impression, a new activity, or a new idea, with that which appeals, or should appeal, to the more mature intellect of an older student. With him it is not enough that the impression or the idea should be new; if it is to arouse interest it must also direct his mind to a purpose. This is to him the effective interest of his games or sport; in the game the desire to succeed or to win is the animating purpose, just as the expectation of catching a fish is the interest which keeps the angler's attention fixed for hours upon his line. In both the desire is fostered by the imagination, which maintains a definite purpose before the mind.

It is sometimes forgotten that as he grows the pupil is no longer "an infant crying for the light," but has become a man with "splendid purpose in his eyes."

While, therefore, it should be the aim of a teacher of young children to set before them the subjects of their lessons in an attractive manner, so that the novelty is never lost, and not to weary their active and restless minds with too sustained an effort, it should at a later stage be the teacher's aim to keep the object and purpose of the new fact or idea as constantly as possible in view, and not to distract the ardent mind with purposeless and disconnected scraps of learning.

I ask you to bear this distinction in mind, for it is a principle which may guide us in differentiating University methods from school methods of education.

The distinction need not involve us in a discussion of the "Ziel-Angabe" in elementary education, for that is rather a question of keeping the interest alive during each lesson than of maintaining a permanent purpose in view throughout a course.

The much discussed heuristic method as applied to very young children does, no doubt, fulfil this object so far as it provides the inquisitive mind with novelty instead of a set task, but so far as it makes the purpose more prominent than the process it may become a method more suited to the adolescent or the adult mind than to that of the young child.

I can fully realise that a most difficult and anxious time for the teacher must be that of the maturing intellect, in the interval between childhood and the close of the school career, when the method and spirit of the teaching must to some extent gradually change with the changing mental characteristics of the pupil. But, whatever may be the right methods of teaching children of ten and young men and women of twenty, many of our failures are due to one or both of two prevalent mistakes: the first, the mistake of teaching children by methods that are too advanced; the second, that of teaching University students by methods that are better adapted for school children. It is with the latter that I wish to deal in this address; but we may in passing remind ourselves that when young men and young women are sent straight from the University to teach children with nothing but their University experience to guide them, it is not surprising that they often proceed at first on wrong lines, and as though they were dealing with University students.

The difficulty of divesting oneself of the mental attitude and the form of expression familiar in University circles, if one is to become intelligible even to the higher classes in a school, is betrayed by the unsatisfactory nature of many of the papers set by University examiners to school children. The teachers complain, and rightly complain, that there is often an academic style and form about them which just make them entirely unsuitable for the child.

It is, of course, hopeful that a diploma in pedagogy or some evidence that they have received instruction in method is now generally required of those who are to become teachers in schools. It seems to me, however, somewhat curious that, while efforts are now being made to give instruction in educational method to such persons, no similar effort is made to give instruction in more advanced methods to those who are called upon at the close of their undergraduate career to become University teachers, and that in consequence many of them have no method at all.

This may be a matter of comparatively small importance to those who possess, not only the necessary knowledge, but also the natural gift of personal influence and the power of inspiring those whom they teach. But for those who are not blessed with these powers it may be almost as difficult to fall into the ways of successful University instruction after the sudden transformation from student into teacher as it is for those who become teachers in schools.

Granting, then, that there should be a radical difference between the ways of school and University teaching, and that there is at present an unfortunate overlapping between the two, let me next consider how the distinction between the intellectual interest of a child and the intellectual interest of a man may guide us in adjusting our methods of teaching when students pass from school to the University.

A tenable, perhaps even a prevalent, view concerning a liberal school education is that its chief purpose is not so much to impart knowledge as to train the mind; indeed, some teachers, influenced, perhaps, in the first instance by the views of Plato, go so far as to think that no subject which is clearly of direct practical use should be taught as such at school. This view they would carry to the extent of excluding many obviously appropriate subjects from the school curriculum, whereas almost any subject may be made an intellectual training; this being a question not of subject, but of the manner in which it is taught. In any event, if the scheme of intellectual training be adequately fulfilled, the period of mental discipline should come to an end with the close of school life, and the mind should then be able to enter upon new studies and to assimilate fresh knowledge without a prolonged continuation of preparatory courses. Indeed, the professed object of entrance examinations to the University is to exclude those whose minds are not prepared to benefit by a course of University study, and to admit only those who are sufficiently equipped by previous training to do so. An entrance examination, then, should not be merely a test of whether a boy or girl has learnt sufficient of certain subjects to continue those subjects in particular at the University; and yet it has unfortunately come to be regarded more and more as performing this function instead of being regarded as a test whether the student is generally fit to enter upon *any* University course. The result is that an entrance examination tends to become a test of knowledge rather than a test of general intelligence; merely one in an organised series of examinations which endeavour to ascertain the advancing proficiency in a limited number of subjects, and therefore tend really to encourage specialisation. Specialisation is not to be prevented by insisting on a considerable number of subjects, but rather by teaching even one subject in a wide spirit. Another result is that the entrance examination belongs properly neither to the school course nor to the University course; if it is taken at the age of sixteen, the remainder of the school career tends to be devoted to University work, which should not really be done at school; if it is taken after leaving school this means that work is being done at, or in connection with, the University which ought to be done at school. It is certainly true that for various reasons a vast deal of education is now being carried on at the Universities which should belong to school life, and, moreover, is being carried on by methods which are identical with those pursued at school. It is equally true that, owing to the early age at which matriculation examinations or their equivalents may be taken, many schools are now asking that at the age of eighteen or nineteen a school examination may be held which shall be an equivalent, not for matriculation, but for the first degree examination at the University. This would really imply that schools should be recognised as doing University work for two years of their pupils' careers—surely a most illogical procedure, and one which supports my contention that there is now very serious overlapping, for it assumes that the work for the first degree examination can be carried on either at the school or the University, and therefore that there is no difference in the methods of the two.

An increasing number of candidates actually present themselves from secondary schools for the external intermediate examination of the University of London; in 1904 there were about 150; in 1909 there were nearly 500 such candidates. This is, of course, a debatable subject, and there are many who think the overlapping of school and university work a highly desirable thing.

There will always be exceptional boys and girls who reach a University standard, both of attainments and intelligence, long before they arrive at the ordinary school-leaving age. Let them either leave school and begin their University career early, or let them, if they remain at school, widen their knowledge by including subjects which are not supplied by the more rigid school curriculum designed for the average pupils; but let them not cease, save in very exceptional cases, to be taught as school pupils, *i.e.* with mental training as the chief object. It is equally certain that there will also be boys and girls whose development is so slow that they barely reach the University standard when they leave school; yet some among them are the best possible material and achieve the greatest success in the end. For such persons an entrance examination will be required at the age of eighteen or nineteen; but I think it is unfortunate that this should be the same as that which quicker pupils can pass at the age of sixteen or seventeen, for an examination designed for the one age can scarcely be quite satisfactory for the other.

I confess that the whole matter is inextricably involved with the question of University entrance examinations. But to enter upon this here would carry us beyond the limits that I have laid down for myself, and it will be more profitable to decide what should be done at school and the University respectively before discussing how the examinations are to be adapted to our purpose. It will be sufficient for me to say that I have been led to the conclusion that if they are to test the intelligence of those who are ready to enter upon a University course, matriculation examinations should be designed to suit the capacity of average pupils not less than seventeen years of age.

Starting, then, with the principle that the period of mental discipline is closed at the end of the school career, and that those who pass to the University come with fair mental training and sufficient intelligence, let me inquire what should be the relation of University teaching to that which the student has received at school.

Under present conditions the schools which aim at sending students to the Universities endeavour to give a general education which will fit their pupils to enter either upon a University course or upon whatever profession or occupation they may select on leaving school. They do not confine the teaching of any pupil to preparation for a special profession or occupation, and they do not generally encourage special preparation for the University.

Now contrast what happens to the pupils leaving such a school to enter a profession or business with what happens to those who proceed to the University. The former pass into an entirely different atmosphere; they are no longer occupied with exercises and preparatory courses which serve a disciplinary purpose; they are brought face to face with the realities of their business or profession, and, though they have to gain their experience by beginning at the lower or more elementary stages, they do actually and at once take part in it.

The University student, on the other hand, too often continues what he did at school; he may attend lectures instead of the school class, but neither the method nor the material need differ much from what he has already done. Should not the break with school be as complete for him as for his schoolfellow who goes into business? Should he not be brought face to face with the actualities of learning? After his years of preparation and mental drill at school should he not, under the direction of his University teachers, appreciate the purpose of his work and share the responsibility of it?

Let me take, as an illustration, the subject of history. A student who comes to the University and takes up the study of history should learn at once how to use the original sources. It will, of course, be easier for him if he has learnt the rudiments of history and become interested in the subject at school; but, if he is really keen upon his University work, it should not be absolutely necessary for him to have learnt any history whatever. In any case, if he has received a good general education and has reached the standard of intelligence required for University work, he ought to be able to enter at once upon the intelligent study of history at first hand; his teachers will make it their duty to show him how to do this; their lectures and seminars will illustrate the methods of independent study, and will make the need of them clear to him. If, as is probable, some acquaintance with one or more foreign languages be necessary, he will take instruction in them as an essential part of his history course, in order that he may acquire the needful working knowledge, and to learn something of them with a definite purpose will be to him far more interesting and profitable than to study them only for linguistic training, as he would have been compelled to do at school. After all, this is what would be done by his schoolfellow who goes into business and finds it necessary, and probably also interesting, to acquire some knowledge of the particular foreign language required in the correspondence of his firm. It will, of course, be all the better for a University student of history to have acquired some training at school in the rudiments of history both ancient and modern, together with the knowledge of classics which is necessary for the former, and of modern languages which is necessary for the latter. But there is not space in the school curriculum for all the subjects that may be required either for the University or for the business of life; the best that can be done is to give a good all-round training and to foster a marked taste or ability where it exists by allowing the boy or girl to include the subjects which are most congenial to them in the studies of their last two years of school life, as I have already suggested, provided that mere specialisation is not encouraged at school even towards the end of the school career.

The University course might then become a more complete specialisation, but of a broad character—the study of a special subject in its wider aspects, and with the help of all the other knowledge which may be necessary to that purpose.

The University teacher will also differ from the school teacher in his methods, for it will be his business not so much to teach history as to teach his pupil so to learn and study history as though it were his purpose to become an historian; in so doing he will have opportunities to explain his own views and to contrast them with those of other authorities, and so to express his individuality as a University teacher should.

One might choose any other subject as an illustration. In science there should be all the difference between the school exercises, on one hand, which teach the pupil the methods of experiment, illustrate the principles laid down in his text-books, and exercise his mind in scientific reasoning, and, on the other, the University training, which sets him on a course involving the methods of the classical researches of great investigators and a study of the original papers in which they are contained, illuminated by the views of his own teacher. He also should awaken to the necessity of modern languages. A boy who, on leaving school, passes not to the scientific laboratories of a University, but to a scientific assistantship in a business or Government department, will very soon find it necessary to go to the original sources and acquire a working knowledge of foreign languages. It is regrettable that under existing conditions a scientific student sometimes passes through his University without acquiring even this necessary equipment. I believe this to be largely due to the fact that he is compelled to spend so much of his time in preparatory work of a school character during the early stages of his University career.

In the literary subjects, and especially in classics, there is, of course, not the same scope for the spirit of investigation which it is so easy to encourage in experimental science. Here the only new advances and discoveries which can appeal to the imagination in quite the same way are those which are being made every year in the field of archæology, and it is therefore not surprising that this subject attracts many of the most ardent students; the methods of the archæologist are more akin to those of the scientific investigator, and his work is accompanied by the same enthralling excitement of possible discovery. For the more able pupils and those who had a natural taste for language and literature no subjects have been more thoroughly and systematically taught for very many years at school, as well as at the University, than the classics; but for the less intellectual children or those who had no natural taste for such studies no methods could well be more unsuitable than those which used to prevail at schools. The grammatical rules and exceptions, the unintelligent and uncouth translation, the dry comparison of parallel passages, the merely mechanical construction of Greek and Latin verse, produced in many minds nothing but distaste for the finest literature that exists.

With the improved methods now in use Greek and Latin may be, and are, presented to the ordinary boy and girl as living literature and history, and school training in them may be made as interesting as anything else in the curriculum. Upon such a foundation the University should surely be able to build a course devoted to literary, philosophical, historical, or philological learning even for the average student, provided that the University teacher undertakes the task of helping his pupils to learn for themselves, and to pursue their studies with a purpose, not merely as a preparation.

The spirit of inquiry which drives the literary student to find for himself the meaning of an author by study and by comparison of the views of others is really the same spirit of inqury which drives the scientific student to interpret an experiment, or the mathematical student to solve a problem. Only by kindling the spirit of inquiry can teaching of a real University character be carried on. Give it what name you will, and exercise it in whatever manner you desire, there is no subject of study to which it cannot be applied, and there are no intelligent minds in which it cannot be excited.

The first question which a University teacher should ask himself is, "Am I rousing a spirit of inquiry in my pupils?" And if this cannot be answered in the affirmative it is a confession that the University ideal is not being realised.

Some assert that this principle should also guide school education, and that it should be the first aim of the school teacher to stimulate the spirit of inquiry. My own view is that with young children this should be less necessary; they all possess it, and are by nature inquisitive. It should rather be the object of the teacher not to spoil the spirit of inquiry by allowing it to run riot, nor to stifle it by making the work uninteresting; if the lesson interests them, their inquisitive minds will be quick enough to assimilate the teaching. We are, in fact, brought back to what I have already emphasised—that the real difference between the inquisitive mind of the child and the inquiring mind of the adult is that the former is yearning for information quite regardless of what it may lead to, whereas the latter must learn or investigate with an object if the interest is to be excited and maintained.

I have often thought it an interesting parallel that among original investigators and researchers there are two quite distinct types of mind, which have achieved equally valuable results. There is the researcher who pursues an investigation with a constant purpose, and to whom the purpose is the inspiration. But there is also the investigator who has preserved his youthful enthusiasm for novelty, and has in some respects the mind of a child; passionately inquisitive, he will always seek to do something new, and very often, like a child, he will tire of a line of research in which he has made a discovery, and take up with equal enthusiasm a totally different problem in the hope of achieving new conquests. I think that a man well known in Sheffield, the late Henry Clifton Sorby, must have been a man of this character. The latter is, perhaps, the most fertile type of original investigator, but it is not the type that produces the best teacher, except for very exceptional and original-minded students; and such teachers do not often found a school of learning and research endowed with much stability. For ordinary students, the investigator who pursues his researches so far as possible to their conclusion is the safer guide.

It seems to me suggestive that there are to be found, even amongst the famous researchers, these two types of mind, that somewhat correspond to the mental attitude of the school pupil and the University student. It is as though these great men have preserved a juvenile spirit, some from the days of their childhood, others from early manhood.

It will now be clear that the principle which I am advocating is a very simple one, namely, that the business of direct mental training should be finished at school, and that at the University the trained mind should be given material upon which to do responsible work in the spirit of inquiry. Preparatory exercises belong to school life, and should be abandoned at the University.

All this seems so obvious that it might appear to be hardly worth saying were it not that the methods which actually prevail are so far removed from this ideal.

When, for example, a boy who has not learnt Greek or chemistry at school comes to the University and proposes to take up one of these subjects, he is generally put through a course of exercises which differ in no essential respect from those which are set before a boy of twelve. In other words, our University method for the trained mind does not really differ from our school method, which is supposed to be adapted to the mind in course of training. Again, boys who have been learning certain subjects for years at school, but are weak in them, have their education continued at the University in the same subjects by the same school methods until they can be brought up to the requirements of a first University examination, which in its character does not differ much from the examinations held at school. Where in this process is to be found the introduction of that spirit of inquiry and investigation which ought to characterise the University course?

It may be asked, In what manner is this change to be introduced, and how is it possible under present conditions, where so many students are all pursuing ordinary degree courses and have no time or opportunity for special work, to provide teachers who can educate them in this spirit, if it is also their duty to get pass students through their examinations? The answer, I think, is that in a University the professors and higher teachers should be, without exception, men who, whatever may be their teaching duties, are also actively engaged in investigation. Their assistants should be teachers who, even if the whole or part of their time is occupied in routine teaching, have yet had some experience in, and possess real sympathy with, modern advanced work under such professors. This is only to be secured by insisting that teachers in a University should all have had some experience of original work, and, just as one of the necessary qualifications for an elementary teacher is some education in method, so a necessary qualification for a University teacher should be some education in research. Anyone desirous of qualifying for University teaching should be compelled to devote a certain portion of his student career to research, and the funds of a University cannot be better applied than to the retention of the better students at the University for the distinct purpose of enabling them to pursue investigation under the professor for a period of one year after they have completed their degree course, if they have not been able to do so during their undergraduate period. It is not, however, too much to hope that the majority of those who are endeavouring to qualify for the higher educational posts will be assisted to obtain this special experience during their degree course. Under the present system at most Universities, unless the student has been fortunate enough to come in contact with a teacher imbued with the spirit of research who is carrying on his own investigations, it rarely happens that he has the time or the means which would enable him to obtain any insight into the meaning of investigation before he leaves to take up teaching work. The need of post-graduate scholarships for this purpose is very widely felt, and is now frequently expressed. To insist upon such qualifications for all University students is, of course, under present conditions impossible; but there should be no insuperable difficulty in insisting upon them for those who are to be allowed to enter a University as teachers.

Researchers are born, not made, and it is not by any means desirable that all University students should be cast adrift to make new researches and seek discoveries even under the direction of experienced teachers and investigators. This must depend to some extent upon the character of the pupil as well as of the teacher.

The mere publication of papers may mean nothing, and much that is dignified with the name of research is of no account. To turn a lad on to research, unless it be in the right spirit, may be only to set him a new exercise instead of an old one; to leave him to prosecute an investigation for himself may be to condemn him to disappointment and failure. On the other hand, to carry on any piece of work, whether it be new or old, in the zealous spirit of inquiry, with faith in a purpose, is to insure the intellectual interest of the student; and I cannot see why this spirit should not animate all University education, whether it be accompanied by original research or not. The essential condition is that the chief University teachers should themselves create an atmosphere of investigation.

So deep-seated is the belief that nothing must be undertaken without a preparatory course of training that even the best and most brilliant students are frequently discouraged from undertaking a new study until they have been subjected to the mental discipline of an elementary course in it.

I cannot refrain from quoting an example which came within my own experience, although I have already alluded to it in another address delivered last year.

When I was at Oxford a young Frenchman of exceptional ability, whose training had been almost exclusively literary and philosophical, and who was at the time engaged on a theological inquiry, expressed to me his regret that he had never learnt to understand by practical experience the meaning of scientific work. And when I assured him that nothing was easier than to acquire practical experience by taking up a piece of actual investigation under the direction of a scientific worker, he explained to me that when he had applied for admission to scientific laboratories he had been told that it was useless to do so until by preparatory courses he had acquired an adequate knowledge of mathematics, physics, and chemistry. I offered to make the trial with him, and began with a problem that happened to interest me and that required a new method of simple experimental research. I soon found that a well-trained mind, able to grasp the meaning of the problem and eager to investigate it, could begin without delay upon the experiments, and in the desire to interpret them could find a pleasure and a purpose in seeking the necessary chemical and physical knowledge; whereas to have begun by acquiring this in a preparatory course, with no definite object in view, would have been to set back a mature mind to school methods of training, and very possibly to have stifled instead of kindling any real scientific interest.

This is, again, an illustration of my contention that the most special study, if carried on in the true University spirit, is very far removed from ordinary specialisation, and involves very wide extension of interest and learning; whereas, if carried on in a preparatory spirit, it is necessarily limited.

In a very short time this student had published three original papers which seem to me of considerable importance, though perhaps on a somewhat obscure subject, and I see that they are now quoted as marking a substantial advance in knowledge.

Of course, this is the exceptional case of the exceptionally able student; but I think it illustrates two things—first, the prevalence of the conventional attitude that preparation on school lines is necessary even for the post-graduate student; secondly, the fact that what is really necessary to the University student is the purpose, and that with this before his eyes he may safely be introduced to new fields of work.

One result of the conventional attitude is that those who have distinguished themselves at school in some subject are often assumed to have a special aptitude in it, and to be destined by Nature to pursue the same subject at the University, whereas their school success may only prove that they are abler than their fellows, and that this ability will show itself in whatever subject they may take up. Such students would sometimes on coming to the University be all the better for a complete change of subject, without which the continuance of the school studies too often means a perpetuation of the school methods. Those who are wedded to the idea of a systematic progression from secondary to university education run the risk of closing the door to this possibility, or at any rate of seriously prejudicing it.

Another result is that when teachers are always playing a somewhat mechanical part in a systematised course, receiving duly prepared pupils and preparing them again for the next stage, such an atmosphere of preparation is produced that many persons continue to spend the greater part of their lives in preparation without any reasonable prospect of performance.

I am well aware that, on the other hand, there always have been, and are now, many earnest and accomplished University teachers who are pursuing the methods that I advocate, whose teaching is always inspired with a purpose, whose pupils are stimulated to learn in the spirit of inquiry, and who consequently exercise a personal influence that is profound and enduring. I am deeply conscious how much I owe to some such teachers with whom I have studied and to others whom I have known. But still it does remain true that this is not yet the atmosphere of ordinary University education, that it does not yet invigorate the ordinary University student, and that to him the passage from school to the University does not necessarily mean a transition from mental discipline and preparation to mental activity and performance.

The distinction that I have in my mind between University and school reaching may be expressed in this way. At school no subject should be taught to a class as though it were intended to be their life-work; to take an example, it too often happens at present, owing really to excessive zeal on the part of school teachers, that mathematics is taught as though each member of the class were destined to become a mathematician; consequently only the few scholars with a real aptitude for mathematics become interested, and the remainder are left behind. On the other hand, at the University each subject should be studied as though it really were the life-work both of teacher and student. Thus, to take the same subject as an illustration, the mathematical student will attend the full courses of his professors and will follow them with the interest of a mathematician; whereas for the scientific student it will only be in those branches of mathematics which concern him that the interest of his special science will put him on terms of equality with the mathematical student. If I may choose an illustration which is familiar to myself, any student of mineralogy can easily be interested in and benefit by a course in spherical trigonometry, because it is one of the tools of his trade, but to send him to lectures on differential equations would be only to discourage him. On the other hand, the student of chemistry would rather be interested in the latter. To each of them certain branches of mathematics as taught by an ardent teacher afford a real intellectual training, but neither would gain much if compelled to follow a general University course of mathematics designed for mathematicians.

It will be observed that I have endeavoured to confine myself to the subject of University education, and not to say much, except by way of contrast, concerning school teaching.

I must, however, return to it for a moment, if only to emphasise the danger of that specialisation, which, since it takes place at school and not at the University, is bound to be narrow, and which is often encouraged in pupils of special aptitude preparing for University scholarships.

That a boy or girl should for a year or even two years before leaving school be practically confined to one subject and should before entering the University be examined in that alone, appears to me to be contrary to all the best traditions of school teaching, and to the often expressed desire of the Universities to ensure a good general education in those whom they admit. There should, I think, be no scholarship examination which does not include several of the subjects of a normal school curriculum, however much additional weight may be given to any of them. Although it may be necessary that University entrance scholarships in one subject should be given either to encourage its study or to discover those who have a special aptitude, yet, so far as scholarships are intended to be rewards for intellectual pre-eminence, they should, I think, be directed to general capacity, and not be used as an encouragement to limited study. From what I have already said it will be clear that I do not attach much importance to special preparation at school for those who intend to proceed to the University. If a boy has a very special taste or aptitude, it should have abundant opportunity for displaying and exercising itself at the University, provided only that it has not been stifled, but has been given some encouragement in the school curriculum. I understand, for example, that those who teach such a subject as physiology at the University would prefer that their pupils should come to them from school with a general knowledge of chemistry and physics rather than that they should have received training in physiology. With the present modern differentiation into a classical and modern side, or their equivalents, the ordinary school subjects should be sufficient preparation for any University course if they are not mutually strangled in the pressure of an overcrowded curriculum.

To be fair, however, I must state another view. A very experienced college tutor who has had previous valuable experience as a master in a public school tells me that in his opinion the real problem of the public schools is the "arrest of intellectual development that overtakes so many boys at about the age of sixteen." "There are few public schools," he says, "whose fifth forms are not full of boys of seventeen or eighteen, many of them perfectly orderly, well-mannered, and reasonable, in some sense the salt of the place, exercising great influence in the school and exercising it well, with a high standard of public spirit, kindly, and straight-living, in whom, nevertheless, it is difficult to recognise the bright, intelligent, if not very industrious, child of two or three years before."

He thinks that there is a real danger of degeneration at this age, owing, for one thing, to the manner in which the boys are educated *en bloc*; up to a certain age boys can be herded together and taught on the same lines without great harm being done, but after a certain time differentiation begins to set in. The school curriculum, however, does not admit of being adjusted to suit the dawning interests of a couple of hundred boys; and he sees no cure for this difficulty except a considerable increase in the staff and a corresponding reduction in the size of the forms. But he thinks that much may be done by an alteration in the system of matriculation examination, which sets the standard at the public schools. He would make this consist of two parts: an examination coming at about the age of sixteen and well within the reach of a boy of ordinary intelligence and industry, and comprising the ordinary subjects of school curriculum at this age; he would then let the boy leave the subjects from which he is not likely to get much further profit and begin to specialise for the remaining two or three years, say, in two subjects, which would then be the material of the second examination. In this way they would make a wholly fresh start at a critical age, and he thinks that the bulk of the boys would probably find this a great advantage.

I quote this opinion because it shows that an experienced schoolmaster regards it as highly desirable that at a certain period in a schoolboy's career a real change should be made in his curriculum, and I have expressly stated that I find it difficult to express an opinion upon this particular educational period.

What should be the exact nature of the teaching before and after the age of sixteen or seventeen for the mass of ordinary boys I would prefer to leave to the decision of those who are best able to judge. I think it highly probable that there should be a considerable alteration of curriculum at the critical age. But, if a break and change of subject are required at this age, I believe that a yet more complete change is required at the later stage when the boy goes to the University, and that school methods should then be entirely replaced by University methods—not because there is then a natural change in the mental powers of the student, but because it is the obvious stage at which to make the change if we are to abandon preparatory training at all. Should it be proposed that the change ought to be made at sixteen, and that after that age something of the nature of University methods should be gradually introduced, my fear is that this would only lead to the perpetuation of school methods at the University.

An interesting question which deserves to be very seriously considered is the question, What sort of school education affords the best preparatory training for the University? I have often heard it asserted that, if a boy is capable of taking up at the University a course which is entirely different from his school course, he will generally be found to have come from the classical side and not from the modern side. An ordinary modern-side boy is rarely able to pursue profitably a literary career at the University, whereas it often happens that ordinary classical-side boys make excellent scientific students after they have left school. I am bound to say that this is, on the whole, my own experience. It suggests that a literary education at school is at present a better intellectual training for general University work than a scientific education. If this be so what is the reason?

There are no doubt many causes which may contribute. In some schools the brighter boys are still retained on the classical side while those who are more slow are left to find their way to other subjects; and some whose real tastes have been suppressed by the uniformity of the school curriculum turn with relief to new studies at the University and pursue them with zeal. But the facts do also, I think, point to some defect in the present teaching of school science whereby a certain narrowness and rigidity of mind are rendered possible. This may be partly due to the lack of human interest in the teaching of elementary science; the story of discovery has a personal side which is too much neglected, though it is more attractive to the beginner and might with advantage be used to give some insight into the working of the human mind and character. Moreover, it would form an introduction to the philosophy of science which is at present so strangely ignored by most teachers.

But another noteworthy defect is the absence of that mental exercise which is provided by the thoughtful use and analysis of language.

I believe that the practice of expressing thoughts in carefully chosen words, which forms so large a part of a good literary education, constitutes a mental training which can scarcely be surpassed, and it is unfortunately true that in the non-literary subjects too little attention is paid to this practice. In school work and examinations in science a pupil who appears to understand a problem is often allowed full credit, although his spoken or written answer may be far from clear. This is a great mistake. A statement which is not intelligibly expressed indicates some confusion of thought; and, if scientific teaching is to maintain its proper position as a mental training, far more attention must be paid to the cultivation of a lucid style in writing and speaking.

The various Universities seem fairly agreed upon the subjects which they regard as essential to an entrance examination—subjects which may be taken to imply the groundwork of a liberal education. Among these is English: and yet of all the subjects which children are taught at school, there is none in which such poor results are achieved. It may be taught by earnest and zealous teachers; the examination papers are searching, and seem to require a considerable knowledge of English literature and considerable skill in the manipulation of the language, and yet the fact remains that the power of simple intelligible expression is not one that is possessed by the average schoolboy and schoolgirl. It is the most necessary part of what should be an adequate equipment for the affairs of life, whether the pupil passes to the University or not, and yet it is, on the whole, that which is least acquired.

Although it is true that the intelligent reading and study of the great masters should assist in the acquisition of a good style, it is equally true that, if they come to be regarded as a school task, they are not viewed with affection, especially in these days of crowded curricula, when there is little leisure for the enjoyment of a book that requires deliberate reading. If the modern strenuous curriculum of work and games has abolished the loafer, it has also abolished leisure, and has therefore removed one of the opportunities that used to exist for the cultivation of literary and artistic tastes and pursuits by those to whom they are congenial. The art of expressing one's ideas in simple, straightforward language is to be acquired not so much by study as by practice. There is no essential reason why children should write worse than they speak; they do so because they have constant practice in the one and little practice in the other. Our grandparents felt less difficulty in expressing themselves clearly than we do ourselves: of this their letters are evidence. It may have been partly due to the fact that they had more time and encouragement for leisurely reading, though they had not so much to read; but I believe that the letters which they wrote as children were their real education in the art of writing English. Much would be gained if boys and girls were constantly required to express their own meaning in writing. The set essay and the *précis* play a useful part, but do not do all that is needed. Translation does not give quite the necessary exercise. What is required is constant, with certain periods of conscious, practice, and that is only to be obtained by making every piece of school work in which the English language is used an exercise in lucid expression. Very few paragraphs in anything written by the ordinary schoolboy—or, for the matter of that, by the ordinary educated Englishman—are wholly intelligible, and teachers cannot devote too much pains to criticising all written work from this point of view. If we first learnt by practice to express our meaning clearly we should be more likely to acquire the graces of an elegant style later. I must add that I believe the training in the manipulation of words would be improved if all children were required to practise the writing of English verse—not in efforts to write poetry, but narrative verse used to express simple ideas in plain language—and I believe that this would enable them the better to appreciate poetry, the love of which is possibly now to some extent stifled by the pedantic study of beautiful poems treated as school tasks.

In such a subject as English composition, in which reform is so badly needed, something, perhaps, would be gained by an entire break with existing traditions—a break of the sort which would be required if it became suddenly necessary to provide for an entirely new type of student.

Now there is one new and interesting development in which, for the first time, an opportunity offers itself of dealing with a body of students who, although possessed of more than average intelligence and enthusiasm, have not received the conventional training which leads to a University course. The tutorial classes for working people which have now been undertaken by several Universities, and which already number about 1200 students, are attended by persons carefully selected for the purpose and anxious to pursue a continuous course of study of an advanced standard. In these classes the Universities will be compelled to begin new subjects for students of matured minds who have not received the usual preparation, and will therefore necessarily deal with them in a new way. Here, if anywhere, the difference between school methods of teaching and University methods ought to be apparent; and I feel sure that, if University teachers attempt conventional methods with these students, they will be condemned to failure. It is certain that these classes will increase enormously and rapidly, and I have great hope that they will for this reason influence the methods of University teaching in a very healthy manner. In the tutorial classes the teachers will be confronted with the entirely new problem of students who have thought much, and of whom many are experienced speakers, well able to express their thoughts by the spoken word, but who, nevertheless, have received little training, and have had still less experience, in expressing their ideas in writing. Many of the students whom I have met have told me that this difficulty of writing is their real obstacle, and the matter in which they feel the want of experience most acutely. It will be a very valuable exercise for those who conduct these classes to instruct their students in the art of writing simple and intelligible English, and I hope that the necessity of giving this instruction will have a good effect upon the conventional methods of teaching English in schools as well as in Universities.

I am conscious that this address is lamentably incomplete in that it is concerned only with the manner of University teaching, and scarcely at all with its matter, and that, to carry any conviction, I should apply myself to the task of working out in detail the suggestions that I have made. But this would lead me far beyond the limits of an address, and I am content to do little more than touch the fringe of the problem. Reduced to its simplest terms, this, like so many educational problems, involves an attempt to reconcile two different aims.

The acquisition of knowledge and the training of the mind are two inseparable aims of education, and yet it often appears difficult to provide adequately for the one without neglecting the other. If childhood is the time when systematic training is most desirable, it is also the time when knowledge is most easily acquired; if early manhood is the time when special knowledge must be sought, it is also the time when training for the special business of life is necessary. To withdraw from the child the opportunities of absorbing knowledge may be as harmful as it is unnatural; to turn a young man or young woman loose into a profession without proper preparation is cruel, and may be disastrous.

And so we get the battle of syllabus, time-table, scholarships, examinations, professional training, technical instruction, under all of which lies the disturbing distinction between training and knowledge.

But, if we inquire further into these matters, I think we shall find that the fundamental question is to a large extent one of responsibility. Left to himself, a boy or a man will acquire a knowledge of the things which interest him, even though they be only the arts of a pickpocket, and will obtain a training from experience such as no school or college can give. If education is to achieve the great purpose of interesting and instructing him while young in the right objects, and also of training him for the proper business of his life before it is too late, is it not mainly a question of deciding when and how far to take for him, or to leave to him, the responsibility of what he is to learn and how he is to learn it? If the teacher bears the responsibility during the period of school training, should not the student have a large share of responsibility in the quest of knowledge at the University?

Now it is of the essence of responsibility that there should be something sudden and unexpected about it. If, before putting a young man into a position of trust, you lead him through a kindergarten preparation for it, in which he plays with the semblance before being admitted to the reality, if you teach him first all the rules and regulations which should prevent him from making a mistake, you will effectually smother his independence and stifle his initiative. But plunge him into a new experience and make him feel the responsibility of his position, and you will give him the impulse to learn his new duties and the opportunity to show his real powers. It is because I feel that this sudden entrance into an environment of new responsibility is so necessary that I would regard with suspicion any attempt to provide a gradual transition between school and University methods.

In matters of discipline and self-control it is possible and advisable to place responsibility upon school children; in intellectual matters it is not advisable, except for the few who are matured beyond their years. It is, therefore, all the more necessary that this should be done at the moment when they enter the University.

This should be the moment of which Emerson says: "There is a time in every man's education when he arrives at the conviction that he must take himself for better or worse as his portion; that, though the wide universe is full of good, no kernel of nourishing corn can come to him but through his toil bestowed on that plot of ground which is given him to till. The power which resides in him is new in Nature, and none but he knows what that is which he can do, nor does he know until he has tried."

The spirit of independent inquiry, which should dominate all University teaching and learning, is not to be measured, as I have already said, by the number of memoirs published, but it is to be tested by the extent to which University students are engaged upon work for which they feel a responsibility. Visit the Universities at the present moment, and, in spite of all the admirable investigation which is being carried on, you will find the majority of students engaged in exercises in which they feel no responsibility whatever. In my opinion this indicates that for them the spirit of true University education has never been awakened. It is, after all, very largely a question of attitude of mind. Any subject of study, whether it be a scientific experiment or an historical event, or the significance of a text, is a matter of interpretation, and to approach it in the University spirit is to approach it with the question, "Is this the right interpretation?" Upon that question can be hung a whole philosophy of the subject, and from it can proceed a whole series of investigations: it embodies the true spirit of research and it opens the door to true learning.

In discussing University education I have not, of course, forgotten that many persons have taught themselves up to a University standard entirely without the aid of professors; indeed, the University of London long ago provided an avenue to a University degree which has been successfully followed by many such persons with the best possible results. But I have endeavoured to remind you that at the University, as at school, for most students the personal influence of the teacher is the important thing; that at the University, as at school, success in teaching depends mainly on the extent to which the interest of the student is aroused; and that at the University this is only to be done by providing him with a purpose and a responsibility in his work in order that he may understand to what conclusions it is leading him. Until this is done we shall still have University students complaining that they do not see the object of what they are learning or understand what it all means. This complaint, which I have often heard from past and present students of different Universities, suggested to me that I should on the present occasion deal with this defect in our customary methods.

In the hope that the attention of University teachers may be turned more fully to this aspect of their work I have ventured to make it the subject of my address.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At Emmanuel College research studentships of the value of 150*l.* each have been awarded to G. E. K. Braunholtz and A. Ll. Hughes. Grants of the following amounts have also been made:—S. Mangham, 60*l.*; R. H. Snape, 40*l.*; C. S. Robinson, 20*l.* The exhibition of 50*l.* offered to an advanced student commencing residence this October has been awarded to J. Ivon Graham, London, Royal College of Science for Ireland. Additional exhibitions of 30*l.* have also been awarded to A. J. Grove, Birmingham University, and F. Smith, Manchester University.

The Clerk Maxwell scholarship is vacant by the resignation of Mr. Wellisch. Candidates are requested to send in their applications to Sir J. J. Thomson (the Cavendish Laboratory) on or before November 5.

At Trinity College the following have been elected into fellowships:—G. N. Watson, G. I. Taylor, H. T. J. Norton, and A. V. Hill.

Oxford.—Dr. Arthur Vaughan, well known for his researches on the Carboniferous limestone, has been appointed lecturer in geology.

Mr. A. E. Richey has been appointed demonstrator in geology. Mr. Richey succeeds Mr. J. A. Douglas, who is now engaged on a geological expedition in Peru. The expedition has been sent out by Mr. W. E. Balston to take advantage, for geological research, of the excavations now in progress in the construction of new railways. Mr. Douglas is accompanied by Mr. Thomas, Rhodes scholar, who goes as a volunteer, and the general management of the expedition is undertaken by Prof. Sollas.

Prof. F. M. Sandwith, Gresham professor of physic, will deliver four Gresham lectures on ancient and modern surgery on October 25 to 28. The lectures are free to the public, and will be delivered at the City of London School at 6 p.m. each evening.

The China Emergency Appeal Committee asks for 100,000*l.* to be used as follows:—(1) 40,000*l.* for the establishment of union medical colleges; (2) 40,000*l.* for the establishment of educational schools of training; (3) 20,000*l.* in aid of literature societies and general translation work. A sum of nearly 14,000*l.* had been received or promised up to the end of August; and the following grants have already been made:—Union Medical College, Peking, 2000*l.*; Union Medical College, Hankow, 1000*l.*; Union Medical College, Moukden, 500*l.*; Union Normal Training College, Shantung University, 1500*l.*; Anglo-Chinese College, Tientsin, 1000*l.*; Christian Literature Society for China, 1700*l.*; China Medical Missionary Association for the Translation of Medical Literature, 300*l.* Donations towards the 100,000*l.* required for the China Emergency Fund may be sent to Mr. Robt. L. Barclay, honorary treasurer (Messrs. Barclay and Co.), 54 Lombard Street, London, E.C.; or to the Rev. Edward T. Reed, secretary, China Emergency Appeal Committee, 28 Victoria Street, Westminster, S.W. The committee has arranged for a meeting to be held in the Guildhall on October 18, when addresses will be given on the opportunity of the educational movement in China by Dr. S. L. Hart, and on medical education in China by Mr. D. Main. An address will also be given by Sir Robert Laidlaw.

The inaugural address at the opening of the winter session of the Birkbeck College was this year delivered by Prof. M. E. Sadler. After sketching the development of English education during last century, and showing how much was accomplished by men like Birkbeck, Prof. Sadler went on to say that both in science and in art the passion of modern study has been to see and to represent things as they really are. This at bottom is the basis of scientific thought, and the purpose of the painter's and draughtsman's expression. To keep one's mind clear as a mirror is the intellectual and also the moral condition of real advance both in science and in art. It is impossible, however, to see things as they really are without a long preliminary discipline, in which one learns to see and how to express. Therefore one side of the modern educational movement is to prolong for all students the period of preliminary preparation and discipline, which, having been accomplished, the student may go to that freer, more self-active task which is before those who have received thorough training and preparation. It is in giving that thorough training and preparation that we in England, compared with other leading modern nations, have been until lately grievously in arrear. It is because our system of intermediate or secondary education is meagre, starved, sectional, that the immense efforts bestowed on technical and adult education by such men as Dr. Birkbeck failed for so long to produce the harvest which they confidently expected. The work of strengthening this period of disciplinary preparation for advanced studies—strengthening our whole system of secondary education—is one of the greatest tasks which are before us now as British citizens.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, October 3.—M. Émile Picard in the chair.—The president gave an account of the life-work of the late M. Maurice Lévy.—Émile **Picard**: A singular functional equation of the Fredholm type of equation.—Charles **Lederer**: The organic compounds of tetravalent tellurium. By the interaction of tellurium tetrachloride and magnesium phenyl bromide in ethereal solution there is obtained chlorobenzene, diphenyl, the compound $Te(C_6H_5)_2$ already described by Kraft and Lyons, and a new derivative, triphenyl-telluronium chloride, the iodide of which, $(C_6H_5)_3TeI$, was prepared by adding potassium iodide. The bromide $(C_6H_5)_2TeBr_2$ is also formed in the reaction.—L. **Gay**: The osmotic equilibrium of two liquid phases.—A. and L. **Lumière** and M. **Seyewetz**: The action of quinones and their sulphonic derivatives on the photographic images formed by silver salts. Aqueous solutions of benzoquinone in presence of sulphuric acid are useful in reducing over-exposed negatives; the replacement of the sulphuric acid by potassium bromide gives a new intensifying solution. The suitable proportions are given in both cases.—Charles **Janet**: The sensitive organs of the mandible of the bee.—Paul **Godin**: Normal asymmetry of the binary organs in man.

DIARY OF SOCIETIES.

WEDNESDAY, October 19.

Royal Microscopical Society, at 8.—Hicksonella, a New Gorgonellid Genus: Jas. J. Simpson.—(1) On the Resolution of New Detail in a *Coscinodiscus asteromphalus*; (2) A Micrometric Difficulty: E. M. Nelson.

Entomological Society, at 8.

CONTENTS.

PAGE

The History of Physics . . . 457
Psychiatry and Psychotherapy . . . 458
Commercial Geography . . . 459
Restorations of Extinct Animals. By R. L. . . . 459
Hints for the Garden . . . 460
Our Book Shelf . . . 460
Letters to the Editor:—
Early Burial Customs in Egypt.—**Prof. G. Elliot Smith, F.R.S.** . . . 461
British Marine Zoology.—**Prof. W. A. Herdman, F.R.S.; Prof. E. W. MacBride, F.R.S.** . . . 462
Hormones in Relation to Inheritance.—**Prof. Gilbert C. Bourne, F.R.S.** . . . 462
Pwdre Ser.—**Prof. T. McKenny Hughes, F.R.S.** 462
Unemployed Laboratory Assistants.—**G. E. Reiss** . 462
The International Union for Cooperation in Solar Research. By Prof. Arthur Schuster, F.R.S. . . 462
Popular Books on Biological Subjects. (*Illustrated.*) 464
The Geology and Archæology of Orangia. (*Illustrated.*) **By J. W. G.** . . . 465
Sport on the Moors and Broads. (*Illustrated.*) **By R. L.** 466
Dr. John Peile . . . 467
Notes . . . 467
Our Astronomical Column:—
Announcement of a Nova . . . 472
Time of the Solar Transit of Halley's Comet . . . 472
Observations of Comet 1910*a* . . . 472
Arabian Astronomical Instruments . . . 472
New Ephemerides for Saturn, Uranus, and Neptune . 472
Irregularities in the Motion of Algol's Satellite . . . 472
The Cambridge Observatory . . . 472
Observations of Neptune's Satellite . . . 472
Some Recent Studies on Fossil Plants. (*Illustrated.*) **By E. A. N. A.** . . . 473
Forthcoming Books of Science . . . 475
The International Congress on Radiology and Electricity. By W. M. . . . 478
The Opening of the Medical Session . . . 479
The Berlin University Centenary . . . 480
The British Association at Sheffield.
Section L.—Educational Science.—Opening Address by **Principal H. A. Miers, M.A., D.Sc., F.R.S., President of the Section** . . . 480
University and Educational Intelligence . . . 487
Societies and Academies . . . 488
Diary of Societies . . . 488

THURSDAY, OCTOBER 20, 1910.

RECENT PROGRESS IN PSYCHICAL RESEARCH.

The Newer Spiritualism. By Frank Podmore. Pp. 320. (London: T. Fisher Unwin, 1910.) Price 8*s*. 6*d*. net.

THE recent untimely and tragical death of Mr. Frank Podmore has directed general attention to his writings, especially to the book which, no doubt fully prepared before his death, has been published posthumously.

Mr. Podmore was an early member of the Society for Psychical Research, and he collaborated with Edmund Gurney and F. W. H. Myers in the collection and discussion of that large mass of cases, consisting chiefly of spontaneous apparitions or death-wraiths, which resulted in the publication of the two volumes called "Phantasms of the Living" in the year 1886.

The objectivity of these apparitions of the injured or dying or dead was always doubted or denied by the writers of that book; but inasmuch as the hallucinations were sometimes veridical—that is to say, inasmuch as they corresponded to or represented some actual occurrence, with a precision which, though not complete, was very striking—was found, indeed, on subsequent most careful and conscientious scrutiny, to be immensely beyond any chance coincidence—the writers devised a theory to explain such cases by means of the direct action of one mind on another through some agency not yet recognised in science.

The actual occurrence of such mental interaction, or thought-transference, was investigated by direct experiment, its possibility was considered proved, and a short account of these experimental cases forms part of the standard treatise referred to above. Prof. Barrett, F.R.S., is the leading surviving pioneer in the work of that period. Not only ideas and images could be thus conveyed, but full-blown apparitions of living people could be apparently effected by purposed concentration of mind acting on sufficiently sensitive percipients.

Since that time Mr. Podmore was an enthusiastic supporter of this doctrine of "Telepathy," as the process was conveniently named by Mr. Myers; and subsequent investigation and cumulative experience have gone far to strengthen the belief in it, as a genuine human faculty, among all those who have worked at the subject. So the reality of some unknown mode of communication between mind and mind may now be considered fairly established, notwithstanding that it has not yet received the sanction of high official science.

But it must never be forgotten that the detection of this process as a fact of observation, and the giving it a name for convenience of reference, by no means explains it or reduces it to the level of commonplace. If a fact at all, it must be a fact of exceedingly great importance. For a new or previously unrecognised human faculty is not the kind of thing that may be expected to turn up every century. It has shown signs, indeed, of being but the precursor and most prominent member of a whole group of human faculties, which had been more or less experimented with and more or less believed in, during the course of human history, until the age of science supervened and relegated everything of the so-called magical or occult to the domain of superstition, thereby excluding it from reasonable consideration.

As now contemplated, however, there is nothing superstitious about telepathy. Indeed, it is often employed as the antidote to what may still be called superstition; and Mr. Podmore in particular—so far from regarding it as only the first-discovered member of a series, after the analogy of such a chemical element as Argon—preferred to use it as a master-key wherewith to open a large number of locks, and thereby to let fresh air into chambers which else would be stuffy and obscure. He was apt to forget, I think, that telepathy is itself an obscure and, so to speak, "locked" faculty, inasmuch as no explanation of it has ever been given, or the process explained, either by physicists or psychologists. We do not even know for certain whether it is or is not accompanied by any physical process or stimulus akin to those with which we are familiar in the case of all the ordinary operations of sense-perception. There are some who think it a direct psychical action—that is to say, a direct action of mind on mind; there are others who think that it may be the result of a wider kind of mental interaction than exists among ordinary human beings, and that it points in the direction of the survival of human personality.

Mr. Podmore did not take that view; he does not seem to have pondered deeply on the actual meaning and process of telepathy. He accepted it as a fact, and tried to explain every other occult phenomenon by means of it—showing a tendency, indeed, to accept readily anything that could be thus explained, and to reject, also readily anything that could not. This is not the place for criticism in detail, but it would be easy to select sentences illustrative of this tendency on the part of the author.

Up to a certain limit, indeed, such a method of procedure is legitimate; and undoubtedly the clue furnished by the working-hypothesis of unconscious telepathic communication has rendered easier of belief a great many strange legends and asserted experiences. But to regard it as the only legitimate clue, to test all facts by means of it, and to reject with contumely those which it does not explain, which it can by no contortions be made to explain, is not so legitimate. And if Mr. Podmore has at all fallen into error—as it is only human that he should—it is in this direction that he has erred. I desire to review with extreme delicacy the work of a deceased writer, especially one to whom the subject of psychical research is largely indebted for acute criticism and remarkable industry. Yet I cannot fail to notice in many parts of the book, and, indeed, in his other writings generally, something that may be called *bias* in favour of the supremacy or monopoly of his favourite explanation.

It is true that some of the most recent investigations by members of the society, those which can be summarised briefly under the title *Cross correspondence*, went some distance towards shaking Mr. Podmore's robust scepticism in everything except telepathy—telepathy, that is, between living persons no matter how distant and disconnected from each other they may be; but though he showed signs of an opening mind in this direction, in many others it remained firmly, and as most will think reasonably, closed. Mr. Podmore was one of those who some time ago had believed too easily and too much—at least so his later self would have claimed—and accordingly he had swung over in the opposite direction; certainly nothing in the nature of what are called "physical phenomena"—a title which is used to summarise a group of cases relating to the movement of objects without apparent contact—could ever find lodgment in his mind.

In this he may turn out to be right, for these so-called physical phenomena are among the most incredible of all; they do not appear to have any immediate or necessary connection with the question of human survival—if true, they appear to be a physiological but extraordinary and, so to speak, ridiculous extension of human faculty—and it would be a great simplification if they could all be relegated to the easy and comprehensive category of fraud. But the evidence will not in my judgment permit this simplification of the problems presented by a hitherto uncharted portion of the universe; and I confess I do not feel that Mr. Podmore's training made him a competent critic of this division of the subject. It is the part of his book which will meet with readiest acceptance, however, inasmuch as it postulates no causes but what are only too well known, such as human deceit, quackery, and gullibility; so it puts no strain on the believing power of the reader, even to the moderate extent of demanding the acceptance of an obscure faculty like telepathy.

But I am bound to say that the treatment here is not as worthy of a careful and responsible critic as is his treatment of subjects more closely allied with telepathy. I would even go so far as to say that his criticism of some experiments, such as those made by Sir W. Crookes, for instance, exhibits clear traces of what I may call conscientious or forensic unfairness; not only because definite assertions are questioned in a way which would undermine the record of any experiment ever made, but because their quotation is preceded by accounts of similar phenomena by over-enthusiastic and incompetent witnesses, whose accounts could not have any weight attached to them, and are only quoted in order to prejudice a fair contemplation of the subject.

If I am wrong in attaching some credence to careful records of unusual physical phenomena, on the strength of actual experience of my own, I wish the statement that I do so to stand as a personal confession in the pages of this scientific journal which will be readily accessible to posterity.

Concerning Mr. Podmore's other scepticisms, however, though I do not by any means in every case agree with them, his criticisms are reasonable and competent; and all the disbelief that he possessed on those subjects he was entitled to, inasmuch as he devoted much time to their consideration, and made a careful scrutiny of the evidence. He was not exactly a first-hand investigator himself, but he diligently studied the work of others. His opinion, therefore, is of weight, and, whether unduly sceptical or not, cannot be lightly estimated like that of persons who pronounce a positive and dogmatic judgment on no evidence at all.

The objection which I sometimes feel to Mr. Podmore's books is that they appear to furnish readers with a succinct summary of the evidence available, whereas they really only furnish selections of that evidence—made to some extent from the point of view of their bearing on his favourite hypothesis. These very readable and in some respects learned books may be useful in opening up the question and arousing interest, provided always that they do not quench it, but they have the flaws inseparable from second-hand testimony. The evidence cannot really be studied in any such volumes. It is probably true that conviction can only be attained by first-hand experience of the facts themselves; but, short of this, the evidence must be scrutinised in the recorded observations of the actual experimenters—such records, for instance, as are contained in the Proceedings of the Society for Psychical Research, and those made by earlier pioneers who in face of much obloquy and ridicule preceded and rendered possible its work.

OLIVER LODGE.

FOSSIL CLUB-MOSSES AND FERNS.

Fossil Plants: a Text-book for Students of Botany and Geology. By Prof. A. C. Seward, F.R.S. Vol. II. Cambridge Biological Series. Pp. xxii+624, with 265 figures and frontispiece. (Cambridge University Press, 1910.) Price 15*s*. net.

IT is twelve years since the first volume of Prof. Seward's important text-book appeared. The progress of fossil botany has never been so rapid as during the interval, and we may congratulate ourselves, with the author, that the delay has enabled him to produce a really up-to-date treatise on some of the most important classes of fossil plants.

The present volume is essentially concerned with the Lycopods and "Ferns"—it is necessary to put the latter word in quotation marks, for in these days nothing is more difficult than to tell whether a reputed fossil fern deserves the name or not.

Two short chapters at the beginning of the volume are devoted to the Sphenophyllales and the Psilotales; the account of the former group given in Vol. I. is here completed by the description of some types of fructification recorded since that volume appeared. The relation of the little family Psilotaceæ to the Palæozoic group of the Sphenophylls is fully recognised, but the author does well to put the former in a class of its own. Some authors have been too hasty in uniting these families, which, though they have important characters in common, are distinguished by features no less striking.

The great class of the Lycopodiales, perhaps the most prominent of all in the Carboniferous flora, occupies a space commensurate with its importance, extending to about 250 pages. The description of the fossil representatives is preceded by a sketch of the recent members of the group, illustrated by some excellent figures both of the habit and the anatomy. This method, which the author extends to all groups which have living representatives, is eminently suitable for a book which is intended for geologists as well as for those who have had a botanical training. The best known of the fossil Lycopods were trees; recently, however, we have learnt a good deal about herbaceous club-mosses which also flourished in Palæozoic times. These are fully described, and it is interesting to note how closely, in habit and reproductive methods, some of them approached the living genus Selaginella. On the other hand, we still have no proof of the early occurrence of Lycopodium, which on theoretical grounds is regarded as the more primitive type.

The great family of the Lepidodendreæ is admirably treated, with equal regard to external features and internal structure. Some progress has now been made in correlating the two, and the results are sometimes a little surprising. Thus the well-marked anatomical species *Lepidodendron fuliginosum*, Williamson, is shown to correspond to at least three species based on external characters—a Lepidophloios and two species of Lepidodendron proper. Thus the two genera last-mentioned are indistinguishable, even specifically, by their anatomical characters, and it is very doubtful whether their claim to generic rank can be upheld.

Until quite recently we had but little knowledge of the structure of the well-known genus Sigillaria, but now, thanks to the work of Bertrand in France and of Kidston and Arber and Parkin in our own country, we have become acquainted with the anatomy of a number of species. The new evidence, together with the characters of the fructifications, has finally confirmed Williamson's view of the close affinity between Sigillaria and Lepidodendron, and of the cryptogamic nature of both alike. At the same time, facts have come to light which might once have been regarded as favouring Phanerogamic affinities, for in two genera of Palæozoic Lycopods organs closely analogous to true seeds have been discovered; in both cases the plants, one herbaceous, the other probably arborescent, are in all other respects typical members of the Lycopodiales. Their seed-like reproductive bodies are regarded by many palæobotanists as a striking instance of parallel development; the author, however, is inclined to see in them evidence of a genetic connection between the Palæozoic Lycopods and certain Conifers.

The second half of the volume is devoted to the Fern-like plants, and here the effect of recent discoveries makes itself felt in an even greater degree than elsewhere. As is well known, a large proportion of the Palæozoic Ferns, formerly so-called, are now under well-founded suspicion of not having been real Ferns at all, but seed-bearing plants of fern-like habit. In several cases this has been definitely proved, and in a majority of the plants in question all the available evidence points towards their spermophytic affinities. At the same time, the resemblance to Ferns, which for so long misled investigators, is by no means wholly fallacious, but, as shown by anatomical and other evidence, indicates a real relationship to the Fern-stock, while on the other hand the connection with the Cycad type of seed-plant is manifest. The practical difficulty is to distinguish between these "Ferns with seeds" and the true cryptogamic Ferns which no doubt really existed side by side with them; habit is no criterion, anatomy is only available in exceptional cases; even where the sporangia are present it is often impossible to say whether they were cryptogamic sporangia or pollen-sacs. The author takes a moderate and reasonable view of the difficult position; he recognises a considerable group of generalised Ferns, his Cœnopterideæ (the Primofilices of Mr. Arber), in which our knowledge of structure and of reproductive processes is sufficient to establish the Fern kinship; he is further inclined to admit a certain number of Palæozoic Marattiales (highly organised Ferns now only represented by a small tropical family), though here the evidence is a good deal more doubtful.

The Pteridosperms, as such, do not come into the present volume, but the last chapter is devoted to a number of genera of more or less uncertain position, most of which will no doubt prove to be seed-bearing plants, while a few may retain their traditional position among true Ferns. The clearly established types of Pteridosperms will be considered in vol. iii., which is to be devoted to seed-plants. This part of the work will be looked forward to with keen interest, for a number of questions of the utmost importance for the theory of evolution will then have to be considered.

The present volume, in its full and impartial treatment of habit and structure, of morphology and distribution, is beyond question the best handbook extant for the important fossil groups of which it treats. It is abundantly illustrated, and provided with an excellent index, and with a bibliography; the latter, taken in connection with that of vol i., is singularly complete, so far as works of any importance are concerned.

Botanists are certain to appreciate Prof. Seward's work; we hope that it may receive equal recognition from geologists, who, even more than their botanical colleagues, stand in need of a modern text-book of fossil plants.

D. H. S.

THE COLLECTED WORKS OF HUYGENS.

Œuvres complètes de Christiaan Huygens. Publiées par la Société Hollandaise des Sciences. Tome douzième, Travaux de Mathématiques pures 1652–1656. Pp. vi+296. (La Haye: Martinus Nijhoff, 1910.)

THIS volume is the second one which contains reprints of published writings of Huygens, the ten first volumes having been devoted to his correspondence. During the years 1652 to 1656 Huygens had still to divide his attention between his scientific work and the study of law, but the extracts from his note-books given in this volume show how little the law was able to fill his mind. In January, 1652, he began to occupy himself with various geometrical problems leading to equations of the second or third degree, of most of which he gave solutions in his "Illustrium quorundam Problematum Constructiones," which came out in 1654 as an appendix to his work on the quadrature of the circle. Both the rough work and the printed essay are reproduced in the present volume, and it is interesting to follow the stages by which he succeeded in submitting problems to algebraical analysis which Archimedes, Nicomedes, and other Greek mathematicians had treated by pure geometry.

The principal publication from this period of Huygens' life is his book on the quadrature of the circle, by which he took his place among the leading mathematicians of the day. It was a time when circle squarers flourished, several of them men of some distinction, such as Grégoire de St. Vincent, whose bulky work appeared in 1647 and called forth several polemical writings. Huygens entered the field in 1651 with his "Ἐξέτασις Cyclometriæ" (reprinted in T. XI. of the new edition), in which he showed the fallacy of St. Vincent's quadrature of the circle. In 1654 he brought out a larger work, "De Circuli Magnitudine Inventa." In this he developed further the use of the properties of the centre of gravity on the basis of the theorems he had published in 1651, and rigorously proved some propositions used by Snellius without proof, as well as a number of new theorems about sums of polygonal perimeters and various quantities, between which the length of the circumference of the circle is intermediate. Finally he calculated π by means of a 60-sided polygon within the limits of three units of the tenth decimal. The number of decimals is, of course, inferior to that previously attained by Van Ceulen and others, but the result was found without the appalling labours which these had gone through, and the investigation is valuable on account of the theorems proved by Huygens.

The lucidity and force of the arguments in the "Ἐξέτασις" had made its author hope that they had convinced Grégoire de St. Vincent of his mistakes. He exchanged a number of civil letters with St. Vincent, but the latter could never be induced to enter on a discussion of the matter, but always evaded it by saying that some day he would answer all his critics at the same time. But several of his pupils entered the lists for him, among whom was the Jesuit Ainscom, who in 1656 published what he imagined was a refutation of all the adversaries of his master, and did his best to convince people of the truth of the four methods of squaring the circle set forth by St. Vincent, but never put into practice by him. Huygens lost no time in replying; his "Epistola" to Ainscomb was published at the Hague in the same year. It forms the concluding portion of the present volume of his works, and in accordance with the praiseworthy rule of the editors of this most valuable edition of Huygens' works, the part of Ainscom's essay dealing with the attack of Huygens is also reprinted.

J. L. E. D.

A PRIMER ON COAL MINING.

First Steps in Coal Mining. For Use in Supplementary and Continuation Classes. By Alexander Forbes. Pp. viii+320. (London, Glasgow, and Bombay: Blackie and Sons, Ltd., 1910.) Price 2s. 6d.

THE present adds one more to the already long list of primers on coal-mining that have been produced so freely of recent years, and unfortunately it cannot be said that it is sufficiently an improvement upon some of its predecessors to justify its publication. It is difficult to see to what class of student such a book as the present one can address itself, or which it can expect to benefit; if it is intended for the instruction of youths actually engaged in mining operations, such definitions as "the men engaged in the excavation of the material are termed *sinkers*," "the portion of the twenty-four hours during which each set works being called a *shift*," "the extreme end of the road . . . is called the *face*," &c., are surely superfluous, as these expressions must be familiar to every boy about a pit. If, on the other hand, the book is intended for those who have no personal knowledge of coal-mining, the amount of information afforded upon the majority of mining operations cannot possibly be sufficient to enlighten them; for instance, it is hopeless to expect that the subject of coal-cutting by machinery can be adequately taught in three pages; in the same way, only twenty pages are devoted to the whole subject of shaft-sinking, including all the special methods, entirely out of place though these are in an elementary book.

Just about one-third of the book has been devoted to an outline of geology, and this is the most, if not the only, satisfactory part of it. The remainder is made up of "scrappy" chapters on the various departments of mining, with some fragments of elementary chemistry and physics distributed amongst them. Not content with this wide range, the author has not hesitated to include even mine surveying, to which he devotes nearly four pages! Of what use he imagines that these can possibly be to anyone it is hard to conceive, even though he has inserted an illustration, without a word of description, of an old-fashioned theodolite, possibly with the object of giving an air of completeness to his index. Had the author contented himself with writing an elementary text-book of geology for the use of miners, he might probably have produced a work of greater use than the more ambitious effort now before us; at the same time, it cannot but be admitted that not even in the geological section has the author displayed the faintest evidence of originality in thought or treatment. This want of novelty throughout the book is shown very strikingly in the illustrations, every one of which appears to have been published before in other works. Their selection has, moreover, not always been a happy one, as witness the picture of the theodolite already referred to. For sheer futility it would be difficult to surpass some of the illustrations to the chemical section, such, for example, as Fig. 129, which represents water being poured out of a jug.

The very best thing that can be said of the book is that it is comparatively free from serious mistakes.

OUR BOOK SHELF.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part i., October. Pp. xvi+88. (London: Gurney and Jackson, 1910.) Price 2*s.* 6*d.* net.

A thoroughly up-to-date and scientific account of the mammals of the British Isles, written in such a style that it may be acceptable to the field-naturalist as well as to the specialist, has long been a desideratum. So far as it is possible to judge from the first part this want promises to be supplied, at all events, from the scientific aspect, by Major Barrett-Hamilton's work, which is to be published in twenty-four monthly parts, so arranged as, when complete, to form three volumes, of which the first is to be devoted to the bats, while the third is to include the whales and dolphins, with an appendix on extinct and domesticated species. Whether the work will appeal with equal strength to that section of the general public interested in natural history remains to be seen. A distinctly popular element is, however, supplied by the twenty-seven coloured plates, reproduced from sketches made for the work by that accomplished artist-naturalist, Mr. E. A. Wilson. The plate in the present part is a group of dormice in a sloe-bush, which we hope will prove the least successful of the series, as the two uppermost figures are scarcely satisfactory, while the eyes of all the individuals appear too small and lacking in prominence.

Except for an instalment of the introduction to the Chiroptera and the general account of the family Vespertilionidæ, the present part is devoted to the noctule and Leisler's bat, each of which has an appalling list of synonyms. The only fault we have to find with these lists is that, beyond a statement on an earlier page (6) to the effect that the generic term Nyctalus was applied to the group by Dr. K. Andersen in 1908, there is no clue to the authority for the names *Nyctalus noctula* and *N. leisleri.* It is true that these names do not actually appear in Dr. Andersen's paper in the "Annals" for the year cited, but reference to that paper ought certainly to have been made in the lists. The work has our best wishes for success.

R. L.

Bacteriology for Nurses. By Isabel McIsaac. Pp. xii+179. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 5*s.* net.

While agreeing with the proposition that the nurse should have a clear and definite knowledge of the principles of the germ theory of infective diseases, we doubt if this book will really aid her to attain this end. It is too much an elementary text-book of bacteriology, and does not contain sufficient of the practical application of bacteriological principles in the every-day routine of the nurse's work. The greater part of the book is occupied by descriptions of the causative organisms of the various infective diseases, but far too little is said about the why and the wherefore of surgical cleanliness and the means of attaining it, and the methods of preventing the spread of infection in the ward and household. Thus the section on sterilisation and the use of disinfectants occupies a bare nine pages, and the principles of antiseptic and aseptic surgery are almost omitted, yet these subjects constitute almost the beginning and the end of the surgical nurse's work. In the section on malaria, while the importance of protection from mosquitoes as a preventive is fully recognised and the "screening" of houses recommended, not one word is said of the mosquito net, which may often be the only means available for carrying out any form of "screening."

These instances of omissions might be multiplied. While, therefore, the book may prove a readable elementary text-book of pathogenic bacteriology for the general public, including the nurse, we cannot but regard it as lacking in many of the bacteriological details which are so essential to the intelligent work of the nurse for whom it is avowedly written.

R. T. H.

The Inherent Law of Life: A New Theory of Life and of Disease. By Dr. Franz Kleinschrod. Translated from the German and edited by Louise C. Appel. Pp. vii+214. (London: G. Bell and Sons, Ltd., 1910.) Price 3*s.* 6*d.* net.

Dr. Kleinschrod is a vitalist of the order of his celebrated countryman, Dr. Hans Driesch. He holds that life is not explicable from a mechanistic point of view. It has its own laws, beyond all physical and chemical formularies. Moreover, as we know life better—at closer quarters, so to speak—than inorganic nature, it is absurd to explain the former by the latter. "All our ideas of nature are obtained directly from the law of life; are vitalisms, as Prof. Lipps, the psychologist, so aptly terms them. Force, energy, gravitation, pressure, &c., are ideas derived from life and transferred to the lifeless world." It is more sensible to interpret the inanimate from the standpoint of the living than conversely.

Disease and healing are, equally, life-processes. A true remedy is a remedy which calls forth the healing processes, and does not merely suppress symptoms, as in the application of ice to inflamed parts. The thing to do is to stimulate function. Digitalis does not increase cardiac strength; it merely whips up the action, and uses up life-force too fast. Graduated exercises really strengthen the heart. Similarly with other pathological conditions. Less drugging, more "nature-cure."

There is much that is debatable in this book, but it is certainly suggestive. On its practical side it is in accord with the trend of modern practice, and the author sensibly admits the *auxiliary* uses of surgery and drugs, thus steering clear of the extremes into which some nature-cure propagandists are apt to rush.

Philosophics. By Prof. Ronald Ross, F.R.S., C.B. Pp. viii+56. (London: John Murray, 1910.) Price 1*s.* net.

The title of this brochure is rather unhappily chosen, for, coupled with the author's scientific and academic distinctions, it may give an untrue impression. As a matter of fact, the book is a collection of short poems, written in the leisure time of a busy and useful career. All are tuneful and satisfying to the ear, and many have the genuine inspiration which distinguishes poetry from mere verse—*e.g.* the "Vision of Nescience," and many a line in the longer poem, "In Exile." Prof. Ross is, of course, best known by his researches on malarial fever, and his discovery of the part played by mosquitoes in carrying infection. The results of his work are world-wide. It seems probable that, largely in consequence of his discoveries, many uninhabitable districts may be rendered fairly healthy; this is already being done in parts of Brazil. The following couple of verses, written at Bangalore, admirably portray the pity in a noble worker's mind, and the pathos of suffering humanity. The title is "Indian Fevers."

> "In this, O Nature, yield I pray to me.
> I pace and pace, and think and think, and take
> The fever'd hands, and note down all I see,
> That some dim distant light may haply break.
> The painful faces ask, can we not cure?
> We answer, No, not yet; we seek the laws.
> O God, reveal thro' all this thing obscure
> The unseen, small, but million-murdering cause."

LETTERS TO THE EDITOR.

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

Early Burial Customs in Egypt.

As the subject of early burials has been raised in Nature with reference to the results of my excavations (pp. 461–2), I suppose some reply will be expected.

The whole question lies in a nutshell. Many thousand graves have been examined by one party of observers, and certain results repeatedly found. Many thousand graves have been examined by another party of observers, in other localities, and such customs are not found. Many people accept the results of both groups; Dr. Elliott Smith will only accept one group. To take an exactly parallel case: by one group of observers a dozen vases with figures of boats have been found among these graves, but by the other group (as I am informed) no examples have been found. The negative evidence of the latter cannot prove the uniformity of customs throughout the country.

To repeat here the statements of most careful observations already published would be a waste of space and attention. All the possible causes named on p. 462 for the accidental shifting of bones were fully before myself and other observers, as we together examined skeletons in unplundered graves; the cases were considered at length before shifting a single bone; and our most careful observations of facts cannot be disproved by differences of ancient custom in other places.

The custom of unfleshing is well known in early Italy and Europe, and practised to this day (with ceremonial anthropophagy) in Africa. It is not surprising that it should also be present in Egypt. Indeed, the references to early anthropophagy in Egyptian ritual and myth would point to its being known, even apart from any physical evidence.

This year, again, we found two unquestionable examples showing the unfleshing and wrapping of every bone separately in linen, without leaving any flesh or skin except a little on the skull. If the corpse had been buried entire—as Dr. Elliott Smith suggests—and subsequently plundered of valuables, no relatives would have then honoured it by breaking it entirely to pieces to rebury it. The unfleshing must have been a primary burial ceremony; and these bodies were of the highest nobles of the third dynasty, and not merely of barbarous peoples. These were published, and the specimens subsequently exhibited for a month in London. I regret that Prof. Elliott Smith did not examine them, nor, indeed, honour our excavations by a single inspection during the years when he was in Egypt.

W. M. Flinders Petrie.

Lord Morton's Quagga Hybrid and Origin of Dun Horses.

May I be allowed to return to the two suggestions made in Nature of September 15, viz. (1) that Lord Morton's quagga hybrid was not a hybrid at all, and (2) that the dun colour in horses is not a reversion?

The first of these was based upon Prof. Cossar Ewart's statement in "The Penicuik Experiments" that "in their body colour none" of his zebra hybrids took after their zebra sire, and on the theory, now well proved, that chestnut is recessive to all other horse colours. It thus seemed impossible that Lord Morton's hybrid, which, according to its portrait, is undoubtedly a bay, could be the progeny of a quagga horse and a chestnut mare.

Some years ago I saw half a dozen of Prof. Ewart's zebra hybrids, and, although I did not observe them as closely then as I would now, they all impressed me as having the colour of their dams *plus* the striping they had got from their sire the zebra. A few days ago Prof. Ewart very kindly showed me over his stud again, and showed me also the skins of some zebra-horse hybrids, and these skins follow the dams in colour. A brown skin had a brown dam, a bay skin a bay dam, a chestnut skin a chestnut dam, and so on. The chestnut skin was highly rufous, but it was still chestnut. There were also two brown-looking skins, yellowish below and about the flanks, belonging to the progeny of a zebra mare and a horse, which Prof. Ewart had not bred; but in this case, I understand, the colour of the horse is unknown.

In support of the first contention, I said it was very unlikely a quagga with whitish "points" and a chestnut mare should have a foal with dark points such as are seen in the portrait of Lord Morton's hybrid. Prof. Ewart points out that "crosses between zebras and ponies have, usually, dark patches at the fetlocks." That may be; but my point was that this would not occur if the dam were a *chestnut*. Every other colour but chestnut might be expected to give foals dark at the fetlocks.

The second suggestion, that dun is not a reversion, was based upon work of my own published last spring. At the time I had only few data with regard to dun, but it indicated dun to be dominant to chestnut, black, bay, and brown, and recessive to grey. Since then I have collected more than 200 matings concerning dun; and leaving out creams (which seem a variety of dun), dun roans, and cases in which the colours of the second parent were unknown, the following table shows the results of mating dun with itself and with the other five usual colours:—

Colours of Parents	Colours of Foals					
	Chestnut	Plack	Bay	Brown	Dun	Grey
Dun × Chestnut...	3	—	4	—	9	—
Dun × Black ...	—	4	—	—	4	—
Dun × Bay... ...	4	3	21	3	8	—
Dun × Brown ...	—	—	2	7	8	—
Dun × Dun ...	1	—	1	—	6	—
Dun × Grey ...	3	4	7	5	16	10

That dun is recessive to grey is shown by the fact that it gets no grey foals unless mated with grey, while its matings with the other colours, as well as with grey, show that it is dominant to, *i.e.* contains, them all. In addition, there are two matings of grey with grey producing duns, and two of grey with black producing duns.

It follows from the above that a dun foal can only be got when one parent is either dun, dun roan, or grey, and that dun can be a reversion, if it can be called such, to grey only. But it could not be expected that among 200 cases there would be no exceptions to the rule. However, I have found only four in which a dun foal had neither a dun nor a grey nor a dun roan parent. But these exceptions help to emphasise the rule, for in each of them one of the two parents was a bay—the second parent being brown in three cases and bay in one—and bay and dun are occasionally mistaken for each other. These cases may, therefore, be taken as misdescriptions.

The Przewalsky horse is a case in point. He has been called dun; but he is not such. He is a bay, a sandy bay, with a large bright nostril patch such as is found among light bay, sandy bay, and "yellow bay" Clydesdales.

I have just come upon the following in Darwin's "Animals and Plants under Domestication" which is *apropos* of the present discussion:—"I have endeavoured, but with poor success, to discover whether duns, which are so much oftener striped than other coloured horses, are ever produced from the crossing of two horses, neither of which are duns. Most persons to whom I have applied believe that one parent must be a dun."

James Wilson.

Royal College of Science, Dublin, October 3.

The colour of Lord Morton's hybrid may not suggest its mixed origin, but this is sufficiently indicated by the mane, tail, and conformation.

A white-legged Iceland pony produced a brown hybrid with dark "points" to a Burchell zebra (Matopo) white below the knees and hocks, and a chestnut Iceland mare produced a bay hybrid to a Przewalsky stallion. Why should not a chestnut mare produce a bay-dun or bay, hybrid to a white-legged quagga?

Lord Morton's quagga was more a bay than a dun, and there are good reasons for assuming that both the quagga and the Burchell zebras are descended from ancestors in colour like the wild horse still surviving in Mongolia. Of three zebra hybrids out of a chestnut mare, two are rufous (or chestnut), but one is fawn-coloured and has dark "patches at the fetlocks." Doubtless dun may contain bay, brown, and black, but on one occasion I obtained a striped dun by crossing a black Shetland pony with a striped bay Arab—an Arab which mated with a yellow-dun Connemara mare produced a pure black. These may only be exceptions that prove the rule.

J. C. Ewart.

Tests for Colour-Blindness.

I am surprised to see in the review of my book in Nature of September 1 the statement:—

"We do not see that Dr. Edridge-Green has furnished us with any increased security, or indeed that any better security is needed, than is obtained from Holmgren's test when this is employed in the precise manner directed by its originator."

In this issue of my book I have devoted nearly nine pages to the detailed condemnation of the Holmgren test, and this portion remains as it was in the 1891 edition. The statements there have been confirmed by numerous observers, amongst whom are some of the ablest scientific men the world contains. In fact, at the recent International Physiological Congress I did not meet with a single man who was satisfied with the Holmgren test.

I will only refer to the statements of Prof. Nagel, who has done so much in connection with colour-blindness.

I pointed out that normal-sighted persons were rejected by this test, and this is abundantly evident by the number of men rejected by the Board of Trade who get through on appeal.

Prof. Nagel in 1898 found thirty-nine cases (2·75 per cent.!) in 1420 examinations in which typical dichromic (red-green blind) mistakes were made with the Holmgren test, and yet when examined by other and more trustworthy methods, as, for instance, the spectroscope, were found not to be dichromics.

I stated that the test green was not the best colour for a first test. Nagel says the same thing. In the reports of the Board of Trade it will be seen that many have passed the green test and failed with the rose test. It may be noted that the Board of Trade have never at any time used the test in strict accordance with Holmgren's instructions, because they have used all three test skeins, whereas Holmgren stated that when the green test had been passed the person might be regarded as normal sighted. Nagel points out the varieties and number of colour-blind persons who are passed by the Holmgren test, and gives the reasons, which are similar to mine.

F. W. Edridge-Green.

The Institute of Physiology, University College, London, October 7.

In 1890 or 1891 the Royal Society appointed a very strong committee, of which Lord Rayleigh was chairman, and it included, among other "able scientific men," Lord Kelvin, Sir George Stokes, Sir William Abney, and Prof. Michael Foster, to report on the general subject of colour-vision and on the tests proper to be used in connection with it. Dr. Edridge-Green gave evidence before this committee, stated fully his objections to Holmgren's test, and displayed the methods which he recommended in lieu thereof. His book was published before he gave evidence; and, as his original objections to the Holmgren test are reprinted *verbatim* in the 1909 edition, it is fair to suppose that no fresh evidence in support of them has been obtained during the intervening time. Besides hearing many witnesses, the committee carried out an extended series of practical investigations, and on April 28, 1892, it unanimously recommended the Holmgren test for adoption by railway companies, ship-owners, and the Board of Trade. The committee pointed out that variations in the amount of deficiency in colour-perception are numerous, and, "when small, are often difficult to classify." No one claims for the Holmgren test that it affords a sufficient basis for a minute classification, but it does afford the surest and most convenient means of excluding from certain industries the small number of persons who could not engage in them without danger to the community.

The Reviewer.

Water Vapour on Mars.

The statement attributed to Director Campbell on p. 317 of Nature for September 8, to the effect that the nights in September, 1909, on which his spectrograms of Mars were taken, "were as perfect for the purpose as could be wished," is open to question. Though the sky may have been clear and the surface humidity low, this does not prove that the aqueous vapour in the upper air was small in amount. September is the month when the total vapour-content of the atmosphere is a maximum, and February is the month when the vapour-content is a minimum, in north temperate latitudes. This is well shown in the curves of energy in the infra-red solar spectrum for February 19, 1903, and September 14, 1903, in the article on "The Absorption of Water Vapour in the Infra-red Solar Spectrum," by F. E. Fowle, jun. (Smithsonian Miscellaneous Collections, quarterly issue, vol ii., part i., p. 1, 1904, Plate i.). The ratio of the intensities of the bands of aqueous absorption {(Mars + earth)/earth} will be greatest when the total absorbent column of the earth's atmosphere contains least water, that is, other things being equal, the ratio may be expected to be smallest in September and largest in February. Director Campbell has chosen the worst month, and Dr. Slipher, who observed in January and February, the best months for making the experiment.

The statement that "with a nearly evanescent α band, the more water vapour one attributes to the terrestrial atmosphere the less remains attributable to that of Mars" is, of course, true, and because the water vapour of Mars is not great in amount it is not desirable to attempt to observe it at a time when the feeble Martian absorption band is swamped in a more powerful terrestrial band.

The depths of the aqueous absorption bands in Mr. Fowle's figure (*loc. cit.*) is many times greater in September than in February; but this does not express the degree of unfavourableness of the September observation adequately, for it is increasingly difficult to detect an increment of absorption due to the addition of a constant amount of vapour, as the total absorption grows greater, and this for the reason that many of the absorption lines have reached a maximum intensity already, so that any further increase of the depth of the absorbent only affects the feebler lines. It should be understood that, with the low power employed, the band is not resolved into its separate lines in the Martian spectrum.

Through the favour of Dr. Percival Lowell I have been permitted to measure the spectra of Mars and the moon photographed by Dr. Slipher at the Lowell Observatory in January and February, 1908. The seasonal gain from lower temperature and diminished moisture in the upper air in winter at Flagstaff is more than an equivalent for any gain in this respect to be obtained by even a double altitude in summer. I have made quantitative measures of the absolute intensity of the little α band in both spectra. The ratio, α(Mars)/α(moon), obtained from six different plates on as many nights, varies from night to night as changes in the terrestrial atmospheric humidity may determine, but all of the plates unite in telling the same story, and show that little α is stronger in the spectrum of Mars.

One of Dr. Slipher's plates, which is, unfortunately, not the best one photographically, although it is better in this respect than any of Director Campbell's, was taken under almost ideal conditions, the air at the surface having a dew point of $-14{\cdot}8^\circ$ C., and the exposure on Mars being equally divided on either side of the lunar exposure with both bodies at the same altitude (40°). The result is conclusive, and shows that the Martian band on this occasion was two and one-half times as intense as the telluric one. Still larger ratios were obtained from other plates.

Similar consistent measures have also been made of the oxygen band, great B, showing that it is in like manner stronger in the spectrum of Mars, although the measurement is a difficult one, because the earth's atmosphere is much denser than that of Mars, and the further small addition of absorbent has but little effect.

Frank W. Very.

Westwood Astrophysical Observatory, Westwood, Massachusetts, October 1.

A Caution.

Fellows of the Zoological and other scientific societies, museum officials and others, are warned against an individual representing himself as a consumptive and asking for a recommendation to a hospital and temporary help.

The *modus operandi* is to call upon you with a bogus introduction from another fellow of your society or someone known to you, and to mention a few other well-known persons as interested in his case.

The individual is rather tall, thin, of wan appearance, and has a dark moustache. His manner shows some refinement and education, and is also persuasive, as proved by the number of those known to have, unfortunately, been victimised by his false representations.

E. A. S.

Dr. John Peile: A Correction.

Owing to the omission of a comma (which is doubtless due to my faulty and hasty writing) in the article in your last issue on the late Master of Christ's, the personages of Prof. Percy Gardner and the President of Queens' College have been merged into one.

Prof. Percy Gardiner is, of course, the professor of classical archæology at Oxford, and the President of Queens' (which should be spelt with the apostrophe *after* the "s," it having been founded by two queens) is the physicist, the Rev. T. C. Fitzpatrick, chairman of the board of physics and chemistry at Cambridge.

I need hardly say that the list of those who were at Christ's College under Dr. Peile was confined to those who acquired a position in certain branches of science. An equally strong list could be drawn up of those who have achieved success in other walks of life.

October 14. The Writer of the Article.

THE CENTENARY OF BERLIN UNIVERSITY.

A BRIEF account of the first day of the centenary festival at Berlin, and of the notable utterance of the German Emperor at its opening *Festakt*, was given in last week's issue of Nature. The celebration lasted over three days (October 10–12), with some sporadic entertainments on the fourth. Unter den Linden, from the Brandenburg gate to the royal castle and the cathedral, showed the chief, if not the only, signs that something unusual was in hand. For Berlin, as one of the academic orators remarked, is not a university city; it is a city containing a university. The well-known building itself, with its statues of the Humboldts and Helmholtz, was decked with garlands, and flags fluttered about the opera square and the new *Aula*, which is the old library. Figures in evening dress, or uniform, or quaint university costume, flitted here and there among the city crowds, and students in the caps and colours of their *corps* drove in open carriages along the wide alleys of the central avenue of Berlin. But except when the torchlight procession was in motion, or the Emperor with his guards passed swiftly along, the hurrying population was little stirred, and traffic followed its usual course.

At noon on Monday, October 10, the delegates met at the University to receive instructions. Each was presented with a commemorative bronze medallion bearing the Kaiser's image, and with two massive volumes of the history of the University, and a useful guide to "Berlin in Wissenschaft und Kunst," prepared by Dr. W. Paszkowski. Those of each nation were requested to choose one of their number to speak for them at the presentation of addresses next day. The venerable Lord Strathcona, Chancellor of Aberdeen and of McGill University, Montreal, was acclaimed the representative of the British delegation. One orator was to be appointed to reply at the festival banquet to the toast of the whole of the non-German delegates, and the choice fell upon Dr. Mahaffy, of Dublin. When the time came, be it said, the versatile Irish scholar played his part in fluent German amid universal applause.

In the evening a solemn thanksgiving was held in the new cathedral. Court-preacher Dryander led the service, which was richly choral, and the sermon was preached by Dr. Kaftan, dean of the theological faculty. His theme was diversity in unity, "many members and one body." On leaving the cathedral, the congregation found the streets lined with soldiers and police, and cheerful crowds awaiting the students' torchlight procession. A large and informal company gathered in the halls and balconies of the University building to welcome the students as they passed in long and well-kept lines, dressed in all the bravery of their *Burschenschaften*. The rector magnificus, Dr. Erich Schmidt, met the students' leaders, who, through their spokesman, Studiosus Heyl, pledged their faith to Alma mater, and raised a thundering cheer for "His Magnificence" and his colleagues. The 3000 members of the procession then dispersed, to spend the night in the time-hallowed ceremonies of the *Kommers*. The professors and their guests promenaded the halls of the University, where a light collation was served in every room. Acquaintances were made and renewed in easy and unceremonious fashion, and a lively conversazione was kept going for several hours.

Next morning (October 11), the more formal celebration began at an early hour in the *Neue Aula*, the centenary gift of the Ministry of Education to the University. The guard of the Alexander regiment was drawn up in front. The corridors and staircases and the hall itself were lined with uniformed students carrying swords and banners. Delegates in strange academic robes, nobles, courtiers, and statesmen, in full-dress and gleaming with decorations, filed into their places. By the time that the Emperor and Empress, accompanied by a number of princes, the Imperial Chancellor, and a brilliant Court-party, entered to the sound of trumpets, the hall presented a dazzling display of military and academic pomp. The rector ascended the rostrum and greeted the assembly in a sonorous oration. Objective science with individual culture, he set forth as the aim of the University from its first foundation. The Emperor nimbly mounted in the rector's place, and amid tense silence delivered an energetic discourse, the substance of which was given in last week's Nature. When he announced his intention to found an imperial association for the foundation and maintenance of institutes for scientific research, with an initial capital of some half-million pounds sterling, the audience broke into long and clamorous applause.

The rector expressed the thanks of the nation in moving words, and called for a *Hoch* for the Emperor, which was given with full-throated enthusiasm, the students clashing their swords and waving their banners in time to the shrill strains of bugles and trumpets.

The Minister of Education, and the Oberbürgermeister Kirchner, next spoke for the governments of state and city, the latter presenting the rector with the deeds of a municipal endowment of 10,000*l.* for the establishment of travelling scholarships for university students. Then followed the presentation of addresses by delegates of home and foreign universities and academies. Those of each nationality came forward in a group, the countries being called up in alphabetical order. The speeches of the respective leaders were supposed to occupy not more than three minutes each, but some at least stretched far beyond that limit. Each delegate as he passed bowed to their Majesties, announced his university, handed in his document, and was greeted by the rector. This part of the proceedings went forward quietly, though at intervals applause broke out as well-known personages were recognised. Thus Poincaré, of Paris, Sir J. J. Thomson, of Cambridge, Lord Strathcona, of Montreal, Macan, of Oxford, Mittag-Leffler, of Stockholm, and Hadley, of Yale, were specially cheered.

Thereupon the prorector, Dr. Kahl, read a long list of jubilee gifts and benefactions. They included one of 5000*l*. from Frau von Wildenbruch for scholarships, a large but unnamed sum from friends of the University for the foundation of students' hostels or residential colleges, 7500*l*. from Dr. Hans Meyer, of Leipzig, for the endowment of a chair of colonial geography, and a multitude of other donations in money and kind. For all of these grateful acknowledgments were expressed, and then, by the whole assembly, the Emperor leading, the *Gaudeamus igitur* was intoned as a finale. The ceremony had lasted over three hours.

Immediately after the ceremony, it was officially announced that the titles of Excellency and full Privy Councillor had been bestowed upon Prof. Harnack, royal librarian; Prof. Diels, philologist; Prof. Wilamowitz-Möllendorf, classical scholar; Prof. Emil Fischer, chemist; Prof. Brunner, jurist; and that a host of decorations of all grades had been conferred upon other officers of the University. Even the chief janitor or *bedellus* was not forgotten.

At three o'clock a banquet for six hundred was served in the hall of the exhibition park. The feast and the speeches lasted until nearly eight in the evening. Prince Rupert of Bavaria, Prince August William of Prussia, the Chancellor von Bethmann-Hollweg, formerly a Berlin professor, and the Minister of Education, Count von Trott zu Solz, were among the guests. The Chancellor and the Minister spoke for the German Government; the Prorector and Dr. Wilamowitz-Möllendorf for the University and its staff; Rector Hölder, of Leipzig, and Prof. Mahaffy, of Dublin, for the Teutonic and non-Teutonic guests respectively; the President of the Gymnastic Association, "Arminia," for the students. To him Prof. Harnack replied, thanking the undergraduates *utriusque sexus*, and draining the newly presented loving-cup to their welfare. Some ominous head-shakings among the professors were observable as the one lady student present, Miss Ilse Tesch, of the faculty of medicine, came up to join in the pledge. The situation was saved by Prince August William, himself a Berlin student, who promptly shook hands with his "Commilitonen" *utriusque sexus*, and solemnly shared the cup with them. The assembly dissolved in laughter and loud applause. Presently the company reassembled at the Royal Theatre, where, in the presence of his Majesty and the Court, a festal performance of Mozart's "Marriage of Figaro" was given in honour of the University and its guests.

On Wednesday morning, October 12, the new *Aula* was the scene of the second *Festakt*. The Emperor was represented by his son, and the place of the courtiers was taken by the city fathers and other representatives of municipal institutions. But in other respects the gathering resembled that of the preceding day. Prof. Lenz, the historiographer of the University, delivered an eloquent and impassioned address on its origin, evolution, and present position. The ideas of its first sponsors, Fichte, Schleiermacher, and William von Humboldt, had been realised or surpassed. Even in the dark days of the Fatherland, the University had not despaired. Hundreds of its members had given their labours and laid down their lives for the unity of Germany. Based on that unity, now once for all achieved, the University had risen triumphant to its present glory. Its watchword was "freedom of research"; its guiding conviction that knowledge is the power that conquers.

Then followed the academic ceremony of conferring honorary degrees. In accordance with German custom, the list of graduands had been kept a secret. For days before the newspapers had speculated regarding the recipients, but, except in a few instances, the current guesses appear to have been wide of the mark. The precedence of the faculties in Berlin rests with divinity; it is followed by law, medicine, and philosophy. It was therefore at once surmised that something abnormal was about to happen when the dean of the law faculty came first to the daïs. In a few words of German he explained his mission, and then in stately Latin proceeded to create, pronounce, and proclaim the Emperor himself a *doctor utriusque juris, cujus auctoritate juris civilis Germanorum codex post sæculi labores prodiit*. The announcement brought the assembly to its feet; a loud fanfare, and cheer after cheer, welcomed the new graduate. The dean of the faculty of theology followed, in a formal and courtly protest, waiving his precedence for that occasion only. He, by resolution of the Senate, and with the approval of his Majesty, proclaimed some fifteen or sixteen doctors of divinity. The Burgomaster of Hamburg, a distinguished merchant, and Dr. James Hope Moulton, of Cambridge and Manchester, were among the number. The dean of the law faculty reappeared, and conferred the LL.D. degree on Prince Rupert of Bavaria, Judge Oliver Wendell Holmes, of New York, Prof. Vinogradoff, of Oxford, the Burgomaster of Berlin, and a long series of professors and high officials holding office in the German civil service. In medicine, professors of philology, philosophy, and law were promoted, side by side with Poincaré, de Vries, Richards (Harvard), the painter Thoma, the musician Reger, the humorist Raabe, of Brunswick, and the master of ceremonies, Knesebeck. It needed all the dean's ingenuity to relate the functions of the honorary doctors of medicine to those of his faculty.

The list of the philosophical faculty, which includes all the departments not covered by the other three, was of considerable length. Some forty names were read out, and a few words were said on each. Prof. Ashley, of Birmingham, Dr. Arthur Evans, of Oxford, and Dr. Lazarus Fletcher, of the British Museum, represented British learning; and the Presidents of Harvard, Yale, and Columbia were selected for the United States. The Imperial Chancellor and the President of the Reichstag, with many other exalted personages, military and administrative, and one lady, Frau Cosima Wagner, of Bayreuth, were included. It gave rise to some remark that none of the British delegates, though Lord Strathcona, Lord Reay, Sir William Ramsay, Sir J. J. Thomson, and Sir Joseph Larmor were among them, received any academic recognition.

The solemnities of the seniors were thus accomplished. But the junior members of the University had festivities of their own to celebrate. The afternoon was occupied by a popular *Gartenfest* in the exhibition park, where students in the costume of 1810 and earlier, old alumni, professors, citizens, and somewhat bewildered guests, held high carnival. The halls of the exhibition, and the arches of the railway viaduct that spans the grounds, were thronged by thousands of cheerful spectators of the numerous entertainments, organised by the students' committee. As the public were admitted on payment, the crowds made sightseeing difficult, and conversation well-nigh impossible. As the evening fell, the academic element receded altogether, and the park assumed a bank-holiday aspect.

At night a vast *Kommers* of the entire body of students took place in the Zoological Gardens. There, under the strict regulations which tradition prescribes, the ceremonies of the *Biercomment* were performed for the edification of the initiated and the entertainment of the foreign visitors. But the present writer had to leave by the midnight express, while the ordered revelry was at its height.

The foreign university delegates included Principal G. Adam Smith (Aberdeen), Zeeman (Amsterdam), Sir J. J. Thomson (Cambridge), Mahaffy (Dublin), Sir Donald MacAlister (Glasgow), Chwostow (Kasan), Brögger (Christiania), Sir W. Ramsay (London), Lord Strathcona (Montreal), President Hadley (Yale), President Butler (Columbia, New York), Macan (Oxford), Poincaré (Paris), Grünert (Prag), Blaserna (Rome), Mittag-Leffler (Stockholm), Bernatzik (Vienna), and A. Meyer (Zurich). Among the representatives of foreign academies and societies were Thomsen (Copenhagen), Johannessen (Norway), Lord Reay (British Academy), Sir J. Larmor (Royal Society), Keen (Philadelphia), Montelius (Sweden), Miura (Tokyo), and Böhm-Bawerk (Austria). The German universities and academies were represented for the most part by their rectors or presidents.

TOWN-PLANNING.

TOWN-PLANNING has always had a fascination for the sociological amateur, and the creation of a model town is one of the most pleasing and least harmful of Utopian dreams. Mr. Burns's Town Planning Act is well-intentioned; under the conditions this is enough, for in the evolution of a town the method of trial is inevitable, the problem *solvitur ambulando.* The one thing needful is the guiding idea, the working principle.

The discussions at the Town Planning Conference have been full of interest. There have been felicitous analogies, ingenious suggestions, and brilliant forecasts. But it is a commonplace that the permanent institutions are those which have not been planned, but have grown by a sort of felicitous adaptation, an unconsciously purposive concurrence of atoms. Throughout the conference it was taken for granted that the town of the future will be evolved from the town of the present by small, continuous modifications. Here is a curious analogy to Darwin's view of the evolution of a new species, by the summation of small variations. Again, throughout the conference there has emerged no master-principle, no architectonic impulse, for the guidance of those who will apply the Act. Still less possible was the emergence of any universal and permanent plan.

What is to be our plan, and what our principle for the evolution of the town of the future? Is the ideal town to be a garden city, with factories in the country, or a combination of gardens and factories? Mr. Lanchester has ingeniously explained the "West End" tendency by suggesting that in the evening, when work is over, one's steps naturally turn to the region of the setting sun, and that this quarter therefore is unconsciously chosen as the place of home and relaxation. Or is the ideal town to be an aërial maze of skyscrapers, overhead ways and wires, somewhat as imagined by Mr. Wells? Will this have roof-gardens? Will different forms of traffic be confined to different levels? Or, again, will the city be half underground? Such questions would be futile, were it not necessary that the working plan of the town-planner must allow for all such eventualities.

It is argued by many that plan must precede structure. As applied to individual units, this is a truism, but it can hardy be applied to a complex growth like a town. It involves the Platonic notion that there is a pre-existing idea of a town. But the idea, that is, the plan, of a town develops with its growth as surely as it originated with its inception. The moral of this is that the plan which every body of town-planners must work upon must be a *dynamic plan*; a moving, shifting, developing, and shrinking, growing and changing plan, the germ of which is to-day's town conditioned by its environment.

There has been, and will be for a time, much useless talk about town-geometry. The straight line and right angle with which street-plans commence, to be varied by curves, other angles, circles, and triangles, according to the circumstances, are fundamental. Æsthetic play with these elements is misguided in the case of streets and areas, no less than in the case of individual houses and blocks. For architectural beauty should be a by-product of adaptation of structure and function. Town-planners need to keep an eye on traditional architecture, which has long lost this essential principle. There is a real danger, in the enthusiasm of a new movement, that the conventional architect may create a body of useless expenditure if allowed to indulge his unscientific ideal of ornament for ornament's sake. He is really more dangerous than the jerry-builder. In the one sphere where he may seem harmless, if not desirable, the designing of public buildings, he is really unnecessary. At the conference, engineers were conspicuous by their absence, but in the town-building of the future the engineer will be the main adviser and collaborator of the builder.

As for a guiding principle in the working of a dynamic plan, there is none, unless we say—science. In the town, as in the house, ease of communication, light, air, and sanitation are the essential needs which scientific building has before it. There are no other components of a golden rule. Continuously applied when circumstances permit, these considerations will gradually improve our cities as science advances. One or two details are useful for discussion. It has long been established that urban populations tend to be more intellectual but physically more degenerate than the rural. Yet East End populations, though degenerate in some respects, have developed a high power of resistance to insanitary conditions. Again, there is some evidence that the town populations of Sweden, once a feeble race, have become, through physical training and scientific environments, physically superior to the country populations, and as fine a race as any in Europe. Parks and open spaces will be permanent blessings, supplying a touch of nature for the soul of the town dweller, though we may come to realise that we have over-estimated the value of light, and may some day artificially purify our air. Such suggestions as a great ring-road round London —certainly concentric communication is defective—and the removal of the great railway termini to one small central area, must be balanced by the possibility of the evolution of other methods of locomotion. Some day London may need great open spaces for aëroplane stages.

Town-planning is a continuous process, and its results are in the future, and themselves to be superseded. But there is one sphere, more or less untouched at the conference, which admits of immediate attention. One of the great obstacles to progress is the slowness with which new inventions are brought into the personal environment of the mass of the population. A striking example of this is the average house. But in the case of house-building, which, after all, is the most important function of architecture, and the one supreme concern of the town-planner, invention has done less than in any department of material civilisation. Only in the matter of artificial lighting, and in sanitation, if in that, is the average house of to-day superior to the average house of two thousand years ago. In the matters of hot-water supply and plumber's work generally, of cooking apparatus, cleaning arrangements, heating, and ventilation, the modern house is a disgrace to a scientific age. What has been done for centuries towards the improvement of door and window mechanism? Even the external material of houses is the same as was used five or six thousand years ago, and is no more damp-proof now than it was then.

Take care of the houses and the town will take care of itself. Here is a work, of vital importance for the welfare of the race, which may well be the first care of those who apply the Act.

A. E. CRAWLEY.

THE MELANESIANS OF BRITISH NEW GUINEA.[1]

IN this volume is presented for the first time an adequate account of the sociology of a portion of the people of British New Guinea. The material which it embodies was collected during two visits of the author to New Guinea, and he has been ably assisted by various members of the Government and of the missions resident in the island. The book is a conspicuous example of what may be achieved by expert inquiry combined with local knowledge.

Dr. Seligmann uses the term Papuasian to signify all the inhabitants of New Guinea and the adjacent archipelagoes. These form two distinct groups. For the taller, darker, and more frizzly-haired people of the west he retains the term Papuan. The smaller, lighter-coloured peoples of the eastern peninsula and islands, in which the true Melanesian element is dominant, are called Papuo-Melanesians. With these Dr. Seligmann deals in the present volume, the Papuans being only alluded to when their physical characteristics or customs refer to the subject of discussion. Following Dr. Haddon's suggestion in the "Decorative Art of New Guinea," the author divides the Papuo-Melanesian peoples into two main groups, the western Papuo-Melanesians and the Massim of the east.

An introduction gives a succinct account of the general sociology and culture of the two groups. These agree in certain physical and cultural characters, which clearly differentiate them from the Papuan, but differ in many respects from one another. The amount of variation among the western Papuo-Melanesians is much greater than that found among the Massim peoples. The greater uniformity of the latter is regarded by Dr. Seligmann as due to a geographical factor. The small islands and peninsulas of the eastern district afforded less shelter for fugitives than the swamps and forests of the west, so that the Melanesian conquest was there more rapid and complete. Owing also to the slower mingling of the Melanesians with the original populations of the west, Dr. Seligmann considers that there is not only a considerable Papuan element in their composition, but that they have also in some cases adopted Papuan languages differing from each other as do the Papuan languages spoken by Papuans. If the Papuan elements were sufficiently strong to impose their language upon their conquerors, they must have been sufficient to have imposed their customs, or, at least, to have modified those which the invaders brought with them.

With the Motu of Port Moresby and the neighbourhood, who are the best known of the western Papuo-Melanesians, the author associates the Koita. The latter speak a Papuan language, and have for generations inter-married with, and built their villages adjoining, the Motu. The fact that the Koita language shows no trace of Melanesian influence, and has names for indigenous plants and animals, which are unnamed by the Motu, presents a difficulty which Dr. Seligmann has not discussed. From the latter, too, they have adopted certain customs and arts. The Ikoro, Gaboni, and Sinaugolo tribes, which closely resemble the Motu, occupy the district inland from Kapakapa and the basin of the Kemp Welch River. All these people are distinguished by the use of the open ceremonial

Copyright by the Rev. H. M. Dauncey.

FIG. 1.—Feather öaöa of the Rore-speaking Tribes. From "The Melanesians of British New Guinea."

platform, or *dubu*. Eastward from Hood Peninsula the coast is occupied by a rather different tribe, among whom the *dubu* gives place to the *koge*, or steeple-house. All three groups have a general likeness in culture and sociology. There is a clan organisation and patrilinear descent. The first sixteen chapters of Dr. Seligmann's work deals in detail with the Koita regulation of public and family life, customs, trade, and religion, and includes an interesting account by Capt. F. R. Barton, of the *Hiri* or annual trading voyage made from Port Moresby to the Papuan Gulf. Another colony of Papuo-Melanesians (Mailu) dwelling around Milport Harbour and Port Glasgow, and speaking a Papuan language, are not discussed in detail by the author, neither are the Koiari and similar people of the hinterland, whom he regards as possessing more Melanesian than Papuan blood.

[1] "The Melanesians of British New Guinea." By Dr. C. G. Seligmann, with a chapter by F. R. Barton, C.M.G., and an appendix by E. L. Giblin. Pp. xxiv+766. (Cambridge: The University Press, 1910.) 21s. net.

The most western group of the immigrant Melanesians are the Roro and Mekeo people of the St. Joseph River, with whom are closely related the Pokao and Kapatsi between Hall Sound and Cape Suckling. In chapters xvii.–xxxi. the social relations and family life of the Roro are detailed, with an account of the clans and village organisation of the Mekeo, and a note on Pokao. This region is characterised by the greater importance attached to the right than to the left side in ceremonial matters, and by the prominence of geometrical design in the decorative art. Among the Mekeo there are traces of mother-right, though descent is patrilineal. A prominent feature in the Mekeo village is the highly decorated *ufu*, or club-house.

Fig. 2.—Popungapi *ufu* of Rarai Village. From "The Melanesians of British New Guinea."

The Massim people of the east are more homogeneous than the western Papuo-Melanesians. Dr. Seligmann makes two divisions, the northern in the Trobriands, Marshall-Bennet, Woodlark, Laughlan, and some smaller islands, the southern in the south-east peninsula of New Guinea between the south shore of Milne Bay and Goodenough Bay, with some of the Louisiades. Each division has its distinctive features. In the north there is a higher cephalic index and cranial capacity, a hereditary chieftainship, and absence of cannibalism. Both sections are remarkable for the building and use of large sea-going canoes, and the characteristic Massim decorative art reaches its highest development in the ornamental prows of these vessels in the north. The author's account of the sociology of the southern Massim includes a collection of folk-tales. The people live in hamlet-groups, the inhabitants of which are more or less closely related by birth or marriage. There is also a peculiar form of totemism in which the members of a clan have as totems a series of associated animals or plants, as, *e.g.* a bird, fish, snake, and plant, the number and nature of these varying in different places.

The northern Massim are described in similar detail as regards the Trobriands, Marshall-Bennets, and Murua. Shorter accounts are given of the Louisiades and Mukaua on the southern and western borders.

The volume is exceedingly well illustrated. There are seventy-nine plates from photographs or native drawings. Most of the former are exceptionally good. In addition there are fifty figures in the text drawn by Mr. Norman H. Hardy, a good map, a glossary of native words, and a very useful index. Dr. Seligmann has produced an interesting, trustworthy, and scholarly work on a most interesting section of the Melanesian people.

S. H. Ray.

THE CENTENARY OF FILIPPO CAVOLINI.

THE first centenary of the death of Filippo Cavolini, the great Neapolitan naturalist, was celebrated on September 12–13, the function having been arranged by the Society of Naturalists in Naples. Citizens, as well as the scientific and the political authorities, answered enthusiastically to the appeal of the society. The municipality and the University united, formed a powerful honorary general committee, the patronage of which was assumed by King Victor Emmanuel III. The chairman of the ordinary committee, composed of members of the Society of Naturalists, was the president of the society, Prof. F. S. Monticelli. The committee published an attractive booklet, giving a *résumé* of the life and works of F. Cavolini.

On September 12 the *aula magna* of the University was thronged by delegates of the Italian and foreign universities, by members of the International Zoological Congress, and by others who had been invited. Amongst the many supporters, apart from the Italian Ministries of Public Instruction and of Agriculture, we note those of many academies and universities of Europe and America, and also the Prince of Monaco.

Prof. Pasquale del Pezzo, rector of the University, thanked the Ministry of Public Instruction, and greeted all who took part in the commemoration in honour of Filippo Cavolini. Commander Rodino presented a welcome from the municipality of Naples, and thanked the Italian Sovereign, patron of the commemoration. Prof. Paladino spoke on behalf of the Royal Academy of Sciences and Letters, recalling at length the personality of Cavolini as citizen and man of science. Prof. Camerano, rector of the Turin University, made an appropriate speech, and Prof. Apáthy, representing the Hungarian University of Kolozsvàr, offered the greetings of the foreign men of science. Dr. F. S. Monticelli, ordinary professor of zoology at the Naples University, then delivered a speech in which, having alluded to the life of Cavolini, and summarily traced his scientific work, he concluded:—"Filippo Cavolini was a biologist in the true and modern sense of the word, both in observation and in experiment; his work marked a new direction in the study of life, a direction that has been corroborated in later times, a direction which Cavolini, in his day, professed and practised."

"The perusal of his works, which will be re-edited by the committee, fully proves that a century ago he, precursor of the present time, experimented on the same lines as those of the present day. This man, to whom, with patriotic pride, we must accord the honour of the scientific discoveries which he first revealed, well merits the remembrance of his fellow-citizens in to-day's centennial festivities, in order that they, not forgetting our ancient culture, should recollect that in times less fortunate for Italy's destiny, Filippo Cavolini, honouring his country, maintained his country's name in science."

The rector afterwards held a reception in the great academic hall. In the evening the Society of Naturalists received the delegates in the Galleria Vittoria. The following day the delegates and congressists were invited by the committee to join an excursion by steamer to Capo Posillipo, to the Villa de Mellis, once Cavolini's property. President Monticelli, in the presence of a large gathering, consigned to the representative of the municipality a commemorative marble tablet, which had been fixed to the house in which the great naturalist achieved his work.

JOHN WILLIS CLARK.

By the death of John Willis Clark, on October 10, the University of Cambridge has lost one of its best known and best loved members. Failing health had quite recently induced him to send in his resignation of the office of registrary of the University, as from the end of September. The interval allowed by statute for filling up this important post is only fourteen days, and it thus happened that his successor was elected on October 12, the day before his funeral took place.

J. W. Clark was to an exceptional extent a product of Cambridge, and the circumstances of his birth and training combined to give him, from early youth, an intimate knowledge of the University. He was born in Cambridge on June 24, 1833. His father, the Rev. W. Clark, fellow of Trinity College, was professor of anatomy from 1817 to 1866. His uncle, Robert Willis, fellow of Gonville and Caius College, held the Jacksonian professorship of natural experimental philosophy from 1837 to 1875. J. W. Clark was thus brought up in an environment which made him familiar with the University at an age when his contemporaries in academic standing of later years had not yet commenced their acquaintance with Cambridge. He was educated at Eton, and from there proceeded to Trinity College, of which he became a scholar, and later a fellow, having obtained a first class in the classical tripos of 1856.

On the death of Prof. Clark, in 1866, a professorship of zoology and comparative anatomy was founded, and the first occupant of the chair was Alfred Newton. At about the same time the zoological specimens which had been contained in the museum of anatomy, some of them dating from the time of Sir Busick Harwood, professor of anatomy from 1785 to 1814, were placed in a museum of their own, reinforced by the collections of the Cambridge Philosophical Society. J. W. Clark was the first superintendent of the new museum of zoology, and he acted in that capacity from 1866 to 1891, when he resigned the office on being elected registrary. During his tenure of the superintendentship, his own efforts, combined with those of Prof. Newton and Prof. (later Sir George) Humphry, gave the museum a character which was eminently suited for the instruction of students of zoology, and made it an educational instrument of the greatest value. Throughout these years Clark was on terms of intimate friendship with Prof. (later Sir William) Flower, at that time conservator of the museum of the Royal College of Surgeons. A series of specimens illustrating the comparative anatomy of vertebrates was formed by a mutual arrangement between the two museums, of such a nature that, for instance, the limb-bones of one side of a particular animal found their way into the museum of the College of Surgeons, and those of the other side into the Cambridge comparative series. Clark was fully impressed with the importance of illustrating the structure of animals in his scheme of exhibits, and the collection over which he presided was distinguished by possessing preparations both of vertebrates and invertebrates, which placed it far in advance of the majority of provincial museums.

During the whole of his period of office at the museum, Clark had, however, wider duties to perform. He found time to act as secretary to the Museums and Lecture Rooms Syndicate, a body which is charged with the care of the buildings, and, to a large extent, with the finance of the scientific and other departments. This was a highly critical period in the history of natural science in the University, since it coincided with the remarkable growth of scientific studies which was so marked a feature of Cambridge at that time. Clark's wise and capable management of affairs, and in particular the interest he took in supervising the planning and erection of the buildings required to provide accommodation for the new studies, have earned for him the well-deserved gratitude of all who have had the scientific interests of the University at heart.

The duties in connection with the museum and with the growth of the scientific departments generally would have been enough to find full scope for the energies of an ordinary man. But this was only one side of Clark's remarkable character, and some of his most notable achievements lay in entirely different directions. His highly valued services to the University as a member of innumerable syndicates and boards must be passed over without comment. The work by which he is best known to many students was connected with the history of the University. The monumental "Architectural History of the University of Cambridge," by the late R. Willis and J. W. Clark, was published in 1886, in four large volumes. It originated in a lecture given by Prof. Willis in 1854, and it was based in the first instance on the materials which had been accumulated by him. The work was taken over by Clark at Prof. Willis's death; and the volumes, as finally brought out by him, are a mine of information in all matters connected with the growth of the University and its colleges, as well as of Eton College. Four years later, in 1890, "The Life and Letters of Adam Sedgwick" was published by J. W. Clark, in collaboration with Prof. T. McKenny Hughes.

As an antiquary, Clark was specially concerned with libraries, and he was an acknowledged master in matters relating to their furniture and fittings. Some of his results in this line of investigation were published in 1901, under the title of "The Care of Books." His interest in libraries took a practical shape in the work he devoted to the University library, as shown, for instance, by his success in raising, within the last few years, a sum of 20,000*l.* in order to place the finances of that institution on a more satisfactory basis. The Fitzwilliam Museum is another institution to which Clark devoted much of his time, and to which he rendered innumerable services. He was a member of the council of the Cambridge Antiquarian Society for forty-nine years, and he read more than fifty papers at meetings of the society.

As a zoologist, Clark's principal interests were connected with marine mammals, as is exemplified by the fine collections of Cetacea, Sirenia, and Pinnipedia which he made for the museum of zoology. His best-known zoological publications refer to these groups of animals, and special reference must be made to his papers on eared seals, published in the Proceedings of the Zoological Society in 1873 to 1884.

During the last nineteen years of his life, Clark was fully occupied by the duties devolving on him as registrary of the University. In this capacity his extraordinary knowledge of the early history of Cambridge and of its forms and ceremonials, his ability in the care and publication of documents, and his acquaintance with procedure were all of the greatest service to the University.

It is difficult to speak dispassionately of Clark's singularly attractive personality, and of the ready sympathy he showed with all sorts and conditions of men.

Advancing years did not take from him the capacity of making new friends, many of whom were chosen from among the younger members of the University.

> "Gracious and apt to win the youngest heart,
> Yet keep the oldest true!"

These words, written of him by his friend, Mr. A. C. Benson, will express the affectionate regard felt for him by many with whom his loss leaves a blank that cannot be filled. Sidney F. Harmer.

PROF MAURICE LÉVY.

In Nature of last week the death was announced of M. Maurice Lévy, sometime inspector-general of the Ponts et Chaussés, and professor at the Collège de France. An interesting account of Levy's investigations in pure and applied mathematics and mechanics is given by M. Émile Picard in an address to the Académie des Sciences, read on October 3 (*Comptes rendus*, cli., 14).

In infinitesimal geometry, Lévy obtained the doctorate in 1867, for an essay on orthogonal coordinates embodying several new and important results. His investigations in this subject also included the study of spiral surfaces. His treatise on graphical statics, of which the first edition appeared in 1874, practically initiated the study of this important branch of applied mathematics in France. The notes at the end of the first edition really constitute original papers on the tension of elastic rods, and on the systems of maximum strength with given amount of material; in them the author discusses the advantages of structures without superfluous connections. A second and enlarged edition appeared in due course, and the completion of a third edition has been unfortunately cut short by Lévy's recent death.

The subject of elasticity occupied a large share—perhaps the main share—of Lévy's attention. After he entered the École polytechnique in 1856, at the age of eighteen, he indicated a new and simple method of investigating the resistance of continuous beams. The problems presented by systems, one of the dimensions of which is small compared with the others, greatly interested him, and a long memoir was published by him on the flexure of elastic plates. M. Picard speaks in high terms of the ingenuity and ability displayed in this essay, while remarking that a more complete solution of the difficulties occurring in this problem is to be sought elsewhere.

A second problem in elasticity was afforded by the stability of rods or prisms under end-thrust, and Levy extended the investigation from straight to circular rods, obtaining extremely interesting conditions of stability by means of an analysis involving elliptic functions. To M. Lévy is assigned the credit also of obtaining for the first time the general equations for ductile bodies strained beyond the limits of elasticity, thus responding to the question put by Saint Venant, arising out of Tresca's experiments.

Hydrodynamics formed the subject of Lévy's second paper, dealing with rectilinear vortex motion. In this, the author took a leaf out of Cauchy's theory of optical dispersion in his application of the higher differential coefficients in studying the mutual action of two vortices.

A development of a more practical character was M. Lévy's investigation of the equilibrium of earth and the strength of masonry supporting walls. Starting with the laws of friction, Lévy found the differential equation of the lines of rupture in limiting equilibrium, and showed that, contrary to Coulomb's results, the surfaces of rupture for a prismatic mass of earth are not in all cases planes parallel to the edges of the prism.

It will thus be seen that M. Lévy played an important part in applying analytical methods to the solution of problems of practical interest, and his works constitute a heritage from which workers in applied science cannot fail to benefit greatly.

NOTES.

The council of the Royal Scottish Geographical Society has resolved to award the society's medal to Prof. James Geikie, F.R.S., for his numerous contributions to geographical research and his great services to the society; and the Livingstone gold medal to Sir John Murray, K.C.B., F.R.S., in recognition of his oceanographical work, and more particularly in commemoration of the completion of the bathymetrical survey of Scottish fresh-water lochs.

We regret to see the announcement of the death, on October 14, of Dr. Sydney Ringer, F.R.S., at seventy-six years of age.

According to a Reuter message from Santiago de Chile, official returns show that the world's consumption of nitrate during the past year amounted to 43,996,966 quintals, an increase of 8,000,000 quintals as compared with the previous twelve months.

Prof. Howard C. Butler, of Princeton, has just returned to that University with an encouraging report of the archæological expedition he has been directing at Sardis, in Asia Minor. The discoveries include a part of the pavement of the ancient city, and the substructure of a large temple of the fourth century B.C. In the necropolis across the river from the city the explorers have discovered fragments of statuary and many gold ornaments of much beauty.

Three members at least of the Yale faculty have lately returned from exploring tours which have occupied them during the long vacation. Prof. C. Schuchert, curator of the Peabody Museum, has investigated the geological formations of southern Labrador, and brought back a ton of specimens. Prof. R. S. Lull has spent several months in Europe studying mainly the European equivalents of the American dinosaurs. Mr. G. G. MacCurdy, curator of the anthropological collection, has been engaged in researches in the Indian antiquities of southern Mexico.

The Home Secretary has appointed a committee to consider the organisation for rescue and aid in the case of accidents in mines, and to frame proposals for the making of an Order or Orders under the Mines Accidents (Rescue and Aid) Act, 1910. The members of the committee are:—Mr. C. F. G. Masterman M.P. (chairman); Mr. R. A. S. Redmayne, H.M. Chief Inspector of Mines; Mr. W. N. Atkinson, H.M. Inspector of Mines; Mr. E. M. Hann; Mr. W. C. Blackett; Mr. John Wilson, M.P.; and Mr. John Wadsworth, M.P. The secretary of the committee is Mr. A. Maxwell, of the Home Office.

In a letter published in the *Times* of October 17 Mr. J. Reid Moir, of Ipswich, announced his discovery of worked flints beneath undisturbed deposits of Crag in the neighbourhood of Ipswich and elsewhere in eastern Suffolk. The flints occur on the eroded surface of the London Clay, at the base of Pliocene deposits, and associated in some cases with phosphatic nodules and fossil bones. It is inferred that the ancient clay surface was inhabited by "pre-Crag man," whose implements, on submergence of the land beneath the Pliocene sea, became covered with Red Crag. The handiwork on the flints is of a more advanced character than that of the eoliths. Two types, at least, of the early East Anglian flints may be recognised; and it is notable that though they must be, if Pliocene, very much older than the Great Ice age, some of them exhibit on their worked surface deep striæ suggestive of glacial action.

In a letter to the Press, Lord Braye and Mr. Frank Hedges Butler state that it is proposed to erect a pillar as a memorial to Percy S. Pilcher, who was killed at Market Harborough on September 30, 1899, while making a flight with his soaring machine or aëroplane. Pilcher was the first Englishman who put into practice the project of gliding through the air with rigid wings, and he had the intention of propelling with a motor the machine he had made. Many who knew him and appreciated his self-devotion and zeal in promoting aviation may like to contribute to the proposed memorial, near the spot where he fell. Subscriptions should be sent to the Pilcher Memorial Fund, Messrs. Barclay and Co. (Gosling Branch), 19 Fleet Street, E.C.

The name of Thorvald Nicolai Thiele, professor emeritus in the University of Copenhagen, has been before the astronomical public for many years, and by his lamented death on September 26 science has lost an able and original worker distinguished in several branches of natural knowledge. As a pupil of D'Arrest and as director of the Copenhagen Observatory he gave much, but not undivided, attention to astronomy, and was known for his careful discussion of double-star observations, and particularly for his criticism of Otto Struve's measures. The problem of the theory of errors in its many applications interested him, and he will be remembered for his discussion of special cases of the problem of three bodies. Outside astronomy he wrote much on insurance problems and statistics connected with tables of mortality. On these subjects he was a recognised authority, and on account of his pre-eminence was one of the few foreigners elected into the Institute of Actuaries. As a teacher he preferred to lecture on the more abstruse problems of astronomy, and never attracted a large class; consequently, his pupils were few and his influence small in comparison with his reputation, but those who were willing to penetrate deeply found in him an encouraging and illuminating master.

The Board of Agriculture is understood to have applied to the commissioners appointed under the Development Act for an annual grant of 50,000*l.* for the purpose of research work in agriculture and for giving technical advice to farmers. A number of agricultural institutions have sent in applications for financial help, but the Board and two of the commissioners—Messrs. A. D. Hall and Sydney Webb—are engaged on a comprehensive scheme that shall ensure the best use being made of the present material. The Board has appointed a special advisory committee, including the Duke of Devonshire, Lord Reay, Sir Edward Thorpe, Dr. Dobbie, Mr. S. U. Pickering, Prof. J. B. Farmer, Lieut.-Colonel Prain, Drs. Teall, Harmer, MacDougall, and Wilson, and Messrs. Davies, Middleton, Staveley-Hill, and Stockman to help generally in the work. Details of the scheme are not yet available. The occasion is a critical one for agricultural science. The amount of money is considerable, and much will be expected in return for it; if those engaged in agricultural research can justify its expenditure they will be rendering good service, not only to agriculture, but to science in general.

Nomenclature occupies a necessary part of scientific activity, and in no branch of science are the difficulties of nomenclature so great as in zoology. The greatest of these difficulties is occasioned by the rules of priority, since if these were strictly applied, many familiar names would fall into disuse, and great loss of time, misunderstanding, and trouble would result. The British Association and the eastern branch of the American Society of Zoologists have recently appealed for support in a movement to exempt animal names of long standing from change under the rule of priority, and have presented a proposition on the subject to the Commission on Nomenclature of the International Zoological Congress. This commission has just issued its triennial report, the chief interest of which lies in a reference to this matter. The secretary (Dr. C. W. Stiles, Smithsonian Institution, Washington, D.C., U.S.A.) now asks all zoologists to send him a list of 100 generic names (with their authors' names) for consideration in connection with this proposition by November 1, together with a list of standard text-books used in zoological or palæontological courses of study. Specialists are also asked to furnish a list of 100 type-species, with full references to their names as determined by Art. 30 of the international rules. All zoologists who wish to preserve the older nomenclature would do valuable service by sending in such lists without delay.

The *Times* of October 7 contains an interesting account of recent Norwegian explorations in Spitsbergen carried out by an expedition under Captain Gunnar Isachsen, which returned to Christiania on September 18 last. The chief land-work of the expedition was done in the north-western part of the main island, the most striking result being the discovery of a not long extinct volcano and hot-springs in Bock Bay, a branch of Wood Bay (not Wijde Bay, as first reported). When the brief announcement of this discovery first reached Europe two months ago some doubt was felt as to the recentness of volcanic action in this quarter, but the details now given seem to prove that the volcanic cone is at any rate of Quaternary age and later than the general glaciation of the region. The cone, about 1650 feet high, is described as consisting partly of lapilli; it occurs in lat. 78° (? 79°) 28′ north, and long. 13° 28′ east (Greenwich), in the vicinity of a north-south fault, which brings Devonian sandstones into juxtaposition with granite. The expedition encountered unusual and difficult ice-conditions, and reports that Bell Sound, in the south-west of the island, was already blocked up by ice toward the end of August, and that hunting sloops are now there frozen up. The weather was very fine until the middle of August, but afterwards there was scarcely one clear day in the western part of Spitsbergen. The large Geological Congress party that visited Ice Fiord under the leadership of Prof. G. de Geer early in August are evidently to be congratulated on their good fortune in having chanced upon the finest weather of the season.

IN *Travel and Exploration* for October Mr. A. de C. Sowerby, in the service of the United States National Museum, describes the exploration of a hitherto little known district in China, the country drained by the Fen-ho, a large tributary of the Yellow River, running north and south through the western part of the Shansi Province. He was successful in procuring a number of new or uncommon specimens, such as moles, polecats, striped hamsters, pikas, and other quadrupeds, but there were practically no birds except bustards, crows, and larks. Sport is abundant; and Mr. Sowerby, who was accompanied by his wife, seems to have been well received by the people.

THE increasing importance of the museum of the University of Pennsylvania has encouraged the director, Mr. G. B. Gordon, to commence the issue of a quarterly journal, of which we have received the first number. The past history and condition of the museum, and several new and interesting acquisitions, have been here described by the sectional officers. It illustrates the liberality of American citizens towards scientific institutions, and the value which they attribute to museums as factors in educational work, that the director now appeals, with confident hopes of success, for the collection of an endowment fund which will give an annual income of seventy-five thousand dollars, which will, it is estimated, meet immediate requirements.

IN the September number of the *Quarterly Journal of Microscopical Science* (vol. lv., part iii.) Mr. A. M. Carr Saunders and Miss Margaret Poole discuss the development of *Aphysia punctata*, with special reference to the origin of the kidney, heart, and pericardium, concerning which very different opinions have been expressed by previous writers. This paper illustrates well the great accuracy in the determination of cell-lineage which is expected of the modern embryologist, and by which alone such problems can be solved. The necessity for such accurate observation is also clearly brought out in a short controversial paper, published in the same number, by Prof. Hubrecht, who endeavours from the study of very early stages in the development of Galeopithecus and Tarsius to demonstrate the untenability of Mr. Assheton's theory of the hypoblastic origin of the mammalian trophoblast. The extremely early segregation of the trophoblast cells in the types referred to certainly seems to afford strong support to Prof. Hubrecht's contention.

IN the *Centralblatt fur Bakteriologie, Parasitenkunde, &c.* (Originale Band 53, 1909), Dr. C. Elders describes and figures a trypanosome found in the blood of a patient in Sumatra. It was observed that at the beginning of the rainy season the Javanese coolies on a rubber plantation situated near the edge of the virgin forest often suffered from a sickness characterised by "continuous, atypical attacks of fever, with painful enlargement of the spleen, liver, and lymphatic glands, sometimes with œdema pedis, often with aches in the head, back, and limbs, and always with increase of the large mononuclear leucocytes." It was in a smear of blood from one of these patients that a single specimen of a trypanosome was found, which appears to differ in its characters, and especially in its small size (8 μ in length), from the African *Trypanosoma gambiense* or the Brazilian *T.* (*Schizotrypanum*) *cruzi*, of which an account was given recently (August 4) in NATURE. Should this discovery be confirmed, this species (which is not yet named) will be at least the third distinct species of trypanosome parasitic on human beings.

A MEMOIR entitled "Flagellaten-studien," by M. Hartmann and C. Chagas, in the *Memorias do Instituto Oswaldo Cruz*, vol. ii., part i., is a very important contribution to the cytology of the Flagellata. The authors have studied the relations between the nuclear and flagellar apparatus, both in the resting condition and during mitosis, in a number of species of this class of Protozoa, and they distinguish four types of flagellar insertion, as follows:—(1) the flagellum takes origin directly from the centriole contained in the nucleus (Rhizomastigina); (2) the flagellum arises from a basal granule or secondary centriole, connected by a filament or rhizoplast with the primary centriole in the nucleus (Protomonadina and Phytomonadina); (3) as in (2), but the basal granule of the flagellum is connected with the centriole of a special kinetic nucleus, and the organism is binucleate (trypanosomes and allied forms); (4) the basal granule (secondary centriole) of the flagellum is connected by a rhizoplast with a centriole of the third order, lying outside the nucleus altogether, and distinct from the primary centriole contained in the nucleus (Euglenoidina). A natural classification of the Flagellata is put forward, based principally on the above-mentioned differences of structure. In this connection it may be mentioned that, as pointed out by Minchin, the two primary subdivisions of calcareous sponges, in the "natural" classification of this class, also exhibit, amongst other characteristic points of difference, distinct types of flagellar insertion in the collar-cells.

THE nomenclature of some of the species indigenous to or visiting the United Kingdom is discussed by Dr. Hartert in the October number of *British Birds*. Among other items, we are told that the thrush "must henceforth be called" *Turdus philomelos*, while the redwing is to be known as *T. musicus*. Nevertheless, in the recently published "Guide to the British Vertebrates in the British Museum" the latter name is retained for the thrush, as is *Turdus iliacus* for the redwing.

IN the Transactions of the Lincolnshire Naturalists' Union for 1909 Mr. G. W. Mason completes his list of the Lepidoptera of the county, while Messrs. Thornley and Wallace continue their synopsis of the local Coleoptera, dealing in this instance with the family Staphylinidæ. In the presidential address we are informed that measures were to be taken for a malacological survey of the county with the view of publishing a complete list of the land and fresh-water molluscs.

DESPITE the usual insufficiency of funds, supplemented in this instance by an inadequate staff, lack of space, and absence of proper show-cases, the Rhodesia Museum at Bulawayo is stated in the report for 1909 to be making continued and in some respects rapid progress. A considerable amount of original research was carried out during the year by various members of the staff. The report concludes with an appendix on the gold-bearing rocks of Rhodesia, and a second on the minerals of the district, both by Mr. A. E. V. Zealley.

Great credit is due to the staff of the Exeter Museum for the rapidity with which they have prepared and arranged for public exhibition the fine series of about 4000 species and 20,000 specimens of land-shells received towards the latter part of 1909 as a bequest from the late Miss Linter. According to the terms of the will, the collection was to be made accessible to the public within a specified period, and this heavy task has been successfully accomplished. Lack of space prevented, however, the whole collection being shown at once, and it has accordingly been arranged to exhibit it in sections. In the October issue of the *Museums Journal* Mr. Rowley describes the manner in which this was done, and likewise the methods of mounting, which he thinks may prove useful to other museums.

While Great Britain has produced many brilliant examples of self-educated men who have won for themselves more or less distinguished positions in science, Ireland, according to the October number of the *Irish Naturalist*, can lay claim to only one such hero of the highest type. This was Samuel Alexander Stewart, who was born in Philadelphia on February 5, 1826, whence he came in 1837 with his father to Belfast, where he eventually worked as a miller. Details of his life and work are recorded in two separate articles in the serial quoted, the former being described by the Rev. C. H. Waddell and the latter by Mr. R. L. Praeger. Most of his papers were devoted to botanical subjects, although local zoology and botany likewise claimed a share of his attention. Mr. Stewart died on June 15 last as the result of a street accident.

The relation of palæobotany to plant-phylogeny forms the subject of an article by Prof. Penhallow, of McGill University, in the October number of the *Popular Science Monthly*. Although considerable progress has been made in the matter of tracing the descent of plants through the geological ages, many gaps remain to be filled. The bryophytes, for instance, which, from their low organisation, ought to date at least from the Silurian, are unknown before the later Tertiary; in this instance the deficiency in their past history may perhaps be attributed, at least in part, to the "imperfection of the geological record," and if this be so the need of caution in making generalisations in this and other cases is self-evident. In conclusion, the author observes that "if palæontology teaches us anything, it is that each great phylum, as well as its various subdivisions, finally reaches its culmination in a terminal member from which no further evolution is possible. But that from some inferior member, possessing high potentialities, a side line of development arises." In an earlier paragraph it is stated that although evolution is still in progress, the possibilities of its continuation are steadily diminishing, and will eventually come to an end.

In part i. of vol. xli. of *Travaux de la Société Impériale des Naturalistes de St. Pétersbourg* Mr. K. Derjugin gives a summary of the contents of a forthcoming memoir on the fauna of the Kola Fjord, in the Arctic Ocean, based on the survey carried on by the yacht *Alexander Kowalevsky* during the summer of 1908. The investigations were carried on by dredging and surface netting, especial attention being directed to the mouth of the fjord, into which both the Kola and the Tulima discharge, and the line of division between the fluviatile and marine faunas determined. The interesting forms included the isopod *Limnoria liguorum*, the mollusc *Xylophaga dorsalis*, and certain bryozoans, such as Loxosoma and Stomatopora, while the plankton contained a rare and remarkable type of Sagitta. In the same issue Mr. W. Schitz directs attention to the northward extension of the range of blue roller and the thicknee. Nests of the former were observed during the past summer in the governments of St. Petersburg and Novgorod, where they had never previously been seen, while in the summer of 1909 the latter bird was noticed near Lake Celigner, in the government of Twer.

Messrs. John Wheldon and Co., 38 Great Queen Street, have recently issued a catalogue of general and economic botanical publications, including a few early herbals and works of Linnæus.

The report for 1910 of the Lichen Exchange Club of the British Isles contains the report of the secretary, Mr. A. R. Horwood, and notes on critical specimens. Two species new to science are recorded under the genera Lecidea and Arthopyrenia.

The Department of Lands in New Zealand is responsible for the management of the State nurseries and plantations and for the operations connected with scenery preservation, for which separate reports for the year 1909–10 have been published. The output of five nurseries amounted to 12,000,000 young trees, of which 8,000,000 were planted, largely by prison labour, on seven plantations. It is surprising to find that nearly all of these are European trees, chiefly the larch, *Pinus laricio*, the spruce, and *Pinus ponderosa*; of the eucalypts, *Eucalyptus Stuartiana* has proved to be a fast grower and is being planted, while the only reference to indigenous conifers states that, owing to failures, it has been decided to discontinue raising plants of *Podocarpus Totara*. It is also noted that deciduous trees and mixed plantations have for the most part proved unsuccessful. The report on scenery preservation indicates that additional areas amounting to 1500 acres were reserved during the year.

A volume (Publication No. 129) emanating from the Carnegie Institution of Washington is devoted to an account of field observations near the desert laboratory at Tucson, Arizona, and experimental cultures in connection with the conditions of parasitism in plants. Dr. W. A. Cannon has discovered parasitism, apparently facultative, in two species of Krameria, a genus assumed to be autotrophic. The species, *Krameria canescens*, was found attached to several hosts, most frequently to *Covillea tridentata*, probably on account of a similar growth habit. The experimental work conducted by Dr. D. T. Macdougal was directed towards inducing dependent nutrition by the insertion of prepared slips into a host plant. The selected hosts were succulents, as Opuntia, Echinocactus, and the "xeno-parasites"—to use the author's name—were species of Cissus, Agave, and others. In the more successful cultures, the xeno-parasites formed roots and showed some degree of development for a year or longer. It was found that a superior osmotic activity on the part of the parasite is an essential. The pamphlet closes with a discussion on the origination of parasitism.

We have received from Mr. E. Leitz a booklet on "Some Hints on the Use of the Sliding Microtome," which contains a good description of the operations of imbedding an object in paraffin, trimming the block, making the "ritzer" lines on one face of the block, and cutting it into sections. The causes of curling, splitting, and wrinkling of the sections, and of sundry other troubles which confront the beginner, are pointed out and the remedies given. Most workers use xylol after dehydration of the tissue to replace the alcohol and to act as the paraffin solvent, but the author advocates the use of toluene; he also recommends dammar as a mounting medium in preference to balsam.

An anonymous contributor to *Symons's Meteorological Magazine* for September communicates an article on "The Meteorological Outlook in South Africa." He points out that this pre-eminent vantage ground for the study of that science has not been utilised as it might have been, and expresses the hope that the new Union Parliament will favourably consider the matter. There are only some half-dozen of the more important stations, and some of these are poorly equipped; in nearly all cases the sites are not satisfactory, and have been chosen with a view to astronomical observations, and none can hope to undertake good magnetical work. A single service for the whole country is advocated, instead of separate services for each State as at present. The writer recommends the establishment of a series of first-order observatories suitably distributed geographically, *e.g.* in one line from Durban to Port Nolloth, and in another line from Bulawayo to East London; also a systematic discussion of all the observations at present in existence, and particularly of the anemometric records kept at some of the ports. Attention is also directed to the necessity of uniformity of times of observation and of the measures used in publications.

The results of the Italian aëronautical experiments near Zanzibar during the last week of July, 1908 (the period selected for international balloon ascents), are published in the *Annali* of the Central Meteorological Office (vol. xxx., part i.). The Italian Government lent the cruiser *Caprera* for the purpose, and deputed Prof. L. Palazzo to superintend the work. The weather during the whole of the time was unfortunately unfavourable; only two successful ascents were made with registering balloons, and ten ascents of pilot balloons could only be observed in the lower strata of the atmosphere. Some useful observations were, however, made with the latter, and showed that the wind direction during the summer monsoon was practically southerly, with more or less easterly components. On July 30 the registering balloon reached an altitude of 4940 metres; at 1500 m. and 3500 m. a small inversion of temperature was observed, both in ascending and descending. The lowest temperature, $-2{\cdot}8°$ C., was registered at 4690 m. during the descent. In the ascent of July 31 the altitude of 6630 m. was reached; the minimum temperature, $-12{\cdot}0°$ C., occurred at 6610 m., during the descent. There was a tendency to an inversion at 3500 m., and a more decided one at about 6200 m., both in ascending and descending.

In the October number of the *American Journal of Science* Mr. A. McAdie directs attention to the urgent necessity of replacing the present bewildering diversity of systems of notation in meteorology by an international system. The work now in progress with the help of kites and the rapid strides which the art of aviation is making both point to an early extension of our knowledge of the properties and motions of the atmosphere, and it is important that the results should be expressed in a form readily understood by all. With Dr. W. N. Shaw, the author advocates the expression of pressures in terms of the barie of one million dynes per square centimetre, which is the pressure at a height of 106 metres in the atmosphere. Temperature to be expressed on the absolute scale, reckoned from $-273°$ C.; humidity in terms of the weight, in grams, of water vapour in 1000 cubic metres of air; and the direction of the wind in degrees from the north towards the east.

The *Revue scientifique* for October 1 reproduces a lecture given by Prof. Jean Becquerel on modern ideas as to the constitution of matter. Although no mathematical symbols are used, the author succeeds in giving a clear and interesting account of the steps by which, since the discovery of the kathode rays, physicists have been driven to the conclusion that, like matter, electricity is atomic in constitution, that the kathode rays are, in fact, streams of atoms of negative electricity. In virtue of their motion these atoms possess an inertia equal to one two-thousandth part of that which an atom of hydrogen would possess, and it seems possible that they form one of the primordial elements out of which matter as we know it is built. How each atom of matter is constructed remains to be discovered, but if the above view is correct it is no longer possible to conceive of the atoms of the chemists as immutable; we must, in fact, turn alchemists.

We learn from an article in *Engineering* for October 14, dealing with the annual report of Lloyd's Register of Shipping, that the Diesel oil engine is now being fitted to three fairly large vessels being built on the Continent under the supervision of the surveyors of Lloyd's Register. One set is being constructed on the older principle of the four-stroke cycle with single-acting cylinders, and will be of about 450 indicated horse-power. A two-stroke cycle, in which the reversal is effected in the engine itself, the crank-shaft being directly coupled to the screw-shaft, has been successfully adopted. A single-acting set on the two-stroke cycle is being fitted to a twin-screw vessel, the power being about 900 indicated horse-power on each shaft. The third set is being made on the two-stroke cycle double-acting system, each cylinder providing two impulses per revolution. This will also be fitted in a twin-screw vessel, the total power being about 1800 indicated horse-power.

In the same report of Lloyd's Register are described several novel features possessed by a set of internal-combustion engines which is being constructed in this country, under the society's survey, for a vessel of about 260 tons. Gas for the engines is to be produced on board from anthracite coal. The cylinders are to be of comparatively small size, and the engines are intended to run at a high rate of revolution, and will not be reversible. The connection with the screw-shaft will be made by means of a hydrodynamic transformer, in which a turbine pump driven by the engine delivers water to another turbine coupled direct to the screw-shaft. The arrangement is such that the screw-shaft will rotate at a much less rate of speed than the engines, and provision is also made for reversing its direction of rotation. The experience which will be obtained from these four applications of the internal-combustion engine is being looked forward to with great interest, and will provide data of great value.

Messrs. E. B. Atkinson and Co., 24 Dock Street, Hull, have sent us a copy of their new catalogue of balances and weights. In addition to containing particulars of the balances of their own designs, the catalogue provides prices and details of all other well-known makes of balance and accessories which Messrs. Atkinson and Co. are prepared to supply.

With the close of the year 1909 the hundredth volume of the *Chemical News* was completed; and as these volumes cover a period of fifty years' progress in chemistry and physics, the announcement that a general index has now been prepared, and is in the press, will be widely welcomed. The price of the general index on publication will be 2*l*., but to subscribers who order it before the date of publication the price will be 1*l*. 15*s*.

The first part of an important work on "The Birds of Australia," by Mr. G. M. Matthews, will be issued by Messrs. Witherby and Co. next month. The author has lived all his life in Australia, and has been a devoted student of its avifauna. He has secured the active assistance of a large number of field-ornithologists in all parts of Australia, and his work will incorporate all the available information upon the subject with which it deals. There will also be hand-coloured plates depicting all the known species of Australian birds. The edition of the complete work is limited to three hundred numbered sets.

OUR ASTRONOMICAL COLUMN.

A Bright Projection on Saturn.—In No. 4445 of the *Astronomische Nachrichten* Signor M. Maggini describes a brilliant projection which he observed on the west limb of Saturn at 23h. 36m. (Cent. E.M.T.) on September 29. The observation was made at the Ximeniano Observatory, Florence, with a 350 mm. Calver telescope, and the projection was seen in profile against the shadow cast by the planet on the ring. It was also seen to be near a large whitish spot at the edge of the south equatorial band. The phenomenon remained visible until the whitish spot left the terminator, and was last seen at 0h. 20m. September 30.

Spectrum and Radial Velocity of ϕ Persei.—The spectrum of ϕ Persei is a peculiar one, in which a dark, narrow, Hγ absorption line appears to be bordered by very bright lines, and as this is the most prominent line on which radial-velocity determinations have been made, the values of the line-of-sight motion have not been in full agreement.

An investigation carried out by Dr. Ludendorff has explained some of the anomalies, and the results now appear in No. 4442 of the *Astronomische Nachrichten*. Photographs were taken at Potsdam on which other faint lines, which could be identified with solar lines in Rowlands's tables, were measurable, and the radial velocities have been determined from these independently. Among other results, Dr. Ludendorff finds that the intensities of the components of the Hγ line oscillate, so that when the emission lines are faint the absorption line is strong, and *vice versa*, but he has been unable to discover any law for the complementary oscillations. The variation curves and the departures from them during several revolutions show that the conditions in the system of ϕ Persei are very complicated and unusual.

Metcalf's Comet, 1910*b*.—Observations of Metcalf's comet, made by M. Quénisset at the Juvisy Observatory, are placed on record in the October number of the *Bulletin de la Société astronomique de France*. On August 24 the comet was seen as a tenth-magnitude nebulosity having a well-marked condensation and a tail about 4′ long in position-angle 120°; with an exposure of sixteen minutes, using a portrait lens working at *f*.3, a tail 45′ long was shown on the photograph.

New elements and a daily ephemeris for this comet are published by Dr. Kobold in No. 4445 of the *Astronomische Nachrichten*. The elements give the time of perihelion passage as September 16, and, according to the ephemeris, the brightness is now slowly declining from magnitude 11·8. The comet is now travelling northward slowly through Serpens, its position for October 20 being given as $\alpha = 15h.\ 28m.$, $\delta = +19^\circ\ 12{\cdot}5'$.

Comets and Electrons.—In an address to the Royal Academy of Science, Bologna, Prof. Righi discussed at length the functions of electrons in producing cometary phenomena; this address now appears, with a French translation, in No. 16, vol. viii., of *Scientia*. Prof. Righi outlined the several theories which have been evolved to account for the various phenomena, paying special attention to the experimental proof of light-pressure, and then showed how the electrons emitted by the sun could produce ionisation, which in turn would lead to such repulsion as would cause the development of a tail. In concluding, he described the results of some experiments carried out at Bologna during the earth's passage through the tail of Halley's comet on May 19. No remarkable variations in the atmospheric potential were recorded, but a greater degree of ionisation than usual was found to exist. The existence of radiations capable of travelling through black paper to a photographic plate was also demonstrated, but this experiment alone is not considered definite enough to warrant the assumption that these radiations could be ascribed to the proximity of the cometary matter.

Measures of Double Stars.—In No. 4445 of the *Astronomische Nachrichten* the measures of double stars made by Mr. Sellors at the Sydney Observatory during 1897–1900 are published. Notes appended to many of the sets of measures give important information as to changes in position-angle and distance during definite periods, &c. No double-star observations were made at Sydney during the years 1901–8.

Recent Results in Solar Physics.—As an extract from the *Atti della Società italiana per il progresso delle scienze* we have received a brochure in which Prof. Riccò gives a very interesting, important, and comprehensive *résumé* of the results obtained from the study of solar physics during recent years. After briefly summarising the earlier researches, Prof. Riccò directs attention to the importance of correlating solar and meteorological phenomena, and refers briefly to the results obtained by Meldrum, Köppen, Lockyer, Bigelow, Nordmann, and others. Then he describes the different organisations which deal with solar research, and passes on to the spectroscopic results. This leads to a long discussion of the spectroheliographic results, and finally to the knowledge obtained from eclipse work.

THE NINTH INTERNATIONAL CONFERENCE ON TUBERCULOSIS.

The International Conference on Tuberculosis held its ninth series of sessions at Brussels on October 5–8 under the patronage of King Albert of Belgium, who throughout took a very keen interest in the conference. The first day, October 5, was devoted to the meetings of the council and to the organisation of permanent commissions, some dealing with entirely new subjects, others with subjects already under consideration. To six of these commissions are referred questions of a more or less scientific character; to another six questions in which social elements predominate.

In the first group predisposition occupies the first place. In this group also are the commissions dealing with channels of infection; milk; methods of treatment, scientific and vaccinal; international method of notation; and the action of the solar rays.

In the second group are included the part played by women in the crusade against tuberculosis; child life and school hygiene; prophylaxis and the part played by the dispensary; the cure (?) of tuberculosis; public measures to be taken against tuberculosis; and the statistics concerning tuberculosis.

On these commissions are represented, so far as possible, the different nationalities taking part in the work of the congress.

On Thursday morning, October 6, the opening ceremony of the conference was under the presidency of M. Berryer, Minister of the Interior, who in a thoughtful and well-informed address compared the Tuberculosis Congress to the great Peace Congress at the Hague, "both inspired by the same profound thought and both wishing to obtain the same results," the former, indeed, helping the latter, "the warring of man against man being gradually replaced, thanks to a more humane sentiment, by a bringing together of all men in common action against the universal ills, vice, misery, disease, and death," a sentiment that was echoed most eloquently by M. Bourgeois, the president of the conference.

Prof. Landouzy, introducing the first subject for discussion, the influence of predisposition and heredity, claimed that these were almost as important from the practical point of view as was the bacillus of Koch itself. He maintained that the tubercle bacillus in the parent might act in one of two ways, either by direct passage from the parent to the offspring, or by some toxic action on the ovum or upon the fœtus. He pointed out that these two sets of conditions were necessarily perfectly distinct, but maintained that the latter was of far more importance than the former, and that it accounted for the peculiar tubercular diathesis so frequently met with in patients. His thesis was that the subjects of this diathesis are degenerates who may "come into the world before their time, are under weight, short in stature, with thin, delicate bones, flattened chests, a skin delicate and soft, small extremities, pale and sickly face, veins very transparent, hair prematurely developed, long eyelashes, glands easily enlarged, aspect weakly." Such characteristics he has found specially amongst his tuberculous patients, and, curiously enough, this is exactly the type taken by the Venetian masters for their models, in whom we see silky golden or red hair, pale, transparent, and delicate freckled skin. This Venetian type, *vir rufus*, he maintained, was specially subject to tuberculosis. Moreover, animals with non-pigmented coats appeared to be more susceptible to tuberculosis than those of darker skin. In the discussion that followed it was agreed that tuberculosis was seldom communicated directly from mother to child, but that a certain transmitted functional debility might leave the child open to the ready invasion of various causes of disease and death, and that in this transmission the mother played a more important part than the father. It was suggested, however, that it was a very difficult matter indeed to demonstrate experimentally any predisposition, native or hereditary, to tuberculosis, though this was a matter that required further consideration.

The natural portals of entry were considered to be the lungs, the mucous membranes of the throat, the tonsils, the intestinal mucous membrane, and the epidermis, whilst the lymphatic glands were looked upon as playing a great part in sifting out and destroying the bacilli, though as they become lowered in vitality and no longer able to cope with the tubercle bacilli they may be broken down, and the scrofulous condition results.

Prof. Calmette, in speaking of the special susceptibility of children of tuberculous parents, said that this receptivity was not specific as regards tuberculosis, but applied generally to various infections and intoxications. The predisposed of the clinicians, he maintained, are very often the subjects of infection already. They are, he thinks, more or less gravely affected, especially as regards the lymphatic glands, and in almost all cases react positively to the various tuberculin tests. Moreover, he finds that if in place of tuberculin he injects mallein, he obtains a marked loss of weight. The stigmata of tuberculosis appearing at certain ages are, he thinks, the result of earlier infections, for he found that of children coming up to be vaccinated 90 per cent. of those from the town of Lille are already infected with the bacillus of tuberculosis even in cases where no definite lesions are developed, whilst in one lunatic asylum he found no fewer than 87·68 per cent. of the patients giving the skin reaction, so that if they were not already tuberculous they were already the bearers of the tuberculous germs.

Other speakers laid stress on tissue predisposition; on the marked respiratory changes that occur, not only in tuberculosis, but in other acute diseases; on the low arterial tension observed in those predisposed to tuberculosis; and on the importance of the observation that in cases where recovery took place pigmentation was both rapid and complete, whilst in those that succumbed such pigmentation did not occur.

One speaker, M. Piery, agreed that the offspring of tuberculous parents are undoubtedly specially liable to tuberculosis, and that the types of the disease in these patients are very varied, but on the other hand he thinks that a certain proportion of such offspring are actually immune, and that these patients, immune to a grave tuberculosis, are just the types in which the so-called stigmata of hereditary predisposition are present. Moreover, he believes with M. Calmette that many of the patients with these "stigmata of hereditary susceptibility" are really already suffering from the disease.

It seemed to be the general opinion that small numbers of slightly virulent tubercle bacilli taken into the alimentary canal might in certain cases act as immunising agents, but that in larger numbers and in virulent form they might set up typical lesions, especially in susceptible animals; that both immunity and predisposition might arise from the same cause, the bacilli in the one case setting up a kind of negative phase, in the other a positive phase, and that until the conditions under which these two phases are produced had been settled it was difficult to determine the part played by heredity in immunising or predisposing to the action of the bacillus.

Of the English delegates, Dr. Nathan Raw said that, as the result of an analysis of 232 cases of tuberculosis that had terminated fatally, he found that pulmonary tuberculosis was most frequently brought about first by direct inhalation of the *Bacillus tuberculosis* into the bronchioles; secondly, by extension from a bronchial gland to the parenchyma of the lung, this being specially associated with or following an attack of some acute infective fever such as measles, scarlatina, or diphtheria; by extension upwards from the abdomen by the diaphragm to the bronchial glands, and then to the lungs; by extension downwards from the glands of the neck directly to the pleura, and then to the apex of the lung; and, finally, by a general infection of the circulating blood, as in acute miliary tuberculosis.

Dr. C. Theodore Williams, following, insisted upon the importance of predisposition and on the wisdom of trying to ascertain the conditions of the human system which cause disposition to tubercle, and, conversely, those which confer immunity from tubercle. Analysing 1000 cases of consumption that occurred in the upper classes, he finds that the age of attack is earlier amongst females than amongst males, and that amongst males affected by hereditary predisposition it is earlier by three years than among those free from hereditary predisposition, and in females by six and a half years. Similarly analysing 400 consumptive cases seen in the out-patient department of the Brompton Hospital, he found that his former conclusion as regards the age of attack being hastened on by family predisposition was confirmed, though here the relative influence on the two sexes differs greatly from what was noted in the richer classes. Among the out-patients, the age of attack was about the same for male as females, the males being attacked earlier than among the rich, the females later. The age of attack in those free from family taint was later in both sexes, and the predisposition influence greater in the male than in the female.

One or two of the later speakers were of opinion that although many of the points raised that afternoon were of undoubted interest and of great importance to the individual, it was somewhat inadvisable to lay too much stress on this question of predisposition, except in so far as it pointed to the necessity to keep these patients out of the range of the attack of the tubercle bacillus. Of course, it was useful in connection with both prognosis and treatment, but at present the campaign must be carried on on a large scale against the tubercle bacillus and to remove the conditions under which it does its work most effectively, the predisposition being taken up specially in connection with the raising of the standard of health and of improving general hygienic conditions. There seemed to be some danger that the importance of the *rôle* of Koch's bacillus might be overshadowed in the popular mind, and it appeared to be necessary to insist that, although the tubercle bacillus does not always set up tuberculosis, no tuberculosis is ever set up without the presence of the tubercle bacillus. If heredity and predisposition are to be put so prominently forward, those who are dealing with the question might sometimes lose heart. At the same time, the acknowledgment that they may play a part should be followed by a call to the physician to look after the building up and strengthening of the patient. Then, again, it was always well to point out that on the one hand many blondes escape tuberculosis, whilst those richer in pigment, the negroes, are often affected, sometimes evincing even a high predisposition.

The morning sittings on Friday, October 7, were devoted entirely to tuberculosis in the child and in the schools, and in the afternoon to women's work in connection with tuberculosis. Mrs. Nathan Raw and Dr. J. Walker both took part in the discussion, stating the case for England. Perhaps the most interesting contribution of the afternoon was that made by Dr. Hermann von Schrötter on the action of sunlight and high altitudes, and their relation to the treatment of tuberculosis. It was of all the greater interest to English workers in that he had collaborated with Dr. Barcroft, who had been sent out to do similar work at Teneriffe. Some of his observations on the pigmentation of the skin seemed to bear out Prof. Landouzy's thesis. Dr. Schrötter believes that the pigment is formed by the cell, probably by the nucleus, that it does not come directly from the blood, and that the capacity to form pigment under stimulation gives some information as to the activity and stability of the cells. He also spoke of the effect of light, especially the ultra-violet rays, and high altitudes upon respiration, circulation, and metabolism, and is decidedly of opinion that not only is tuberculosis a disease of obscurity, but that it is a disease of concentration of population.

Saturday morning, October 8, was devoted to the nomination of committees and to the reports brought by the various foreign delegates. From these reports it may be gathered that not only in England, Ireland, and Scotland, but in many Continental countries, especially Sweden, tuberculosis is a gradually diminishing factor in both mortality and morbidity.

The social functions held during the conference were almost as interesting as the scientific sederunts. The receptions given by M. Beço, the Governor of Brabant, in the Government buildings of the province, and of the Burgomeister and the Town Council of Brussels in the Hôtel de Ville, were as interesting from the associations of the places in which they were held as from the people one met there. The annual dinner was also a great success, and the speaking was of a very high order. Amongst the congratulations and messages sent to the conference was one from King George dated from Balmoral Castle:—"The Queen joins me in thanking you and the members for your kind telegram. We earnestly pray that successful results may attend your labours, and that a further stimulus may be given to the great international campaign that is being carried out against this terrible disease. George, R. et I." Telegrams were also received from the Queen of Denmark, from the Kings of Rumania, Sweden, Spain, and Norway, from the Emperor of Germany and from President Taft, all of them expressing similar interest in the work of the conference. It may perhaps be held that no outstanding work was brought forward at the conference, but those who were privileged to take part in it could not but feel that these international conferences serve as admirable "stock-taking" occasions, and, as successes and failures are recorded, of determining, or at any rate of obtaining information as to, the best method of carrying on the campaign against the White Scourge. As they are held in a different country each year, they also afford opportunities of seeing how the work is being tackled and how far it is succeeding in various parts of the world.

THE INTERNATIONAL SCIENTIFIC CONGRESS AT BUENOS AIRES.

ONE of the important features of the celebration of the Centenario of the Revolution of May 25, 1810, was the International Scientific Congress. This congress was held in Buenos Aires from July 11 to 25, 1910, inclusive, under the auspices and direct management of the Argentine Scientific Society.

Great interest was manifested in this, as in other portions of the celebration, by the residents of Argentina. In spite of the distance from the populous northern hemisphere, the congress was well attended, there was great interest manifested in all the sections, and it can well be said that it was successful.

The opening session of the congress took place on the afternoon of July 11 in the Colón Theatre, the magnificent playhouse of Buenos Aires. The great popular interest was evidenced by the very large and fashionable attendance at these opening exercises. A short address of welcome was pronounced by the Minister of Public Instruction, Dr. Rómulo S. Naón. The principal address was made by the president of the congress, Engineer Luis A. Huergo, and short addresses by the foreign delegates, the whole being interspersed with excellent music.

The serious work of the congress began on the following day, when the various sections met at the principal scientific headquarters of the city. One of the sections held meetings in the library of the patriot Bartolomé Mitre, whose residence is now preserved as a museum by the city.

The work of the congress was divided into eleven principal sections as follows:—Mathematics, physics, and astronomy; chemistry; geology and geography; biology; anthropology; engineering; agriculture; psychology and pedagogy; jurisprudence and social science; military science; and naval science.

In the limits of a short account such as this it will be entirely impossible to give even the *titles* of all the papers presented. It is necessary, therefore, to refer only to those which appear to be of the greater interest to the general readers of NATURE, at the risk of omitting many of equal or perhaps greater importance.

Several of the delegates delivered public lectures in Buenos Aires and La Plata. A special meeting of the delegates from Spanish-speaking countries was held at the rooms of the Argentine Scientific Society to inaugurate a movement "to purify, to enrich, and to unify" the technology of the Spanish language.

Mathematics, Physics, and Astronomy.

Several interesting papers were presented in the field of pure mathematics, notably those by Volterra upon integral equations and their applications, and by Dr. Franck upon the surface of the second order of Lie and their relations to a point upon any surface whatever. Prof. Torres y Quevedo gave an exposition of the mathematical theory of an electromechanical calculating machine. A paper was sent by Prof. L. A. Bauer giving an account of the work done with the new magnetic survey vessel of the Carnegie Institution of Washington, the *Carnegie*. This vessel has proven successful beyond expectation.

In the subsection of astronomy, the observatories of Santiago, Chile, the temporary observatory of the Carnegie Institution at San Luis, La Plata Observatory, and the Argentine National Observatory at Córdoba were represented. The plans for the new Chilean National Observatory were shown by Dr. Ristenpart, as well as photographs of Halley's comet; two charts of the series being prepared by that Observatory from the Cape Photographic Durchmusterung. Prof. Tucker, in charge of the Carnegie branch observatory at San Luis, read a paper dealing with the fundamental system of star positions, which is being prepared by the department of Meridian Astrometry of that institution under the direction of Prof. Boss. Sunrise and sunset tables to 1950 were presented by the La Plata Observatory. Several papers were presented by the Córdoba Observatory dealing with the work in progress there, as well as a series of photographs of Halley's comet which had been obtained there. A proposition was discussed to publish an astronomical ephemeris suitable for the South American countries in place of those now issued by several of the observatories.

Chemistry.

Among the many important papers presented in this section were contributions to the study of Argentine oil, by Dr. Sabatini; composition of the alfalfa and other forages grown in Argentina, by Engineers Lavenir and Negri. These investigators demonstrated the superiority of corn grown in the Argentine. Dr. Quiroga presented a new chemical nomenclature of inorganic bodies.

Geology and Geography.

The principal papers in this section related to the countries of Argentina, Chile, and those adjoining to the east and north. The subject of mines and the laws relating to them, including fuel deposits, occupied a chief place. Engineer Patron presented a paper on the development of geographic and geodetic work of Chile, Prof. Codazzi one on mining in Colombia, Señor Maurtúa on geographical work in Peru. Engineer Machado presented a paper on petroleum in Chile, Engineer Hermitte and Lieut.-Col. Romero on the petroleum formation of Argentina. The topography and mineralogy of the Andes region was treated of in various papers.

The Argentine Meteorological Office presented a large number of interesting papers, chiefly upon the meteorology of Argentina and the southern ocean. The director, Dr. Davis, presented a paper upon the temperature of Argentina as compared with other portions of the globe. A paper by Prof. Clayton dealt with a new method of forecasting which promises to cover periods much longer than is now possible. Profs. Mossman and Solyom presented papers on the effect of the antarctic currents upon the weather of South America, and the cyclones and anti-cyclones of the South American continent, respectively.

Dr. Knoche presented a paper descriptive of the organisation of the meteorological service of Chile, and Dr. Montessus de Ballore a paper on a convention of the seismological services of Chile and Argentina. Dr. Negri read a paper on two seismical laws discovered by himself.

Biology.

The communications to this section included the following:—The action of the principal alkaloids on protozoas, Prof. Scala; a contribution to the study of some arthropods of Chile-Argentina, Prof. Porter; contribution to the study of sea fishes in Uruguay, Prof. Bouyat; the mosquitoes, gad-flies, and serpents of Argentina, Señor Brethes; the marsupials of Chile, Dr. Wolffsohn; the vegetation of the north-western portion of Argentina, Dr. Seckt; a reclassification of Argentine vascular plants, Dr. Stuckert.

Anthropology.

Two papers were presented by Dr. Ameghino relating to three fossil human skeletons found in Arroyo Siasgo and El Moro. Other papers discussed different characteristics of the Indians and indigenous inhabitants of certain regions of South America, particularly Argentina, and of means of caring for such peoples and preserving accurate data respecting them. The origin of the American races and the languages of different South American races were subjects of investigation. Of especial interest were the results presented by Prof. Mercante of a comparative study of 1200 of the Argentine youth between the ages of six and twenty years, the sexes being nearly equally divided.

Engineering.

Many of the papers in this section dealt with architecture, particularly that of the Latin American countries. Notable among these were the papers of Engineer González. Engineer Selva discussed the advisability of houses for workmen and the best forms of such houses. A sentiment was adopted emphasising the absolute necessity of finding a solution for the question of reducing house rent for workmen and employees of modest salary. The same author also discussed the subject of earthquake construction. The subject of reinforced cement construction occupied the attention of one session. Railway and bridge questions occupied another session. The question of irrigation is a very important one in several of the South American republics, particularly Argentina. Conforming to the importance of the subject, two sessions were devoted to the discussion of the laws and systems of irrigation in Argentina, and with various plans for betterments. Rivers and harbours and their various needs received attention in another session, as did various municipal matters relating to sanitation, transportation, and streets, in another. The engineering section attracted unusual attention.

Agriculture.

Engineer Juan A. Devoto presented a paper detailing his investigations of the micro-organisms of milk. Dr. Wolffhugel read a paper on the zooparasites of the domestic animals of the Argentine Republic. Recommendations were made to protect the guanaco and vicuña. Great interest was manifested in this section, and a large number of papers were presented dealing with the practical details of this branch of science. One which attracted much attention was on the degeneration of the Malbeck, by Señor Suárez.

Psychology and Pedagogy.

In this section Prof. Jakob gave the inaugural address, discussing human beings with defective brains. Among the papers were:—Value of psychological statistics in pedagogy, Señor Mercante; necessity of methodical investigation of the child and all abnormal persons, Dr. Piñero; abnormal psychology and education, Prof. Senet; investigations of the nervous system, Dr. Roveda; the measurement of intelligence, Dr. Vidal; experiments upon the sensitiveness of the human skin, Dr. Duceschi.

RESOLUTIONS.

During the congress a large number of resolutions were adopted by the various sections, which at the close were ratified by the entire congress. The substance of some of the most important is given below.

The necessity of solving the problem of reduced rent for the workman and the employee, so that they may live near their work, which is usually in the centre of the city. It may be remarked in passing that this question is especially important in Buenos Aires, where the population is spread over a very large area in one-story houses, instead of the tall structures of Anglo-Saxon cities.

Reiterating the necessity of prosecuting and accelerating the Pan-American railroad according to a fixed plan.

The advisability of studying the causes which hinder the more general adoption of reinforced concrete constructions

The strong approval of a project for the formation of a "Union Internacional Hispanoamericana de Bibliografía y Tecnología Cientificas." The details of such an organisation were worked out.

Recognising the convenience of a reform of the Gregorian calendar.

Recognising the advantage of adopting the meridian of Greenwich for all American countries and from January, 1911, basing their time on meridians differing by an exact number of hours from Greenwich, as is already in use in the United States.

The urgent necessity of preventing adulterations and frauds in foods.

Recommending the adoption of standards of purity for the potable water of the Republic (Argentina); the necessity of forming an American society of chemists; the establishment of biological stations with a view to the study of marine life and the development of the fish industry; the advantage of legislation which will encourage the development of the petroleum industry and prevent all monopolies in this industry; the study of the German language in science courses along with French and English; the utility of employing the "altazimetro" invented by Rear-Admiral Mansilla, to facilitate nautical calculations; the stereographic method of locating the stars for nautical purposes, proposed by Captain Ballvé; an international American commission of psychological and pedagogical studies and a children's congress of specialists; the formation of agrarian societies modelled after those of France; the greater use of agricultural machinery, and the teaching of the use of such machines; the study of the conditions and regions suitable for the growth of the sugar beet with the view of extending its production; the development of the cotton-growing industry; uniform regulations in all American countries governing the importation and exportation of animals; legislation looking to the protection of working women before and after childbirth, and making compulsory the providing of time and suitable accommodation by employers for the necessary attention to babes.

C. D. PERRINE.

RECENT INVESTIGATIONS ON THE CULTIVATION OF RUBBER.[1]

EXPERIMENTS on the cultivation and preparation of rubber are being pushed forward at several stations, and the results are discussed in the agricultural journals circulating in tropical and subtropical countries. Methods of tapping the tree have been studied in Hawaii, and found to have a marked effect on the yield of latex. Trees

[1] *Tropical Life.*
The *Agricultural News.* (Imperial Department of Agriculture for the West Indies.)
Bulletins of the Federated Malay States, and of the Hawaii Agricultural Experiment Stations.

tapped with a V-cut gave much less than others with a vertical cut, the greater yield, however, being partly due to the fact that the length of the incision in the latter case is greater than in the former. No advantage was gained from the use of four cuts daily instead of two. The effects of nitrate of soda on the flow of latex have also been studied. Fertilisers are in use in rubber plantations for increasing the growth and vigour of the trees, and it now appears that nitrate of soda also increases the flow of latex. In one experiment a group of five trees yielded 0·9 oz. of dry rubber in three days before applying the nitrate, and 1·3 oz. in the three days following its application, each tree receiving half a pound of the fertiliser. How far the method is economical has yet to be determined. All these experiments were made with Ceara rubber trees.

A number of analyses have been made of the latex from the plants growing in the Botanic Gardens, Singapore. A thirty-two-year-old tree of *Hevea brasiliensis* gave at one tapping 27 fluid ounces of latex, of which 61·08 per cent. was water, 2·3 per cent. serum solids, mainly organic matter, and 36·29 per cent. coagulum was obtained by means of acetic acid. Almost the whole of the coagulum was rubber, only a little resin being present. From another variety, *Landolphia Heudelotii*, the dry rubber yielded 89·5 per cent. of pure rubber and 10·5 per cent. of resin.

The question of preparing the rubber after the latex is obtained is of very great importance. Fine hard Pará rubber containing 10 or 20 per cent. of moisture has a higher relative value than the practically pure sheets from the East. It is considered that the difference in value is partly due to the difference in method of dealing with the latex, and a process has recently been devised in which the latex is treated with smoke, creosote, and acetic acid, so that it may coagulate under conditions comparable with those obtaining in Brazil. In this process, steam at a pressure of 30 or 35 lb., mixed with the fumes from strongly heated green palm leaves or other green parts of trees, is forced by a steam injector into tanks containing the strained latex. In about ten minutes the caoutchouc globules coagulate and rise to the surface.

An incidental problem is the most economical way of dealing with a rubber plantation until the trees come into yielding. A Bulletin from the Federated Malay States Department of Agriculture sets out the advantages of *Coffee robusta*. This plant, discovered wild in the Congo region in 1898, grows more rapidly and fruits sooner than the well-known *C. liberica*. When grown in rubber plantations, it yields a small return in the second year and a good return in the third and following years, but after five years it competes so seriously with the rubber that it must be cut out.

THE MINERAL RESOURCES OF THE UNITED STATES.[1]

IN response to the latest of the periodic scares of impending bankruptcy due to the exhaustion of fuel, ore, or soil, the Geological Survey of the United States has been instructed to estimate the national economic mineral resources. Its report (Bull. No. 394), dealing with quantities on a continental scale, may excite the envy of the single countries of Europe; and though the factors are uncertain, the available supplies of most minerals are sufficient to render political restriction of output unnecessary. Thus, in the case of coal, Pennsylvania is known to have enough to last for 492 years at the rate at which the material was being exhausted in 1907. Ohio has only used 0·9 per cent. of its proved supplies, and at the rate of production in 1907 they will last for two thousand years. In Maryland the coal will last for another 948 years. Mr. Gannet, in a general summary of the extent of the coal reserves, estimates that only one-third of one per cent. of the known and easily accessible supply was mined during the last century.

In regard to the other fuels, the future is less assured for natural gas and petroleum. Assuming that petroleum generally comes from beds 5 feet in thickness, and with 10 per cent. of pore space, an acre would yield 5000 barrels of 42 gallons each. The extent of proved oil land in the States is enormous. Thus, it is expected that the State of California alone will supply 5,000,000,000 barrels. There has been a steady increase in the yield from 2000 barrels in 1859 to 166,000,000 in 1907. The yield, however, has fallen in many of the States, including Pennsylvania and New York, where, according to Dr. Day, it will be negligible ten years hence. The yield has fallen in Ohio, West Virginia, Kentucky, Colorado, Indiana, Texas, and Louisiana; but it has risen in California, Illinois, and Kansas. Dr. Day concludes that if the present production is not increased, the available supply will last the States for ninety years; but if the demand increases as rapidly as during the past few years, the end may come in 1935. He therefore suggests that oil should be limited to the purposes for which it is indispensable, such as lighting in scattered houses and as a lubricant. As half a pint of oil is used in an engine for every ton of coal burnt, the exhaustion of cheap lubricants would be an industrial disaster.

Dr. Day reports on the supplies of natural gas. In most cases the wells have a short life, and 1,000,000,000 cubic feet are still being wasted daily. Much of the waste is said to be unavoidable, as the gas cannot be saved economically from wells from which oil is being pumped; but legislation to prevent unnecessary waste is recommended. After a well has ceased to yield gas under high pressure, a supply can be obtained for years by pumping.

A mineral famine in the United States is most often predicted for iron, as the ores of present value are restricted in depth. The estimates compiled by Mr. Hayes show that there is no immediate fear of the end of the Iron age. He estimates the ore supply now available in the United States at 4,788,000,000 tons. If the present rate of increase in the consumption of iron be maintained, this quantity would, however, be used during the next thirty years; so that before 1940 American iron production would have begun to decline, and low-grade ores not included in the estimate quoted would have to be used. Mr. Hayes, however, concludes that the factors are so indeterminable that any further prediction as to the date of exhaustion of American iron ores " is so uncertain as to be wholly unprofitable and unwarranted."

The United States have been one of the leading producers of phosphates since 1867, and nearly half the phosphate manufactured is exported for the benefit of the exhausted soils of Europe. At the present rate of increase, the supply will only last twenty-five years, and Mr. van Horn, the author of the report on phosphates, therefore recommends that future leases should only be granted on condition that the phosphate shall be used in the States.

That predictions of a coal famine in America are idle may be realised from the reports on the little-known coalfields of the western and central States in Bulletin 341. It is edited by Mr. Marius R. Campbell, and includes twenty-two separate memoirs and a bibliography. The coals are partly Eocene, belonging especially to the Fort Union Series, and partly Cretaceous, coming mainly from the Mesaverde Series. The Sentinel Butte Field in North Dakota and Montana yields an Eocene lignite, of which 33,000,000,000 tons are available within a thousand feet of the surface, and in seams 3 feet or more in thickness. The coal yields excellent producer gas, and can be made into briquettes without the addition of any binder. The coal contains 34 to 45 per cent. of water, and after it is air-dried its calorific efficiency is from 8200 to 8600 British thermal units. From Sentinel Butte a series of coal fields extends south-westward through Montana, Utah, Colorado, Nevada, and New Mexico. The Eocene coals become less important, and the Cretaceous coals more important to the

[1] United States Geological Survey. Bull. 341.—M. R. Campbell. Contributions to Economic Geology, 1907. Part ii., Coal and Lignite. Pp. 444, xxv pls., 7 figs. (Washington: Government Printing Office, 1909.)
Bull. 347.—F. E. Wright and C. W. Wright. The Ketchikan and Wrangell Mining Districts, Alaska. Pp. 210+v, xii pls., 23 figs. (Washington: Government Printing Office, 1908.)
Bull. 374.—F. H. Moffit and A. G. Maddren. Mineral Resources of the Kotsina-Chitina Region, Alaska. Pp. 103, x. pls., 9 figs. (Washington: Government Printing Office, 1909.)
Bull. 379.—A. H. Brooks and others. Mineral Resources of Alaska, Report on Progress of Investigations in 1908. Pp. 418, x pls., 21 figs. (Washington: Government Printing Office, 1909.)
Bull 380.—C. W. Hayes and W. Lindgren. Contributions to Economic Geology, 1908. Part I, Metals and Non-metals, except Fuels. Pp. 406, ii pls., 32 figs. (Washington: Government Printing Office, 1909.)
Bull. 394.—Papers on the Conservation of Mineral Resources. Reprinted from Report of the National Conservation Commission. February, 1909. Pp. 214, xii pls., 2 figs. (Washington: Government Printing Office, 1909.)

south-west. Thus the Cretaceous coals at Crazy Mountain, Montana, are too thin to be mined, except for local use; but at Lewiston, Montana, the Lower Cretaceous coal from the Kootenai formation is of great value, though high in sulphur; the Grand Mesa field in Colorado has an estimated supply of 15,000,000,000 tons of Mesaverde coal, of a calorific value of from 8000 to 13,000 thermal units.

A second Bulletin (No. 380), "Contributions to Economic Geology, 1908," deals with minerals except fuels. Mr. C. W. Hayes has superintended the preparation of the reports on the non-metals and iron ores, and Mr. W. Lindgren those on the rest. The Bulletin consists of twenty-five papers and numerous bibliographies. Some of the reports are based upon only a few hours' or a day's visit, but others are preliminary reports based upon a longer study. J. S. Diller and G. F. Kay describe the Grants Pass goldfield in Oregon, which is one of those frequent and disappointing fields where the gold is very widely distributed through innumerable small veins and veinlets; the absence of well-defined lodes is unfavourable to profitable mining, until some clue be discovered to the distribution of the richer patches. The ores are found in association with greenstones and granodiorites intruded into altered sediments. The placer deposits are widely scattered, and are worked by many small mines, employing from three to five men each. Some of the placers are Cretaceous shore deposits.

Mr. F. L. Hess reports upon the tin, wolfram, and tantalum deposits of South Dakota. Tin is so scarce in the United States that much interest was excited by its discovery in pegmatite dykes traversing the Algonkian schists at Harney Peak. Assays showed the presence of up to 6 per cent. of tin, and the Harney Peak Tin Company was established to work the deposits on a big scale. Three million dollars of English money, in addition to some American, was spent in the venture, and Mr. Hess tells us that the 5000 tons of ore put through the mill yielded only 0·25 per cent. of tin. The tin cost more than its weight of gold. This failure is, perhaps, not surprising, as pegmatite dykes have never been found to pay as tin ores except on a small scale. The wolfram ores of the same locality are known from the descriptions of Mr. J. D. Irving, and though Mr. Hess does not altogether agree with his theoretical conclusions, he remarks that Mr. Irving's prediction as to the limited economic value of the deposits has been fully justified. This wolfram ore is of some interest, as it occurs as a replacement of dolomite and was introduced by solutions rising along vertical fractures.

Of the four papers in this Bulletin dealing with iron ores, one of the most interesting is by Mr. E. C. Harder, on the ores of the Appalachian region in Virginia. Some of the ores occur in the pre-Cambrian schists and crystalline rocks of the country at the eastern foot of the Alleghany Mountains; but the ores are not commercially important. They, however, include the interesting titaniferous magnetites of the Blue Ridge, which have been formed as segregations in a basic syenite (unakite); and the truly magmatic origin of these small bunches of ore is shown by the many included specks of minerals belonging to the enclosing rocks. The more important ores occur in the Palæozoic rocks of the Appalachian plateau, including "brown ores" of three distinct origins. They are "mountain ores" associated with Lower Cambrian quartzites, "valley ores" found in residual material formed from Cambrian limestone, and the Oriskany ores, which occur as replacements in the Silurian Lewistown limestone.

The manganese ores of the United States have been studied by Mr. Harder, who promises a special bulletin upon them. The ores are widely distributed, but are not much mined, since they usually occur in pockets of not exceeding 25,000 tons, and cannot compete with the imports.

Among reports on the non-metallic minerals is a short note on the mica deposits of southern Dakota, by Mr. D. B. Sterrett. The mica is found in pegmatites, which are sometimes intrusive dykes and sometimes veins due to pneumatolytic action. The two types pass imperceptibly into one another. The supply of sheet mica for lamps and furnace doors exceeds the demand, and most of the mica obtained is employed for the manufacture of electric machinery. There is a short report by E. G. Woodrow on the sulphur deposits near Thermopolis, Wyoming; the sulphur is deposited by hot springs, where the water comes in contact with limestone. The sulphur is deposited as crystals, and also as masses replacing the limestone.

Mr. Matson contributes some notes on the clays of Florida, and describes the ball clays, which are usually described as kaolin, as they are white burning, and can be used for either porcelain or white earthenware. As they are sedimentary, Mr. Matson seems unnecessarily doubtful as to whether they can be included in kaolin.

Bulletin No. 374 describes the mineral resources of the Kotsina-Chitina region of Alaska, by F. H. Moffit and A. G. Maddren. The name Chitina means "copper river," and copper is the most promising mineral of the district, though it has not yet been proved to occur in conditions under which it can be profitably mined. The district also contains some coal and alluvial gold, which has been worked since 1902. The copper is mostly found in the lower part of the Triassic Chitistone limestone, where it rests on the Nikolai greenstone, a series of basaltic lava flows, from which the copper is thought to have been derived.

The investigations on the general mineral resources of Alaska made in 1908 are reported in Bulletin 379, in a series of nineteen papers, edited by Mr. A. H. Brooks. The mining industry as a whole suffered a decline in output during that year owing to the diminished yield of copper. Gold is still the main source of wealth, though the yield fell slightly below that of 1906. Four-fifths of the supply is alluvial, and the cost of working the placers is so heavy that only the richest are worked. The lode mines, on the other hand, are low grade, the most important being those of the Alaska Treadwell group. Its ore yields only 2·3 dollars of gold per ton, but, owing to the large quantity and easy methods of mining, it can be worked at a cost of one dollar a ton. In spite of local predictions, dredges have already proved successful, and their use must add greatly to the available mineral wealth of the district. The most interesting placer deposits are those at Nome, on the Seward Peninsula, where the famous Third Beach, discovered in 1905, is still being worked. Alaskan shore placers are at present the most important that are being worked anywhere for gold. The report by Moffit and Knopf on the Nabesma-White River district shows that the copper there occurs in Carboniferous basaltic amygdaloids and in limestone along the contact with some intrusive diorites; but the fabulously rich copper deposits reported have not yet been found.

J. W. G.

AIRSHIP FLIGHTS.

FOR some time public attention has been directed chiefly upon the records achieved by aëroplanes. Two airship flights undertaken during the past few days serve to illustrate what may be accomplished by dirigible balloons. On October 15, at about 8 a.m., Mr. Walter Wellman left Atlantic City in his gigantic airship *America* with the object of voyaging to Europe; and on the following day the frameless airship *Clément-Bayard No. 2* travelled from Lamotte-Breuil by Compiègne to Wormwood Scrubbs—a distance of nearly 260 miles—in six hours.

The *Clément-Bayard No. 2* is 251 feet long, and its greatest diameter 44 feet 4 inches. The *Times* gives the following particulars of the construction of this airship.

Inside the bag there are two compensating air balloons which can be filled separately. The car, 26 feet 3 inches beneath the envelope, is 147 feet 5 inches long. The stern is provided with a keel to preserve stability. The metallic framework is composed of triangular steel rafters, except in the portion occupied by the motors, crew, and passengers, where they are quadrangular. At the hind extremity this framework takes a turn upwards to support the equilibrator, a large triplane-like apparatus with eight square compartments resembling the main cell of a Voisin aëroplane, controlling ascent and descent. The equilibrator, comprising the rudder, composed of two mobile planes on vertical axes at either end of the triplane, is worked by an irreversible mechanism. There are two propellers driven by two 120 horse-power Clément-Bayard motors mounted on a steel frame furnished with springs to deaden the vibration. Each propeller is driven by its own motor, but, in case of need, one single motor can drive the two propellers at the same time. The gear for the reduction of speed is placed in the prolongation of the driving shaft, beyond the propeller. The two propellers, of polished wood, have a diameter of 19 feet 8 inches, and are placed laterally in front, one on each side of the car, projecting beyond the sides of the steel framework. They occupy a position midway between the car and the balloon. The tractive power of each propeller is ascertainable at any moment. The dirigible is built to be able to ascend to an altitude of 6560 feet, and it is capable of travelling about 750 miles without replenishing its supplies of gas and fuel.

The *Clément-Bayard No.* 2 left Lamotte-Breuil with a crew of seven people, including M. Clément, the designer of the vessel, on October 16 at 7.5 a.m. (G.M.T.), passed over Amiens at 8.29 and Boulogne at 10.15. The Channel was crossed in some fifty-five minutes, and Ashford seen at 11.45 a.m. Tonbridge was passed at 12.20 p.m., the Tower Bridge at 1.4, and Wormwood Scrubbs was reached at 1.25. The whole distance, of nearly 260 miles, was thus covered in a little more than six hours at an average speed of about 43 miles an hour. The greatest altitude attained during the flight was between 800 feet and 900 feet, but most of the travelling was done between 600 feet and 700 feet. The average temperature was 60° F. The success of the enterprise must be attributed largely to the very favourable weather conditions which prevailed during the flight. There was only a slight wind, and it was in a direction which assisted the movement of the airship, so that the demand made upon the power of independent navigability was not great. We still await the construction of an airship which will satisfy the War Office tests, one of which is that the vessel has to traverse a triangular course of 300 miles within a fixed time-limit. When this has been done it will be possible to form a satisfactory estimate of the advantages of power-driven airships over the ordinary spherical balloon.

The *America*, in which Mr. Wellman with five companions made the daring attempt to cross the Atlantic, is a dirigible of the frameless type; it is 228 feet long, its greatest diameter 52 feet; and it has a volume of 345,000 cubic feet. According to the *Daily Telegraph* (under the auspices of which, with the *New York Times* and other American papers the flight was undertaken), the balloon is composed of three thicknesses of cotton and silk gummed together with rubber to make it gas-tight, and weighs 4850 lb. Underneath the balloon is suspended by steel cables the car, weighing 4400 lb. This car is built of the highest grade steel tubing, and in places withstands stresses of twelve tons. It is 156 feet in length, and the steel tank at its base is 75 feet long, with a capacity of 1250 gallons of gasoline. The engines, three in number (two of 80 horse-power and a service motor of ten horse-power), are placed in the steel car. Each of the large motors drives a pair of twin screws, and each propulsion system is independent of the other. The motors and other machinery weigh about 1500 lb. An electric light system, a wireless telegraph equipment, and a telephone connecting the different parts of the ship were installed.

Hanging from the airship by a steel cable is the equilibrator, a part of which floated upon the sea, the other being suspended vertically in the air. The purpose of this is to act as an automatic regulator of the upward and downward movements of the airship. When the ship rises it must lift some of the equilibrator from the sea in order to go up, and this added weight checks the rising movement. Conversely, when change of temperature or accumulation of moisture caused the airship to descend, a greater part of the equilibrator was let down upon the sea, thus reducing the weight carried by the balloon and checking the descent.

The total supply of gasoline carried was 10,000 lb., or about 1800 gallons, which was considered sufficient to drive the airship from Atlantic City to Europe. The distance is about 3000 miles. With one engine running the airship could make a speed of 20 miles per hour, and the quantity of gasoline carried would run one engine 200 hours. With both engines running the ship's speed in still air could be about 26 miles per hour.

After leaving Atlantic City at 8.5 a.m. on Saturday morning, October 15, the *America* travelled 20 miles in the first hour, but later the rate was reduced to 15 miles an hour. Nantucket Island, which is about 300 miles from the starting place, was reached in twenty-four hours. A wireless message was received from Mr. Wellman at 12.45 p.m. on Sunday, October 16, when the airship passed out of range of communication with Nantucket Island. The vessel was then directed to the north-east, and early on the morning of October 17 was believed to be travelling between Nantucket Island and Nova Scotia. At 4.30 on October 18 the airship was sighted in distress by the Royal Mail Steam Packet Company's steamer *Trent*, and after some difficulty Mr. Wellman and his crew were rescued and taken on board, the airship being abandoned. The position in which this occurred was latitude 35° 43′ N. and longitude 68° 18′ W., which is nearly 400 miles east of Cape Hatteras, on the North Carolina coast. The total distance covered by the airship appears to have been about 900 miles, and the duration of the voyage, during which she was in the air continuously, was sixty-nine hours.

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

THE address of the president of Section A, Prof. E. W. Hobson, was read on Thursday, September 1; this has appeared in full in these columns (NATURE, September 1, p. 284). It was succeeded by a paper—probably the most important paper read at the meeting—by Sir J. J. Thomson on positive rays. By the use of very large vacuum tubes Sir Joseph has been able to investigate the discharge at higher vacua than hitherto. Specially studying the rays which pass through a hole in the kathode, he detects:—(1) Rays undeviated by magnetic or electric forces. (2) Secondary positive rays, produced by these, which are deflectable by both forces, have a constant velocity of about 2×10^8 cm./sec. at all pressures and potential differences. The value of e/m for these is 10^4. They are accompanied by negatively charged ones similar in every respect to the positive ones, except in respect to charge. (3) Rays characteristic of the gases in the tube, conspicuous only when the pressure is low. Their velocity varies with the potential difference. When several gases are present, the maximum kinetic energy of the rays from each gas appears to be the same and equal to that due to a fall through the potential difference between the negative glow and the kathode. The value of e/m is inversely proportional to the atomic weight of the gas. They are probably atoms carrying unit positive charge; in the case of hydrogen there are rays corresponding to the molecule as well. Some of these have negatively charged rays associated with them. In a magnetic field the rays from a mixture of gases spread out into a sort of spectrum. With carbon monoxide two bands are formed, one due to carbon, the other to oxygen. As exceedingly small quantities of gas may be dealt with in this way, it appears probable that interesting results may follow from the application of this method to the analysis of gases in vacuum tubes. (4) Retrograde rays, travelling from the kathode in the same direction as the kathode rays. These are of types (1) and (2). They have negative constituents.

Dr. R. A. Houston followed with an exhibition of a spectrophotometer of the Hüfner type, which he has previously described in the *Phil. Mag.* for February, 1908, and with a description of a new and simple means of producing interference bands. An approximately right-angled prism is placed in front of a slit; the two emergent beams produce interference bands in front of the prism. This is being used as a student's exercise; it does not appear, however, that the bands can be put to any practical use. A new gyroscopic apparatus was next exhibited by Prof. A. E. H. Love. The machine consists essentially of a pair of bicycle wheels fixed to a round steel bar as an axle. The bar is prolonged beyond one wheel to carry a wooden wheel, by means of which it can be set spinning, and the other wheel carries a square tin plate on which is fixed a card coloured in squares. The machine is so mounted that it can turn freely about its centre of gravity. To throw it out of truth without disturbing the centre of gravity two small bolts are inserted in the rims, one in each, at opposite points. The machine is set spinning about the axis of the wheels. When the instantaneous axis cuts the card at a point well within a square, a patch of the colour of that square is seen distinctly, and the rest of the card appears confused. As the axis moves, a series of distinct patches are seen at short intervals.

On Friday, September 2, the section divided. In the mathematical department Major P. A. MacMahon opened the proceedings by reading a paper on functions derived from complete and incomplete lattices in two dimensions, and the derivation therefrom of functions which enumerate the two-dimensional partition of numbers. The investigation was suggested by the solution of a ballot problem of finding the chance that at every stage of the voting the candidates are in their final order.

Dr. Baker in his paper on a certain permutation group said that he had been led to inquire into its properties by becoming interested in a game played by some children. The game consisted in writing down a series of letters and then rearranging them by writing the last first, the first second, the last but one third, the second fourth, and so on. When the rearrangement was completed it was performed again, and so on repeatedly. Finally, it was found that, after a certain number of rearrangements, the original order of the letters was obtained.

For instance, the set of seven letters

$$a \quad b \quad c \quad d \quad e \quad f \quad g$$

gives

$$\begin{array}{ccccccc} g & a & f & b & e & c & d \\ d & g & c & a & e & f & b \\ b & d & f & g & e & c & a \\ a & b & c & d & e & f & g \end{array}$$

Dr. Baker showed that when there are n letters the number of rearrangements required to reobtain the original order is the least number r, such that one of the two numbers 2^r-1, 2^r+1, is divisible by $2n+1$.

Dr. Baker also read a paper on the trisection of elliptic functions, in which the problem was discussed in connection with the theory of the quartic equation.

Lieut.-Colonel Allan Cunningham read two notes of great interest on the theory of numbers, one on the factorisation of $(2^{77}+1)$, and the second on the question whether (2^p-2) is divisible by p^2 (p a prime). Upon these Dr. Baker made the following remarks:—

We are often told that the problems of the physicist are set to him by nature itself, but the problems of the mathematician are invented by himself, and therefore worthy of less attention. Those to whom this seems a sound criticism will probably admit that the puzzling problems of integral numbers are put to us from without. We should therefore regard the theory of numbers with especial concern, quite apart from its own extraordinary interest. In Germany at the present time great progress is being made in the subject; it touches our reputation as English-speaking mathematicians to encourage, so far as we can, a similar interest in the theory of numbers here.

Prof. A. W. Conway read a paper on the convergence of a certain series used in electron theory. The series was one obtained by means of Lagrange's expansion.

Dr. J. W. Nicholson read a paper on some problems of initial motion of electrified spheres, in which he referred to the work of G. W. Walker and Prof. Conway. Starting with an electron having a small Newtonian mass, it was shown that difficulties are met with when this mass is reduced to zero; it appears impossible to ascribe an initial acceleration to a conducting sphere without introducing imperfection in the conductivity, although the electrical distribution on the sphere tends to become uniform very rapidly. These results have a bearing on a possible conception of the electron. These difficulties are absent from the corresponding problem for an insulating sphere.

Dr. Duncan M. Y. Somerville pointed out the need of a non-Euclidean bibliography. It is now thirty years ago since Halsted published the first bibliography of non-Euclidean geometry, and one still finds it referred to as a standard work. In the discussion Prof. Love suggested that a report on the subject would be more valuable. (The general committee has since appointed a small committee to consider this question and draw up a report if considered advisable.)

Mr. H. Bateman read a paper on the present state of the theory of integral equations, in which he sketched the history of the subject and indicated some of the physical applications. Prof. Conway and Prof. Webster remarked that in the problems they had tried it was very difficult to get a simple solution by means of integral equations. In answer to this, Dr. Hobson pointed out that in the problems referred to the theory of integral equations fails to give a simple solution because a simple form of the solution does not exist; but by studying the theory we can hope to obtain some idea of the form and behaviour of the solution, although the analytical expression for it is not suitable for calculation. This important, exhaustive report of Mr. Bateman's has been ordered to be printed *in extenso*.

Mr. Bateman also read a paper on the foci of a circle in space and some geometrical theorems connected therewith. Special attention was paid to twisted polygons formed of isotropic lines.

Prof. J. C. Fields read a paper on the theory of ideals. Starting from Hensel's power-series, he defined adjointness relative to a prime p in a manner analogous to that in which he has defined the property in connection with the algebraic functions. If ϵ is the solution of an algebraic equation, it was shown that we can construct a rational function $R(\epsilon)$ possessing any assigned set of adjoint orders of coincidence corresponding to a prime p. It is deduced that we can construct a general function $R(\epsilon)$ which represents only integral algebraic numbers, and possesses a single coincidence with the branches of an assigned one of the cycles corresponding to any prime, while it is not conditioned with regard to any other specific prime or any other cycle corresponding to the prime in question. The aggregate of numbers so represented is a prime ideal.

The report of the committee on the further tabulation of Bessel functions was taken as read. This committee is proceeding to calculate the functions $I_n(x)$ and $K_n(x)$. Its scope has been extended so as to empower it to proceed to the calculation of any necessary functions.

Meanwhile, a joint meeting of the physics department and Section B (Chemistry) was being held. The proceedings of this meeting will be in part reported by the chemical section. Two papers only will be dealt with here. A paper was read by Mr. J. A. Crowther on the number of electrons in the atom. From the mean scattering of β particles in passing through a substance, it is deduced that the number in question is three times the atomic weight, provided that the positive electricity in the atom has a volume comparable with the atom itself. The substances considered are carbon, aluminium, copper, silver, and platinum. The numbers obtained, if the positive electricity be assumed to be divided into small particles comparable in size with the negative, are not proportional to the atomic weight—a result which would be in conflict with experiments on the scattering of Röntgen rays—and it is thence concluded that this alternative hypothesis is not correct.

The second paper was by Dr. R. D. Kleeman, on the attractive constant of a molecule of a compound and its chemical properties. Making use of previous deductions from surface tension and latent heat data, Dr. Kleeman shows that the various chemical compounds can be divided into groups, and it is found that this grouping corresponds with that obtained from purely chemical considerations; for example, the amines fall into three groups. The property specially studied is the ratio $T_c/\Sigma\sqrt{(A)}$, where T_c is the critical temperature and the denominator is the sum of the square roots of the atomic weights of the components of the compound.

The proceedings on Monday, September 5, began with a demonstration by Dr. H. J. S. Sand of vacuum-tight seals between iron and glass. An iron wire is sealed into a glass tube. While the glass is hot a small piece of heated steel tube surrounding the wire is pushed a few millimetres into the glass. After cooling, the tube is soldered to the wire. The vacuum-tight seal is produced between the inner surface of the elastic steel tube, which on cooling is put under tension, and the glass, which comes under compression. Seals with wires of 1 mm. diameter have been produced in this way.

Dr. T. H. Havelock followed with deductions from the relations between densities and refractive indices. Dr. A. G. Webster (of Worcester, Massachusetts) gave a detailed account of a complete apparatus for the measurement of sound. The producer of the sound was a steel diaphragm rigidly driven by an electrically maintained tuning-fork, and made the back of a resonator of the form of a small hollow chamber or of a tube of variable length. The reaction of the sound upon the amplitude of the fork enables the constants of the resonator to be accurately determined, so that the rate of emission may be measured in watts. The phonometer (or measurer of the sound) is a glass diaphragm, made the base of a resonator, and bearing a light mirror, which constitutes one mirror of a Michelson interferometer. The displacement is measured stroboscopically by a telescope, and the amplitude of the pressure change is read off on a scale in dynes cm.$^{-2}$. The instrument is as sensitive as the ear for a pitch of 256 vibrations per second, and an accuracy within 10 per cent. is claimed.

In the short discussion aroused by this paper some doubt seemed to be felt of the agreement of results given with those obtained by Lord Rayleigh, but in the absence of trustworthy memories the point was left unsettled. Questioned as to the power exerted while he himself had been speaking, Prof. Webster left it to be inferred from the statement that ten million cornets (each of which could be heard half a mile away) emitted at the rate of a horse-power.

Prof. W. M. Hicks followed with a paper on the relation of spectra to the periodic series of the elements. In this he described some results recently obtained by him in a critical study of the spectral series of the second and third groups of the periodic table of elements, more especially their dependence upon the atomic volume of the element. Values for atomic volume or of density very close to observational values can be deduced in the case of the first three groups of the periodic series. Applying the method to the spectrum of europium as given by Exner and Hashek, a density of 13·1 was predicted for that element. Sir Norman Lockyer, discussing the paper, emphasised the importance of a study of series, especially in regard to the stars. In a paper on the series spectrum of the mercury arc, Dr. S. R. Milner gave the results of a photographic study of the mercury arc *in vacuo*, thus avoiding the faint continuous background which fogs the plate when the arc is observed in air; very much longer exposures can for this reason be given, and many new lines are then observed, among which the lines forming the continuation of the various series of mercury were strikingly developed. Measurements have been made up to the fifteenth line in the diffuse series and the thirteenth of the sharp series. Rydberg's difference law is exactly satisfied.

Mr. A. E. Oxley described an apparatus for a production of circularly polarised light obviating the lateral displacement of the beam produced by Fresnel's rhomb, but possessing the advantages of this rhomb in other respects. Two similar rhombs of glass are placed end to end in contact so as to form a *bent* double rhomb. By suitably choosing the dimensions the required object is attained. The angle of the rhomb chosen is $74° 38·2'$ for glass of index 1·5035. The length (15 cm.) is, however, inconveniently long. A much shorter form, in which three reflections of the light occur, is obtained by putting in close contact two trapezium-sectioned prisms, the faces in contact being those containing the shorter of the two parallel edges of the trapezium. The relative retardation can be made $2\pi + \pi/2$, and the emergent light will then be circularly polarised. The apparatus can advantageously replace a quarter-wave plate in the quantitative study of elliptic vibrations. Mr. Oxley also described a new half-shade analyser, consisting of a double rhomb of glass of suitable angle to produce a retardation of 3π, which is equivalent to $-\pi$.

Section G (Engineering) then joined to participate in a discussion on the principles of mechanical flight, opened by Prof. G. H. Bryan. This discussion wandered away from the title, and developed into one on the relative positions of the mathematician and the practical engineer in the origination and development of new ideas on the subject of aviation. The engineers were present in strength, and the evidence brought forward from the parallel case of motion on water seemed to be greatly in their favour. Of the points more particularly bearing upon the advertised title of the discussion we may mention Mr. Dugald Clerk's advocacy of much lighter engines and of a considerable modification of the usual thermodynamic cycle. He recommended differences of pressure of two to one instead of five or more to one as at present. Mr. Scoble's account of his propeller tests was also of much value.

The proceedings of Tuesday, September 6, were opened with a discussion on atmospheric electricity, initiated by Dr. Charles Chree. He explained that atmospheric electricity includes a great variety of phenomena. Omitting aurora as a subject so large as to require a separate discussion, there are the questions of the potential gradient in the atmosphere, the influence of potential gradient and electrical charges on the growth of vegetation, the phenomena of thunderstorms, the loss the charge experienced by insulated bodies, the number and nature of the positive and negative ions in the air, the vertical earth-air currents, and the phenomena of radio-activity. The potential gradient and its diurnal and annual variation have been the subject of study for a good many years, and we know that the phenomena vary largely with the season of the year at any given station, and that there are notable differences between different stations at ground-level. As yet but little is known of the diurnal and annual changes at different heights in the free atmosphere. Observations made near the top of the Eiffel Tower suggest that the phenomena alter rapidly as the height above the ground increases. Thus observations from balloons and kites, if these could be maintained at a fixed level, would be of great importance. The influence of electricity on the growth of plants, first seriously studied by Prof. Lemström, seems not unlikely to prove in the future to be of economic importance. The phenomena of thunderstorms have received considerable attention from meteorologists, but many lines of investigation present themselves. The loss of charge of insulated bodies and the ionic charges in the atmosphere have been studied most in Austria and Germany—Elster and Geitel, in particular, having done much pioneer work. In this country Mr. C. T. R. Wilson has investigated the electric charge brought down by rain, and has invented an instrument for measuring the earth-air current. While a great number of theories have been advanced to account for the several phenomena, there are few, if any, of them which command anything like universal acceptance.

Sir Oliver Lodge referred to the existence of a positive gradient of potential during fine weather and a negative gradient during wet weather, and spoke of the possibility of influencing the weather by varying the potential gradient, and thought that rain might be produced in this way, and that here was a field of experiment for the enterprising capitalist. Referring to the effect of electricity on plant life, he explained that the experiments with which he had been connected showed that in dull weather the plants were stimulated by the electricity, and the effect was good, but in bright, sunny weather they were over-stimulated, with consequent bad results. He did not think that the action on plants was due to nitrification, but to some effect on the growing tips.

Dr. Shaw pointed out that in order to produce rain in considerable quantities it would be necessary to find a source for an enormous amount of energy, and he urged that any attempt to reverse the electric field should be first of all thoroughly worked out in the laboratory. He asked whether fine weather electricity had anything to do with thunderstorms. The two phenomena seemed to be distinct from one another.

Sir J. J. Thomson thought the real difficulty about producing rain by electrical methods would be political. If one's efforts resulted in deluging neighbouring countries with rain they did not want, or in depriving them of their normal supply, difficulties would begin. As he understood Sir Oliver Lodge, it was not a question of supplying energy, but of transforming energy already existent in the atmosphere in order to produce rain. He referred also to the difficulty of explaining the return to earth of the outward flowing negative electricity, and mentioned, in conclusion, the relation between the radio-active contents of the air and its previous history; air which had travelled over the sea was much less radio-active than that which had been for some time over the land.

Dr. Chree in his reply emphasised the fact that during rainfalls there are fluctuations of potential, and in conclusion urged the necessity of observations over much wider areas before many of the problems of atmospheric electricity could be settled.

At this stage the section divided. In the department of cosmical physics Dr. W. Schmidt, of Vienna, communicated an interesting description of a new instrument, the variograph, designed by him for measuring short waves in atmospheric pressure. He showed records obtained by it at Innsbruck and Vienna. Conditions at Innsbruck, especially in the winter months, are very favourable for the production of waves, the cold air in the valley lying beneath a warmer upper layer. By recording with two instruments 2 km. apart, Dr. Schmidt deduced that both progressive and standing waves occurred, the period of the latter being considerably greater than that of the former; in a particular case the periods were 3·5 minutes and 9 minutes respectively, and the record showed the interference of the two sets of waves. Dr. Schmidt showed, too, that in Föhn weather, when regular waves were recorded, the regularity ceased when the Föhn wind actually broke through the cold layer and blew at Innsbruck, proving that the layer of discontinuity was essential to the formation of the waves. In some cases regular waves preceded by several hours the occurrence of line-squalls, corroborating Russell's observations of cirrus clouds.

Mr. Dines spoke on the records from the upper atmosphere obtained during the passage of the earth through the tail of Halley's comet. The traces obtained by Mr. Dines in ordinary cases are of two kinds, one in which the up and down curves coincide, the other in which loops are formed. The traces at the time of the comet showed an abnormally large proportion of the second kind, but it was not possible to say if the peculiarity was due to the comet or to the type of the prevailing weather.

Dr. Nicholson in a paper on radiation pressure in cosmical problems showed that more extended calculations do not confirm Schwarzschild's results in detail, but the general character of these results is preserved.

Miss Margaret White showed a series of slides giving the results of the hourly balloon ascents made from Manchester in March. The results corroborated in their main features those obtained in June, 1909, and communicated at the Winnipeg meeting.

Mr. Stupart gave some results of an inquiry into the vertical temperature gradients in Canada in the winter months. The principal conclusions were:—(1) that in cold winters in Manitoba the temperature increased upwards, the mountains being warmer than the plains; (2) that in warm winters the mountains were colder than the plains, and the vertical gradient approached the adiabatic value.

Mr. Gold communicated the results of an investigation into the effect of radiation on H_c, the height, and T_c the temperature of the advective region. So far as radiation is concerned, the variation both in the temperature and in the absolute humidity of the atmosphere tend to increase the value of H_c with approach towards the equator, but their effects on T_c are in opposite directions. A necessary condition for the existing state of affairs is that the atmosphere should be very nearly transparent to low temperature radiation for considerable regions in the spectrum.

Prof. F. G. Baily described a sensitive bifilar seismograph for recording undulatory movements of the earth's surface of short period. By a system of multiplying levers, great sensibility is attained, and it may be expected that, when the present experimental instrument is replaced by a final form exposed in a suitable chamber, valuable results will be obtained.

In the department of general physics, which sat simultaneously with the above, Mr. Twyman described, on behalf of Prof. C. Féry, a successful attempt to simplify the long-range spectrograph to make it suitable for industrial investigations concerning metals, alloys, &c. The principle of auto-collimation is employed, a 30° quartz prism being traversed twice by the beam of light. By giving suitable curvatures to the two sides of the prism it acts also as the lens-system, producing a sharp spectrum on a cylindrical surface, exactly as with a curved reflecting grating, and with a much less inclination of the plate.

In a paper on the magnetic field produced by the motion of a charged condenser through space, Mr. W. F. G. Swann discussed the possibility of detecting the presumed field by means of a rotating coil, even though the impossibility of detecting it by a magnetic needle is admitted. His analysis seemed to indicate that if the specific inductive capacity may be looked upon as a quantity absolutely continuous throughout the dielectric, a magnetic flux through the coil should exist, but that if the dielectric action is to be explained by electric charges or doublets, no resultant magnetic flux is to be anticipated. Experiments made by the author gave a null effect, and this is taken to support the doublet theory of dielectric action.

Three papers were read by Prof. J. C. McLennan on behalf of the authors, who are his students at Toronto. In the first Mr. V. E. Pound details the results of experiments on the secondary radiation from carbon at low temperatures when bombarded by the α rays from polonium. Fifty per cent. more is produced at the temperature of liquid air than at atmospheric temperature. This is attributed to the much larger amount of air occluded in the carbon. The second paper, by Prof. McLennan and Mr. N. Macallum, was on a resolution of the spectral lines of mercury by a high-grade echelon spectroscope made by Messrs. A. Hilger. A number of slides were exhibited showing the components of the green and blue mercury lines and their resolution under the action of a magnetic field. The third paper was by Mr. W. T. Kennedy, on the active deposit obtained when the emanation from actinium is allowed to diffuse freely between two parallel plates placed about 2 millimetres apart over the actinium salt, the plates being maintained at a difference of potential of 250 volts. The deposit is found to reach a maximum for a particular gas-pressure. It was concluded that the proportionate amount of emanation which possesses a positive charge varies with the pressure.

Dr. H. S. Allen followed with an important summary of our present knowledge of photoelectric fatigue. This was accompanied with a bibliography, which has been ordered to be printed *in extenso*. This was succeeded by an interesting paper by Drs. W. Makower and S. Russ and Mr. E. J. Evans on the recoil of radium B from radium A. The magnitude of the effect observed was of the order to be expected if radium B carries the atomic charge of electricity and if its atomic weight is 214, as is to be expected on the transformation theory of radio-active processes.

The proceedings on Wednesday, September 7, began with a very interesting account by Sir Norman Lockyer of his work on stars and their temperatures. The spectra of the hottest stars indicate that in them we have to deal simply with hydrogen and with another form of hydrogen produced from it: but helium runs hydrogen very close as one of the constituents of a star's earliest atmosphere. Iron, even in a proto-form, enters into a star's atmosphere at a much later stage, and iron such as we know it in our laboratories at a later stage still. The general conclusion from Sir Norman's work is that we are able to establish a palæontology of chemical substances.

Prof. W. M. Hicks sketched some of the evolutions of a vortex, and was succeeded by Dr. C. Chree, who read a critical paper on the rate of propagation of magnetic disturbances. Dr. Bauer, of the Carnegie Institution, believes he has established as a fact that the so-called "sudden commencements" of magnetic storms are propagated at such a rate as to take, on an average, about $3\frac{3}{4}$ minutes to go round the earth, and he believes that the cause of these disturbances is a peculiar form of overhead electric current in the plane of the earth's equator due to charged ions, the height of which, on the average, is about fifty miles. Dr. Chree considers that the theory which Dr. Bauer has advanced to account for the motion of these charged ions is unsatisfactory in several respects, and he further considers that the experimental evidence which has been brought forward by Mr. Faris to support Dr. Bauer's theory is inconclusive.

Then followed several reports of committees, which were either outlined or taken as read. These included the report of the seismological committee, in which reference is made to the interesting results on the semi-diurnal change in level (caused by the tide) obtained by Plummer at Bidston Observatory. The meeting of the section then came to an end.

CHEMISTRY AT THE BRITISH ASSOCIATION.

IN arranging the programme for the Sheffield meeting the organising sectional committee had made it the main object to discuss broader questions of interest to other sections rather than to encourage the reading of papers appealing mainly to specialists; further, in view of the special character of the industries of Sheffield, much of the programme was devoted to metallurgical subjects. The results of the meeting fully justified this departure, and the three joint discussions not only proved of the greatest interest, but were most stimulating in character; indeed, it is probable that in two cases, at least, they will serve as points of departure for much new research. The metallurgical papers were equally stimulating and in harmony with the tone set by the president's address—the meeting as a whole should do much to inspire the filling of some of the gaps in our knowledge to which Mr. Stead made reference.

The joint discussion with Section A attracted a very large audience. The subject chosen—combustion—should have had the cooperation of the engineers, who were discussing the report of their committee on gaseous explosions on the same morning, but could not see their way to attend the joint meeting. Prof. Bone presented a report giving a very complete summary of the principal researches upon the chemical aspects of gaseous combustion during the past thirty years. He dealt in turn with ignition temperatures, the explosion wave, the pressures produced in gaseous explosions, the influence of moisture upon combustion, the combustion of hydrocarbons, and the influence of hot surfaces upon combustion. This last question is of considerable technical importance, hot surfaces accelerating dissociation, and probably also combustion, and hence playing a potent part in the development and concentration of the heat in gas-fired furnaces. The line of attack followed has been to determine the rates of combination of different gases with oxygen when the reacting mixtures are brought into contact with various solid surfaces at selected constant temperatures.

Sir J. J. Thomson directed attention to the fact that combustion was concerned, not only with atoms and molecules, but also with electrons, *i.e.* bodies of much smaller dimensions and moving with very high velocities. These may precede the explosion wave and prepare the way for it by ionising the gas. The motion of the ions can be stopped at once by means of a transverse magnetic field, and it would be of great interest to repeat Prof. Dixon's experiments on the photography of the explosive wave under such conditions.

It had been shown by the work of Townsend and others that in carefully dried gases the velocity of the negative electrons might be 100 times as great as the velocity of the positive electrons. The amount of moisture required to reduce this velocity to its ordinary lower value was exceedingly small, and comparable with that required to initiate chemical change. It was not unlikely that the two phenomena were very closely related.

In reference to the influence of hot surfaces in promoting combustion, it was not improbable that the emission of charged particles from the surface was a factor of primary importance. Hot lime gave out an enormous stream of negative electrons; hot metals emitted an excess of positive electrons. These electrons might produce very important effects by uniting (perhaps selectively) with moisture, with the oxygen or with the inflammable constituent of the gaseous mixture. The action of surfaces might ultimately be found to depend on the fact that they formed a support for layers of electrified gas in which chemical changes proceeded with high velocity.

Sir Oliver Lodge referred to the fact that the velocity of sound was not a constant quantity. If a bullet were to travel with a velocity greater than that of sound the air would be shattered as if by an explosion. This result was in practice prevented by the compression, and consequent heating, of the air in front of the bullet, whereby the velocity of sound was momentarily raised to perhaps three times its ordinary value. Whilst hot surfaces promoted combustion, cool surfaces had an opposite effect; this was responsible for the production of vast quantities of soot and smoke, especially in firing steam boilers. The discovery of a surface which would promote combustion even at lower temperatures would be of very great value.

Prof. H. B. Dixon stated that the explosion of hydrogen and chlorine by light was of special interest, as it did not occur in the well-dried gas. Both Mellor and Chapman and Burgess had failed to find any evidence of ignition by light of a mixture of two substances—three kinds of molecules seemed to be necessary. But when once the explosion wave was started it proceeded independently of moisture, and, indeed, was actually most rapid in the dry gas; the explosion was then propagated by molecular collisions between pairs of molecules. It was not unlikely that invisible compression waves might travel a little in front of the visible flame, the particles being thereby raised to a higher temperature, but remaining uncombined until they collided with one another.

Prof. Armstrong denied the possibility of any interaction taking place between two substances if neither was an electrolyte. Highly purified materials must be used for work of this kind. Perhaps the most suggestive experiment was that of Sir James Dewar, who had purified helium so perfectly by the use of charcoal cooled in liquid air that it would not permit an electric discharge to pass through it, although the presence of the gas was clearly shown by the radiometer.

A paper on the molecular weight of radium emanation, by Sir Wm. Ramsay and Dr. R. W. Gray, was delivered by Dr. Gray, who first described in detail the construction of the micro-balance used, and showed how the exact volume of emanation weighed was determined. The mean value of 221 was obtained for the molecular weight of the emanation, and the fact emphasised that the radium emanation was in every sense a true chemical element. Chemically it is absolutely inert, and the atomic weight shows that it falls into the argon series in the periodic table, filling the second vacant space below xenon. The name "niton" (shining) and the chemical symbol Nt was proposed for the emanation. Sir J. J. Thomson suggested that the name should be left to the Congress of Radiology at Brussels (see NATURE, October 13).

The more purely physical papers read at the joint meeting are dealt with in the account of the proceedings of the physical section.

The report on solubility submitted by Dr. J. V. Eyre is the outcome of a systematic study of the literature; the material is classified chronologically and according to subject, and contains a brief statement of the main conclusions arrived at by the various authors.

The conjoint discussion on the biochemistry of respiration was of the greatest value in enabling workers on the subject, representing the three sciences concerned, to correlate their views. Mr. F. F. Blackman, who opened the proceedings, gave a very complete summary of the present position of the subject, dividing it into three sections:—(1) the nature of the chemical reaction (or complex of reactions) that constitutes respiration; (2) the extent to which this reaction in the cell conforms to the laws of general chemistry; (3) the influence on the progress of the reaction of the peculiar medium (protoplasm) in which it takes place. A summary statement of respiration takes the form of the equation for the complete oxidation of glucose, but actually the process is most complicated. The existing theories as to the stages in which glucose undergoes oxidation and the part played by oxidases were all fully described.

Mr. Blackman advocated the hypothesis that normal respiration consists of two processes, a small "protoplasmic respiration" which cannot be suppressed without death, and a larger "floating respiration" which depends on the available sugar supply, and can be reduced or abolished by starvation.

A brief summary of the oxidative breakdown in animal tissues was given by Mr. H. M. Vernon, who described some of his own work on the subject.

Dr. E. F. Armstrong summarised the existing knowledge with regard to the oxydases, and debated whether they are to be regarded as organic enzymes or as inorganic catalysts in a colloidal substrate. The facts that oxydase solutions retain their activity after somewhat drastric purification, that they invariably contain, even after the most thorough purification, traces of manganese, iron, or calcium salts, and that their action may be imitated by colloidal suspensions of the salts of these metals, are all in favour of the later view. On the other hand, there is distinct evidence of the specific nature of oxydases and of the existence of different oxydases. He further described the remarkable blackening of the leaf of *Aucuba japonica* produced when this is exposed to toluene or chloroform vapour, the change being attributed to an oxidative effect produced by an oxydase. A systematic investigation of what substances were able to cause this blackening showed it to be produced by most organic vapours, *e.g.* ethyl acetate, ether, benzene, &c., by carbon dioxide, and by such salts in aqueous solution as cadmium iodide, mercuric chloride, and sodium and potassium fluorides. All these substances possess but little affinity for water, and it is supposed that they are therefore able to pass through the differential septa, enter the cell, and set up osmotic disturbances whereby the cell contents become diluted and hydrolysis sets in to restore equilibrium. This brings the various cell enzymes into play, and a general degradation takes place. Measurements of the amount of sugar or starch or glucoside in the leaf before and after stimulation confirm this view—a great increase in the amount of reducing sugar is produced.

The stimulative effect of chloroform on respiration formed the subject of a paper by Mr. D. Thoday, whose results appeared to harmonise very closely with those of Dr. Armstrong; this paper will be more appropriately discussed under Section K. Prof. Armstrong, who followed, made a critical examination of the mechanism of the oxidative changes, and laid stress on the extremely complicated nature of the respiratory phenomenon.

The joint meeting with the Educational Section to discuss the neglect of science by industry and commerce attracted a large audience. Mr. Blair, who opened, spoke at considerable length in detailing evidence which he had collected from 150 past students of universities or institutions of university rank—all belonging to a class for whom the earning of a living was imperative. His paper appeared in full in NATURE of September 15. Following a supplemental paper by Sir Wm. Tilden, the subject was debated in turn by Dr. H. T. Bovey, Principal Griffiths, Dr. Beilby, Sir Wm. White, Mr. J. E. Stead, and Prof. Armstrong. The general tone expressed, both in Mr. Blair's address and by subsequent speakers, was one of hope, and it was agreed that England is not so far behind other countries in the application of science to commerce and industry as is often asserted. The main fact emphasised was that it was, above all, necessary to educate the public and bring home to them the advantages of pure science, and, further, it was all-important to establish some easy means to bring about a better understanding and more frequent communication between those who studied science and those concerned in its application.

On Tuesday, September 6, it was necessary to divide the section, the metallurgical and the organic chemistry papers being taken separately. The first paper, by Prof. J. O. Arnold, dealt with a fourth recalescence in steel. Steel in cooling contracts to a certain point, and then suddenly expands. It is agreed that this takes place three times; but Prof. Arnold, as the result of several years' experience, considers there is a fourth recalescence due to constitutional segregation, namely, the falling out between Ar_3 and Ar_1 of the ferrite and hardenite from their state of solid solution into microscopically visible masses. Numerous photomicrographs and cooling curves were shown to support this view. In the ensuing discussion Dr. C. H. Carpenter contended there was no need to term the process a fourth recalescence, and interpreted it as a prolongation of the Ar_3 and Ar_2 inversions. He criticised adversely the apparatus employed by Prof. Arnold, advocating in its place the differential method of registering recalescence. Prof. Arnold, in replying, stated this method to be quite untrustworthy. Mr. Stead said it is well known that in steels containing under the eutectoid proportion of carbon, when cooling from Ar_3 to Ar_{1-2-3}, the carbides and ferrite segregate. Prof. Arnold by his very careful research was the first to show that this segregation is coincident with an evolution of heat.

Prof. H. M. Howe, in a brief paper on allotropy or transmutation, took the view that changes such as that from the diamond to lampblack in reality involve transmutation, and the fact that but a single series of derivatives is given by such compounds was explained as meaning that the derivativeless element inevitably transmutes whenever it enters into combination.

A second paper dealt with the closing and welding of blow-holes in steel ingots, in which the author supported the practice of allowing blow-holes to form rather abundantly, so as to prevent the formation of a pipe, and then, relying on the ease with which such steel welds, trying to get flawless metal by welding these blow-holes up in the process of rolling the ingot out into its final form. This procedure is of great economic importance in that it enables the steel maker to avoid the serious discarding which would be necessary in case his ingots were free from blow-holes, and hence deeply piped. Many metallurgists have condemned the practice on the ground that the closing of blow-holes is impossible, because the gas which they contained must remain ever present during the rolling, even though somewhat compressed. Prof. Howe described in detail experiments showing that the blow-hole gases had been reabsorbed by the metal to a very great degree, and suggested prolonging the exposure to a temperature above the welding point, so as to complete the reabsorption of the gas while the metal was still weldable. The welding of the blow-holes should be promoted rather by the practice of "reheating" than by that of "direct rolling." Following some remarks by Prof. Arnold and Mr. Hadfield, Mr. Stead described an investigation carried out with Mr. F. M. Parkin on the same subject, which proved conclusively that when two metallic surfaces, quite free from oxide or any foreign matter, are brought together and hammered at temperatures from 1100°–1150° C., they weld up completely. The question as to what becomes of the imprisoned gas requires careful research; when the cavities are large the gases are enormously compressed, and must interfere with efficient welding. As a result, blisters occasionally appear on finished sheets if afterwards reheated. The gases extracted from a large blister in a soft steel slab gave on analysis:—CO_2, 23 per cent.; CO, 50·5 per cent.; hydrogen, 17 per cent.; marsh gas, 3·5 per cent.

The next paper, on the provident use of coal, by Prof. H. E. Armstrong, gave rise to a very considerable discussion. During the early stages of combustion a variety of volatile inflammable substances are given off which burn with a smoky flame. By first coking the coal at a low temperature these may be removed and recovered, and a fuel obtained which burns as readily as coal and gives a hotter fire. The gas given off by the coking process is very rich, and it was advocated that this be substituted for the product now produced by carbonising coal at very high temperatures, so as to obtain the maximum possible yield. It is essential that the quality of gas be improved; since the sulphur clauses of the Gas Acts were repealed there has been a steady deterioration. There is no reason why the coal now used in the raw state by the community should not be first coked at a low temperature. The gas would be available as an illuminant and for heating; the residual coke could be burnt without producing smoke, and a variety of bye-products would have considerable commercial value.

Prof. A. Smithells stated that the point to be proved was whether fuel of the type advocated could be produced under conditions which would enable it to compete economically with the coal and products as put on the market under existing conditions. He considered the whole question to be in the experimental stage.

Dr. Beilby pointed out that in order to supply the public with soft coke instead of the 40 million tons of coal now required for domestic purposes the gas industry would have to be completely revolutionised, and some other very large uses found for the gas and other bye-products. It would not be possible to get chemical uses for such a large quantity, and it would have to be largely burnt as fuel. Mr. Archbutt emphasised the evil caused by sulphur in the gas; the public is not aware of this being the cause of the corrosion of brass, tarnishing of silver, and the destruction of books and furniture. Mr. A. W. Oke defended the gas companies, and other speakers supported Prof. Armstrong, who, in replying, stated that the use of a very large radiant and the supply of a greater quantity of gas was progress in the wrong direction. He agreed with Dr. Beilby that it would be necessary to regard the products of coking from the point of view of their fuel value, but that was a largely enhanced fuel value.

Prof. McWilliam described the properties of a series of steels with varying carbon contents, but containing, in addition, about 1 per cent. manganese, and a similar series containing 2 per cent. chromium, from results recently obtained by him in conjunction with Mr. E. J. Barnes. In pure iron-carbon steels the strength rises steadily with the amount of carbon up to 1·25 per cent. carbon, a further increase resulting in a reduced strength. The carbon is present as iron carbide, and other elements mainly influence the nature, composition, or distribution of the carbide in the steel. The effects of heat treatments such as long annealing and quenching, followed by tempering at different temperatures, are comparatively small when the carbon is low, but greater as the carbon is increased. Comparative tables were shown of steels with carbon contents and heat treatments as nearly alike as could be selected, and varying only in the special element added, to illustrate the very considerable and abiding influence of the fundamental chemical composition.

In the absence of the author, a communication by Dr. Rosenhain, on the crystalline structure of iron at high temperatures, was taken as read. The conclusions drawn from the research are that iron at temperatures up to 1100° C. behaves as a crystalline aggregate; it exists in three different modifications possessing widely different mechanical properties, the temperature range at which these modifications exist being consistent with their identification with the α, β, and γ forms of iron. β Iron, though existing at a higher temperature, is markedly stronger and harder than α iron. Iron as found in approximately pure metal at high temperatures possesses the structure and some of the properties of γ iron as found in certain alloy steels. The failure to harden pure iron by quenching is due to the difficulty of inhibiting the $\beta \rightarrow \alpha$ transformation by rapid cooling except in the presence of carbon. If β iron could be preserved in existence at the ordinary temperature it would possess a very high degree of hardness and strength probably quite comparable with that of hardened steel.

Dr. S. M. Copeman brought forward the subject of ferro-silicon, with special reference to possible dangers arising from its transport and storage. A number of accidents have occurred from the handling or transport of ferro-silicon, particularly cases of sudden illness and death caused by the gases evolved from certain cargoes. The subject has had full inquiry at the hands of the Board of Trade, who entrusted the investigation to Dr. Copeman, with the collaboration of Mr. S. R. Bennett and Dr. Wilson Hake. Most of the high-grade ferro-silicon, containing 50 per cent. of silicon, is produced electrically in France. About 4000 tons are imported annually into England. This alloy is exceedingly brittle, and readily decomposes in a moist atmosphere, when poisonous fumes of phosphoretted hydrogen are evolved. The official recommendations adopted by the Board of Trade comprise the need for ascertaining that the ferro-silicon has been broken into small pieces some time before being taken on board ship; the proper marking of each barrel; the prohibition of conveyance on passenger vessels; and the adoption of certain other precautions during transport. Subsequently Dr. Wilson Hake described the apparatus he had employed for analysing the poisonous gases produced, and Mr. S. R. Bennett showed photomicrographs of certain ferro-silicon alloys. The suggestion was made that the alloy might be protected from moisture by immersion in varnish, but it was stated that it crumbles so readily as to be always presenting new surfaces.

Two rival theories have been suggested to explain the corrosion of iron and steel. The electrolytic theory assumes that pure oxygen (or air) and pure liquid water *alone* are necessary to effect the rusting of pure iron. According to the acid theory, the presence of at least traces of an acid either free or combined with a base is essential to corrosion. Dr. J. N. Friend described a simple form of apparatus by means of which the correctness of the acid theory is established.

A paper embodying researches carried out in the chemical department of Sheffield University, by Messrs. C. Chappell and F. Hodson, dealt with the influence of heat treatment on the corrosion, solubility, and solution pressures of steel. The tests made were simple corrosion, *i.e.* loss of weight after immersion in sea water; galvanic corrosion, *i.e.* loss in sea water in contact with Swedish bar iron; solubility in 1 and 2 per cent. sulphuric acid after seventy-two hours; solution pressure in sea water, 1 per cent. sulphuric acid and N/10 ferrous sulphate. The results show that the solubility tests are untrustworthy as a guide to the relative rates at which the steels corrode. The general effect of heat treatment on the various properties examined is found to be the same in the case of all the tests except simple corrosion, where heat treatment exerts practically the opposite effect. Although heat treatment exerts considerable influence on corrosion, it cannot be expected to make up for the defects due to segregation or inferior material. A research committee, with a grant of 15*l.*, was appointed for the further study of this question, with Mr. W. E. S. Turner as secretary.

The sub-section, under the chairmanship of Prof. Orme-Masson, was occupied mainly with papers from the chemical laboratories of Sheffield University, which testify to the valuable amount of original inquiry which is being carried out there under Prof. Wynne's guidance. Prof. W. P. Wynne and Dr. J. Kenner presented a paper dealing with the nitrochloro- and dichloro-toluene sulphonic acids, whilst Dr. J. Kenner and Mr. E. Witham described the formation of tolane derivatives from benzotrichlorides. A paper on an instance illustrating the relative instability of the trimethylene ring as compared with the tetramethylene ring was read by Dr. J. F. Thorpe (Sorby research fellow). Open-chain nitriles formed from three carbon rings readily pass into imino derivatives of cyclopentene under similar conditions; four carbon rings remain entirely unaffected. A second paper, by Mr. A. D. Mitchell and Dr. J. F. Thorpe, dealt with the elimination of a carbethoxyl group during the closing of the five-membered ring. The closing of an open chain of five carbon atoms to form a five-membered ring imparts to the molecule a condition of tension which limits the capacity of the constituent carbon atoms to combine with groups of more than a certain volume.

Three important physical chemical communications were made by Mr. W. E. S. Turner. The first paper, written jointly with Mr. C. J. Peddle, dealt with molecular association in water, illustrated by substances containing the hydroxyl group. The fact that molecular association may take place in water is not generally recognised, but the authors find it to be quite extensive among aromatic substances. Benzoic acid, for example, is associated in water to a greater extent than in benzene, and the aromatic acids examined nearly all exhibit marked association. A second paper was entitled "The Problem of Molecular Association. 1. The Affinities of the Halogen

Elements." As the result of the determination of the molecular weights of fifty to sixty halogen containing substances of different types, it was shown that molecular association occurs only when the halogen compound is an electrolyte, that there is no special virtue in the halogen elements—such as the existence of a large number of contra or residual valencies—neither is there any virtue in the halogen ion differentiating it from other ions. Molecular association in neutral solvents is the reverse of the supposed electrolytic dissociation in the dissociating solvents.

The third paper, by W. E. S. Turner and E. W. Merry, dealt with the molecular complexity of nitrosoamines. Measurements of the surface energy of three nitrosoamines show that aliphatic nitrosoamines are associated liquids, whilst aromatic nitriles and nitro-compounds are non-associated.

Dr. F. M. Perkin communicated a short note on the action of metals upon alcohols. When ozone is bubbled through lead suspended in a state of fine division in alcohol lead ethoxide is formed, and this substance is readily obtained on boiling up finely divided lead with absolute alcohol. A few drops of alcoholic mercuric chloride solution are added to facilitate the reaction, or dry air is bubbled through the heated mixture for the same reason.

The method has been extended to the preparation of lead methoxide, cadmium ethoxide, mercurous ethoxide, and silver ethoxide.

The reports of the research committees contained much valuable matter. That on dynamic isomerism dealt with the absorption-spectra of camphor and a number of its derivatives. The report of the study of hydroaromatic substances deals with the constitution of the 3 : 5-dichloro-*o*-phthalic acid obtained from dimethyldihydroresorcin and the preparation of 1 : 1 : 2-trimethylcyclohexanone.

The transformation of nitroamines committee report on the chlorination of anilides and the transformation of acylchloroaminobenzenes, and also on the bromination of anilides. The committee on isomorphous sulphonic derivatives of benzene state that during the past year the results obtained by the examination of twenty-nine derivatives of the 1 : 4 series have been discussed from the point of view of the Barlow-Pope theory, correlating crystalline structure with molecular form, and found to be in complete accordance with it.

GEOLOGY AT THE BRITISH ASSOCIATION.

As was perhaps natural in a year when a geologist, Dr. Bonney, was president of the association, there was an excellent gathering at Section C, which was fortunate in being able to welcome, in addition to the president, Prof. A. P. Coleman, three other geologists from Canada, Dr. R. Bell, Mr. J. B. Tyrrell, and Prof. Spencer. The meetings of the section were well attended, the number of papers presented was sufficient to afford a full programme for the last day (Wednesday), and several well-sustained discussions took place. Any account of the sectional proceedings would be incomplete without a reference to the interesting series of excursions arranged by Mr. B. Hobson and Mr. Cosmo Johns. On Saturday there was a whole day excursion to the Castleton district under the leadership of Dr. Arnold Bemrose, while four half-day excursions were carried out. The sectional dinner was attended by more than sixty members. Successful joint meetings were held with the geographical section and agricultural sub-section; the papers read on the latter occasion are referred to in the report of the subsection.

The great majority of the papers and reports read before the section were stratigraphical in character. In pre-Cambrian geology there was, in the first place, the president's address on "The Canadian Shield," already printed *in extenso* in Nature (vol. lxxxiv., p. 333).

Two reports were also presented dealing with pre-Cambrian rocks, one on the composition and origin of the crystalline rocks of Anglesea, and one on Charnwood rocks.

Lower Palæozoic stratigraphy was represented by a paper by Dr. J. E. Marr and Mr. W. G. Fearnsides on the Lower Palæozoic rocks of the Cautly district, Sedburgh, and a further paper by Miss G. R. Whatney and Miss E. G. Welch described the graptolitic zones from the Salopian beds of the same area; the only other region in which the majority of these zones have hitherto been traced is the Welsh border country. Two reports relative to the Lower Palæozoic rocks were also presented; the committee appointed for the excavation of critical sections in the Palæozoic rocks of Wales and the west of England presented an important report drawn up by Mr. E. S. Cobbold on excavations among the Cambrian rocks of Comley, Shropshire, this including a general revision of the results yielded by the excavations of the past three years and a vertical section. An interim report on the rocks of the Glensaul and Lough Nafooey areas, cos. Mayo and Galway, was also read.

A number of papers had reference to Carboniferous strata. Mr. Cosmo Johns' lecture on local geology was chiefly concerned with the Carboniferous rocks, and he further presented a paper on the Yoredale series and its equivalents elsewhere. The report of the committee on the faunal succession of the Lower Carboniferous (Avonian) of the British Isles consisted of an important report drawn up by Dr. A. Vaughan correlating the Belgian succession of the Carboniferous limestone rocks with that of the south-west of England. Mr. E. E. L. Dixon presented a paper on the geology of the Titterstone Clee hills, and three important papers bearing on the Coal-measures of the south Pennine area were read, viz. that by Mr. H. Culpin on marine bands in the Coal-measures of south Yorkshire, that by Mr. W. H. Dyson on the Maltby deep boring, and that of Dr. L. Moysey on some rare fossils from the Derbyshire and Notts coalfield. Members of the section had an opportunity on one of the excursions of inspecting the fine collection of fossils at the Maltby mine, and of obtaining many for themselves, while Dr. Moysey kindly brought his collection to Sheffield, and it was on view during the meeting. A report was also presented by the committee for the investigation of the fossil fauna and flora of the Midland coalfield.

An important discussion took place relative to the concealed coalfield of Notts, Derby, and Yorkshire, which recent discoveries have proved to be far more extensive than was formerly supposed. Prof. P. F. Kendall, in opening the discussion, described the evidence for a great eastward and southward extension of the concealed coalfield, the south-western margin being probably formed by a prolongation of the ancient rocks of the Charnwood area. He further announced that coal had been met with in a boring at Scunthorpe, a point eleven miles to the east of its previously known extent. Triassic geology was represented by a suggestive paper from the Rev. E. C. Spicer on present-day Triassic condition in Australia, and by one by Mr. A. R. Horwood on the origin of the British Trias.

A number of papers and reports had reference to African geology. Dr. J. W. Gregory read a paper on the geology of Cyrenaica, Dr. J. D. Falconer one on the geology of northern Nigeria, and Dr. F. H. Hatch one on the geology of Natal.

A somewhat lengthy report on the correlation and age of South African strata was presented, and a second report on topographical and geological terms used locally in South Africa.

One of the most interesting discussions during the meeting was that following a paper by Mr. G. W. Lamplugh on the shelly moraine of the Sefström Glacier, Spitsbergen, and its teachings. Observations on this glacier, which is subject to somewhat rapid advances and retreats, showed that (1) in a very few years a thickness of some 70 to 80 feet of shelly Boulder-clay could be accumulated, the glacier scooping up the material from the sea bottom and pushing it before itself; (2) that in this clay uninjured shells occurred plentifully; (3) that within a few yards of the spot where the Boulder-clay was accumulating many forms of animal and plant life could flourish—all points of importance in helping to an understanding of British glacial deposits. Other papers referring to glacial geology were a report on erratic blocks, and a paper by Prof. E. Hull on the glacial rocks of Ambleside.

Very few papers dealt with palæontological subjects. Mr. M. Odling described a problematical fossil from the Chipping Norton limestone, and Dr. M. C. Stopes read a paper on structural petrifications from the Mesozoic and their bearing on fossil plant impressions.

Sir T. H. Holland read a suggestive paper on the cause of gravity variations in northern India; Mr. T. Sheppard gave a well-illustrated account of the Humber during the Human period; Dr. Tempest Anderson showed a magnificent series of photographs in illustration of his paper on Matavannu, a new volcano in Savaii (German Samoa); and Dr. A. Irving read papers on the pre-oceanic stage of planetary development and on a buried Tertiary valley through the Mercian chalk range, and its later rubble drift. Prof. A. McWilliam described the metallurgical industries in relation to the rocks of the (Sheffield) district. Finally, reports were presented by Prof. J. Milne on seismology, and by Prof. W. W. Watts on geological photographs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Gedge prize has been awarded to G. R. Mines, of Sidney Sussex College, for his essay entitled "Researches on the Physiological Action of Inorganic Salts chiefly in Relation to the Cardiac and Skeletal Muscles of the Frog."

R. H. Compton, Gonville and Caius College, has been elected to the Frank Smart (university) studentship.

The State Medicine Syndicate has appointed J. E. Purvis, of St. John's and Corpus Christi Colleges, to be secretary to the syndicate in the place of Dr. Anningson, who has resigned the office after twenty-five years' service.

The council of the Institution of Civil Engineers is prepared to consider applications for a nomination to the Palmer scholarship. The nominee must be the son of a civil engineer, must be desirous of studying and graduating at the University of Cambridge, and must be in such circumstances as to need the scholarship, which is of the annual value of 40*l*. Copies of the regulations may be had from the secretary of the institution, Great George Street, Westminster, S.W.

THE first course, dealing with neurology, of the Page May memorial lectures in physiology, will be delivered by Prof. C. S. Sherrington, F.R.S., at University College (University of London) on the following Mondays and Tuesdays, at 4.30 p.m.:—October 24 and 25, November 7 and 8, November 28 and 29. The lectures are open to the public without fee.

IT is announced in *Science* that at Yale University the salaries of professors and assistant professors have been increased by 9800*l*. from the alumni fund. The salaries of full professors are to be 800*l*. to 900*l*. and 1000*l*., based mainly on length of service, but modified somewhat by university responsibility and personal distinction. In the case of assistant professors the maximum salary is increased to 600*l*.

THE Aëronautical Society offers the following course of lectures at the Northampton Polytechnic Institute, Clerkenwell:—November 2: the study of dynamic flight, J. H. Ledeboer; November 16: the mechanics of the aëroplane, Algernon E. Berriman; November 30: theory and design of propellers, T. W. K. Clarke; January 11, 1911: aëroplane surfaces and controls, with some remarks on chassis, Herbert F. Lloyd; January 18: the motive power in aëroplanes, Captain A. D. Carden, R.E.; January 25: lines of aëronautical research, Bertram G. Cooper. The lectures will be given on Wednesdays at 8 p.m., and applications for tickets are to be addressed to the secretary of the Aëronautical Society, 53 Victoria Street, Westminster, S.W.

A CIRCULAR letter has been issued from the Education Offices of the London County Council inviting from the optical trade an expression of opinion on the advisability of endowing a central opto-technical institute at a cost of probably 30,000*l*. for the building alone. As a successful issue to this project is dependent mainly on the expression of a large volume of trade opinion in its favour, Mr. J. Aitchison arranged for a meeting of opticians to be held on Monday last, October 17, at Anderton's Hotel, Fleet Street, E.C., at which it was resolved to support the suggested establishment of an opto-technical institute in Clerkenwell "to further the work which has been hitherto carried on at the Northampton Institute, and has proved of great value to the optical industry." In his letter convening the meeting Mr. Aitchison remarked:—"Whatever difference may still exist between different parties in the trade, all are agreed to cooperate in whatever seems to be possible for the advancement of our industrial status, by forwarding the course of technical education and concentrating public attention on the importance of the movement."

THE first part of "Statistics of Public Education in England and Wales" for 1908–9 is now available (Cd. 5355). It deals entirely with educational statistics. New tables have been added this year giving particulars as to the occupations of the fathers of pupils and as to the previous education of pupils in secondary schools. The tables dealing with technical education remain much the same as in previous years. Before giving particulars as to the number of technical institutions in England, it must be pointed out that the Board of Education defines a technical institution as one giving an organised course of instruction in day classes, including advanced instruction in science, or in science and art, and provided with a staff and equipment adequate for the purpose. Provision must be made in such institutions for at least a two years' systematic course in science, or in science and art, either alone or in conjunction with subjects of general, commercial, manual, or technological instruction. Except in special cases no student may be admitted to the course unless he has passed through at least a three years' course of instruction in a "recognised" secondary school, or is more than sixteen years of age and qualified by his general education to profit by a course of advanced instruction. In 1908–9 forty such institutions were recognised by the Board of Education, and they provided 121 courses. The number of teachers in the institutions was 787, and the number of students who attended at any time during the year was 3314. Of the teachers 766 were men, and of the students 3091 were boys and men. As regards the age of the students, it may be said that 1046 were under eighteen years of age. The number of efficient secondary schools on the Board's grant list was 804 in 1908–9. These schools provide a progressive course of instruction in the subjects necessary to a good general education upon lines suitable for pupils of an age-range at least as wide as from twelve to sixteen or seventeen. Among other things, an adequate proportion of the pupils must remain at least four years in the school. In these 804 efficient schools there were 4338 men- and 4098 women-teachers teaching 73,270 boys and 62,401 girls.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 4.—Mr. Francis Jones, president, in the chair.—T. **Thorp**: A method for preventing the tarnishing of silver-on-glass parabolic mirrors. The mirror was carefully levelled on a turntable, and its axis of rotation made coincident with that of the turntable. The whole was then rotated uniformly at the calculated speed required to cause a liquid to assume the same parabolic form as that of the mirror. A 1 per cent. solution of "Schering's" celloidine in amyl acetate (after a lengthy period of settling) was flooded on to the surface of the mirror to a depth of about one-third of a millimetre. This was allowed to dry very slowly, when the resultant film was found to have a perfectly even surface of a thickness of about 1/300th of a millimetre. On testing the mirror no perceptible loss of definition was observed, and in actual use the performance was satisfactory. It is absolutely essential for the success of the method that the mirror be quite enclosed, and exposed only to an atmosphere of amyl acetate so as not to be allowed to dry, for about one hour after the solution has been flooded on, as, without this precaution, a perfectly uniform film cannot be obtained.—Dr. Henry **Wilde**: The origin of cometary bodies and Saturn's rings. The first part of this paper is a further exposition of the author's theory of the origin of comets and cometary bodies from the interior of the planets of the solar system, with new illustrations drawn from experimental mechanics. Dr. Wilde considers that the recently discovered satellites of Jupiter and Saturn, which have retrograde motions, are planetary ejectamenta, and from their comparative minuteness are hardly entitled to rank as satellites. The theory advanced by Olbers, the illustrious discoverer of Pallas and Vesta, that the planetoids are fragments of an exploded planet, finds confirmation in the great irregularities of their orbits and the direct and retrograde motions of cometary bodies. The author next discussed the origin of Saturn's rings, which has for a long time engaged the attention of natural philosophers. Kant assumed that Saturn at an early period of its history had the characteristics of a comet, and that its tails contracted upon the planet and formed a ring. Laplace supposed the rings to be the original nebular substance uncondensed into the form of a satellite. The author ventures to affirm that the rings are the ejectamenta of Saturn when its diminishing energies were insufficient to eject a comet with its train of meteorites, or a cometary satellite. Dr. Wilde adduced evidence to show that the interior rings were formed some time subsequently to the outermost one, which is separated from the others by an annular space of 2585 miles. The author has drawn up a table of distances of the rings from Saturn and the times of their revolutions, calculated from his measurements of the photographs recently taken at the Lick Observatory.

NEW SOUTH WALES.

Linnean Society, August 31.—Mr. C. Hedley, president, in the chair.—Dr. H. G. **Chapman**: A contribution to the study of the precipitins. The paper records the results of an examination, by gravimetric methods, of the relations of the interacting substances in precipitin interactions. It was found that the amount of precipitate yielded by each antiserum was a fixed quantity for each cubic centimetre of antiserum, provided that sufficient homologous protein was present to precipitate completely the precipitin in the antiserum. In total interactions the weight of precipitate was proportional to the amount of antiserum. In partial interactions the weight of precipitate increased with ascending weights of homologous protein. Since the precipitates are derived mainly from the antiserum, it has been possible to determine the weight of the anti-substance in the antiserum. Consequent on the results of the gravimetric study of the interaction, a method has been devised to separate the proteins of closely allied species. Suggestions are made as to the composition of a precipitin-antiserum, as regards the components, giving rise to general avian and specific interactions. The preliminary results of the application of the test to the differentiation of vegetable proteins are recorded. They show that a group-specificity holds for proteins of vegetable origin. The derivation of precipitate from antiserum has not been sufficiently considered in relation to deviation of complement.—Dr. A. J. **Turner**: Revision of Australian Lepidoptera, part v. Part v. deals with the subfamily Geometrinæ of the family Geometridæ, comprising 40 genera and 124 species. The number of known species has been greatly added to, especially from the northern part of Australia, since the publication of Mr. Meyrick's "Revision of Australian Lepidoptera, No. ii., Geometridæ," in the society's Proceedings for 1887 (p. 835).—A. F. Basset **Hull**: Description of a fossil Chiton (Mollusca) from north-west Tasmania. The description is based on an example of a median valve, which shows the species to have been allied to, but distinguishable from, *Lorica affinis*, Ashby and Torr, and the living *L. volvox*, Reeve. The specimen was collected by Mr. W. S. Dun from the base of the Turritella sandstone at the foot of a bluff between Wynyard and Table Cape. The beds are referred to the Jan Jukian by Hall and Pritchard; that is to say, they are near the base of the Tertiary, as developed in southern Australia. Victorian geologists correlate them with the marine series at Spring Creek. The Eocene age attributed to these beds must be regarded as purely relative.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Standardisation of Locomotives in India, 1910: Cyril Hitchcock.

WEDNESDAY, OCTOBER 26.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Annual Meeting.

FRIDAY, OCTOBER 28.

PHYSICAL SOCIETY, at 5.—Demonstration of a New Method for producing High-tension Discharges: Prof. Ernest Wilson and W. H. Wilson.—The Behaviour of Steel under combined Static Stress and Shock: F. Rogers.

CONTENTS.

	PAGE
Recent Progress in Psychical Research. By Sir Oliver Lodge, F.R.S.	489
Fossil Club-mosses and Ferns. By D. H. S.	490
The Collected Works of Huygens. By J. L. E. D.	491
A Primer on Coal Mining	492
Our Book Shelf	493
Letters to the Editor:—	
Early Burial Customs in Egypt.—Prof. W. M. Flinders Petrie, F.R.S.	494
Lord Morton's Quagga Hybrid and Origin of Dun Horses.—Prof. James Wilson; Prof. J. C. Ewart, F.R.S.	494
Tests for Colour-blindness.—Dr. F. W. Edridge-Green; The Reviewer	495
Water Vapour on Mars.—Prof. Frank W. Very	495
A Caution.—E. A. S.	496
Dr. John Peile: A Correction.—The Writer of the Article	496
The Centenary of Berlin University	496
Town-planning. By A. E. Crawley	498
The Melanesians of British New Guinea. (*Illustrated.*) By S. H. Ray	499
The Centenary of Filippo Cavolini	500
John Willis Clark. By Dr. Sidney F. Harmer, F.R.S.	501
Prof. Maurice Lévy	502
Notes	502
Our Astronomical Column:—	
A Bright Projection on Saturn	507
Spectrum and Radial Velocity of ϕ Persei	507
Metcalf's Comet, 1910*b*	507
Comets and Electrons	507
Measures of Double Stars	507
Recent Results in Solar Physics	507
The Ninth International Conference on Tuberculosis	507
The International Scientific Congress at Buenos Aires. By Prof. C. D. Perrine	509
Recent Investigations on the Cultivation of Rubber	510
The Mineral Resources of the United States. By J. W. G.	511
Airship Flights	512
Mathematics and Physics at the British Association	513
Chemistry at the British Association	517
Geology at the British Association	520
University and Educational Intelligence	521
Societies and Academies	521
Diary of Societies	522

THURSDAY, OCTOBER 27, 1910.

ANCIENT PLANTS.

Ancient Plants: being a Simple Account of the Past Vegetation of the Earth and of the Recent Important Discoveries made in this Realm of Nature Study. By Dr. Marie C. Stopes. Pp. viii+198, with 122 figures and frontispiece. (London: Blackie and Son, Ltd., 1910.) Price 4s. 6d. net.

FOSSIL botany, once the very type of a dry-as-dust subject, has attracted a good deal of attention of late years, and its more important discoveries and conclusions have become the common property of students of botany, at least in this country. Miss Stopes aims at interesting a wider class. "There is no book," she says, "in the English language which places this attractive subject before the non-specialist, and to do so is the aim of the present volume"; further on she adds that her book is dedicated "especially to all those who take an interest in plant evolution, because it forms a thread in the web of life whose design they wish to trace."

The author is well qualified for her work, and has attained a considerable measure of success. Her style is interesting, and if sometimes a little careless, that is, after all, a minor point. Miss Stopes is somewhat severe on her predecessors, of whose work she speaks thus: "But, like the records left by the plants themselves, most of this literature is unreadable by any but specialists, and its really vital interest is enclosed in a petrifying medium of technicalities" (p. 2). Her object is to make these dry bones live, but it has been tried before.

The chapters on the various kinds of fossil plants and on coal are very well done, especially the account of coal-balls, those calcareous nodules which contain the wonderful structural specimens on which our knowledge of coal-plants so much depends. On this subject the author is a leading authority.

The "Seven Ages of Plant Life" (chap. iv.) range from the archæan to the present day; the sacred number seven may have a charm for some; otherwise we should have thought a shorter list would have been more useful; there are only four really important periods to be distinguished in the history of plants as known at present. The chapter on stages in plant evolution is wisely kept quite elementary, any general discussion of the evolution of the various groups being necessarily postponed until all have been studied. The assumption that life is "endowed with a continuous impulse to advance" (p. 43) will strike the Darwinian reader as unduly mystical.

The diagrams and curt descriptions of cells and tissues of recent plants given in chap. vi. will scarcely help the general reader very much; unless he has had more training in botany than this, he had better leave the anatomy of fossil plants alone. The truth is that fossil botany, if it is to include structure, is *not* a subject for a beginner. Those, however, who have done some laboratory work before may find this outline of anatomy of some service by way of recapitulation.

Ten chapters are devoted to the past histories of plant families, and form the main division of the book. It is impossible to follow these chapters in detail; on the whole, they give a very good sketch of some of the chief results of modern research, but their merits will be best appreciated by those who have some previous knowledge. The author has some incisive remarks on the modern theory of the origin of Angiosperms from Cycadophyta, allied to the Bennettitales; she says: "We must not forget that the Bennettitales have only recently been realised fully by botanists, and that a new toy is ever particularly charming, a new cure particularly efficacious, and a new theory all-persuasive" (p. 103). This is quite a fair hit, but the next paragraph is less happy. In criticising the supposed primitive position of the Ranales among Angiosperms, the author states that they are most frequently delicate herbs, and that they are peculiarly remote from the group of Bennettitales in their vegetative structure. Really it is the shrubby Magnoliaceæ which chiefly come into the question; in the structure of the wood some of these plants are more like Gymnosperms than any other of the Dicotyledons.

The concluding chapter, which includes an ingenious attempt to forecast the future course of plant-evolution, is very interesting. It is perhaps a pity that in the space of about one page the author tries to give an idea of the mutation theory as opposed to pure Darwinism. An altogether misleading idea of Darwin's position is given, and the whole question would have been better omitted in a book for beginners.

In the appendices some hints on the collection of fossil plants are given, followed by a short bibliography. It is rather hard on Mr. Kidston that he is only represented by his British Museum catalogue of 1886, a list which he would certainly regard as now out of date. The book concludes with a glossary of some botanical and geological terms.

Most of the illustrations are good and useful; a few, especially some of those from photographs, are less clear than is desirable in an elementary book.

Although, as we have seen, there are some points open to criticism, Miss Stopes's book is an enterprising and able attempt to popularise a difficult subject. The really keen student will undoubtedly be stimulated to pursue the study of fossil plants further, and even those who are not students will get some new ideas and derive a certain amount of interest from a book which is sometimes brilliant and never dull.

D. H. S.

BRITISH RAINFALL.

British Rainfall, 1909. By Dr. Hugh Robert Mill. Pp. 120+308. With maps and illustrations. (London: Edward Stanford, 1910.) Price 10s.

THIS volume is the forty-ninth of the series, and the largest hitherto issued, but the price remains the same as when it was a quarter of the size. The value of the work of the British Rainfall Organisation in all questions in which an accurate knowledge of the rainfall is essential has been acknowledged on all sides, and has frequently been referred to in our columns. Owing to the continual growth of the work, the director, who for many years has received no financial help except from the observers themselves and a few subscribers interested in the subject, has in recent years had to meet a considerable deficit. In order to ensure the undertaking "from the risks of mortality," he has made over the unique collection of documents and his interest in the concern to a strong representative body of trustees, who have formed an endowment fund, while Dr. Mill will continue to act as director, as before; this arrangement was referred to in our issue of June 16.

Part i. includes an interesting article by Mr. Gethin Jones on the snowfall of the Snowdonian range; one of the photographs shows a large patch of snow lying on June 29 last; also a discussion of the duration of rainfall in 1909 by the editor. In part ii., eighty pages are occupied by observers' remarks; the director has hinted elsewhere that the space might be more serviceable for printing additional monthly values. In addition to the usual tables, interesting chapters are devoted to the discussion of heavy rains in short periods and on rainfall days, with maps illustrating some of the greatest falls. There are also maps showing (1) the amount of rainfall and (2) percentage of average, with a short discussion, for each month. For the British Isles, as a whole, the rainfall of the year (38·56 inches) was exactly the average; but during the last twenty-one years dry years have been more than twice as frequent as wet ones. Reference is made in the report to a crusade against entering the rainfall to the wrong day. This is most important, and, unless one rule is adhered to, accurate maps of monthly rainfall cannot be drawn. But, notwithstanding the efforts of meteorological conferences to ensure uniformity, differences do still exist in some of the best foreign services. To take only one case, the Austrian "Instructions" (1905, p. 17) correctly direct that, even when known to have fallen in the early morning, the amount should be entered to the previous day, while the Norwegian "Year Book" (1909, p. ix) says the rainfall measured in the morning is entered to the preceding day, except when it is known for certain that it fell after midnight.

INDIAN CRUSTACEA.

Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum. By Lt.-Col. A. Alcock, F.R.S. Part i., Brachyura. Fasciculus i., Introduction and Dromides or Dromiacea (Brachyura Primigenia). 1901. Pp ix+80+viii plates. Price 7 rupees. Fasciculus ii., The Indian Fresh-water Crabs—Potamonidæ. 1910. Pp. iv+135+xiv plates. Price 14 rupees. (Calcutta.)

THE "Catalogue of the Indian Decapod Crustacea," which is in course of publication by the Trustees of the Indian Museum, Calcutta, consists of a series of independent fascicles, each complete in itself, and forming a systematic monograph of the Indian species in the group with which it deals. The two parts under notice relate to the Brachyura. The first, published nine years ago, contains a general introduction to the series giving an outline of the morphology of the Decapoda, so far as it is necessary for systematic purposes, and describing as a type *Nephrops andamanica*, a form closely resembling the Norway lobster of our own coasts. This is followed by a statement of the characters distinguishing the Brachyura or true crabs, and a sketch, all too short, of their bionomics, with special reference to the Indian species, prefacing a systematic account of those belonging to the Tribe Dromiacea. This tribe is of special interest on account of the very primitive character of some of its members, which enable the origin of the Brachyura to be traced back, as Bouvier showed, to the lobster-like Nephropsidea. Many important types were captured by the *Investigator* in the Bay of Bengal, and are fully described and figured in this fascicle.

The group of Brachyura dealt with in the second fascicle is also of special interest, although for very different reasons. The river-crabs of the family Potamonidae (formerly known as Telphusidae) are found in fresh waters throughout the tropical regions of the world. Their geographical distribution has been especially studied by Dr. A. E. Ortmann, who used it in his ingenious speculations regarding the former distribution of land and water on the surface of the globe. The geographical relations of any group of organisms, however, can only be studied with profit when their systematic relations have been determined with some degree of certainty, and it happens that the river-crabs, like many other groups of fresh-water animals, present special difficulties to the systematist. There has hitherto been no general agreement with regard to the limits, not only of species and varieties, but even of genera and subfamilies, and the very valuable monograph of the family recently published by Miss M. J. Rathbun in the Archives of the Paris Museum, while immensely lightening the task of subsequent workers, made very obvious the unsatisfactory character of much of our knowledge of the group. Lt.-Col. Alcock now directs attention to certain structural characters, hitherto for the most part overlooked, which enable the species to be grouped in well-defined categories, and he proposes an entirely new classification, in which species hitherto placed side by side in the same subgenus are widely separated in distinct subfamilies. The application of this classification to the river-crabs inhabiting other regions is only hinted at in this memoir, but there can be no doubt that it will greatly modify our conceptions of their geographical relations.

In the power of terse and lucid description, in the acute perception of systematic affinities, and in the breadth of view derived from a familiarity with many diverse groups of the animal kingdom, Lt.-Col. Alcock has few equals among living carcinologists, and it is a matter for congratulation that his retirement from the post of superintendent of the Indian Museum has not terminated the long series of important memoirs on the Indian fauna which we owe to his pen.

W. T. C.

NATURALISTS' NOTES FROM THE OLD SPANISH MAIN.

Our Search for a Wilderness. An account of two ornithological expeditions to Venezuela and to British Guiana. By Mary Blair Beebe and C. William Beebe. Pp. xix+408. (New York: Henry Holt and Co.; London: Constable and Co., Ltd., 1910.) Price 10s. 6d. net.

A FEW years ago the authors wrote a pleasant little book, "Two Bird-lovers in Mexico." The present "Search for a Wilderness" did not prove difficult, because they found one in the mangrove swamps on the old Spanish main, opposite the island of Trinidad. They hired a little sloop, and cruised about on the San Juan river, which falls into the Gulf of Parian. The mud-flats teemed with life, and after nightfall arose the many quaint and mysterious sounds of the tropical jungle. For one of these sounds, a muffled choking, they found an unexpectedly simple explanation. The anaconda makes its lair in a hole in the bank at the waters' edge. When the rising or falling tide laps into or out of the vacated mudhole, a big bubble of air frees itself with a sudden gasping sob. Further up the river they visited La Brea, the strange lake of pitch in the midst of a region of primeval forest.

Whilst on this visit to Venezuela the collecting of birds was incidental; they went in the spring of 1909 to British Guiana, accompanied by an assistant, to collect birds in earnest; but Mr. Beebe is certainly not a destructive ornithologist. His party killed only about one hundred specimens, and these because of some special interest, and there occurs the following passage which deserves quoting. "We were glad to find that the most difficult privilege to obtain is a permit to collect birds, and the very stringent laws in this respect are an honour to the Governor (Sir Frederick Hodgson, K.C.M.G.), and his colonial officials. Thanks to the absence of the plume and general milliner hunter, the game hog, and the wholesale collector, birds are abundant and tame."

From Georgetown as their centre they made several trips. Hospitably entertained, and being spared all the usual annoyances of transportation, they visited, by launch, the Hoorie gold mines in the north-western corner of the colony, an excellent place for studying the ways of its wild inhabitants. Thence they made their way back to the capital, threading little-known rivers and creeks in a canoe, and for five days they were paddled, portaged, towed, and pushed through a wonderland abounding in beautiful birds, butterflies, and orchids, and they were made welcome for the night at little isolated Indian missions.

Next followed a trip up the Essequibo and one of its tributaries to the Aremu mine. In these waters they saw the little freshwater flying fish, *Carnegiella spigatus*, which, however, "did not leave the surface entirely, but skimmed steadily along in a straight line, with the tip of the deep keel of the abdomen just cutting the surface." The travellers were keen and lucky enough to make many interesting observations, which they have recorded in a pleasantly easy style, illustrated with numerous good photographs of scenery and scenes of many creatures, from man to insects. A narrative sparkling with incidents needs no froth like the following: "Most curious of all were the Loricates or armoured catfish, with a double row of large overlapping scales enclosing their body from head to tail. Like the Hoatzin among the birds, these fish are strange relics of the past, preserved almost unchanged from the ancient fossil Devonian fauna." Relics of the past, by all means, but what have the Siluroid Teleostean fishes to do with the Devonian epoch?

A visit to the savannahs and lagoons of the Abary river, with its abundance of bird life, for instance, large colonies of the quaint Hoatzin, was cut short by a broken wrist suffered by the lady. We wish them many more such pleasant trips, and may they not be undeceived in their optimistic opinion as to "the falsity of most of the universal slanders on a tropical climate."

GRAPHICAL CHEMISTRY.

Leitfaden der graphischen Chemie. By Dr. R. Kremann. Pp. 36+5 modelle. (Berlin: Verlag von Gebrüder Borntraeger, 1910.) Price 6.60 marks.

IN view of the importance of a knowledge of the equilibrium relationships which are involved when two or more substances are brought together in different quantities under different conditions of temperature and pressure, and of the rapid progress which has been made in recent years in the study of more complicated cases of such equilibria, it is essential that the student of physical chemistry should be familiar with the various methods which are used for the graphic representation of experimental results.

There can be no doubt that the interpretation of the space models, which are employed with great advantage to depict the equilibrium relationships of ternary and quaternary systems, offer considerable difficulties to those who are not familiar with the subject. This is the author's experience, and the issue of a series of five adjustable cardboard models, with an explanatory guide, is intended to facilitate the acquirement of a knowledge of the rudiments of graphical chemistry.

The cardboard models, which are made to scale from experimental data, represent respectively the equilibrium relationships in the following systems—(1) Silver nitrate and water (2) potassium sulphide, magnesium sulphate and water (3) tin, lead and bismuth (4) ammonium nitrate, water, methyl alcohol and ethyl alcohol (5) water and the reciprocal pairs of salts —sodium chloride + ammonium hydrogen carbonate $\rightleftarrows$ ammonium chloride + sodium hydrogen carbonate.

These systems afford sufficient material for an exposition of the various modes of graphic representation, but it is very doubtful whether prepared models of this character can be of much service to the student whose aim is thoroughly to understand the connection between the space models and the actual experimental data. In the reviewer's opinion the requisite familiarity can only be obtained when these data are directly utilised by the student in the actual construction of equilibrium models. This demands the expenditure of considerable time, but the results obtained are incomparably better than those which follow from the manipulation of prepared models. On the other hand, the cardboard models are to be preferred to the plane projections which form the usual text-book method of graphic representation. From this point of view the series of models may be found to be useful, anl would have been more so if the explanatory matter in the accompanying text had been considerably extended.

AMATEUR ASTRONOMY.

The Amateur Astronomer. By Gideon Riegler. Translated by G. A. Clarke. Pp. 319, with 112 illustrations. (London: T. Fisher Unwin, 1910.) Price 3*s.* 6*d.* net.

DESPITE the host of astronomy books which has appeared in recent years, there may be room for a well-written, concise guide-book for the beginner in practical work; but, even if there is, we fear that the volume under review does not fill it adequately.

The author first deals with the questions of site, instruments, books, &c., and then proceeds to give a series of notes on the characteristics of the individual objects observable with a modest equipment. Thus the constellations are taken, and the peculiarities of selected individual stars described. Then the same form of treatment is given to double-stars, star-clusters and nebulæ, and variable stars, followed by a chapter describing solar features. In the chapter on the moon, which comes next, a large number of individual craters, plains, &c., are described, but, in the absence of a complete map, the beginner will find, despite the inclusion of undefined latitude and longitude, that some of the smaller features figured are not easy to locate. Chapters on the planets, comets, and meteorites and shooting stars complete the tale.

The general scheme of the work is not unattractive, but grave faults mar its execution. Simple points are treated discursively, whilst more difficult ones, on which the amateur should have clear, if elementary, information, are passed over with one or two imposing terms. An example or two will serve to show that it would have been better to omit many items altogether; dogmatic statements may convince the beginner, but the greatest care should be taken to convince him rightly.

For example, oxygen and cadmium (p. 154) are *not* exceptionally prominent elements in the sun, and certainly do not provide the crucial difference between its spectrum and that of Aldebaran; nor is mercury an outstanding feature of the latter. But worse follows, for we are informed that, while hydrogen is not represented in the spectrum of Betelgeuse, thallium is such a prominent feature "that its lines stand out quite plainly, *in spite of the great distance of the star*"; the italics are ours. There are only two or three pages of spectroscopical details, but it is a great pity that they were ever published.

Other matters, apart from spectroscopy, could be quoted to the same effect, but the above will probably suffice to show that the book is marred by serious faults, dangerous for the beginner.

It only remains to add that the work often bears the impress of translation; long and involved sentences are not uncommon, and such inversions as "6 magnitude," "4·5 magnitude," used almost throughout, are annoying.

W. E. ROLSTON.

OUR BOOK SHELF.

A Guide for Medicine and Surgery, compiled for Nurses. A Handbook for Nurses. By Sydney Welham. Pp. ix+230. (London: Mills and Boon, Ltd., 1910.) Price 3*s.* 6*d.* net.

IN order to do their work satisfactorily, nurses require some knowledge of the principles of medicine and surgery. This is fully recognised in every modern hospital, and due provision is made for instruction of the nursing staff in the elements of anatomy, physiology, pathology, medicine, and surgery. Courses of lectures on these subjects are arranged and the nurses are encouraged to supplement lectures by reading. There is no doubt that a small handbook, such as the volume under review, will be found very useful for purposes of reference, although it makes no attempt to replace the recognised text-books. The style is simple and direct, the type is clear, the index is admirable, while a glossary of medical terms, a list of Latin phrases commonly used in prescriptions, with many other practical tables, diet scales, recipes, &c., greatly enhance the value of the book. It is eminently practical and convenient.

It would be ungracious to criticise a small volume which deals with every branch of medicine in 230 pages on the ground that it did not contain original matter. It succeeds in giving a great deal of information, and the views expressed are in accordance with modern thought. In a short preface the author disclaims any attempt to teach nursing, but, nevertheless, many of his hints will be useful even to nurses of considerable experience, while it will be of real value to young probationers. It will help them to understand the cases that come under their care, it will enable them to follow clinical instruction in the wards, and it will serve as a handbook on which they can rely for assistance in practical emergencies, and also when they are preparing themselves for examinations.

The Death-dealing Insects and their Story. By C. Conyers Morrell. (Manchester: H.A.W. Offices, 7 Brazenose Street, 1910.) Price 1*s.* net.

THIS little book is one of the many which have been recently published for the purpose of instructing the laity regarding recent discoveries in connection with insects and disease. It is one of the best of them, and possesses a good style without being too diffuse. The connection of mosquitoes, tsetse-flies, ticks, and fleas with malaria, elephantiasis, sleeping-sickness, tick fever, and plague are described in a manner which will appeal to laymen. We miss the name of Bruce in connection with trypanosomiasis, and though the excellent Campagna experiment of 1900 was useful for advertisement, it can really scarcely be cited as conclusive proof of the mosquito theory of malaria.

The author seems to be rather optimistic as to the results of sanitation in West Africa, regarding which little genuine evidence is forthcoming. He is wise in not paying too much attention to the numerous scientific "Mother Shiptons," who have so frequently attempted to gain credit for discoveries on the strength only of their prophecies. But the book can safely be recommended to such of our lay friends as meditate living in the tropics. R. R.

Abhandlungen Jean Rey's, über die Ursache der Gewichtszunahme von Zinn und Blei beim Verkalken. Deutsch herausgegeben und mit Anmerkungen versehen. By Ernst Ichenhäuser and Max Speter. Pp. 56. (Leipzig: W. Engelmann, 1909.) Price 1.20 marks.

JEAN REY'S "Essais sur la recherche de la cause par la quelle l'estain et le plomb augmentent de poids, quand on les calcine" have been familiar to English readers for some years past, through the valuable agency of the Alembic Club, which has issued an English translation as one of their series of reprints. The present German translation is published as No. 172 of Ostwald's Klassiker der Exakten Wissenschaften. The essays, written in 1630, contain a remarkable discussion on an increase in weight which had been observed, by an apothecary at Bergerac named Brun, to take place during the calcination of metallic tin in an iron vessel. The conclusion, arrived at by argument rather than discussion, that the gain in weight was due to the condensation of air, was a remarkable anticipation of views that were not generally accepted until the time of Lavoisier, 140 years later. The German reprint is provided with a valuable series of notes dealing with the history of the essays and with various points requiring elucidation in the essays themselves.

Elementary Regional Geography. Great Britain and Ireland. By J. B. Reynolds. Pp. viii+184. (London: A. and C. Black, 1910.) Price 1s. 4d.

Cambridge County Geographies. Nottinghamshire. By Dr. H. H. Swinnerton. Pp. xi+153. *Lanarkshire.* By Frederick Mort. Pp. viii+168. (Cambridge: University Press, 1910.) Price 1s. 6d. each.

MISS REYNOLDS has written an interesting and easy account of the geography of the British Isles which will be useful as an introduction to the subject. A few practical exercises for young pupils to work have been introduced; but the book would have been more valuable had this aspect of the teaching been more prominent. The excellent illustrations will certainly secure the attention of juvenile readers.

A very broad view of geography is taken by the writers of the latest additions to the "Cambridge County Geographies." Space is found by each author, in a slight treatment of a large subject, for sections on antiquities, ecclesiastical, military, and domestic architecture, and on the history of the county. Both volumes are well up to the high standard reached by other books in the series.

The Cambridge Pocket Diary for the Academical Year 1910–11. Pp. xv+255. (Cambridge: University Press.) Price 1s. net.

BOTH the staffs and students of schools and colleges will find this pocket diary very convenient. Beginning with September 20, 1910, and extending to September 30, 1911, it covers every length of academic year, and will be useful in all educational centres. Besides this interval of time, for which full space is given, several pages are devoted to the weeks until the end of 1911, so that important engagements for the early part of the succeeding professional year can be booked. The diary also contains a useful miscellany of general information.

LETTERS TO THE EDITOR.

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

The Biological Laboratories at Woods Hole.

I HAVE noted with interest a recent discussion in NATURE of August 25 and September 15 and 29 in which the biological laboratories at Woods Hole have received incidental mention. I pray that you may give me this opportunity to correct some very prevalent misconceptions regarding the status of the Government station there. In NATURE of September 15 Prof. MacBride has voiced some of these misconceptions very clearly. "It is true," he writes, "that there are *two* stations in Woods Hole, one supported by the Federal Government and devoted entirely to economic work, and the other supported entirely by zoologists; but the station which has attained world-wide fame, owing to the quantity and quality of the research which has issued from it, is the second and purely scientific one" (pp. 330, 331).

Now, although Prof. Herdman has pointed out in two letters the misleading character of these statements, it appears that Prof. MacBride is "of the same opinion still," for in your issue of September 29 he avers:—"That valuable scientific work of general interest occasionally issues from the laboratory of the U.S. Bureau of Fisheries, which was founded and is maintained for research on economic lines, is totally irrelevant" (p. 396).

What the United States Fish Commission[1] laboratory at Woods Hole was originally founded for may best be gathered from a perusal of the earlier annual reports of the first commissioner, the naturalist Spencer F. Baird. He emphasises more than once the futility of attempting to deal broadly with fisheries problems without an intelligent understanding, not only of marine life as a whole, but of all the various physical and chemical factors which may affect this. (See especially first report of the commissioner, p. xiii.)

The whole history of the United States Fish Commission, and of the Woods Hole station in particular, bear abundant testimony to the sincerity of this broad-minded attitude of its founder. The pioneer faunistic work of Verrill and his colleagues in the 'seventies and 'eighties was carried out very largely under the auspices of the National Fish Commission, and Woods Hole was the chief headquarters from which these explorations were conducted. Furthermore, one need only refer to the past reports of the commission to find in the list of those who have worked at the Woods Hole station many of the most prominent names in American biology. Here we meet, for example, with the names of Farlow and Gill, of E. B. and H. V. Wilson, of Morgan, Bumpus, Andrews and Eigenmann, to say nothing of Brooks and Ryder, who have passed away. These men were not, for the most part, engaged upon "economic" problems in any strict sense of the word. And in more recent years some of the physiological work of G. H. Parker, C. J. Herrick, W. B. Cannon, E. P. Lyon and others, has been conducted in the Fish Commission laboratory, as well as the taxonomic work of such men as Edwin Linton, C. W. Hargitt, C. C. Nutting, W. M. Wheeler, H. L. Clark, and C. B. Wilson.

I regret that anything like a defence of the scientific status of the Fisheries Laboratory has been necessary in these columns, for the facts here stated are well known to every American zoologist who is familiar with conditions at Woods Hole. But unfortunately all zoologists, even in America, are *not* familiar with the conditions at Woods Hole, and the misconceptions voiced by Prof. MacBride are still held tenaciously in certain quarters.

As Prof. Herdman has pointed out, there are two scientific laboratories at Woods Hole. But conditions are even more complicated than this, for the Bureau of Fisheries itself maintains two more or less independent institutions there. One is the biological laboratory, maintained by

[1] Changed in 1903 to the Bureau of Fisheries of the Department of Commerce and Labour.

the Bureau's "Division of Scientific Inquiry," the other the hatching station, maintained by the "Division of Fish Culture." These two establishments are under different heads, and are, so far as possible, independent of one another, though they to a large extent share the same buildings. The biological laboratory, in the general scope of its work, does not differ widely from the other leading marine laboratories of the world. It is true that greater emphasis is laid upon the economic aspect of marine biology, and a number of investigators are each year employed by the Bureau to conduct researches upon such subjects as the food value and chemical composition of marine organisms, or upon problems directly related to the natural history of food fishes; but to say that investigations are restricted to such lines is to do great violence to the facts. The Bureau has always put a liberal construction upon the word "practical," realising that no hard-and-fast line should be drawn between pure and applied science, and regarding all information as ultimately useful which gives us a deeper insight into the life of the sea.

The two biological laboratories at Woods Hole—the "Marine Biological Laboratory" and that of the Bureau of Fisheries—have worked together side by side since the establishment of the former in 1888. The choice of its name by the privately supported institution has—unintentionally, of course—been the source of much of the misapprehension of which I am speaking. The name, "*The* Marine Biological Laboratory," would seem to imply an exclusive occupancy of this field, whereas the United States Fish Commission was conducting biological work at Woods Hole as early as 1871, and its present laboratory building was erected in 1885.

Another source of misconception is the fact that the Fisheries Laboratory has no definite organ of publication. Its scientific results, so far as they are economic or faunistic, or in any way related to the natural history of the sea, are in a large measure published in the Bulletin of the Bureau of Fisheries. The results in other fields of work are embodied in papers—and the number of these is great—scattered through all our various biological journals in this country and abroad. On the other hand there exists the "Biological Bulletin," which is the official organ of the Marine Biological Laboratory, though it also accepts contributions from workers in all parts of our country, oftentimes including those in the Fisheries Laboratory at Woods Hole. It is needless to add that the Marine Biological Laboratory does not make the least pretence that this journal represents its own output in any exclusive sense.

But, after all, the main source of confusion relative to the two laboratories at Woods Hole is the fact that the biologists there form a single scientific community, the members of which mingle freely together without regard to their place of work. In fact, the same investigator may work one year in one laboratory, the next year in the other, or he may even hold tables in both simultaneously; and so the reading public lumps together all our productions as Woods Hole work, and draws no fine distinctions. In the circumstances, it is natural that the laboratory which bears the name of "*The* Marine Biological Laboratory" should be frequently credited with the entire output. This is written in no spirit of resentment, but merely as an explanation of the prevalence of this widespread misconception of the situation at Woods Hole.

It will be cheerfully granted that the "Marine Biological Laboratory" accommodates a much larger number of investigators—perhaps twice as many, on the average—as does its sister institution; and it is not likely that anyone connected with either laboratory fails to recognise that a considerably greater output of scientific results must at present be credited to the former. On the other hand, the Government laboratory had, until recently, the only really efficient steam vessels available for scientific research, and has had other decided advantages in its physical equipment. But we at Woods Hole waste little time in idle comparisons such as these. Most of us are too busy endeavouring to make an occasional contribution to our common science.

Whether or not the two laboratories will continue to cover so largely the same field of activity it remains for the future to decide. These are some good arguments for a greater division of labour than at present exists.

FRANCIS B. SUMNER.
(Director, Biological Laboratory of the U.S. Bureau of Fisheries at Woods Hole, Mass.)

Washington, D.C., October 12.

The Cocos-Keeling Atoll.

I CONSIDER myself fortunate that the author of the review of "Coral and Atolls," which appeared in NATURE of October 6, has addressed two direct questions to me, for in the answering of these questions it may be possible to open in a more frank manner the discussion of those problems with which I have dealt, and which are to be solved by dispassionate argument and investigation rather than by anonymous destructive criticism.

The first question which the reviewer puts to me is couched in the following form: he rightly asserts that I assume the lagoon of an atoll to be a slightly submerged reef, and then he asks, "Why this assumption without evidence?" For answer I would point out that the evidence is given freely in the work which he reviews (notably at pp. 251–2, and elsewhere), and, since he has apparently overlooked it, I will repeat that it consists, among other things, of the fact that submerged atoll-shaped reefs, and reefs also atoll-shaped, but of which some portion of the outer rim is awash, or on which some island débris is piled, are well-known geographical facts. The central part of the submerged reef forms the lagoon of the developed atoll, which is therefore not inaptly described as a "slightly submerged reef."

His second question is in connection with the mode of formation of atolls from the disintegration of high oceanic islands surrounded by a barrier reef. He asks me how I would explain "Agassiz's wonderful series of photographs of Fijian islands within barrier reefs" when I state that "the picture of the high island towards the completion of the process, when, after having stood resisting in a troubled sea, it so conveniently crumbles to pieces within the calm of an encircling barrier reef, appears to me to be contrary to all natural laws." I would give as explanation the very obvious suggestion that the formations illustrated (I presume in Bull. Mus. Comp. Zool. Harv., vol. xxxiii.) are not the outcome of the development of the barrier reef, for similar conditions are found, quite apart from any coral structures, all over the world, the coast-lines of islands in northern seas providing equally good examples.

It may perhaps be permissible to extend this reply so as to embrace the answers to some assertions of the reviewer regarding corals and coral islands, and to point out some misquotations from the work under discussion and some misconceptions of its conclusions.

The variability of the growth forms of corals is one of the problems discussed, and I have urged that sediment—as a factor of the environment—is a potent cause of modified coral growth. That the environment as a whole, and not merely the presence of silt, was considered, may be gleaned from the discussion of the growth of young colonies of Pocillopora (p. 100).

The reviewer turns from this to observe that the variability of corals "may aptly be compared to the growth shown by our forest trees in different environments. Reef corals, too, resemble trees in that they are largely dependent for their food on chlorophyll, which is present in minute algæ living in their digestive cavities. The coloration of most reef corals is largely due to these algæ, and their mode of growth is sympathetic to them in that the coral skeleton is deposited so as to expose the polyps to the maximum amount of light." The reviewer then adds, "Such appear to us the ordinary views of zoologists."

The only logical meaning that I can attach to this is that zoologists as a class ordinarily believe that the variability of the growth forms of corals—and of forest trees—is due to the fact that they contain chlorophyll in their tissues. That zoologists as a class would subscribe to this thesis appears to me unlikely, and the reviewer has yet to explain the variability of those corals which, as is well known, possess no symbiotic algæ.

It would seem almost unnecessary to point out to one who criticises this work as being "in no way scientific" that the argument that, because forest trees are largely dependent on chlorophyll for their food, and corals are also largely dependent on chlorophyll for their food, therefore the reactions of forest trees and corals to varying environments will be similar, is not strictly scientific either. That the final test of specific form of corals must be the characters of the zooid is a fact on which I have insisted throughout, and the similarity of zooids in dissimilar forms is a fact that I have noted, although the reviewer appears to have entirely overlooked it.

That Wayland Vaughan found no difficulty in transplanting corals does not surprise me, for many others (myself among them) have also experienced no difficulty in the mere transplantation—any more than in the mere transplantation of "forest trees"; the difficulty only comes in (as is expressly pointed out, p. 123) when the coral is transplanted to an environment in which its growth-type, developed in a different environment, is unsuitable. In the experiments described I have pointed this fact out, and dwelt especially on cases of removing corals from a rough-water environment to a place where still water and the deposition of sediment were the prevailing conditions. In doing these experiments I was unconsciously repeating those previously carried out by Ehrenberg. Darwin (quoting from Ehrenberg's "Uber die Natur," p. 49) states that "where there is much sediment placed so as to be liable to be moved by the waves, there is little or no coral: and a collection of living specimens placed by him on a sandy shore died in the course of a few days" ("Coral Reefs," p. 89).

To pass to another section of the article, the reviewer correctly says that I describe the encircling reef as "a mosaic inlay of coral fragments cemented together into a solid platform," and then adds, "*but there is no evidence that it was ever really examined*"! Apart from the ungenerous suggestion that in a fifteen months' investigation of the atoll the encircling reef was never really examined, and that the author drew on his imagination or on previous descriptions for what lay for ever open to his inspection, is the gross oversight that a chapter is devoted to this feature, that its structure and formation are described (pp. 163, 254, &c.), and illustrated at Plate xiii., which shows a fractured surface of the "mosaic inlay." Had the reviewer genuinely thought that the encircling reef was never examined he was over-generous in describing me as "a painstaking naturalist"; if he did not entertain this thought, then he did ill in embodying this remark in his article. It is obvious that in places the reviewer has failed to grasp the meaning of the text which he would criticise, and, in speaking of the encircling reef, he charges me with drawing deductions from "a similar platform . . . found at 13 feet above mean tide-level." I presume that this charge is based on the statement at p. 283, that "where these steps are evident, the *island rise* is 13 feet above mean tide-level." The "island rise" is explained (and figured at Plate xiv.) as the rise of débris piled on the breccia platform, and in the sentence immediately preceding that quoted it is definitely said that the "steps of breccia rise one above the other to a total number of three or four, and to a height of almost as many feet." What is actually found, and what the description would appear to clearly depict, is a portion of breccia platform elevated to a height of something less than 4 feet, surmounted by a pile of débris reaching to a total height of 13 feet. What ambiguity might be imputed to the text should have been removed by one glance at Plate xv., which was specially included to depict the condition. I would point out to the reviewer that had intact breccia platforms been found at 13 feet above mean tide-level more dogmatic statements concerning probable elevation might have been made.

The reviewer has not only laid himself open to the charge of having failed to survey with accuracy the material he criticises, but he has also slipped into misquotations. Concerning the base on which coral structures are built, he cites me as saying that "it matters not what the base may be so long as its platform comes within the *wind-stirred* area." This area (above the limiting line of sedimentation) is, in the passage misquoted (p. 246), and consistently throughout, called the *wave-stirred* area. The two things may appear identical to the reviewer, but I think that his failure to grasp the difference diminishes the value of his criticisms upon the point.

F. WOOD-JONES.

St. Thomas's Hospital Medical School.

I HAVE not a copy of Mr. Wood-Jones's work before me, but I regret misquoting him with regard to the *wave-stirred* (not *wind-stirred*) area; I still desire more information on *the limiting line of sedimentation*.

Readers of NATURE must decide how much scientific evidence is given that the lagoon of an atoll is a slightly submerged reef. Perhaps I misunderstand the term "slightly submerged reef." I do not regard the lagoon in an atoll, which was formed, as Darwin suggested, by subsidence, as covering a reef at all. I do not think the borings in the lagoon at Funafuti suggest a reef such as surrounds a lagoon, and I do not consider that the nature of the rock under atoll lagoons is or can be settled without borings. Some evidence was doubtless obtained by Mr. Wood-Jones by dredgings, &c., as his book shows he has as thoroughly examined his atoll as he was able, but I do not regard the existence of atolls and atoll-shaped reefs elsewhere as more than indirect evidence of that which exists at Cocos-Keeling.

In Fiji there are many elevated islands. Some of these have fringing and others barrier reefs, which superficially appear to be of the ordinary coral-reef type. Such reefs cannot have existed when the islands were first elevated, and it seems to me that Agassiz's photographs show that high islands do crumble to pieces within the calm of encircling barrier reefs. This process would certainly be *convenient* for the formation of fringing and barrier reefs round these islands if organisms exist there which prevent the processes of disintegration from extending below the water-line over certain areas around them. In any case, it seems to me certain that islands within barrier reefs are being removed by some agency or other, and that the resulting reefs would simulate atolls.

So far as I can find out in the Madreporaria, the extraordinary variability in growth form has only been described in reef-builders which possess, in some form or other, chlorophyll in their tissues. I do not think my paragraph on the subject will be misunderstood by your readers. I adhere to my statement that "our author does not appear to have examined the zooids to see whether he is really dealing in any genus with one or more species," and leave this question to be settled by your readers.

Of course, the encircling reef was *really* (or genuinely) examined, and with considerable care, but I certainly did not consider, from Mr. Wood-Jones's work, that there was internal evidence that he had *sufficiently closely* examined it. I cannot follow all Mr. Wood-Jones's paragraph, but I quite fail to see where I have charged him with drawing deductions as to the encircling reef from "a similar platform found at 13 feet above mean tide-level." It would perhaps have been better if I had not used the word *similar*.

THE REVIEWER.

Early Burial Customs in Egypt.

IN his letter to NATURE of October 20 (p. 494) Prof. Flinders Petrie says:—"The whole question lies in a nutshell. Many thousand graves have been examined by one party of observers, and certain results repeatedly found. Many thousand graves have been examined by another party of observers, in other localities, and such customs have not been found."

I would analyse the contents of the nutshell in a slightly different manner. Both parties, working in every region in Egypt, have found precisely the same state of affairs. One party, under the influence of the glamour of Egypt and what is said to happen in early Italy and Europe and modern Africa, interprets it as evidence of cannibalism and "Jack-the-Ripper" practices. The other has put forward a simple record of all the facts observed and the obvious explanation of them, and has found, not only no sign of any deliberate mutilation, but overwhelming evidence of the reality of the ancient Egyptian's profound reverence for the bodies of his dead relations, and of his horror of mutilating them, even for the purpose of making the incisions necessary for embalming.

Since this correspondence began, a full discussion of all the data relating to the subject under consideration has been published in the report for 1907–8 on the Archæological Survey of Nubia. There the facts will be found recorded for the use of anyone interested in the matter.

G. Elliot Smith.

Effect of Heat on Soils.

Mr. A. D. Hall in his opening address to the Agricultural Sub-section of the British Association at Sheffield mentioned "a process of heating the soil before sowing" and "a process of firing the soil preparatory to sowing the crop," both of which seem very similar to "burning bush" as practised in the West Indies. On reading Russel and Hutchinson's paper on "Partial Sterilisation of Soil" in *Journ. Agric. Sci.* for October, 1909, it struck me that their work afforded a probable explanation of "burning bush," and I now make the suggestion in the hopes of obtaining some evidence. The process seems to be similar to that known as *chena* in Ceylon, *ladang* in Malaya, and *jhuming* in India (see J. C. Willis, "Agriculture in the Tropics," pp. 1 and 2), and perhaps someone with experience of the East could throw further light on the question.

It is a common practice in Trinidad for a small cultivator to rent a piece of abandoned land, which is cleared by burning the "bush" in the dry season. In the wet season the clearing is generally planted with maize, which is usually followed by cassava, yams, tanias, &c. In a few years the cultivation is no longer remunerative, and the land, once abandoned, quickly goes back to "bush." One explanation is that the ashes of the burnt "bush" supply a certain amount of mineral plant food in a readily available form (the nitrogen in the plants burnt would, of course, be lost). This plant food would presumably produce an increased yield, but the effect would not last many years. Another—and I think a more probable—explanation is that the burning results in a partial sterilisation of the soil, with a greater production of ammonia. The fact that maize is the first crop grown after the "bush" has been burnt is significant, since it is a crop which is benefited by a nitrogenous manure.

C. Harold Wright.

Government Laboratory, Trinidad, B.W.I., October 8.

The Colours and Spectrum of Water.

A perusal of the articles which have appeared in your journal on this subject (Nature, vol. lxxxiii., pp. 48, 68, 188, 487, and vol. lxxxiv., p. 87) leads me to ask if the spectrum of water has ever been thoroughly investigated. It is difficult to believe that this has not been done, and yet there is but little allusion to the important bearing the character of the spectrum must have upon the colour. I should be glad to learn what is the origin of a feature I have sometimes observed in the spectrum, as seen with a "miniature spectroscope" by Browning. This is a dark band or line at about wave-length 6000, which I noticed in June, 1887, in Sark, in clear water, both in the sea and in fresh water. The latter was bluish-green, and the sea was green. So far as this line would have any influence on the colour of the water, it would tend to make it blue; but the colour would be much more influenced by the very strong general absorption in the whole of the red and orange beyond the dark line. In the sea water this general absorption extended more feebly to the D line of the solar spectrum, and even to the dry-air band δ.

In the deep green water of Lago Maggiore the spectrum was almost identical with that of the sea at Sark; I made the wave-length of the dark line about 6050.

The Lake of Geneva is noted for the deep blue of its clear water. In it I failed to see the dark line, but the general absorption of the red end of the spectrum was very striking.

The bluest water I ever saw—bluer than the Mediterranean, Red Sea, or Indian Ocean (I have not been to Capri)—was, however, the Blaue See, near Kandersteg, and the Lago di Garda. In the former, pieces of pot at the bottom appeared pure Prussian-blue. During a stay of a few days by the Lago di Garda I could not make out the law of its changes in apparent colour, but at times it was far bluer than the bluest sky I ever saw. It usually had a slightly greenish tinge. Both these lakes are extremely clear. I regret not having observed their spectrum.

T. W. Backhouse.

West Hendon House, Sunderland, October 19.

Luminous Paint.

Mr. C. A. Emery, of Marlborough College, has directed my attention to a passage in Livy (xxxix., 13) where the following occurs:—

"Matronas Baccharum cum ardentibus facibus decurrere ad Tiberim, demissasque in aquam faces, quia vivum sulphur cum calce insit, integra flamma efferre."

This he renders:—

"The Bacchantes would run down to the Tiber with burning torches, and plunging them into the water would take them out with the flame unextinguished, because they were covered with a mixture of living sulphur and lime."

The expression "vivum sulphur" is thus explained by Pliny:—

"In Italia quoque invenitur sulphur. Genera quatuor: vivum, quod Graeci apyron vocant, nascitur solidum, hoc est, gleba: quo solum ex omnibus generibus medici utuntur. Solum (cetera enim liquore constant, et conficiuntur oleo incocta) vivum effoditur, translucetque, et viret."—Plinii Hist Nat. Lib., xxxv., 50.

It would seem, therefore, that calcium sulphide was discovered, and its luminosity observed, about nineteen hundred years before Marggraf, who in 1750 A.D. prepared the substance by "calcining gypsum with combustible matter." Eighteen years later Canton obtained the same effect by "igniting calcined oyster-shells with sulphur." (Inverted commas from Roscoe and Schorlemmer's "Treatise on Chemistry," under "Calcium and Sulphur.")

As neither of these manufacturing methods is difficult, it seems reasonable to suppose that one or other might have been known in Livy's day, and from the Latin text a modification of Canton's method seems probable.

Except for the above, I can find no direct reference to the discovery of calcium sulphide.

I noticed when reading Charles Reade's novel "The Cloister and the Hearth" that one of the more striking incidents depended on the use of a phosphorescent paint. As this powerful story is of the fifteenth century, I considered the phosphorescent paint an anachronism, for Brandt is said to have discovered phosphorus in 1669, and the "Bologna stone" (barium sulphide) was discovered only a few years earlier. But Reade may have been aware of the passage in Livy or may have known about Pliny's "Pholas"—the rock-boring mollusc (Piddock)—the phosphorescence of which is said to remain long after death.

Possibly some readers of Nature may be able to throw more light on the origin of "luminous paint."

R. G. Durrant.

The College, Marlborough.

Velocity of Negative Ions in Hydrogen at Atmospheric Pressure.

Some time ago Prof. Chattock and I attempted to measure the velocity of the ions from a point discharging in pure and impure hydrogen at atmospheric pressure by the wind-pressure method, in the hope of finding that the negative ion was influenced by the presence of small traces of oxygen. The results were given in *Phil. Mag.*, April, in which it was shown that the change which the complete elimination of oxygen caused was surprisingly great. Thus the apparent specific velocity of the negative ion in pure hydrogen was >230 cm. sec.$^{-1}$, volt cm.$^{-1}$, but it rapidly dropped to 7·6 on the addition of oxygen up to 1 per cent. The velocity of the positive ion was unaffected by traces of oxygen impurity, and was 5·8 throughout.

The change in the case of negative discharge might have been caused in two ways:—(a) by a great diminution with purity in the size of the negative ion in hydrogen; (b) by back discharge from the plate. If the latter were true the wind-pressure method breaks down, and the above values of velocity are not real. As it was certain that some back discharge was present, it seemed reasonable at the time to attribute the whole effect to this cause, but some recent work of Franck shows that it was probably not correct to do so.

Franck has shown (*Verh. d. D. Phys. Ges.*, xii., 291 and 613, 1910) that in gases such as argon and nitrogen the specific velocities of the negative ions obtained by α rays rapidly increased as the last traces of oxygen were removed. Thus in pure argon and nitrogen he obtained values as high as 206·4 and 144·6 respectively. As in the above, however, the positive ions were unaffected.

In the light of these results it is probable that the negative ions in point discharge in hydrogen, like those in other oxygen-free gases, are either corpuscles or are very small, although in our work the unknown amount of back discharge present prevented the determination of their true specific velocity.

These results throw considerable light on various phenomena occurring in point discharge, and I hope to publish later a more complete discussion.

A. M. Tyndall.

Physical Department, University of Bristol.

An Irish Pteridosperm.

Readers of Nature familiar with the many valuable additions to knowledge made by British palæobotanists within the last twenty years will be interested to know that in the course of rearrangement of the fossil plants in my charge in the botanical division of the National Museum in Dublin I have found, while comparing the specimens of Sphenopteris in this collection with those in the collection of the Geological Survey of Ireland (of which my colleague, Prof. Grenville Cole, is director), that in the latter collection there is a specimen of *Sphenopteris Hoeninghausi* from the Coal-measures of Glengoole, co. Tipperary, which shows all the characteristic features of *Lyginodendron Oldhamium* (including its spines, sclerotic network, venation, and conchoidal pinnule segments). Moreover, the specimen shows, *in direct continuity* with the vegetative part, the *Calymmatotheca Stangeri* condition regarded first by Scott, and now by many others, as probably the seed-producing part of Lyginodendron, from which the *Lagenostoma Lomaxi* seed has already, as Oliver and Scott have satisfactorily shown, in all probability fallen out. The specimen in question, if my interpretation is right, proves the correctness of the conjecture that *C. Stangeri* is part of the true pteridosperm Lyginodendron. I hope to publish shortly an illustrated account of the find.

T. Johnson.

Royal College of Science, Dublin, October 24.

Fermat's Theorem.

The following proof of this theorem may be of some interest. Take the scale of notation the radix of which is x, and write down all the numbers of p digits, any or all of which may be zero. The number of these numbers is x^p. From one number we can, in general, derive $p-1$ others by cyclical permutation, the exceptions being those numbers that are periodic with a period that is a submultiple of p. Suppose p to be a prime, so that its only submultiple is unity. Then all the numbers except the x numbers that have their digits the same can be arranged in sets of p each (which are easily seen to be mutually exclusive). Hence the number of these numbers, which is x^p-x, is divisible by p, and if x is prime to p we see immediately that $x^{p-1}-1$ is divisible by p, which is Fermat's theorem. It is clear that this proof depends on permutations and combinations, not really on scales of notation, which, indeed, we have only used because of the clearness that they lend to its statement.

H. C. Pocklington.

11 Regent Park Terrace, Leeds.

The Uganda-Congo Boundary.

With reference to the note on this subject in Nature of September 1, has not the writer fallen into a slight error in quoting (p. 268) the definition of limits in the "Berlin Act" as applicable to the Congo State? Reference to the text of the Act will show that the passage quoted relates, not to the State, but to the Free Trade area in the Congo basin and neighbouring territories constituted at that time, with limits by no means coincident with those of the State. In fact, the "Berlin Act" had nothing to do with the State (as such), which was constituted, not by the conference, but by agreements with individual Powers negotiated about the same time.

The frontier originally claimed by the State in this region, and definitely accepted by several of the Powers, *was* the thirtieth meridian, for however unsatisfactory this might be, there could hardly, in 1885, have been a question of the adoption of the water-parting, which would at that date have involved far more uncertainty than the meridian. It was even doubtful to which of the two basins Lake Edward belonged. The mistake in 1894 seems to have consisted, not in the gratuitous introduction of the thirtieth meridian, but in its partial retention (viz. in the Ruwenzori district), to the detriment of Uganda, while replaced farther north by the water-parting, greatly to the advantage of the Congo State.

Edward Heawood.

1 Savile Row, September 16.

It is quite true that the definition quoted in the note was that of the Free Trade area, but as the recognition of the Congo State, on our part, contained no definition of frontiers, we were entitled in 1894 to maintain that, in default of any specific deviation agreed upon mutually, the two frontier lines were identical. So far as I am aware, up to the date of the treaty of 1894 we had not admitted, nor, indeed, seriously considered, any claim on behalf of the Congo State to territories outside the Congo basin.

The history of the whole series of transactions is somewhat complicated and difficult, but it seems that, whatever were the intentions of the signatories to the Berlin Act and of the framers of the original agreements with the Congo State, any distinction between the State and the Free Trade area disappeared at an early period of their history, and had ceased to exist by 1894.

The Writer of the Article.

An Agaric with Sterile Gills.

The occurrence of agarics with sterile gills is well known in certain species; it has been noticed most in those with purple spores. A few days ago I met with two specimens of *Panaeolus campanulatus* in Sutton Park, near Birmingham, in which the gills were of a pinkish-grey colour, somewhat closely resembling the tint of the dry pileus. There was a total absence of the usual variegated, grey and black, appearance. The pileus was large and well developed, measuring 1½ inches high and broad, stipe quite 4 inches long, and presenting all the characters of that of *P. campanulatus*. On examining sections of the gills it was seen that numerous basidia were present, projecting beyond the paraphyses; very many of them had the four sterigmata of full size, but not one over the whole of the gills of both specimens had produced a spore, nor were any produced afterwards, so long as the fungi were preserved. Unfortunately, they had been gathered before I saw them, so that it was impossible to ascertain if there was any visible cause for the sterility.

W. B. Grove.

The Botanical Laboratory, Birmingham University.

ART THE COMRADE OF SCIENCE.[1]

IT has long been known that Mr. A. H. Thayer, the discoverer of the great principle of countershading in nature, was preparing a fully illustrated exposition of his observations and theories, and that his son was helping him in the enterprise. The present beautifully illustrated and finely printed work is the result. The great discovery of the obliteration of apparent solidity by means of countershading, first published

FIG. 1.—Plymouth Rock Hen, lacking countershading, and therefore conspicuous against a background of Plymouth Rock skins.

in 1896 (*The Auk*, vol. xiii., pp. 124 and 318), was convincingly illustrated in this country by the models prepared by Mr. A. H. Thayer, and presented to the natural history museums of London, Oxford, and Cambridge. An account of the principle, as well as the description of the Oxford model prepared by the present writer, appeared in NATURE for April 24, 1902 (vol. lxv., p. 596).

After the great and wide-reaching discovery which has probably been accepted by all naturalists who have studied it, the author has gradually extended his conclusion that the colours of animals are adapted for concealment, and carried it into regions where a very different interpretation had been accepted. Thus in his papers in the Transactions of the Entomological Society of London (1903, pp. 553–569), and in the *Popular Science Monthly* (December, 1909, p. 550), Mr. Thayer maintains that appearances which have been explained as warning, mimetic, and sexual are to be interpreted by the one dominant and universal principle of concealment in nature. It cannot be said that, in these later developments, Mr. Thayer has succeeded in convincing any large number of naturalists, and it is therefore of especial importance that a detailed, complete, and fully illustrated statement should have appeared in the present volume.

The great bulk of the work, which opens with an introductory essay, dated 1907, by Mr. A. H. Thayer, is occupied, first, by a full and admirable exposition of the principle of obliterative shading and the combination with it of "picture patterns," and secondly, by a sketch of the distribution of these methods of concealment throughout vertebrate animals and insects, the birds being treated in far greater detail than any other group. Mr. Thayer's later views are not expounded separately, but are to be found scattered in various parts of the volume, which must be carefully studied as a whole by any reader who would do justice to the author and his father.

The value of obliterative countershading is well illustrated by figures of two breeds of fowl in which it is lacking. However closely such fowls may harmonise with the colour of a flat background, they must be rendered conspicuous against it by means of shadow, as is at once obvious in Fig. 1.

A series of interesting photographs of models makes it clear that obliterative shading is even more important than markings for the purpose of concealment. Thus, the model in Fig. 2 represents a relatively inconspicuous gap in the pattern of the background; that in Fig. 4, possessing the pattern, is by comparison a strikingly distinct and solid object. We are thus led to conclude that the perfect obliteration represented in Fig. 3 depends in larger measure upon the principle illustrated in Fig. 4 than upon that shown in Fig. 2.

The vast importance of this same principle is demonstrated, not only by diagrams, but by large numbers of representations of actual animals to be found in later pages of the work. A striking example is seen in Fig. 5, where the animal has been photographed in a position which reverses the obliterative tendency of its colouring in the normal position. We here get maximum conspicuousness—the lightest tint in the strongest light, the darkest in the deepest shadow.

The relation of the pattern to perspective is discussed in an extremely interesting and original section (chapter iii.), where the conclusion is reached that "the obliteratively shaded surface must bear *a picture of such background as would be seen through it if it were transparent*." This is well illustrated by the diagram shown in Fig. 6, where the smaller pattern of the highest part of the bird is seen against the receding, and therefore to the eye diminished, details of the background.

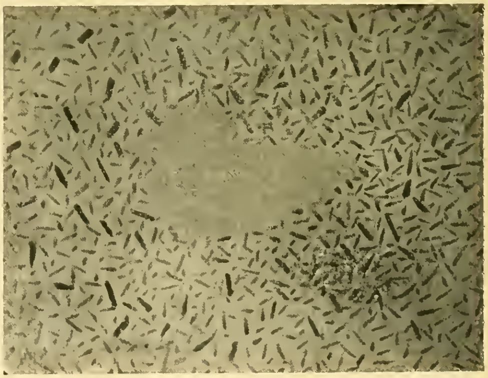


FIG. 2.—Bird-shaped Solid Model, obliteratively shaded in full, and correctly lighted, but revealed by the want of pattern.

Mr. Thayer discriminates sharply between all such *obliterative coloration* depending on countershading combined with background picturing, and *mimicry*, or the simulation of a solid object. He truly points out

[1] "Concealing-Coloration in the Animal Kingdom." An Exposition of the Laws of Disguise through Colour and Pattern: being a Summary of Abbott H. Thayer's Discoveries. By Gerald H. Thayer. With an Introductory Essay by A. H. Thayer. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 31s. 6d. net.

that the goal of the first principle is *invisibility*, of the second *deceptive visibility*. "The latter principle is open to unlimited variations of method and result, whereas the former . . . is in its main essentials strictly limited. There are innumerable kinds of solid objects for animals to simulate in appearance, but there is only *one* way to make a solid object in a natural lighting cease to appear to exist" (p. 25).

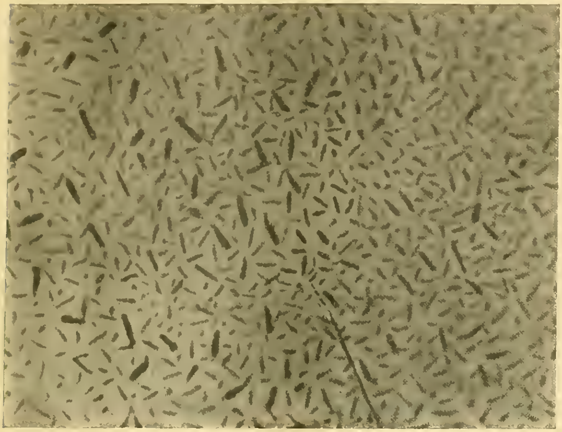


FIG. 3.—Model similar to that shown in Fig. 2, and similarly lighted, but concealed by possessing a pattern like that of the background.

The use of the term "mimicry" to indicate the second category, although common, is to be deprecated. It is inconvenient to apply the same term to the resemblance of a moth to a wasp, and that of a caterpillar to a twig. The wasp-like moth is always spoken of as an example of mimicry; and the term *imitation* may be conveniently used in a technical sense to include the twig-like caterpillar and all the other innumerable examples of special protective resemblance. The important classification of cryptic resemblances, which Mr. Thayer now establishes more thoroughly and correctly than before, may be appropriately expressed by the use of the terms (1) *obliterative* or *aphanistic coloration*, and (2) *imitative* or *eikonic resemblance*.

No fewer than sixteen out of the twenty-seven chapters of the book are concerned with the colouring of birds, the patterns being classified according to the nature or distance of the background that is pictured. A vast amount of patient and loving observation of nature is here summed up and expressed. We shall look forward with the deepest interest to the comments of those special students of bird-life in Europe and America, who will make a point of testing these conclusions by fresh observations made in the field from the author's point of view. This is written in no spirit of doubt, for Mr. Thayer's statements and illustrations are, with certain exceptions, to be considered later, most convincing. No naturalist could reasonably doubt, for example, the significance of the grass-pattern shown in Fig. 7, which the author justly describes as "one of the most remarkable photographs ever taken of obliteratively coloured birds in nature" (p. 46). The two points by which the bird is most easily recognised are the dark eye and the dark shadow under the feathers, so that this wonderful illustration helps us to understand the importance of eye-masking markings (see pp. 81, 82), as well as of obliterative counter-shading.

The coloured plates of the "Male Ruffed Grouse in the forest" (II.), the "Cottontail Rabbit" (VII.), and the "Copperhead Snake on dead leaves" (XI.) are very remarkable illustrations, justly claimed by the author and his father to be "the first ever published, which rightly illustrate and in some respects do justice to the wonderful effects of obliterative coloration, based on the great law of *obliterative shading*" (p. 128).

The five coloured plates of caterpillars (XII.–XVI.) are extremely beautiful, showing for the first time the important part played by obliterative shading in these forms. The attitudes of caterpillars generally must be re-examined in the light now thrown upon them by this great artist-naturalist; for there is little doubt that many of the best-known and commonest illustrations represent an inaccurate position. It is unfortunate that the names of so few of the figured species were ascertained, but there should be little difficulty in the identification of such beautiful reproductions. There is an evident inadvertence in the orientation of Fig. C or D on plate XII., both represented in a similar position, although D is described as the reverse of C.

FIG. 4.—Model similar to that shown in Fig. 3, and similarly patterned, but wrongly lighted and therefore conspicuous.

The necessities of space prevent a further account of this remarkable and splendidly illustrated exposition of the principles of obliterative colouring, and its distribution throughout the animal kingdom. We must now, in the concluding paragraphs, deal with special interpretations and later developments which are likely to cast an entirely undeserved suspicion upon this admirable account of a great discovery.

In the first place, in the present state of our knowledge of a most difficult subject and the great need for numberless exact observations and precise records,

FIG. 5.—Domestic Hare laid on its back, out of doors, so that the oblite ative shading is reversed. Photographed from life.

illustrations in which the background has been "copied, colour-note for colour-note," from the animal itself, are a hindrance and not a help (plates I., III., VI., VIII., IX., X., and Fig. 123). The inferred environment is not necessarily incorrect—the rattlesnake (Fig. 123) at least is almost certainly represented with truth—but the inference is not scientific evidence, and it is likely to act as a hindrance, because some readers may be led into accepting it as a proof, others into scoffing at the whole subject. Furthermore, the inferred significance of the animal's colouring may be wholly mistaken, as I doubt not is the case with the beautiful and poetic plates IX. and X., representing "flamingoes at dawn or sunset, and the skies they picture." Such an interpretation is quite inconsistent with the wonderful representation of flamingo life prepared by Dr. F. M. Chapman for the American Museum of Natural History, New York. The present writer had seen the representation and knew well the unrivalled knowledge and experience which had gone to the making of it, and he therefore wrote to his friend and asked his opinion as to the meaning of the colours of these birds. Dr. Chapman kindly replied as follows:—

My observations of flamingoes (which I should add were made only in the Bahamas) lead to the belief that our American bird (*Phoenicopterus ruber*) is protected by its haunts and habits rather than by its colour. At all times, whether feeding singly or when nesting and solidly massed in hundreds, it is from any point of view an exceedingly conspicuous object. Apparently, therefore, it thrives only when it is beyond the reach of predatory Mammalia and Reptilia, its centres of abundance being oceanic islands, like the Bahamas or Galapagoes, or small keys off the mainland. It is true that flamingoes formerly visited the shores of southern Florida in great numbers, but they have never been known to nest there, and they frequented only the vast shallow bays where they could feed far from land, and where it was almost impossible to approach them; for it should be especially noted that these flamingoes are as shy as they are conspicuous. The character of the regions they frequent usually enables them to see as far as they can be seen, and the brilliancy of their colours seems to be compensated for by their extreme wariness. For example, a professional hunter of flamingoes on the Florida coast tells me that for six days a week for two consecutive weeks he pursued a flock, estimated to contain 2000 flamingoes, without securing a single specimen.

I am, of course, aware that man should not be classed among the natural enemies of the flamingo, nor their colours be explained from the human view-point, but the fact just mentioned at any rate illustrates the bird's alertness and the difficulty with which it is approached.

As, in the Bahamas, at any rate, the flamingo feeds only on molluscs, its colours are apparently not deceptive or aggressive. In short, it is my belief that the flamingo's colours are to be placed among the cases where colour has run riot, unchecked by any need for protection from enemy or prey, and that the bird has continued to exist only where the dangers to which of necessity its colour would expose it are happily absent.

The flamingo has been considered at some length. With regard to the peacock in the wood (plate I.), it can only be said here that the interpretation is hardly likely to be accepted by anyone who has watched the male bird displaying before the female or in rivalry with another male.

Nor are many naturalists likely to be convinced by Mr. Thayer's interpretation of recognition markings and warning colours, an interpretation rendered sufficiently clear by Figs. 8 and 9. Here, as in all other examples of animal colouring, Mr. Thayer considers the one dominant interpretation to be concealment,

FIG. 6.—Diagram showing the picturing of perspective by animals' patterns. The bird is supposed to be looked at from the side and above so that the smaller pattern of its head and neck is against the more distant and therefore reduced pattern of the ground surface.

the Spilogale's "dark stripes passing for vegetation, and his white stripes for the sky." This explanation of warning colours has been recently criticised, and in the opinion of the present writer entirely refuted, by Mr. R. I. Pocock (Proc. Zool. Soc., 1908, pp. 944–959), and the corresponding interpretation of recognition

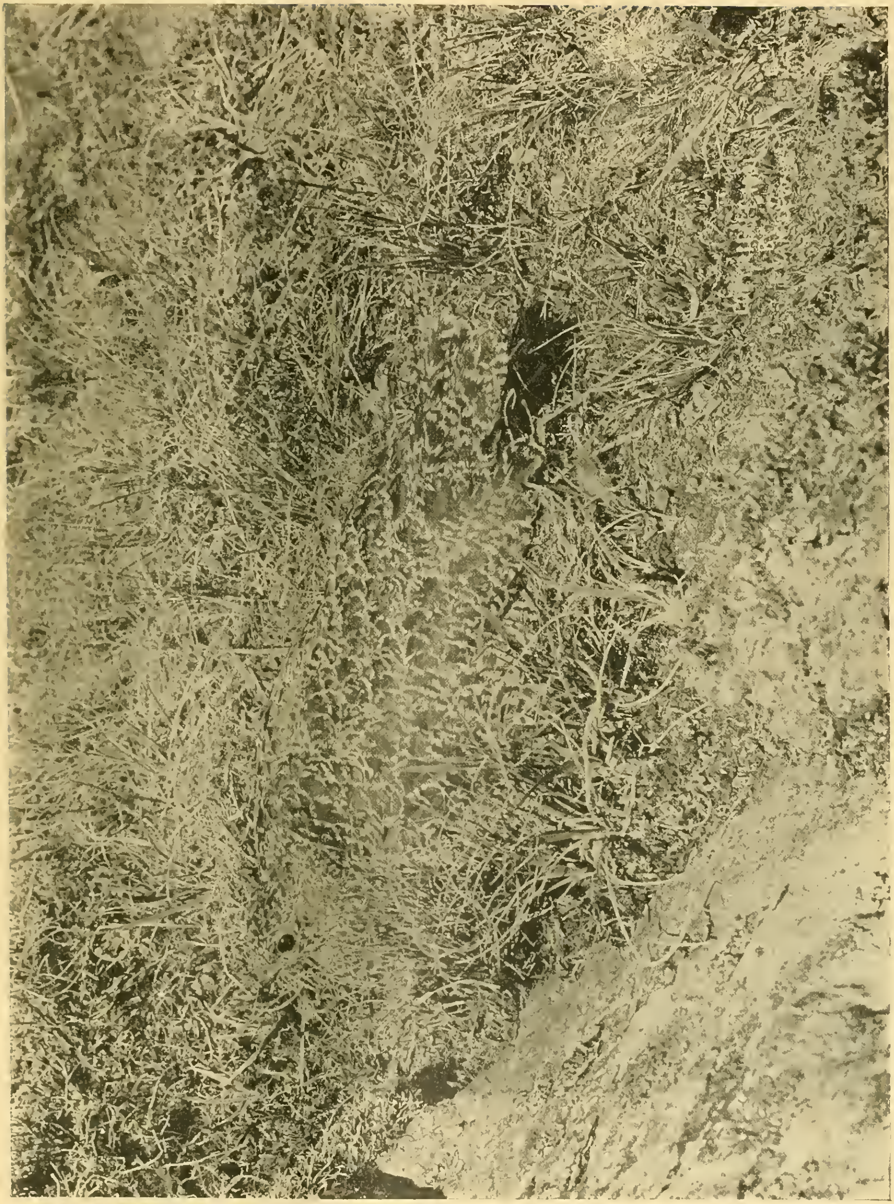


Fig. 7.—Rocky Mountain White-tailed Ptarmigan on her nest. Photographed from life by Evan Lewis.

markings by Mr. E. Thompson Seton ("Life-Histories of Northern Animals"). As regards the interpretation of the mimetic resemblances of butterflies as due to a syncryptic resemblance to flowers and the surrounding vegetation and its interstices, it is impossible to say

FIG. 8.—Spilogale, or Little Striped Skunk, seen from above—man's and hawk's point of view. From photograph of a stuffed skin, out of doors.

more than that such a theory does not explain many well-known characteristics of the mimetic groups.

Whatever be the verdict of the moment, a man will be judged and ought to be judged by what he has done, not by what he has failed to do. It has been said that "What's hit is history, what's missed mystery." While the misses do not make the hits any the less, the mystery may serve to throw light upon the workings of a mind that has made history.

E. B. P.

FIG. 9.—Spilogale, seen from below—mouse's and cricket's position. From photograph of stuffed skin, out of doors.

ETHNOGRAPHY AT THE BRITISH MUSEUM.[1]

THE purchaser of this handbook will feel no regret that it is not cast in the form of a guide. Many, perhaps most, of those who buy museum publications do so as they leave the building, and although the fate of such mementoes cannot be determined with certainty, it may be assumed that they are sometimes read at leisure. A descriptive handbook on broad lines is, therefore, a better investment for the average visitor than a guide of the old, and arid, type. The present example is worthy of the best fate that can befall it at the hands of the man who looks in from the street, and it will be cordially welcomed by those whose interest in ethnography is less casual and fortuitous.

The introduction contains a brief survey of the progress of geographical exploration from classical times onward, and traces the discoveries which rendered possible the development of the comparative study of mankind. The scope of ethnography is defined in a concise discussion of man in his relation to the material world, to his fellows, and to the supernatural.

The greater part of the book, which deals with the collections as exhibited in the Museum, is arranged under geographical headings, and the limitations of the collections are naturally reflected in the handbook. Thus, under Persia, India, and Japan, the subject of arms and armour is practically the only one considered, whilst China is only referred to incidentally. The culture of Tibet, Ceylon, Indonesia, and some of the tribes of northern and central Asia, is entered into in greater detail. Useful summaries are given of the general conditions of the life and culture of the peoples of these areas, with reference not only to their arts and industries, but also to their customs and beliefs. Racial origins and affinities are briefly considered, and the latest views are stated. The same treatment is adopted with regard to the peoples of Australia, Oceania, Africa, and America. Special mention may

[1] "Handbook to the Ethnographical Collections." Pp. xv+304. (London: Printed by Order of the Trustees, British Museum, 1910.) Price 2s.

be made of the able condensation of the complex subject of the culture, distribution, and relationships of the Negro and Bantu tribes of Africa.

An important feature, and one which will be widely appreciated, is the large number of illustrations, many of them in the form of plates. The geographical and tribal index also adds greatly to the value of the book for reference purposes.

Contemporary portrait figure in wood of Bope, great chief of the Bu Shongo, *c.* 1790. Kasai District, Congo State. From the British Museum "Handbook to the Ethnographical Collections."

Whilst giving ungrudging praise to the handbook, the hope must be expressed that the extension of the museum buildings will afford opportunity for the accommodation of the ethnographical collections under conditions that will enable them to be displayed in a manner more worthy of their importance. The provision of a section of technology, for example, would not only be an extremely popular addition, but would immensely increase the educational value of the collections. It seems doubtful, however, whether those who intermittently rule over us have yet been convinced that museums are educational institutions. It is certain that they have not appreciated the importance of the study of man, working-man excepted.

H. S. H.

SIGHT TESTS IN THE MERCANTILE MARINE.

THE Board of Trade has issued an important report (Cd. 5256) on the sight tests used in the mercantile marine during the year 1909. Out of 6084 candidates, 56 failed in form vision, and were not re-examined; while out of the remaining 6028 there were 86 failures in colour-vision, of whom 31 appealed and were re-examined, with the result that 15 were passed and 16 were finally rejected. The total absolute rejections were, therefore, 71 in 6084, or 1·49 per cent. During the first ten months of the year, colour vision was tested by the three skeins of wool originally recommended for the purpose by Holmgren; but during November and December two other skeins, a purple and a yellow, were added. With these the rejections were in somewhat larger proportion (1·81 per cent. against 1·17) than when only three skeins were used; but the total number of candidates examined by the new method (882) was hardly sufficient to afford any basis for a conclusion.

In the case of the fifteen men who, having originally been rejected as colour-blind, were re-examined and accepted on appeal, the report gives no information on the very important point of the precise methods employed in testing them, or on the precise "matches" made by them, either at the first examination or at the subsequent one. In the case of those who were finally rejected, we are told what they did. "A.B.," for example, selected "sage-grey, fawn, and greenish-yellow" as matches for the green skein, "greenish-blue" as a match for the pink skein, "blue and carmine," as a match for the red skein, and so on, until he is finally dismissed as "completely green-blind." But of a man who, having been rejected, "appealed and passed," we are not told anything but that he had previously "failed in the colour-vision tests," and we have no information as to how the alleged "failure" was redeemed.

There can be no question that, in every case in which an original rejection has been overruled, very clear evidence of error on the part of the first examiner, and of special care on the part of the second one, should be forthcoming. We believe that failure to reach correct conclusions by means of Holmgren's three skeins would be due, probably in all cases, to neglect of Holmgren's very precise instructions as to the manner in which they should be used; and, if it were found that the original conclusions of any examiner were often overruled on appeal, an urgent necessity for reconsidering his fitness would arise. It is manifest that no original rejection should be set aside except upon the clearest and most satisfactory evidence; because, however much we may sympathise with instances of hardship, if such there be, or with worthy men deprived of a calling, it must be remembered that the difference between red and green is to the normal-sighted so complete and absolute that they can scarcely understand even the possibility of confounding them. A case in which the difference is less than this, a case in which there is any question, any possibility, of confusion between the two colours in any conditions of weather or of illumination, is one in which the benefit of any possible doubt should not be given to the individual examined, but to the persons who may possibly be carried in a ship or a train placed under his control. It follows that the evidence on which a re-examined man has been accepted is of far more public importance than that on which he has been rejected; and it is to be hoped that, in the next report upon the subject, this aspect of the question will be borne in mind.

Of the 71 rejections for colour-blindness, 35 were on account of red-blindness (complete in 20, incomplete in 15), and 36 on account of green-blindness (complete in 23, incomplete in 13), so that the several defects are practically of about equal frequency. No case of monocular colour-defect is recorded.

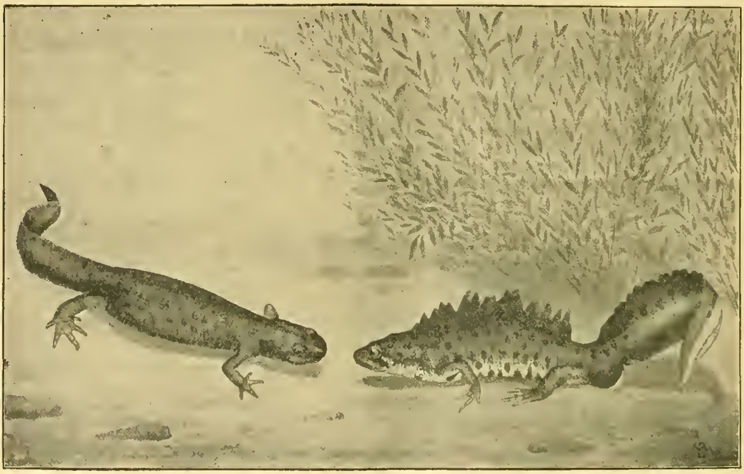
The last paragraph of the report announces that, after January 1, 1914, the standard of form vision in the mercantile marine will be raised, and that candidates will be required to possess full normal vision in one eye, and "at least" half normal vision in the other. It will probably be news to most of our readers that less than this very modest standard has hitherto been required; and ophthalmologists generally will, we think, agree with us that the possession of only half vision, in one of his eyes, by a young or middle-aged mariner, is a circumstance which would fully justify his being submitted to periodical re-examination. "Half-vision" would in many cases indicate disease, often of a character likely to be progressive.

STRUCTURE AND FUNCTION.[1]

THE aim of this stately book is to show how the various types of animals have solved the fundamental problems of life, and how their structure is to be interpreted in terms of their functions and environment. The keynote of the book is to keep the animal alive and to study its adaptations. We must congratulate the author on the success of his endeavour, for he has written a worthy successor to the once-famous, now forgotten "Anatomischphysiologische Uebersicht des Tierreiches," by Bergmann and Leuckart. The outstanding merit of the achievement is in its unified or synthetic presentation of the facts—it is at once anatomical and physiological, œcological and evolutionist. This general biological outlook is very useful for the analytic student.

Dr. Hesse has evidently worked for a long time over his book—it is scholarly, up-to-date, and clear, and commands our warmest admiration. It deals with the individual organism and the processes of its life—such as movement and feeling, nutrition and reproduction. There is nothing remarkable in the mapping out of the subject; it is the working-out that is remarkable in its thoroughness and lucidity. In treating of reproduction, the author necessarily gets beyond the individual, and leads on towards the second volume, in which Prof. Doflein is to deal with the relations of organisms with one another and to environmental influences.

The book is illustrated with quite remarkable generosity and skill. It is not merely that the illustrations are very numerous and beautiful, but they are peculiarly fresh and interesting, and there is a delightful intellectual flavour about them. They not only adorn the tale, they tell a story by themselves. Dr. Hesse's emphatically distinctive book has been well treated by the publishers, and we hope the result will be a great success. We have no counterpart of it in Britain.



Episode in "Courtship" of Crested Newt. From Hesse and Doflein's "Tierbau und Tierleben."

[1] "Tierbau und Tierleben in ihrem Zusammenhang betrachtet." By Prof. R. Hesse and Prof. Franz Doflein. Band i. Der Tierkörper als selbständiger organismus. By Prof. Richard Hesse. Pp. xvii+789. Leipzig and Berlin: B. G. Teubner, 1910.) Price 20 marks.

RECENT INVESTIGATIONS ON PELLAGRA.

THE visit of Dr. Louis Sambon to Italy to investigate the cause of pellagra has proved eminently successful. Dr. Sambon was sent out by the Pellagra Investigation Committee in March, 1910, in consequence of his having advocated for some time that pellagra was not caused by the consumption of diseased maize, as has been thought to be the case hitherto. Dr. Sambon was of opinion that pellagra was due to a protozoal infection, and that the disease was conveyed by an insect in much the same way as several other ailments are transmitted, such as malaria, sleeping sickness, kala-azar, filariasis, &c. The members of the Pellagra Investigation Committee, finding Dr. Sambon's idea was based on sound scientific reasonings, proceeded to collect money for the purpose of enabling him to proceed to Italy and pursue investigations on the spot.

Dr. Sambon visited the provinces of Bergamo, Milan, Brescia, Padova, Rome, and Perugia, and wherever he came in contact with the disease he found that the consumption of maize, whether diseased or not, had nothing to do with the prevalence of pellagra. Endemic centres of the disease have existed in Italy persistently for at least a century. The disease is not met with in towns, but only in certain parts of the country, namely, in the districts where a sandfly of the class Simuliidæ, and belonging to the genus Simulium, is met with. No actual parasite has as yet been discovered in the blood; but the geographical distribution of the disease, its epidemiology, and its close resemblance in behaviour to other diseases in which a parasite has been discovered, confirms Dr. Sambon in the belief that it is a protozoal infection carried by a sandfly that is the etiological factor in pellagra.

As a parallel we have the case of yellow fever. In yellow fever we know the agent of transmission to be a mosquito. No parasite has been discovered in the blood in yellow fever, but the experiments carried out are so conclusive that the disease is of the nature of a protozoal infection that yellow fever is classed as one of the protozoal infection with a parasite that is ultra-microscopic. Pellagra is in the same category. There are certain factors in infections of this kind which enable us to conclude that a disease is of a certain class, although the microscope is at fault.

Dr. Sambon proved:—(1) That the endemic centres of pellagra in Italy have remained the same since the disease was first described. (2) That the season of recurrence of pellagra coincides with the season of the appearance of the fully-fledged sandfly to the extent that even if the spring is early or late so the sandfly is early or late in appearing, and synchronously pellagra cases correspond in their appearance. (3) In centres of pellagra infection whole families are attacked at times simultaneously. (4) In non-pellagrous districts when a pellagrin is met with the disease never spreads to others, and the patient acquired infection during a sojourn in a pellagrous district. (5) In the case of a family that has moved from a pellagrous district to a non-pellagrous district the children born in the former are pellagrins, whilst those of the children born subsequent to removal to a non-pellagrous district do not develop the disease. (6) The disease is not hereditary, although infants a few months' old may become infected, especially if taken out to the fields in pellagrous districts, where their mothers work during the season, when the sandflies are in evidence. (7) Pellagra is not contagious, but is transmitted to each individual by an infected sandfly.

Dr. Sambon, from the epidemiological and topographical aspects of pellagra alone, has been able to show by well-nigh conclusive proof that pellagra is an insect-borne disease. It is hoped that money will be forthcoming whereby a study so well began and so fruitful in results shall be further investigated, so that not only Italy but the many countries in which pellagra is a scourge and a calamity may be freed of one of the most frequent causes of insanity.

DR. MELCHIOR TREUB.

THE death of this distinguished botanist, which occurred at Saint Raphaël, Var, on October 3, closes a career of remarkable brilliancy. Born at Voorschoten, near Leyden, on December 26, 1851, Melchior Treub entered the University of Leyden in 1869, and shortly after the completion of his undergraduate career was appointed assistant in the Botanical Institute there. This position he occupied from 1874 until 1880, when he was appointed, in his twenty-ninth year, to the directorship of the Botanic Garden at Buitenzorg, in Java, which had become vacant owing to the untimely death of the talented Scheffer.

The striking quality of Treub's early work, published before and during the tenure of his assistantship at Leyden, more than justified the selection, by the Netherlands Government of so young a man to fill so important a post, and afforded the happiest auguries for his success in this new and wider field. But high as were the expectations which Treub's friends were entitled to entertain, their most sanguine hopes fell far short of what Treub was able to accomplish during the twenty-nine years of his sojourn in Java.

Succeeding as he did a man of high aims, whose unwearied exertions in giving effect to them were largely responsible for his early death, Treub, with rare administrative skill, brought the renowned institution of which he had been given charge to a pitch of material perfection and a position of scientific importance far surpassing his predecessor's fondest aspiration. While developing and extending the economic activities whose foundations had been laid by Scheffer, Treub was able in the midst of his multifarious and engrossing administrative duties to undertake and complete the investigation of many important scientific problems, the details of which enrich the pages of the famous "Annales du Jardin Botanique de Buitenzorg," founded by Scheffer, and edited from the second volume onwards by Treub.

To the herbarium which has been associated with the Buitenzorg Garden since its foundation, and to the museum organised by his predecessor, Treub was able, almost from the outset of his directorship, to add a series of well-equipped and fully-staffed laboratories for the prosecution of technical and scientific research. One of his earliest acts was to persuade his Government to provide a special laboratory reserved for the use of foreign workers, who might care to visit Java and undertake, in the midst of its rich vegetation, original botanical study.

Treub's own contributions to the advancement of natural knowledge have been so numerous and are so well known to all students of general botany that they need not be recapitulated here. One of the outstanding features of his work is its reflection of the catholicity of his interests, which prevented him from ever becoming a specialist. His exceptional capacity for observation and his thorough mastery of method enabled him to enter with equal success many fields of study. Everything he had occasion to say on morphological, embryological, physiological, or phytogeographical subjects was worth saying, while his faculty for exposition enabled him so to present his results as always to arrest attention. The one field of botanical activity which he never entered was that of systematic study, with the needs of which, however, partly from the width of his sympathies, partly owing to his absorbing economic interests, he was fully conversant; perhaps none have benefited more immediately or more greatly by his kind and ungrudging assistance than systematic students.

Equally unnecessary here is any *résumé* of the results of Treub's practical activities or any recapitulation of the benefits thereby accruing to tropical agriculture, forestry, and pharmacology. The great value of the assistance given by him to the industries concerned has, however, lain in the fact that the practical results attained have always depended on scientific research. So ably did he teach the lesson that successful practice must depend on science, that he was enabled, towards the close of his career in Java, to effect the establishment of a truly scientific Department of Agriculture in the island, with himself as its head. In connection with this enterprise, he had occasion to visit various Eastern establishments, among them that organised by the United States Government in the Philippines. While in Manila, he contracted a severe illness the effects of which he was unable to shake off on his return to Buitenzorg, and some time thereafter he was compelled temporarily to relinquish his charge. A sojourn of some months in the mountains of Java effected so much improvement in health that he was able to return to duty. But again his health gave way, and a little over a year ago he was reluctantly compelled to retire from the post he had filled with so much distinction for nearly thirty years. Under medical advice, he spent the winter in Egypt, and in spring went to live at Saint Raphaël, near Cannes.

His retirement was a source of unmixed regret to his colleagues in Java, because of the loss of his hand from the helm. To his many friends in Europe, however, the necessity did not present quite the same aspect; these looked forward to the double pleasure of renewed personal intercourse with Treub, and to that increased scientific activity for which his release from heavy official duties promised him opportunities.

This was not to be, and botanists throughout the world now mourn the loss of one of the ornaments of their science. To those who had the privilege of his personal friendship the blow is greater still. They have lost in Treub a brilliant, stimulating, and sympathetic colleague, one whose width of culture and charm of manner rendered intercourse with him a continual pleasure. Above all, they have lost a kind and constant friend.

DR. SIDNEY RINGER.

THE career of Dr. Sidney Ringer, which came to a close recently at Lastingham, Yorkshire, is a fine refutation of the common statement that the cares of medical practice do not permit of active scientific research in these days. Engaged in a large and successful consulting practice, and in teaching in a large medical school, he yet found time for much work in the advancement of pure science. His interests in medicine lay largely in therapeutics, in which his text-book remains authoritative, and his experimental researches appear to have arisen from the desire to put therapeutics upon a more secure foundation by investigating the effects of drugs on the animal organism. From 1870 to 1880 he published a number of papers dealing with the effect of various alkaloids and other drugs on animals, and these were continued at intervals in his later years. Many of these have been confirmed by later workers, and have taken their place in literature along with the work of the other founders of the modern pharmacological school. Among other subjects taken up at this time, the mutual antagonism exhibited by some of the alkaloids appears to have interested him in particular, and his experience with these probably influenced his later investigations.

From about 1880 Ringer struck out on a line of his own in his investigation of the inorganic salts of the blood and other tissues. At this time practically nothing was known of the biological significance of these, and their presence in the tissues was discounted in the physiology of the time. His investigations were so complete that the laboured investigations of a multitude of foreign observers in recent years have added little of fundamental importance. The essential feature which Ringer demonstrated was that while each of the salts induces abnormal conditions when applied alone to the tissues, each of them is necessary for normal function; living matter requires inorganic salts, but these must be presented in certain proportions.

In particular, the special *rôle* played by lime salts in the economy of the tissues was first demonstrated by Ringer, and its antagonism to sodium and potassium was developed in a number of papers in the *Journal of Physiology*. The sodium and potassium in the body fluids has to be counteracted by lime, and such "balanced" solutions, when formed artificially, are harmless to living tissues, as he showed in a number of instances. The solution of salts introduced by him, and universally known by his name, is to-day to be found in every biological laboratory, and its use has led to developments in many fields of research. The work on which its composition is based has often received too little attention. This may be accounted for by the time at which it appeared: Ringer's work was done before the modern views of diffusion and dissociation of salts in solution found their way into biology. And the investigators who approached the study of the biological relations of the salts from the side of the new physico-chemistry appear to have overlooked the work of those who had investigated the subject without the aid of the newer methods. Quite recently, however, some amends have been made in this respect, and it is now recognised that the pioneer in this work had reached in essentials the same position twenty years ago as has now been attained generally.

From 1895 onwards, Ringer ceased active work in research, but his interest was unabated. Two years ago he might have been seen in his old place in the physiological laboratory at University College investigating some point which had attracted his attention. One cannot help regretting that he could not devote himself wholly to experimental research, in which he showed outstanding powers; but, on the other hand, his clinical work could ill have been spared by medicine. Few in these modern times have been able to combine such insight in the biological aspect of medicine with an equal eminence in practice.

C.

NOTES.

ON Wednesday, October 19, Sir William Ramsay conducted Mr. Francis Fox, chairman (who first suggested the utilisation of the Trenwith Mine pitchblende), and the other directors of the British Radium Corporation over their works at Limehouse. From the ore, which comes from the Trenwith Mine at St. Ives, 550 milligrams of radium as bromide have already been extracted, as well as the uranium which it accompanies, practically without loss. In an account which appeared in the *Times* of October 20, the reporter is in error in stating that Cornish pitchblende is richer in radium than the Austrian ore; on the contrary, the constancy of the ratio between uranium and radium has been repeatedly confirmed. From inspection of the Trenwith Mine, there appears good reason to hope that the present supply will be maintained, if not exceeded. The productive capacity of the works at Limehouse is about 100 milligrams a week.

A REUTER message from Stockholm states that this year's Nobel prize for medicine has been awarded to Prof. Albrecht Kossel, professor of physiology in the University of Heidelberg. Each prize will amount on this occasion to 7734*l*.

IT is proposed to hold in Paris next spring an international exhibition concerned with agriculture, oyster-culture, and fisheries. The organising committee has its office at 161 rue Montmartre, Paris.

The Royal Society informs us that the studentship on the foundation of the late Prof. Tyndall for scientific research on subjects tending to improve the conditions to which miners are subject has been awarded for the ensuing year to Dr. T. L. Llewellyn, of Bargoed, Wales, for research regarding the cause and cure of the disease in miners known as nystagmus.

Dr. Báthori, writing from Nagybecskerek, Hungary, informs us that the Hungarian Academy of Science has this year awarded the Bólyai prize, of the value of 10,000 crowns, to Prof. David Hilbert, university professor of mathematics at Heidelberg. The jury consisted of two foreign mathematicians—Poincaré (to whom the prize was awarded in 1905) and G. Mittag-Leffler—and two Hungarians, Y. König and G. Rados, both from Budapest.

News has been received from Italy of considerable damage wrought in the island of Ischia, accompanied by loss of life, due, in the first instance, to what is described as a cloud-burst. A hurricane has been referred to in the meagre accounts which have as yet reached this country, and from the local character of the phenomenon it seems likely that it was of the nature of a tornado, with torrential rain. The disaster occurred during Sunday night and Monday morning, October 23–24. The Paris *Bulletin International* for Monday, October 24, makes no mention of the disturbance, and contains nothing apparently associated with the occurrence except that at Naples the rainfall, measured at 7 a.m. for the preceding twenty-four hours, was 1·30 inches, and at Rome 0·87 inch. At Naples a further rainfall of 1·28 inches for the twenty-four hours ending October 25 is recorded in the Paris *Bulletin*, making the aggregate fall in forty-eight hours 2·58 inches. At Cette, in the south of France, 3·11 inches of rain fell in the twenty-four hours ending 7 a.m. October 25.

Early in November the University of Leyden proposes to celebrate the eightieth birthday of Prof. J. D. van Bemmelen. Prof. van Bemmelen was born on November 3, 1830, and has been engaged in scientific work since 1856. He has contributed greatly to the foundation of the Dutch school of physical chemistry. Prof. H. A. Lorentz, of Leyden, is the chairman of the committee organising the celebration, and Dr. W. P. Jorissen the secretary. It is proposed to publish as a memorial of the celebration a collection of memoirs by fellow-workers on the subjects with which Prof. van Bemmelen's name is associated, and already some sixty have been received. The memoirs will be published in one volume by M. C. de Boer Junior, Helder, Holland.

The annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W., on Tuesday and Wednesday, January 17 and 18, 1911. At this meeting a number of papers will be presented, including some of an essentially practical character, together with the preliminary report to the corrosion committee. It will be remembered that this committee was appointed some months ago to investigate cases of corrosion of the non-ferrous metals. The preliminary report will show the present state of our knowledge of the corrosion of non-ferrous metals and alloys, and will contain suggestions for a research into the causes of the corrosion by sea water of brass condenser tubes. The institute has now been founded just two years, and has celebrated its birthday by becoming an incorporated institution.

Speaking at the inaugural meeting of the Oxford branch of the Research Defence Society on Monday, Lord Cromer gave a number of instances of the value of research in medicine. In the course of his remarks he said:—Step by step the micro-organism of all the principal diseases—relapsing fever, leprosy, typhoid, tuberculosis, cholera, diphtheria, tetanus, influenza, plague, and dysentery—has been tracked to its lair. There is so great a wealth of evidence to show the results already achieved that it is difficult to decide which subject to mention particularly. The case of plague may, however, be taken as an example. When this terrible disease broke out in India some fourteen years ago a panic ensued. Vast sums of money were spent on disinfectants and other perfectly useless remedies. All was in vain. The epidemic continued to ravage whole districts. Then science took the matter up. The connection between the plague and the prevalence of rats was noticed. The fact that the rat flea, and not the rat itself, was the propagator of the disease was established. The anti-plague vaccine was discovered by Mr. Haffkine—but it took some years of observation before all these results could be obtained. When they were obtained science at last reaped its proud and well-merited reward. Colonel Bannerman, a distinguished Indian bacteriologist, said that in a number of cases in the Punjab, the aggregate population of which is about 827,000, some 187,000 were inoculated four months before the plague appeared, and that some 640,000 were not inoculated. Only 314 deaths occurred amongst the inoculated, while no fewer than 29,723 occurred amongst those who had not been inoculated. In other words, it may be said that experimental science saved the lives of about 8000 human beings, and those lives would not have been saved had it not been for the series of experiments conducted on living animals.

In the Harveian oration delivered before the Royal College of Physicians of London on October 18, Dr. H. B. Donkin discussed "Some Aspects of Heredity in Relation to Mind." He pointed out that the hypothesis of hereditary criminality lacks substantiation, though "a considerably larger minority of persons with clearly appreciable mental defect, apparently of congenital nature, is found among convicted criminals than in the population at large." It cannot be assumed that the criminal is a racial "degenerate." In inquiring into the causation of "congenital" mental defect, Dr. Donkin retained a severely sceptical position. In some cases a lineal sequence of defectives is sufficiently frequent to render it highly probable that this condition is truly innate, and thus transmissible; in other cases it may be an indirect result of malnutrition and the like in the parent; and there are other possibilities. Dr. Donkin laid emphasis on the difficulty of making sure whether mental and moral characters are inborn or "acquired," but it may be pointed out that his view of the distinction is not exactly that held by most biologists. In regard to the inheritance of mental qualities, he followed Sir Ray Lankester in attaching great importance to "educability." "The innate and transmissible factor of the mind of man is the organic potentiality for making mental acquirements." He did not, however, enter into a discussion of the hereditary reappearance of distinctive mental traits, and we venture to point out that his identification of mental acquirements and modifications will not commend itself to biologists who care for precision. A very interesting feature in the oration was the collection of some of Harvey's observations on heredity, in which Dr. Donkin was inclined to detect an "inkling of the great question regarding 'inherited' and 'acquired' characters."

At the Royal Society of Medicine on October 21 Dr. Franz Nagelschmidt gave a demonstration on "The Thermal Effects produced by High-frequency Currents." D'Arsonval directed attention, twenty-five years ago, to the "disagreeable burning sensation" that invariably accompanies the application of high-frequency currents. In the apparatus now shown this thermal effect is specially encouraged. Instead of the very high voltage (upwards of 100,000 volts) used in the ordinary forms of high-frequency application, the apparatus for diathermy gives about 800 volts, but the current which actually traverses the body reaches as much as $2\frac{1}{2}$ amperes. Stronger currents have been employed, but are not, in Dr. Nagelschmidt's opinion, free from danger. The demonstrator placed two circular electrodes at opposite sides of a piece of raw liver, and showed how the passage of the current produced a solid column of coagulated liver, the borders of which were strictly limited by the diameter of the electrodes, the portions of liver immediately outside the cylindrical coagulated block remaining quite unaffected. The sharply limited action of the current was demonstrated even more graphically by means of a solution of white-of-egg contained in a glass trough. In this case, when the electrodes were placed near opposite ends of the trough, a column of coagulated albumin could be seen to form between them, and if a small current (0·5 ampere) were used the coagulation commenced, not at the electrodes, but at a point midway between them, and extended thence to the electrodes. The practical applications of this current were described, and it was shown how masses of diseased tissue (such as cancers) could be removed without loss of blood and without fear of damaging contiguous parts. Apart from this, many forms of localised pain could be relieved in a few minutes by applying an electrode to the area of skin overlying the painful region. Several other possible therapeutic uses of the diathermal currents were mentioned, including the power of these currents to strengthen and accelerate the heart's action. The high-tension current is obtained by a motor generator giving alternating current. The current to be applied to the patient is easily regulated from a switch table.

Lieut.-Colonel L. A. Waddell, one of the leading authorities on the literature of Tibet, has deposited in the library of the India Office about one thousand books and manuscripts collected by him during the last expedition to Lhasa. These include a remarkable collection of ancient anatomical drawings from the Temple of Medicine at Lhasa, which preserve in pictorial form the old-world Indian beliefs regarding the structure and functions of the internal organs of the body. Much of this Indian surgical lore is probably of Greek origin, but the routes by which it may have reached India have not been clearly traced. This Tibetan series of drawings is believed to have reached Lhasa in the eighth century A.D. The collection will prove of much interest to students of Oriental surgery.

The prehistoric boat discovered at Brigg, Lincolnshire, in 1886, formed the subject of a law-suit, the result of which was that it was awarded to Mr. Cary-Elwes, Lord of the Manor, who has now presented it to the Hull Museum. It is in a rather dilapidated condition, but has been repaired, so far as possible, under the supervision of the curator, Mr. T. Shepherd. In his useful series of museum manuals he has now given full details of the discovery, with various drawings and photographs illustrating this remarkable exhibit. To this is appended a bibliography, which shows that few objects of antiquity discovered in this country have given birth to a more extensive literature.

In a supplement to the Annals of the Transvaal Museum Messrs. Gunning and Haagner have published a check-list of the birds of South Africa, based on Reichenow's "Vögel Afrikas," but bringing the subject up to date. The Zambezi-Cuneni line (lat. 16° S.) is taken as the boundary of the area, in which 919 species are recognised.

To the Annals of the Transvaal Museum for February Mr. J. Hewitt contributes an article on the zoological region of South Africa as deduced from the composition of its Lacertilia. After mentioning that the Zambezi-Cuneni line does not form a natural zoological boundary, as there is an extensive overlap of the southern and tropical faunas, the author expresses the opinion that the southern districts of Africa possess a fauna sufficiently peculiar to entitle this area to be regarded as a distinct zoological region, divisible into several subregions. "As regards the entity of the South African region as a zoological area, there can be no doubt but that the distinction between the peculiar endemic fauna of southern Africa and tropical Africa is too pronounced to permit of our regarding the South African region as merely a province of the large Ethiopian area, and, indeed, but for the infiltration of tropical forms, no one would hesitate to unite South Africa with Madagascar as a region quite distinct from the more northern parts of Africa. But the question of the northern boundary of our area is quite another matter." The author's conclusions seem to be entirely based on reptilian and amphibian evidence.

Great interest attaches to a paper by Mr. G. E. Pilgrim in vol. xl., part i., of the Records of the Geological Survey of India on new genera and species of mammals from the Indian Siwaliks, chiefly, it seems, those of the Punjab and Bugti Hills. Among numerous other forms, special reference may be made to *Sivapithecus indicus*, a new generic type based on the last lower molar of an anthropoid, which agrees in size and general form with the corresponding tooth of the gorilla, but has lower cusps and no cingulum. Upper and lower jaws indicate a second new anthropoid, referred to the European genus Dryopithecus. If rightly assigned to Mœritherium—and the reference is only provisional—a small and primitive proboscidean molar from the Bugti Hills apparently indicates a migration of the ancestors of the elephant-group from northern Africa to north-western India. From a phylogenetic point of view, perhaps the most interesting of all the new "finds" is the genus and species described as *Dorcabune anthracotheroides*. This species, according to Mr. Pilgrim, "shows the most extraordinary mingling of traguloid and anthracotheroid characters. Its upper molars may be described as like those of a Dorcatherium, only of an extreme bunodont and brachyodont type. . . . The same type of structure is displayed in the lower teeth, which, however, differ less, qualitatively, from Dorcatherium than the upper ones. . . . On the whole, the genus may be appropriately placed in the Tragulidæ."

The determinations of a small collection of plants gathered by Dr. Th. Derbeck on the shores of the Gulf of Tartary, near the mouth of the Amur, are communicated by Mr. V. L. Komarov to the *Bulletin du Jardin impérial botanique*, St. Petersburg (vol. x., part iv.). A characteristic littoral formation was prevalent, in which *Elymus mollis*, *Rosa rugosa*, and *Poa glumaris* were conspicuous. Two new species are created in *Leontopodium tataricum* and *Saussurea Derbecki*. The list of 158 plants affords an interesting comparison with the flora of Saghalien.

A short article communicated to the *Gardener's Chronicle* (October 22) by Mr. H. S. Thompson on botanising in County Kerry will interest the keen field botanist. Mt. Carrantual, the highest peak in Ireland (1041 metres), and a noted locality for Alpine plants, was the chief centre of attraction. The discovery of *Juncus trifidus* near the summit practically establishes a new record, and *Sieglingia decumbens* was also collected at an elevation above 1000 metres. Lower down, the two closely related species or varieties, *Saxifraga decipiens* and *S. Sternbergii*, were found in company with *S. stellaris*. Another find of great rarity was supplied by *Sisyrinchium angustifolium* growing with Drosera, *Lobelia Dortmanna* and bog Asphodel by Lough Caragh.

Three generic revisions are published in vol. xliv. of Engler's *Botanische Jahrbücher*: Dr. M. Burret discusses the relationships and distribution of African species of Grewia, Dr. W. Moeser amplifies a former collation of the genus Helichrysum in Africa, and Dr. Heinz Stiefelhagen contributes an account of the genus Scrophularia preparatory to the compilation of a monograph. The last survey of the genus Scrophularia was prepared by Bentham for De Candolle's Prodromus, since which time the species have almost doubled in number, mainly owing to plants collected in Persia, China, and Tibet. The author is of opinion that the genus is in an early stage of development. He fails to find a natural group character in the absence of a staminode, and bases his primary divisions on the habit, *i.e.* whether the plants are herbaceous or shrubby with well-developed leaves or xerophytic undershrubs with scanty leafage.

A sketch of the flora and plant formations of the Kermadec Islands, contributed by Mr. R. B. Oliver to the Transactions of the New Zealand Institute (vol. xlii.), is the outcome of a visit for eleven months to Sunday Island and flying visits on the way home to the three smaller islands. Several species are added to the flora, bringing up the total to 114 ferns and flowering plants. The author makes a new species of a smooth-stemmed lofty tree fern, *Cyathea kermadecensis*, separating it from another endemic species, *C. Milnei*, that has a short, rough stem. The forest formations are the most extensive and important. The dry forest shows three tiers of vegetation; the topmost consists almost entirely of trees of *Metrosideros villosa* about 60 feet in height; smaller trees such as *Rapanea kermadecensis, Myoporum laetum*, the palm *Rhopalostylis Baueri*, and *Cyathea Milnei* form the next tier, while *Pteris comans* supplies the ground vegetation in many districts. The other Cyathea, characteristic of wet zones, in one locality forms a forest as lofty as the Metrosideros. The author proposes to include the Kermadecs, with Lord Howe and Norfolk Islands, in a "subtropical islands' province" of the New Zealand region.

The *Rassegna Contemporanea* for September contains two articles of scientific interest. One is the speech given by Cannizzaro at the complimentary banquet at Rome on the occasion of his receiving the Copley medal of the Royal Society, a copy having been preserved along with his copious scientific and political correspondence. A photograph of part of the manuscript is also reproduced. Another article, by Riccardo Dalla Volta, deals with the International Agricultural Institute recently founded to collect agricultural statistics on an international basis. There is a useful field of work in this direction. The methods of collecting statistics and of crop reporting vary considerably in different countries, and any organisation that makes for greater uniformity is to be welcomed.

The Agricultural Department of the Transvaal is continually suggesting new crops and new industries to farmers, and in a recent issue of its Journal (vol. viii., No. 32) one of its experts discusses the possibility of raising ostriches. The best feathers are only produced when the birds are sufficiently nourished, and a good supply of food is therefore necessary. Lucerne is so valuable a food that wherever it can be grown the birds may be expected to thrive; about 40 lb. of the green crop or 10 lb. of the hay is taken by an ordinary ostrich weighing from 250 to 300 lb. If maize or other concentrated food can be supplied less lucerne becomes necessary, and a larger number of birds can be kept on a given area. A number of districts are indicated where ostriches might be expected to do well.

In the meteorological chart of the North Atlantic Ocean for November, published by the U.S. Weather Bureau, Prof. W. L. Moore points out that this month marks the beginning of the stormy season over the Transatlantic routes. For the purpose of illustrating the general behaviour of the storms, instructive synoptic weather charts are drawn for each day from November 11–16, 1909, inclusive, showing a typical case. The storm in question originated in high northern latitudes, and moved in a more or less easterly direction from Newfoundland to the north-east of the Azores. The chart for November 16 shows that the barometric depression had deepened and increased in size until the entire eastern part of the ocean was affected by the storm area. It also shows that a second barometric depression, apparently an offshoot of the central system, had formed about 500 miles north-westward of the Azores, which gave rise to severe weather along the northern shipping routes. Its approach to the British Islands seems to have been checked by the high-pressure system prevailing there.

Snowfall in the Transvaal is a somewhat exceptional occurrence; so far as can be ascertained, there have been only eleven years out of the last fifty-seven (1853–1909) in which it has been recorded. On two occasions, 1903 and 1904, the falls were very slight, and none was experienced during 1905–8 inclusive. The *South African Journal of Science* for September contains an interesting article on the subject by Mr. H. E. Wood, of the Transvaal Meteorological Service, with special reference to the heavy storm of August 16–18, 1909. Although a rather heavy fall occurred at Johannesburg in May, 1892, the fact of the town being covered to a depth of several inches on the morning of August 17 was such an unusual event, especially for the younger generation, that the day was celebrated as a general holiday. The maps of the distribution of atmospheric pressure show that the snowfall was associated with the rapid approach of a high-pressure system towards a region over which low pressure had previously existed. In the author's experience it has always been found that any widespread rainfall over eastern South Africa is connected with a rising barometer.

Prof. A. Piutti has sent us an abstract of a paper by him, read before the Royal Academy of Naples, on the absorption of helium in salts and minerals. Prof. Piutti has been able to detect helium in the gases extracted from borax and other salts, which have been melted and then suddenly chilled while a current of air has been bubbling through them. This experiment he regards as throwing doubts on Prof. Strutt's conclusions on the measurement of geological time from radio-active data. It is urged that helium may have been absorbed by the molten material of the igneous minerals, either from the atmosphere or from gases existing in the interior of the earth, and that similar processes may even have occurred in the sedimentary rocks.

THE third part of *Terrestrial Magnetism and Atmospheric Electricity* for the present year contains two valuable tables of corrections to the British Admiralty, the German Admiralty, and the United States Hydrographic Department magnetic charts of the North Atlantic, by Dr. L. A. Bauer and Mr. W. J. Peters, based on the observations made by the magnetic ship *Carnegie* during her recent cruise. Over almost the whole area the three charts show too low values for the west magnetic declination, the error being generally less than a degree, but in some cases it is nearly 3°. As the error is in the same direction for 5000 miles, it may result in a serious error in the position of a vessel at the end of a voyage. The corrections to the dip are not always of the same sign; their average magnitude is nearly 2°, and the actual amount in one case exceeds 4°. Over most of the region the values of the horizontal intensity given in the charts are too high by 8 units in the third decimal, C.G.S. units.

A NEW electric generating station was opened on October 12 at the Northampton Polytechnic Institute. The plant was supplied by Messrs. Siemens Brothers Dynamo Works, Ltd., chiefly for instructional purposes as an example of the latest ideas in central station practice, and comprises electrical apparatus for alternating- and for continuous-current working. The buildings of the polytechnic are sufficiently large to present experimental facilities on an engineering scale for most of the problems which have to be handled in larger stations. It is intended to run the station on a thoroughly commercial basis; the coal, wages, and other expenses will be strictly charged up, and every unit of electrical energy supplied for the purposes of the work of the polytechnic will be metered regularly and sold to it. The senior students, with the help of the technical staff, will take charge of this work. The main features of the plant are two gas-driven sets, each consisting of one continuous-current generator and one high-voltage alternator in tandem. The polytechnic authorities have issued for the use of intending students and others a full and well-illustrated description of the details of the whole plant, including gas-engines, suction gas-producer plants, alternators, motor-generator set, switchboards, transformers, and so on.

COMMENTING on the *Atlantic* airship voyage, the *Engineer* for October 21 does not pretend to any regret that the attempt has been an unqualified failure. Nothing of any value could have been expected from such a voyage arranged for spectacular purposes only. Enough, and more than enough, has been done to make the conquest of the air spectacular. If flight in its varied forms is to rise above the level of a mere sport, it is time that a little steady humdrum, useful work was entered upon, and that the praise of the public and the winning of prizes were forgotten. Much remains to be done, and it is well that it should be done steadily and scientifically by honest spade-work, and not under the glamour of popular sensationalism.

THE successful launch of the White Star liner *Olympic* at Belfast on October 20 gives occasion for a long illustrated article in *Engineering* for October 21. With a total weight of 27,000 tons, it can be understood that very careful provision had to be made to ensure the successful floating of the ship. The standing ways were about 800 feet long and the sliding ways about 700 feet long. The ship overhung the cradle aft to the extent of 80 feet, and forward to about 50 feet. The average pressure on the ways was only just above 3 tons per square foot. The declivity of the ways forward was $\frac{3}{8}$-inch per foot, and aft $\frac{1}{2}$-inch per foot. On the occasion of the launch the weather was perfect, with a slight stern wind. The pressure on the hydraulic ram of the trigger arrangement was 435 tons, and on this being released the ship moved at once, the hydraulic starting jacks not being used. The time taken was sixty-two seconds, and the maximum speed attained was $12\frac{1}{2}$ knots. When brought to rest, the bow of the vessel was 500 feet from the end of the ways. Messrs. Harland and Wolff deserve most hearty congratulations on their success, this success being due, in a large measure, to the minuteness and precision with which every detail connected with the operation had been anticipated.

A BOOK on "English Philosophy," by Mr. Thomas M. Forsyth, is shortly to be issued by Messrs. A. and C. Black. Its aim is to give an outline of the development of English philosophy from Bacon to the present day.

ERRATUM.—The author of the review of Prof. Seward's "Fossil Plants" in NATURE of October 20 writes:—"May I point out a slip, for which I am responsible, in my review? On p. 491, column 1, Arber and Parkin should be Arber and *Thomas*."

OUR ASTRONOMICAL COLUMN.

A BRILLIANT METEOR ON OCTOBER 23.—Mr. W. F. Denning writes:—"A splendid meteor was seen by Mr. J. E. Clark at Purley, Surrey, on October 23, at 8h. $12\frac{1}{2}$m. It shot slowly from $52°+34°$ to $72°+40°$, and left a streak for six seconds. The flight was directed from a radiant in the head of Aries, and the duration was four seconds. From Lincolnshire and the eastern counties the meteor must have appeared a magnificent object, and further descriptions of its apparent course will be very useful to aid in determining the real path above the earth."

SIMULTANEOUS PHOTOGRAPHIC OBSERVATIONS OF A REMARKABLE METEOR.—Herr Sykora, in No. 4447 of the *Astronomische Nachrichten*, gives particulars of the path of a bright meteor, of which the trail was photographed at three different stations, Taschkent, Iskander, and Tschimgan, on August 11, 1909. The brightness of the meteor varied considerably during the flight, and as the knots and outbursts are similarly shown on all three photographs, it has been possible to determine the heights at which they occurred. The first part of the trail, then very faint, began at 112 km., and suddenly brightened up at 97·7 km.; then there were marked outbursts at 88 and 85 km. respectively, with a sudden falling off at 83 km. At 81 km., however, a sudden recalescence occurred, and final extinction took place at 80·7 km. The radiant was found to lie in the position $\alpha = 44{\cdot}0°$, $\delta = +56{\cdot}9°$.

TWO REMARKABLE PROMINENCES.—No. 2, vol. xxxii., of the *Astrophysical Journal* (September, p. 125) contains a note, by Dr. F. Slocum, describing two remarkable prominences photographed with the Yerkes spectroheliograph during March and April.

One of these was remarkable for the lengthy period of its existence, the other for its extreme activity and brief existence. The former was first seen disappearing over the western limb of the sun on March 4, but reappeared, larger and transformed, on March 16; it was last photographed on April 28. On March 18 the prominence extended from latitude $-20°$ to $+25°$, and its longitude was about 70°; throughout its existence, of probably about 55 days, the southern limit was practically constant, but the northern limit varied considerably. The recorded apparent height varied between 77,000 km. (March 18) and 12,000 km. (April 1); when last photographed (April 28) the height was 61,000 km., but prominence plates secured on May 11, 12, 13, and 14 showed no trace of the outburst. A number of photographs, in H_α, calcium, light are reproduced in the journal, and it is stated that visual observations on April 13 showed the prominence to have the same form and size in the radiations $H\alpha$, $H\beta$, and D_3.

The other prominence was first noticed on a plate taken at 7h. 46·7m. G.M.T. on March 24. It was then conical in form, with a base extending from position-angle 230° to 235°, and an apparent height of 46,500 km. On a photograph taken March 25, at 2h. 54·9m., the prominence had assumed a rugged tree-form, with the trunk in position-angle 229·7°, and the height was 75,500 km. Then a rapid increase of height set in, and by 5h. 55·4m. the greatest altitude shown on the plate was 319,500 km. (nearly 200,000 miles), but the top of the glowing mass was beyond that. The greatest motion was observed between 4h. 56·1m. and 4h. 57·9m., during which period 11,600 km. were covered at a rate of 107 km. (66·8 miles) per second. This increase of height occurred in two ways, first by actual growth and then by detachment from the limb and the upward motion of the complete mass. At 7h. 43·3m. there was no trace of the prominence, which had apparently vanished upwards, and Dr. Slocum suggests that this floating away, rather than subsidence, is characteristic of eruptive prominences.

THE RELATIONS BETWEEN SOLAR AND TERRESTRIAL PHENOMENA.—In No. 4, vol. viii., of *Scientia* Abbe Th. Moreux has a long article (pp. 279–305) dealing with the connections between solar phenomena and terrestrial meteorology, more especially rainfall. He points out that as yet the science is in its infancy, that we are still unable to forecast scientifically, and then proceeds to show, by an excellent review of what has already been done, what progress has been made and what hopes for the future are well founded. The labours of Herschel, Schwabe, Wolf, Norman Lockyer, Meldrum, Chambers, Brückner, Stone, Balfour-Stewart, W. J. S. Lockyer and others, are discussed, and it is shown that a gradual progress in the collection of data and the correlation of phenomena has taken place. A fitting tribute is paid to the English Government for the installation of the Solar Physics Observatory, and the related observatories in India and Mauritius.

Finally, M. Moreux suggests that the excessive floods and rainfall of the present epoch are in accordance with precedent, heavy precipitation following the spot activity of 1905–7, and he suggests that the outlook for the future, in the matter of establishing laws which will warrant forecasting, is hopeful.

SEARCH-EPHEMERIDES FOR WESTPHAL'S COMET, 1852 IV.—Three search-ephemerides for Westphal's comet are given by Herr A. Hnatek in No. 4447 of the *Astronomische Nachrichten*: each ephemeris covers the period November 1, 1910, to January 30, 1911. As the period of the comet is uncertain, these three ephemerides are given, based on elements which give it as 60, 61, or 62 years respectively. The declinations are all between 56° and 60° south, and the computed magnitudes range from 13·1 to 14·8.

THE INTERNATIONAL CANCER CONFERENCE AT PARIS.

THE first International Conference on Cancer was held in Heidelberg in 1906 under the auspices of the German Cancer Committee, on the occasion of the opening ceremony of a cancer hospital and laboratory erected and equipped through the efforts made by Prof. v. Czerny, the distinguished surgeon. Out of that conference there developed an International Association for the Study and Suppression of Cancer, modelled on the lines of the International Association for the Suppression of Tuberculosis. This body, together with the French Association for the Study of Cancer, was responsible for the second conference, held in Paris on October 1–5 under the patronage of the President of the Republic. M. Doumergue, the Minister of Public Instruction, presided over the opening ceremony, attended by 150 delegates, including official representatives of the twenty-three foreign Governments. Dr. E. F. Bashford, director of the Imperial Cancer Research Fund, represented the British Government.

In his opening remarks M. Doumergue, after directing attention to the reunion of the nations in spontaneous congresses for the relief of physical, social, and moral miseries as a characteristic of the present age, pointed out the significance of the unanimity of these humanitarian endeavours, enlarged upon the advantages accruing from exchange of views and from the dissemination of discoveries, and asserted the futility of isolation. In his opinion the publicity obtained for the proceedings of such conferences is bound to bear fruit in a profitable collaboration between the medical profession, the public in general, and patients suffering from cancer.

Prof. von Czerny, the president of the conference, then addressed the delegates, and was followed by Prof. Bouchard, president of the French association, and Prof. Landouzy, dean of the faculty of medicine. Each surveyed the cancer problems from different points of view, the question of parasitic etiology, the alleged increase of the disease, and the possibilities of surgery, radium, and electrotherapeutics being discussed by von Czerny. Landouzy took more the point of view of the physician, seeing in much of the work that had been done on immunity indications of ultimately obtaining a curative serum. The foreign delegates were afterwards called upon.

The scientific papers were grouped in six sections:—(1) histology and histological diagnosis; (2) statistics; (3) clinical diagnosis; (4) treatment; (5) etiology and experimental pathology; (6) comparative pathology. Section (1) appointed a committee to draw up an international nomenclature of new growths. The discussion on statistics and statistical methods revealed strong criticism of the methods and results expounded by Prof. George Meyer, of Berlin, and no progress was made towards the compilation of comparable international cancer statistics. The papers in Section (3), on clinical diagnosis and on the chemistry of cancer, showed that serum diagnosis could not be trusted to replace older methods. The papers on treatment were followed by important discussions on the value of aids to surgical treatment, *e.g.* fulguration, X-rays, radium.

Little was said in favour of fulguration. The employment of radium was very fully discussed. Few of the speakers were prepared to employ it in other than small superficial lesions without previous resort to surgery; although many speakers had employed radium, they appeared to be of the opinion that they had in their possession quantities too small to permit of satisfactory conclusions as to its ultimate value. In Section (5) von Dungern, of Heidelberg, gave an account of the immunity reactions to transplanted cancer; he confirmed the conclusions of the Imperial Cancer Research Fund to the effect that the phenomena in question were due to the artificial induction of active resistance or "active" immunity to the cancer cell. Dr. Fichera had applied the results obtained by immunising animals with normal tissues to the treatment of cancer in man. He claimed to have caused the disappearance or reduction in size of true malignant new growths. Dr. Borrel described the evidence he had collected bearing on the possibility of Cestodes and Demodex fulfilling the part of carriers of a hypothetical cancer virus. Dr. Borrel's cautious statements called forth a vigorous criticism on the part of Durante. In the section of comparative pathology Prof. C. O. Jensen described tumours occurring on beets; no causative parasites were found in them. These tumours had been transplanted into other beets. From their general biological behaviour he very cautiously inclined to regard them as analogous in the vegetable kingdom to cancer in the animal kingdom.

The delegates were entertained in the most hospitable and attentive manner, both officially and privately. Much of the time officially devoted to discussion was absorbed by what were really new unannounced contributions, and, apart from the discussions on clinical matters and on treatment, very little serious discussion took place in the official sittings. This shortcoming was, to some extent, compensated for by the willingness of the delegates to discuss their respective points of view in private intercourse; nevertheless, purely scientific and theoretical questions suffered by being crowded out by matters assumed to be of more pressing importance from the point of view of the lay public.

As in the opening ceremony, so also in the closing ceremonies, interest centred round the utterances of Dr. Bashford with reference to the attitude of Great Britain towards the International Association, the organisation and proceedings of which have, in the past, not met with unanimous approval. The abstention of Great Britain from membership of the International Association was possibly in M. Doumergue's mind during his opening remarks, and was unambiguously referred to at that ceremony by Dr. Bashford, who explained that in Great Britain the opinion is held that the time is hardly ripe for congresses concerning a disease of which so little is known as cancer, and which, at present, it is impossible to prevent, there being at the same time nothing revolutionary for such conferences to agree upon or to discuss. What is wanted at present is rather an army of independent active workers, for, as in the past in regard to other matters, so in the future with regard to cancer, advances in knowledge are to be expected from individual investigation rather than from the deliberations of national committees or international conferences. Still, workers in Great Britain have done all that is practicable to further international intercourse and collaboration, and will do so in the future.

In his closing remarks von Czerny, as president, expressed the hope that the objections to the organisation and assumed functions of the International Association will be removed before the conference is again called together, probably in Dresden in 1913.

It may be recalled that the proposal to hold a second International Conference in Paris was made after a proposal to hold the first International Cancer Congress in London had been rejected by responsible persons in this country.

REPORTS OF METEOROLOGICAL OBSERVATORIES.

BREMEN, "*Meteorological Year-book*" (1909).—This volume, the twentieth of the series, gives a short monthly summary of the weather, observations thrice daily (in the form adopted by the International Committee), two-hourly readings of the self-recording instruments, and monthly and yearly *résumés*. The results for earth temperature at various depths (0–300 cm.), evaporation, solar and terrestrial radiation, &c., for a number of years are shown both graphically and in tabular form. The curves of duration of sunshine, evaporation, and solar radiation all exhibit a similar and peculiar kink from July to August. Dr. Grosse points out that, whereas Hann considers that evaporation is most intimately connected with temperature, he (the author) thinks it is more closely connected with the duration of sunshine. The rainfall at Bremen is greatest between June and October inclusive; July has a decided maximum.

Liverpool Observatory (1909).—The Mersey Docks and Harbour Board, which maintains this important institution in the interest of navigation, has caused a second seismometer to be erected under Prof. Milne's supervision, and some devices of great delicacy were introduced in order to solve certain problems connected with the physics of the earth's crust. The instrument has not been long at work, but it is said that the records indicate clearly a deformation of the surface due to the load of tidal water in the Mersey estuary. We have before pointed out that the automatic meteorological instruments include anemometers designed by Osler, Robinson, and Dines respectively; the tables show for each day the velocities recorded by the Dines' instrument, the horizontal motion of the air, and the extreme pressure on the square foot—in addition to the direction. The mean temperature of the year (mean of maximum and minimum), 48·1°, was 1° below the average; the absolute maximum, 76·4°, occurred in May, and was 12·7° below the highest record; the minimum was 22·3°, in December, 13·8° above the lowest record. The rainfall, 28·45 inches, was very slightly below the normal.

Royal Alfred Observatory, Mauritius (1909).—From tables showing the means and extremes of the principal meteorological elements, it appears that the mean temperature of the year was 72·9° as compared with the average, 73·4° (1875–1905); mean of daily maxima 80·4°, minima 66·7°; absolute maximum 89·3°, in December; minimum 54·7°, in July. Maximum in sun's rays 163·4°, in January; minimum terrestrial radiation 45·7°, in May. Rainfall, 47·83 inches, as compared with an average of 47·95 inches; the principal feature was a total excess of 11·23 inches above the normal in June and July. The rainfall of June was the greatest on record in all parts. The annual amount for the whole of the island (mean of seventy-two stations) was 90·50 inches, as compared with an average of 82·37 inches. During the year eight cyclones occurred in the South Indian Ocean; tracks of six of them in January and March are given. The mean magnetic declination was 9° 16·34′ W. The magnetic disturbance which occurred on September 25–26 was the greatest on record, the total movement in horizontal force being 0·00650 C.G.S. unit. Photographs of the sun were taken daily when weather permitted, and 103 negatives were forwarded to the Solar Physics Committee.

Transvaal Meteorological Department (1908–9).—The number of stations reporting to the Johannesburg Observatory during the year ended June 30, 1909, was 599, an increase of fifty-two since the last report; these are mostly rainfall stations. The year was the wettest since accurate statistics have been collected, but several such rainy seasons will be required before the springs can regain their former activity. The average for the whole colony was 40·6 inches, on eighty-three days; the greatest rainfall was on the eastern slope, in the Leidenburg district, where more than 109 inches on 133 days were recorded. Maps are given showing (1) the rainfall for 1908–9, and (2) the mean for the last five years; the latter shows that only the eastern part of the colony has an average of more than 30 inches. No snowfall was reported by any station. but some was seen on the hills on August 21, 1908. The meteorological tables include hourly or two-hourly readings at Johannesburg and Pretoria. Daily weather forecasts are issued, and are exhibited at all postal telegraph offices. The Johannesburg Observatory is well provided with self-recording instruments, and it is expected that a set of Wiechert's instruments for recording earthquake phenomena will be shortly installed; at present the department distributes and collects postcards giving particulars of any earthquakes noticed.

Deutsche überseeische meteorologische Beobachtungen (*Heft xviii.*).—As in several past years, this very valuable series of observations has been published by the Deutsche Seewarte, with the assistance of the German Colonial Office. The present volume includes monthly and yearly summaries of the stations under the control of the Seewarte, also observations at the imperial observatory at Tsingtau and affiliated stations, and those made in East Africa, some of which are printed *in extenso*. The data refer mostly to 1908, with a few arrears, and useful references are given in many cases as to where the earlier observations may be found. We note in the Acta (1909) of the Solar Commission of the International Meteorological Committee, which proposes to publish certain meteorological data for the whole globe in a condensed form, that the German oversea observations will be turned to good account. The headquarters of the commission (of which Sir Norman Lockyer is president) are at present in London, in connection with the Solar Physics Observatory at South Kensington.

TREES AND TIMBER.

THE difficulty of identifying timbers exported from partially explored countries is only too well known, so that any attempt to arrange an authentic collection of specimens of tropical timbers deserves recognition. With this object, Dr. M. Büsgen has placed on record in the *Mitteilungen aus den Deutschen Schutzgebieten* (vol. xxiii., part ii.) the distinguishing characters of the trees noted on an expedition through the German Cameroons, and has published a series of figures illustrating sections of representative timbers, of which original specimens are stored at the Forestry College in Münden. The author records a preponderance of species for the families Leguminosæ, Apocynaceæ, Euphorbiaceæ, and Moraceæ. Among the more important trees are *Chlorophora excelsa*, apparently identical with African teak; *Enantia chlorantha*, a yellow-wood; *Entandophragma Candollei*, a source of mahogany; *Lophira alata*, known as ironwood; and *Mimusops djave*, that furnishes Congo mahogany.

In connection with the economic side of Indian forestry, Mr. R. S. Troup has prepared reports on the fissibility of some Indian woods and the prospects of the match industry in the Indian Empire, the former published in the Indian Forest Records (vol. ii., part ii.), the latter in the Indian Forest Memoirs (vol. ii., part i.). The experiments on fissibility indicate that splitting depends mainly on the nature of the grain, and that a hard wood with straight grain, such as *Acacia catechu*, splits more readily than a cross-fibred soft wood, such as *Bombax malabaricum*. Tests were also made to compare the cleaving force required in tangential and radial planes, with the result that for most timbers cleavage proved to be easier in the tangential plane. The memoir on match woods is very comprehensive, and sets out the results of practical manipulation with different woods, suitable locations for factories, the possibility of obtaining supplies, and an article on the manufacture of matches. Species of poplar, willow, and alder—the trees that yield wood used in European factories—are found in parts of India, but not in sufficient quantity. Fortunately, a number of Indian trees yield suitable wood, amongst which *Bombax insigne* and *B. malabaricum* are expected to furnish the bulk of supply.

An article in the *Kew Bulletin* (No. 6) on new trees and shrubs, contributed by Mr. W. J. Bean, refers with one exception to Chinese introductions. Three conifers are described: *Larix Potaninii*, a larch attaining a height of 70 feet; *Picea complanata*, a flat-leaved spruce; and *Tsuga yunnanensis*. Of the dicotyledons, a pinnate-leaved species of Syringa is a novelty collected by Mr. Wilson for Messrs. Veitch; *Pyrus Folgneri* is an attractive horticultural addition to the genus, and *Meliosma Veitchiorum* possesses both morphological and horticultural interest, as it is the only tree in the family Sabiaceæ hardy enough for outdoor cultivation in this climate, and promises to be a most ornamental acquisition to the garden. Considerable interest attaches to a revision of the genus Entandophragma communicated by Mr. T. A. Sprague, because various species of the genus, and the allied genera Pseudocedrela and Swietenia, are important sources of timber.

SELECTIONS FROM AMERICAN ZOOLOGICAL WORK.

NATURE for 1908, vol. lviii., p. 140, contained an illustrated account by Mr. N. H. Corquodale of a pair of hartebeest horns attacked by a tineid larva. Another instance of antelope horns—in this instance those of a waterbuck—being attacked by such larvæ is illustrated by Mr. A. Busck in vol. lvi., No. 8, of Smithsonian Miscellaneous Collections. The author claims to have shown the nature of the larval tubes—apparently the work of *Tinea vastella*—more distinctly than has been done before.

The *spolia* of the Smithsonian Expedition to East Africa continue to afford the bases for new work, among which we may refer to a description by Mr. W. H. Dall, in No. 10 of the volume just cited, of three new land-shells, two referable to Buliminus and the third to Limicolaria.

It is always satisfactory when two or more observers arrive independently at the same conclusion. An instance of this is afforded in a paper on chimæroid fishes by Messrs. Bean and Weed, published in Proc. U.S. Nat Mus., No. 1723, where the authors come to the conclusion that the Japanese species described by Mr. S. Tanaka under the new generic title of Anteliochimæra is not separable from the long-beaked chimæras of the genus Harriotta, a view which had been previously adopted by Messrs. Holt and Byrne, although this was unknown to the authors until their paper was in type. Excellent figures are given of the typical *Harriotta raleighana*.

In this connection it may be mentioned that the part of the Journal of the College of Science of Tokyo University containing Mr. S. Tanaka's description of the so-called Anteliochimæra has only lately been received, although it is dated October, 1909.

Among papers relating to the North American fauna, mention may be made of Messrs. Meek and Hildebrand's list of fishes inhabiting the lakes, rivers, and lagoons of the Chicago district, issued as No. 9 of vol. vii. of the Zoological Publications of the Field Museum. Special interest attaches to the fish-fauna of the district owing to the changes caused by the growth of the great city; and it is hoped that the paper will lead to careful study of these changes, as well as to observations on the distribution and habits of the various species.

In another faunistic paper, Proc. U.S. Nat. Mus., No. 1719, Mr. D. Coquillett supplies a list of the type-species of North American genera of Diptera, a subject which comes very opportunely at a time when so much attention is being devoted to the biting flies of the world. That there was need for revision is exemplified by the statement that a certain fly, *Tachina vulgaris*, has been redescribed and renamed 257 times, one writer alone having made from it 245 species, arranged in five genera; this being only one—it may be hoped the worst—out of many cases. The author carries priority in nomenclature to the bitter end, a matter of less moment in this than in many other groups.

Perhaps the most important of all the papers in the batch on which these notes are based is one by Mr. A. H. Clark (Proc. U.S. Nat. Mus., No. 1756), on *Proisocrinus ruberrimus*, a new genus and species of stalked crinoid from the Philippines. The new form is by far the tallest existing member of the group hitherto discovered, the height, exclusive of the root, exceeding 40 inches. In colour it is brilliant scarlet, thereby differing from the purples and greens of the Pentacrinidæ, and the yellows of the Apiocrinidæ and Bourgueticrinidæ. The family position of the new genus is still uncertain; the general structure of the calyx and arm-bases recalling Bathycrinus, while the arms and pinnules are of the type of those of the Pentacrinidæ, although most of the stem resembles that of Calamocrinus. There is also an approximation—apparently more than superficial—to Millericrinus.

In No. 1759 of the aforesaid Proceedings Mr. J. A. Cushman describes a collection of arenaceous Foraminifera obtained by the *Albatross* during her recent cruise in the Philippines. Ten species and one genus (Sphærammina), are believed to be new. In the new genus the test consists of a series of spheroidal or ovate chambers arranged on a straight axis, with the one last formed envleoping the rest. In several respects it recalls the Miocene *Ellipsoidina ellipsoides*.

R. L.

DISTRIBUTION OF WEEDS.

THE numerous means by which nature ensures the distribution or dispersal of seeds of wild plants are well known to students of botany. For example, some seeds (Papaver, Orobanche) are very light and easily scattered by the wind; others (Cnicus, Senecio, Rhinanthus) bear flight organs or "wings," by means of which they sail away on the breeze; some seed vessels are so constructed that on ripening and opening they throw out the seed with considerable force (Lupinus); while some fruits bear hooks, by which they become attached to animals and man, and so secure distribution (Galium, Arctium). Unhappily, many serious weed pests are also distributed by man in agricultural and horticultural seeds and various other means, and doubtless many botanists have read of the emigrant Scotchman who, in the pride of his heart, took specimens of the national emblem to Australia, and so introduced a very harmful weed.

A few months ago an advertisement, resembling a paper butterfly, was widely distributed, and, probably for realism and novelty, it was made to bear the burr of the burdock (*Arctium Lappa*). This advertisement doubtless received attention owing to the fact that recipients attached it (by the "burrs") to the clothing of other members of the household! It appears that the same method has been utilised—perhaps by the same advertisers—in Australia, and the following extract from the *Agricultural Gazette of New South Wales* (August 2) is of interest:—"The Chief Quarantine Officer for Plants has informed the Under-Secretary for Agriculture of a most extraordinary method whereby an objectionable weed might be broadcasted throughout the State. It appears that, as an advertising medium, some printed paper, representative of a flying insect, has been sent to Australia, and the genius who invented this particular style of advertisement, in an endeavour to make it more realistic or uncommon, had attached to each specimen the burr or seed of the noxious weed 'Burdock' (*Arctium Lappa*). The authorities in Western Australia had called the attention of the Director of Quarantine to the use to which the burr of this noxious weed was being put. It is needless to say that business firms stopped the issue of the advertisement under notice as soon as they knew there was a serious objection to its use."

Burdock is a very troublesome weed, and it is clear that our colonial friends have to be on the alert if they are to prevent the introduction of new plants in the manner outlined.

THE LANCASHIRE SEA-FISHERIES LABORATORY.

THE eighteenth report of the Lancashire Sea-Fisheries Laboratory (for the year 1909) contains an account of work carried out at the University of Liverpool, at the sea-fish hatchery at Piel, and at the Port Erin Biological Station. Mr. James Johnstone describes five species of internal parasites of fishes from the Irish Sea, the three genera discussed being Lebouria, Prosthecobothrium, and Echeneibothrium. The same author reports on the measurements of some 55,000 plaice from the district, curves representing the frequency of fish at each unit of length for the most important fishing grounds being given. The average weights of plaice at each unit of length from various fishing grounds have also been determined. Taking Heincke's formula $w = \frac{l^3}{100}k$ where w is the weight in grams and l the length in centimetres, the monthly variations in the value of k have been calculated for several of the grounds. The value shows a maximum in July, and the minimum appears to be in January, at which time of the year very little food is found in the stomachs of the plaice.

A considerable section of the report is occupied by papers on hydrographical work done in the Irish Sea by Mr. Johnstone and Dr. H. Bassett. It is doubtful, however, whether the comparatively slender data contained in the papers of the latter writer can be usefully employed in the way suggested by him, in connection with the prediction of climatic conditions over extended periods of time. Very much more research will be necessary before such predictions can have any but a speculative value.

The report concludes with a paper by Prof. Herdman, Mr. A. Scott, and Mr. Dakin on plankton work carried out off the Isle of Man in 1909. The paper as a whole tends to confirm the doubts, which have often been expressed, as to the value of the quantitative methods of plankton work, as at present practised. Until some trustworthy instrument has been devised for accurately measuring the quantity of water which has passed through the net on each occasion, the elaborate methods of counting the organisms captured would hardly seem to repay the time which must necessarily be employed upon them.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THE attendance of zoologists at the meetings of Section D was affected by the fact that the International Congress of Zoology at Graz and the International Congress of Entomology at Brussels had taken place so recently. These meetings abroad were probably responsible for the absence of a few of those who in previous years have contributed papers to the section. The programme, being a little less crowded than usual, was taken at a more comfortable pace, and reasonable time was available for discussion and remarks on the various subjects under consideration. The attendance at the meetings of the section was very satisfactory, especially in the circumstances, and the interest in the proceedings was fully maintained to the end; indeed, the concluding meeting was one of the best of the series.

Coral Snakes and Peacocks.

The popular lecture, which for several years has been a feature of the programme of the section, was given before a large audience by Dr. H. F. Gadow, F.R.S., who chose for his subject "Coral Snakes and Peacocks," and illustrated his remarks by a series of lantern-slides in colour. He first described some of the physical features of Mexico, during a visit to which country his observations on coral snakes (Elaps) were made. The red, black, and yellow markings of these snakes have been said to be of the nature of "warning coloration," but Dr. Gadow pointed out that, although the markings are conspicuous when the snakes are lying in a dish or other vessel, the colours commingle, especially in the dusk, with the natural surroundings of the animal, so that it becomes very inconspicuous. Coral snakes are entirely nocturnal in habit; they lie in hiding during the day, so that the explanation of their coloration as "warning" is unwarrantable. Many harmless snakes are coloured in a similar manner to the coral snakes, *e.g.* among a large collection of Coronella from various places in Mexico examples of one species were found which seem to have "mimicked" several of the colour patterns exhibited by species of Elaps. But Dr. Gadow pointed out that the specimens of Elaps and Coronella found in the same locality do not exhibit the same colour pattern. Dr. Gadow's conclusion, stated briefly, was that the resemblances in colour pattern between Coronella and Elaps are instances of pseudo-mimicry. In the second part of his address Dr. Gadow traced the gradual transition from a comparatively simple feather with light and dark bands to the "eyed" feather, with fully developed metallic lustre, of the mature peacock's "fan." He then described the retrogressive changes leading from the "eyed" feathers to the modified feathers of the back and margin of the "fan."

Coccidia and Coccidiosis in Birds.

Dr. H. B. Fantham described his observations on the life cycle of the sporozoon *Eimeria* (*Coccidium*) *avium*, which produces a form of "enteritis" in grouse, fowls, and pheasants, especially in young birds. Resistant oöcysts of the parasite are voided in the fæces of the infected birds, and are acquired by other birds in their food or drink. A mature oöcyst contains four sporocysts, in each of which are two active motile sporozoites. After the oöcysts have been swallowed by a bird, the cyst wall is softened by the pancreatic juice, the sporozoites creep out and penetrate the epithelial cells of the duodenum, in which they become rounded and grow, feeding passively on the host cell. After attaining a certain size, the nucleus and protoplasm of the parasite—now a schizont—divides into a cluster of merozoites arranged *en barillet*, *i.e.* like the segments of an orange. Very little residual protoplasm remains after the formation of merozoites. These small, vermicular merozoites glide away and invade other cells, within which they grow to schizonts and multiply. A number of generations of merozoites is produced in this way, and the destruction of the epithelium and the derangements resulting therefrom in some cases cause death of the host. In most instances some merozoites pass down into the cæca, where they grow and multiply, producing intense inflammation. Sooner or later a limit is reached, both to the power of the bird to provide nourishment for the parasites and to the multiplicative capacity of the parasite itself, and then sexual forms are produced. Some of the organisms become large and contain much reserve food material. These are the macrogametocytes, each of which, after the maturation changes, becomes a single macrogamete. Slightly smaller parasites, with little or no reserve material, undergo nuclear multiplication and give rise to many minute biflagellate microgametes, which disperse and swim away in search of macrogametes. Each of the latter has precociously invested itself with a cyst wall, in which a micropyle is left for the entry of the microgamete. One microgamete only fuses with the macrogamete, and then the oöcyst wall is completed by closure of the micropyle. This series of changes, from infection to the formation of oöcysts, extends over about eight or ten days in the grouse. At first the oöcysts are uninucleate, and their contents completely fill them; later the contents concentrate into a spherical mass, the nucleus divides into four, around each of which the protoplasm aggregates, forming four round sporoblasts. Each sporoblast develops into an oval sporocyst, in which two sporozoites are formed. The oöcysts, when dropped, are very hardy; some which had been taken from a moor a year previously were found to be still alive.

Coccidiosis is accompanied by an increase in the number of polymorphonuclear leucocytes in the blood of the host, together with a decrease in the number of the erythrocytes. Young birds are much more susceptible to coccidiosis than older ones, but older birds which have become "chronics" serve as reservoirs of oöcysts, and are constant sources of infection. Lime dressing of the soil, which destroys oöcysts, is the most effective treatment at present known for combating coccidiosis.

The Formation and Arrangement of the Opercular Chaetae of Sabellaria.

Mr. Arnold T. Watson contributed an account of the opercular chætae of *Sabellaria alveolata*. The operculum, with which this tube-building polychæte defends the opening of its tube, consists of two crescent-shaped structures, each of which is composed of three concentric rows of paleæ, of characteristic form, borne at the distal extremity of the peristomial lobe. Viewed from above, the exposed portions of the paleæ of the outer and middle rows are seen to be arranged in an imbricated manner, their free ends directed outwards, while the free ends of the paleæ of the innermost row, the chætae of which alternate in position with those of the middle row, are directed inwards and upwards. Mr. Watson has found that there are two "nests" for the formation of the chætae, an outer one supplying the outer paleæ and an inner one producing the middle and inner paleæ, which are packed alternately in the nest. The chætae can be traced, and evidently travel, in a somewhat spiral fashion to reach, in rotation, their respective positions at the dorsal end of each opercular crescent. A similar process was observed in *Sabellaria spinulosa*, but in this species there are, in each lobe, two or three long, curved, acicular dorsal chætae in addition to the three rows of chætae which form the operculum. In certain members of the family, *e.g.* Pallasia, the operculum is armed with only two rows of paleæ, but there exist, in addition, two or more hooks, placed dorsally, in positions corresponding to the acicula above mentioned. These hooks have been regarded by some zoologists as homologous with the missing middle row of opercular paleæ, but this view is rendered very doubtful by the conditions found, and described above, in *Sabellaria spinulosa*.

The Anatomy and Physiology of Calma glaucoides.

Calma is a small nudibranch mollusc living exclusively on the eggs of fishes, which it simulates closely in appearance. Mr. T. J. Evans described the modifications which this animal has undergone in response to its specialised diet. The radula, a rasping instrument in other gastropods, has become a saw for cutting open the eggs, the teeth being reduced to a single row. The stomach is enormously enlarged, and in well-fed specimens is filled with a hard, albuminous mass. During the feeding period the growth of the genital organs is retarded; they do not develop until the contents of the stomach have been digested, by which time space is available for the growing gonads. The gonads are not massed as in an ordinary Eolid, but are packed in the angles between the liver diverticula, and the male duct has been pushed forward to the level of the mouth. There is no intestine or anus, and the excreta of the first year remain on the floor of the stomach and liver branches under the food of the second year. In the cerata certain amœboid cells of the hæmocœl enter into relations with the liver cells and absorb protein from them. When fully impregnated with nutritive material they fall back into the hæmocœl as oval glassy cells, and the protein contents are gradually absorbed during the winter fast.

Sex and Immunity.

Mr. Geoffrey Smith gave the results of further work on the effects of the parasitic cirripede Sacculina on the spider crab Inachus. He has previously shown that the effect of the parasite is to cause the male host to assume adult female characters externally, and, after the death of the parasite, internally also, for large ova were produced in the testes. The effect of the parasite on the young female crab is of a similar nature, for the young infected female is forced to assume adult female characters at a premature stage. Mr. Smith suggested an ingenious explanation of these phenomena. He showed that, in an infected Inachus of either sex, the Sacculina-roots manufacture yolk similar to the ovarian yolk of a normal female Inachus. The parasite thus forces the crab, whether male or female, to produce substances in the blood from which the Sacculina-roots can manufacture yolk; as fast as these substances are produced the Sacculina takes them up and, by anchoring them, stimulates their continued production. These yolk-forming substances, saturating the body fluids of infected crabs, both male and female, cause the development of the secondary sexual characters. When the parasite dies and its roots no longer assimilate the yolk-forming substances, they are taken up by the remains of the gonad (which, while the crab was parasitised, had been reduced and non-functional), which consequently proceeds to form ova. In the parallel case of Peltogaster, parasitic on Eupagurus, Mr. Potts has shown that small ova are formed in the testes of the host while the parasite is still alive, so that, in this case, the excess of yolk-forming substances is taken up by the gonad during the life of the parasite. This over-production of a substance which is being anchored by a parasite is regarded by Mr. Smith as closely analogous to the production of antibody in immunisation. By supplying the Sacculina with the yolk-forming substances, the crab protects other nutritional substances necessary for its vital organs from being abstracted by the parasite.

In answer to comments by Prof. Bateson, F.R.S., and Prof. Hartog, regarding the nature of the eggs found in the testes of male crabs recovering from the attacks of Sacculina, Mr. Smith stated that such ova are as large and as fully formed as normal eggs, become pigmented (red) like the latter, and, so far as structure is concerned, are entitled to be regarded as ordinary eggs. Replying to observations by Mr. Doncaster regarding the presence or absence of "femaleness" in the male crab, Mr. Smith said that the conditions indicated that the male contains latent female potentialities, for these latter could not be introduced by the Sacculina, and yet complete formation of morphological female characters took place in recovering males.

The Colours of Insect Larvae.

Prof. Walter Garstang described a series of experiments which he had carried out this summer on the effects of foods deficient in chlorophyll on the coloration of phytophagous larvæ of Lepidoptera. The experiments were designed to confirm and extend the results obtained in 1892 by Prof. Poulton, who showed that, in the case of *Tryphaena pronuba*, larvæ fed on the white mid-ribs of cabbage retained a white ground colour (with the addition of superficial black pigment in the later stages), while larvæ fed on yellow etiolated leaves developed the same green and brown pigments as those fed on green leaves. Prof. Garstang obtained very similar results, using the larvæ of *Euplexia lucipara*. Larvæ fed from the time of hatching on the yellow inner leaves of lettuce developed the same green pigments as those fed on green leaves, while larvæ fed on the mid-ribs acquired a semi-transparent whitish colour, very faintly tinged with green or yellow. The superficial blackish markings developed in all cases.

On the other hand, the larvæ of *Mamestra brassicae* fed on mid-rib of lettuce and on carrot, while failing to produce the normal green colours, also showed a marked deficiency of the black superficial pigments which formed a conspicuous element in the coloration of normal green-fed larvæ during the last two stages. Several larvæ fed on mid-rib were practically white at the time of pupation; those fed on carrot were slightly darker. Further experiments would be necessary to show whether the deficiency of black pigments was due to altered metabolism or was comparable with the many cases among Geometrid and Vanessid pupæ, &c., in which the formation of black superficial pigment-screens is subject to inhibition from white or yellow backgrounds. The latter interpretation of this case was regarded by Prof. Garstang as improbable on the evidence available, for the mid-rib set had been kept for the most part in a dark cupboard, and two of these larvæ, transferred, when half grown, to purple cabbage in the light, had shown the same features to a pronounced degree.

In the discussion which followed, Mr. Doncaster inclined to the other interpretation, and suggested that the light reflected from the alimentary canal of the specimens on purple cabbage (which became blue-green after ingestion) may have had an inhibitive effect.

Insect Coloration.

Mr. Mark L. Sykes exhibited specimens of various insects among leaves and other natural objects, and in his remarks held that the colours of these insects supported the view of protective coloration. Mr. G. Storey, commenting on some remarks of Mr. Sykes on mimicry, mentioned Prof. Punnett's experiments on certain Ceylon butterflies of the genus Papilio, which are supposed to afford one of the most striking cases of mimicry. These experiments, he thought, were by no means sufficient to overthrow the theory of mimicry, but they showed that the mimickers derived little protection from their deception from certain classes of their enemies.

The Biology of Teleost and Elasmobranch Eggs.

Dr. W. J. Dakin confirmed the results reached by Botazzi and others which indicated that the osmotic pressure and salinity of the blood of marine teleosts were different from that of the external medium in which they lived, but were affected by changes in the salinity of the water. The blood of the eel has a lower osmotic pressure in fresh water than in the sea, and the blood of fresh-water fishes is less saline than that of marine fishes.

The osmotic pressure of the blood of elasmobranchs is almost identical with that of the sea water in which they live.

Dr. Dakin extended his observations to the eggs of certain fishes, and showed that the specific gravity of plaice eggs can be altered by varying the salinity of the water in which they are living. The egg-contents are therefore not independent of the sea water. He also showed that the salinity and osmotic pressure of the egg-contents was much less than that of the medium in which the eggs were living, and about the same as that of the blood of the adult fish. There is therefore an equilibrium between the sea water and the egg-contents which does not consist in an equality of osmotic pressures; while both osmotic pressures are very different, a change in that of the water produces a small but definite change in that of the egg-contents. Death of the egg-contents destroys the conditions under which this equilibrium is sustained, and the egg-contents increase in salinity by reason of the influence of the surrounding sea water; a corresponding increase in specific gravity takes place, and the egg is no longer able to float.

The osmotic pressure of elasmobranch eggs is very different from that of teleost eggs, though both may be living in water of the same salinity. The relation existing between the egg-contents of dog-fish eggs and the water is the same as that between the blood of the adult fish and the medium in which they live.

Semination in the Sanderling.

Prof. C. J. Patten has already pointed out that examples of the sanderling (*Calidris arenaria*), apparently in nuptial plumage, and occurring along our shores at the height of the breeding season, are not fully matured, their plumage presenting a slight difference from the true nuptial garb. To this plumage the name pre-nuptial was applied. Prof. Patten found, on examining the testes of such birds, that although a certain amount of spermatogenesis had taken place, no real functional activity had been reached. Of the sanderlings which occur on our coasts during the period when they ought to be nesting, those birds not pairing seem to divide into small parties and to lead a sort of nomadic life from shore to shore until about the end of August, when they tend to muster; in September they join company with migrants coming from northern climes, the latter, as a rule, being young birds in first autumn plumage. There are thus formed flocks of young and partially matured birds. The fully adult birds arrive about October. Prof. Patten considers that there is reason to believe that other species of shore-birds take more than a year to reach maturity, and that, prior to this period, their desultory migratory movements correspond in the main with those of the sanderling. Investigations into the question of semination in these cases would afford elucidation of some points of importance regarding avian migration and geographical distribution.

Anatomical Adaptations in Seals to Aquatic Life.

Dr. H. W. Marett Tims exhibited a series of lantern-slides illustrating some of his observations on the collection of embryo seals obtained by the *Discovery* expedition, and directed attention to the adaptations to aquatic life which these animals present. The rotation of the limbs to the adult position takes place at an early stage of development. The shortening of the neck is produced by a great ventral curvature of the spine in the cervical and anterior dorsal regions. This, too, is indicated at a very early embryonic stage in both male and female. Dr. Tims remarked, incidentally, that the manner in which the cervical region of the skeletons of seals in our museums was set up, namely, with the vertebræ almost in a straight line, was quite wrong. The prevention of the entrance of water into the lungs is brought about by a secondary growth of the posterior edge of the soft palate, which becomes fused with the wall of the œsophagus. The fact of the very early establishment of these modifications affords an instance of what some would regard as examples of the inheritance of acquired characters.

The Temporal Bone in Primates.

Prof. R. J. Anderson contributed some notes on the temporal bone in primates, pointing out that the squamosal shell, which has three or four ossific centres, sometimes shows a separate zygomatic part and occasionally a separate upper triangular part. The antero-posterior and vertical measurements of the bone in several primates were given; they vary from 5 : 1 in Pithecia to less than 2 : 1 in Semnopithecus. The various antero-posterior dimensions were regarded as evidence of facial influence and the vertical ones of cranial influence.

The Oxford Anthropometrical Laboratory.

Dr. E. Schuster presented some first results from the Oxford Anthropometrical Laboratory. One of the most interesting tests there carried out was that devised to measure the power of concentration. A pattern, made by pricking nine holes in a piece of cardboard, was shown to the subject five times, on each occasion for only a small fraction of a second. The subject was then asked to make a map of it on squared paper, which he generally failed to do correctly; he was shown the pattern again five times, and asked to make a fresh map, and so on until he produced a correct one. It was found that those men acquitted themselves best under this test who subsequently did well in the final schools, and that men reading science and mathematics were, on the whole, better than those reading other subjects.

The Relation of Regeneration and Developmental Processes.

After dealing with a large number of examples illustrating this subject, Dr. J. W. Jenkinson pointed out that, in development, three processes are clearly recognisable—cell and nuclear division, growth, differentiation. Differentiation—the main problem—is determined by external factors, such as the physical and chemical environment, and by internal factors, *e.g.* the initial structure of the germ and the interaction of developing parts. Experiments prove that there exist in the cytoplasm definite organ-forming substances arranged in a definite manner, and sometimes stratified and graded. Such an arrangement accounts for the observed progressive restriction of the potentialities of parts. During cleavage these substances are segregated into cells, but the order in which this takes place seems to be immaterial; the essence of segmentation is the reduction of the ratio of cytoplasm to nucleus.

In regeneration—the production of a whole structure by a part in a differentiated organism—similar processes and factors may be observed. The regenerate often differs quantitatively or qualitatively (heteromorphosis) from the original; reversal of polarity is a special case of the latter. Features common to all regeneration are:—(1) the covering of the wound; (2) cell multiplication (resulting in the reduction of the cytoplasm-nucleus ratio); (3) growth, always at right angles to the cut surface, and at a rate which alters like the ontogenetic rate; (4) differentiation, which usually follows the ontogenetic order, but may differ from it (anomalous behaviour of germ layers). Of the external factors concerned little is known except that the actual injury is the prime stimulus; the internal factors are:—(1) interaction of parts; (2) size (there is a minimal size); (3) degree of differentiation (power of regeneration decreases with age); (4) level or material (necessarily cytoplasmic, since the nuclei are all alike); (5) polarity, which may be expressed in terms of a graded stratification of materials. The adult organism contains the same organ-forming substances as were present in the germ, and arranged in a similar way; the difficulty is that the former is divided into cells. A further difficulty is presented by the anomalous behaviour of the germ layers and by the fact that a part, in which these substances exist, *ex hypothesi*, in other than the correct proportions, can yet form a whole. This indicates that the problem is fundamentally one of assimilation; and Dr. Jenkinson pointed out, in conclusion, that metabolism and regeneration in the protozoa are solely dependent on the presence of the nucleus.

Prof. C. S. Minot gave an address, which, however, cannot be summarised in a few lines and without the aid of diagrams, dealing with the relations of the primitive streak, blastopore, neurenteric canal, and medullary folds in various vertebrates.

Cytological papers by Prof. Hartog and Dr. Edwin Hindle were contributed to the joint meeting of Sections D and K, and Dr. E. J. Russell read, to the joint meeting of Section D and Sub-section B, a paper on the part played by micro-organisms, other than bacteria, in determining soil fertility. A notice of these papers will be found in the reports of the proceedings of Section K and of Sub-section B. J. H. ASHWORTH.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

IN his presidential address on some of the more pressing needs of geography, Prof. A. J. Herbertson spoke of geographical classification and terminology especially with regard to the genetic classification of land forms, and gave suggestions as to a suitable form of notation. In speaking of geographical units, he laid great stress on the significance of vegetation to the geographer, for which a study of climatic regions is as necessary as a study of morphological ones. Dr. Herbertson's address was printed in full in NATURE of September 22.

The first paper was by Dr. J. D. Falconer, on the origin of some of the more characteristic features of the topography of northern Nigeria. The rivers belong to two great hydrographical systems, the Niger-Benue and the Chad systems. The watersheds are lofty plains of a mature topography, while the prominent hills exert only a secondary influence on the drainage system. In their upper and middle courses the rivers flow over open plains the surface of which is diversified by numerous isolated granite domes, turtlebacks, and inselberge. In their lower courses they often flow in deep valleys bounded on either side by ranges of flat-topped hills. These hills have been carved out of horizontal sedimentary rocks, while the isolated domes of the upper plains are clear evidence of a crystalline floor. The peculiar character of the river valleys is entirely due to the recent origin of the whole river system.

Two papers were read by Dr. W. S. Bruce, the first on Prince Charles Foreland, Spitsbergen, the second on his plans for a second Scottish National Antarctic Expedition. During the summers of 1906, 1907, and 1909, Prince Charles Foreland was explored by Scottish expeditions under Dr. Bruce's leadership. The expedition of last year in the steam-trawler *Conqueror* was on the most extensive scale of the three, and practically completed the exploration of the island. The chief object of the work was to make a detailed map of the Foreland on a scale of two miles to the inch. This map is a continuation of similar work carried on by the Prince of Monaco on the mainland, and by Norwegians under his direction. The island is about fifty-four miles long and from three to seven and a half miles broad, with an area of 262 square miles. An almost continuous range of hills, the northern Grampians, occupies the northern two-thirds of the island, and rises to 3800 feet in Mount Monaco and 3300 in Mount Jessie. Separating these from the Ross heights at the southern end is an extensive low-lying part, called the Foreland Laichs, apparently a raised sea bottom. On the east an almost continuous ice-sheet flows from the northern Grampians to Foul Sound, but the west is free from glaciers. A bathymetrical survey of Foul Sound demonstrated a bar towards the northern end over which vessels drawing more than 12 or 15 feet have difficulty in finding a passage. The rocks are mainly Hekla Hook schists and graywackès, with a small pocket of tertiary beds on the east near Ferrier Haven. The completed topographical map will be one of the most detailed ever made of any part of the polar regions.

The plans for a second Scottish National Antarctic Expedition were first published in 1908, but have since been matured and elaborated. It is intended first of all to complete the bathymetrical survey of the South Atlantic between Buenos Aires and Cape Town, and Cape Town and the South Sandwich group. A course will then be set for Coats Land, discovered by Dr. Bruce in 1904. Wherever a suitable landing-place can be found along this coast, the base of the expedition will be established. From this base Dr. Bruce will endeavour in the following summer to cross Antarctica *viâ* the Pole to Victoria Land, a long journey, but one which for the greater part of the way will be over entirely new ground, and must result in considerable light being thrown on the complex and difficult problem of the structure of Antarctica. After landing Dr. Bruce and his party on Coats Land the ship will continue eastward, conducting oceanographical work along the edge of Antarctica. On this work Dr. Bruce lays particular stress. It is also hoped to map in the "missing" coast line between Coats Land and Kaiser Wilhelm Land. After refitting at Melbourne, the ship will proceed southward to pick up Dr. Bruce at some point on Victoria Land, and then make for New Zealand. Thence *viâ* Cape Horn a course will be made for Coats Land to embark the remainder of the party left there, who will have been conducting meteorological work during two winters and one summer. From Coats Land the expedition will return home. The exploratory work will be conducted entirely in the Weddell and Biscoe quadrants, for Dr. Bruce recognises that the Ross sea and adjacent lands are the special province of Captain R. F. Scott and Sir Ernest Shackleton. The total cost of the expedition will be about 50,000*l*.

In the afternoon Captain J. K. Davis, of Sir Ernest Shackleton's recent expedition, read a paper on the voyage of the *Nimrod* from Sydney to Monte Video. Attempts were made to locate certain doubtful islands, viz., Royal Company Islands, Emerald Island, the Nimrod group, and Dougherty Island. None of these islands were found, and deep soundings were obtained on or near their supposed positions. They may therefore be removed from the chart. A visit to Macquarie Island resulted in some interesting collections. The two-hourly meteorological observations taken during this voyage, which extended through May and June, should prove of great importance.

Friday morning was devoted to a joint meeting with Section C. Three of the papers dealt with local geography. Mr. C. Johns gave an account of the geology of the Sheffield district. He was followed by Prof. A. McWilliam, who read a paper on the metallurgical industries in relation to the rocks of the district. Sheffield is a striking example of a town that has arisen in response to local geographical controls. In past times the thick woods of the district supplied the principal metallurgical fuel, charcoal. The clay ironstone yields excellent pig-iron suitable for castings and the best qualities of wrought iron. The bulk of the ironstone now used, however, is brown iron-ore, hydrated ferric-oxide, from Northampton, Leicester, and Lincoln, though for the best steels the hematite ores of Lancashire, Cumberland, and Spain are imported, and Swedish wrought irons are used for cutlery and edge tools. The district is one of the richest in the kingdom in regard to coal supply. Different beds are found suitable for making coke for crucible, cupola, and blast furnaces, and even one that fulfils the very exacting needs of the cementation furnace. The sandstones of the coal measures, often containing 98 per cent. of SiO_2, yield excellent ganister. Fireclay is abundant and of exceedingly good quality. The sandstones of the coal measures, not millstone grit, are now principally employed for grindstones. The carboniferous limestone is available as a flux, while fluorspar, easily obtainable in the great heaps of gangue left by the lead miners of Derbyshire, is used to help in desulphurising steel. Lastly, a soft Upper Permian sandstone makes an ideal moulding sand, since, from the nature of the component grains, it exactly strikes a compromise between binding properties on the one hand and porosity on the other. Speaking after this paper, Prof. Kendall directed attention to the importance to Sheffield of the unoxidised iron ores of Leicestershire and Lincolnshire, which are almost identical with the Cleveland iron ore. When the oxidised ores of Northamptonshire and Lincolnshire are exhausted in about thirty years' time, these will be of great value to Sheffield. Prof. Herbertson insisted on the importance of improving the Trent as a waterway in connection with the eastward extension of the coal-field.

The Humber during the human period was the subject of a communication by Mr. T. Sheppard. With the help of a series of maps, he showed the changes that have occurred in the Humber and on the coast of Holderness from the time of Henry VIII. until the present day. The rapid destruction of the coast at the rate of several feet a year is, in a sense, compensated for by the silting up of the Humber and the growth of new land. Hull is slowly but steadily moving southward to maintain its position as a deep-water port.

Dr. Tempest Anderson gave a description of Matavanu, a new volcano which broke out in Savaii in the Samoa Islands in 1905. Other papers read before the joint meeting of Section E and C were, on the present Triassic conditions in Australia, by Mr. E. C. Spicer, and one by Dr. W. H. Hobbs on some considerations concerning the alimentation and the losses of existing Continental glaciers.

In the afternoon Dr. Hamilton Rice gave a lecture on his journey across South America from Bogotà to Manáos, the object of which was to discover the sources of the Uaupés River. The route from Bogotà was to Villavicencio, and thence over the Andes to San Martin and the densely forested area of the Amazon basin. He described the aborigines inhabiting the banks of the Uaupés, among whom he found both Caucasian and Mongoloid types.

On Monday, September 5, the first paper was by Mr. J. Howard Reed on the geography of British cotton-growing. A shortage in the supply of raw cotton threatens seriously to affect Lancashire. The quantity of cotton used to-day in Lancashire is only a trifle more than was the case twenty years ago, but the amount used on the Continent has nearly doubled, and the total is now more than twice that of the British figure. The American mills now consume an amount nearly equal to the whole of the continental demand and about double the British demand. Mr. Howard Reed foresees a serious crisis for the Lancashire mills unless supplies of raw cotton can be obtained from other than American fields. It is only by fostering and developing cotton-growing in British colonies that, he believes, the English cotton industry can be saved from virtual extinction. Hence the efforts of the British Cotton-growing Association. Considerable success has attended the efforts of the association in the British West Indies, but the greatest results are expected from Uganda, Nyasaland, and Nigeria. The increased production of cotton, due to the efforts of the association, has been progressive from year to year, but the needs are so enormous and the work so colossal that the increased supplies obtained during seven years only reach about one-thirtieth of Lancashire's average yearly demand. Mr. Reed said that a sum of five millions might well be employed in the development of cotton-growing, and the African colonies he looked upon as an incomparable field. Mr. G. G. Chisholm, in making some remarks on this paper, declined to take anything like so pessimistic a view with regard to the future of our cotton industry, nor, on the other hand, was he so hopeful with regard to the effect on Lancashire of the remedies suggested.

Major R. G. T. Bright followed with a paper on the Uganda-Congo boundary survey, in which he described the country on the western frontier of the Uganda protectorate. Captain E. M. Jack communicated a report on the survey of the 30th meridian arc, Uganda protectorate, 1908–9.

Lieutenant P. T. Etherton, Indian Army, gave an account of a journey from India through Gilgit, Hanza, across the Pamirs, and thence by Chinese Turkestan, Mongolia, and Siberia to the Trans-Siberian railway. Lieutenant Etherton left Lansdowne in the Himalayas in March, 1909, and reached the Siberian railway in February, 1910. From the Pamirs the route was by the Ili Su Pass (16,750 feet) to the Yarkand River, and thence to the Kulan Urgu valley by a previously unexplored pass at 17,400 feet. Three months were spent in the Tian Shan mountains, during which time the little-known Great Yulduz valley was traversed. Thence the expedition passed by the Ili valley to the town of Kulja. From here Lieutenant Etherton struck through the Sairam Nor and Ebi Nor country to Chuguchak, and reached the foot of the Altai mountains on the northern side of the Black Irtish valley in the depths of winter. After considerable difficulty the expedition reached Zaisan, a small town on the Siberian-Mongolian frontier, early in January this year. Big game shooting was the chief object of the journey.

On Tuesday, September 6, the first paper was by Mr. William Wilson, on a new globe-map of the world. The author emphasises the importance of the globe in geographical teaching, and he overcomes the drawbacks of its high price and cumbrous nature by mounting a special globe map on thin cardboard and cutting out the gores. The two ends of the map are joined to form a cylinder by a clip at the equator; a spindle is introduced, and the tips of the gores are passed down over the ends of the spindle by means of holes punched at the ends of each gore where the poles would be. A metal clip at each end holds the tips in position, and serves as a convenient means of handling the globe. The apparatus can be made up or dismantled in a few minutes, and can be studied flat or as a globe. The world from equator to pole is divided into three belts of 30° each, which form the primary divisions of latitude. The longitudes are divided primarily into eight groups of 45° each, a group forming a gore. By these primary divisions the world is divided into forty-eight sections. The sections can be enlarged to any extent, forming an atlas on a simple equal scale that is readily grasped. A set of "window" diagrams, each one combining a section of one belt on this plan and the same area as shown on Mercator, makes an instructive demonstration of the exaggeration necessary to Mercator.

Two papers followed dealing with regional surveys of selected areas of the British Isles on the lines indicated some years ago by Dr. H. R. Mill. Mr. James Cossar dealt with the Midlothian district. After pointing out the configuration of the area, Mr. Cossar dwelt on its geology so far as it affects the place relations, local conditions, or economic development. Thus the volcanic action of the past gave rise to hills and ridges in the western part of the region, which have in cases offered sites for fortifications, as Edinburgh Castle and Inchkeith, and have materially affected the lines of communication. The export of road metal and the physical conditions at Queensferry, which favoured the construction of the Forth Bridge, both entail a discussion of geological facts. The importance of the glacial period was considered, firstly in its influence on the physical structure, secondly on the drainage system, and thirdly on the economic resources. In this connection

Mr. Cossar examined and described a remarkable series of dry valleys which have resulted from glacial action. The history of the rivers and their present economic value were discussed, and then successively Mr. Cossar examined the climate, vegetation, mineral resources, industries, occupations, and distribution of the population.

Mr. O. G. S. Crawford's regional survey was of the Andover district, which he discussed under the successive headings of physical features, natural vegetation, industries, including agriculture, settlements, and communications, concluding with a survey of the reaction of man upon his natural surroundings.

Mr. H. Brodrick read a paper on the underground waters of the Castleton district of Derbyshire. To the west of Castleton is a long valley, in the base of which runs one of the transverse Pennine faults which brings down the carboniferous limestone, so that the streams to the north run over the Yoredale beds to sink into the limestone. Of the several streams, only one ends in a cave of any size, the Giant's Hole. It was this stream principally that Mr. Brodrick explored.

Dr. C. A. Hill read a paper on the further exploration of the Mitchelstown caves in Ireland, carried out by himself and Mr. Brodrick. At the Dublin meeting in 1908 the author gave an account of these caves, but since that date an exhaustive survey of both caves has been carried out.

Several papers of geographical interest were contributed to other sections, but special attention must be directed to the discussion, opened by Prof. P. F. Kendall in Section C, on the concealed coalfield of Nottingham. In the course of his remarks Mr. Kendall announced that the coal measures had been reached at Scunthorpe, eleven miles east of Thorne. Borings are also in course of progress at Thorne, Snaith, Selby, and Newark. This coalfield, he considered, would be the hope and support of industrial England in the future.

ENGINEERING AT THE BRITISH ASSOCIATION.

THE first meeting of the engineering section was held on Thursday, September 1, when, in addition to the president's address, only one paper was taken—the testing of lathe tool steels, by Prof. Ripper. Two methods of testing lathe tools are commonly employed; in one, the object of the test is to ascertain the length of time the tool will run under given conditions before it has to be reground: in the second, the object is to ascertain the actual cutting speed which would entirely destroy the tool in twenty minutes. Prof. Ripper was of opinion that both these methods were of doubtful utility, the latter because, in order to determine the standard speed, so many tests had to be made. He had, therefore, devised another method, which he called the speed-increment test. In this method the tool was started at a standard cut—at a surface speed of, say, 30 feet per minute—and the speed of cutting was then gradually increased by equal increments of 1 foot per minute until the tool broke down. Prof. Ripper showed a number of curves to illustrate the results obtained by this method of testing, and, after the reading of the paper, he gave a demonstration in the University laboratory. The variation of the speed was obtained by means of an electrical drive.

The first business of the section on Friday, September 2, was the discussion on the third report of the committee on gaseous explosions. The chief experimental work undertaken by the members of the committee had been the determination of the amount of radiation from flames. Prof. Callendar had experimented on the radiation from open flames in the laboratory, and Prof. Hopkinson on radiation from gases in a closed combustion chamber. These experiments showed that a flame was, to a certain extent, transparent to the same radiation that it emitted, Prof. Callendar finding that two similar flames placed one behind the other radiated nearly twice as much as a single flame. Before the discussion opened, Prof. Dixon described the experiments he had recently carried out on the ignition of gases by adiabatic compression. The gases were rapidly compressed in closed glass tubes, and a continuous photograph was taken by means of rapidly moving films. Prof. Dixon pointed out that it had been anticipated that such gases would be uniformly heated, and that they would, therefore, ignite simultaneously at all points; he did not, however, find this to be the case—the explosion was never sharp nor violent; the ignition invariably began at one point, and then spread throughout the tube. The discussion largely turned on the question of the part played by radiation in regard to the missing quantity in gas-engine heat balances. Captain Sankey pointed out that the modern gas engine had an efficiency of 80 per cent. to 90 per cent. when compared with the standard theoretical gas engine, and that there was thus only a loss of some 10 per cent. to 20 per cent., there being, therefore, not much scope for further improvement.

The remaining business for the day was the reading by Prof. Ripper of a paper on a new method of testing the cutting quality of files. Until the invention of the Herbert file-testing machine a few years ago, the only method of testing the cutting power of files had been the hand tests carried out by expert workmen. From some experiments he had been asked to carry out, the author was of opinion that the results obtained in the Herbert file-testing machine were not normal, and he considered that this machine had a serious defect; owing to the fact that the file moved across the face of the test bar through an absolutely constant path, the teeth of the file, each stroke, worked in identically the same grooves or furrows on the face of the test bar, the result was that the surface of the test bar became occasionally, as it were, glazed, and the file ceased to cut properly. With the view of overcoming this defect, Prof. Ripper designed an addition to the Herbert machine with the object of making the path of the file no longer a constant one. To secure this result the file was no longer held rigidly at each end, but was connected by ball joints, the effect of which was equivalent to the wrist movement at each end of the file during ordinary hand-filing. The eccentric motion at one end of the file was obtained by a worm gearing actuated by the reciprocation of the machine. The author found that with this addition the Herbert file-testing machine gave extremely concordant results, and a number of curves were shown to illustrate this point. After the conclusion of the day's proceedings a demonstration of the machine was given in the engineering laboratory.

The section opened its proceedings on Monday with a paper by Mr. P. Dawson on the electrification of the London, Brighton and South Coast Railway between Victoria and London Bridge. The author had been responsible for the design of this important work. Bearing in mind the possibility of future developments, he had decided to adopt single-phase electric traction at 6700 volts, with a periodicity of 25. The motors would develop 115 horse-power for one hour, with a rise of temperature of only 70°, and 60 horse-power for twelve hours continuously under the same conditions; there were four motors to each car. Great trouble was experienced in overcoming the difficulties due to the low head room at certain of the overhead bridges; thus while the normal height of the overhead wires was 21 feet 6 inches above rail-level, there was only available a height of 13 feet 9 inches at some of the bridges, and the collector bow had to be adapted to this extreme variation in height. So far the installation had proved entirely satisfactory.

This paper was followed by one by Mr. H. E. Wimperis on the use of an accelerometer in the measurement of road resistance and horse-power. The accelerometer designed by the author consists of a brass box, which contains a copper disc mounted on a vertical pivot, with its motions damped by a permanent magnet. The centre of gravity of the disc is not in the axis, hence, when the box moves forward, one side of the disc tends to lag behind, and thus to wind up partially a coiled spring, and so actuate a pointer moving over a scale. An ingenious gearing prevents the reading from being affected by any accelerations at right angles to the direction of motion. By the use of this instrument road resistances can be read off at sight, and the brake and indicated horse-power of the engine can be obtained for various speeds.

Prof. Coker next described his experiments on the cyclical changes of temperature in a gas-engine cylinder near the walls; it was found that the highest temperature near the walls could be measured by couples made from 10 per cent. alloys of iridium and rhodium with platinum; the author estimated that the maximum temperature at the place of measurement was between 1850° and 1900° C.

The business of the day concluded with a discussion on the principles of mechanical flight, opened by Prof. Bryan. As a matter of fact, owing to the line of argument adopted by the opener, there was practically no discussion on principles, but there was a somewhat heated debate as to the respective provinces of the mathematician, the physicist, and the engineer in solving the problems of mechanical flight. If the engineer is to wait until the mathematician has evolved a completely satisfactory theory as to the stability, &c., of aëroplanes, it is quite clear that little further progress will be made. The successful developments of most of the mechanical devices now employed by man have followed lines very different from those which seem good to Prof. Bryan; and mathematical theory has generally followed, and not preceded, the engineer's victory over the forces of nature.

The proceedings were opened on Tuesday, September 6, by a paper by Prof. Coker on the optical determination of stress. Prof. Coker has been working for some time at this problem, utilising the well-known fact that glass is rendered doubly refractive by stress; as glass, however, owing to the difficulty of obtaining suitable pieces free from initial strains, has proved unsuitable, the author has fallen back on the use of xylonite, which answers admirably. The apparatus necessary included an arc lamp to supply the beam of light, and lenses and prisms. The author showed a number of lantern-slides of the permanent records he had obtained by making use of Lumière colour plates.

Prof. Dalby then read his paper on the measurement of the air supply to a gas-engine cylinder; the air on its way to the engine flows through an orifice into a chamber, from which it passes to the suction valve; the engine is fitted with an apparatus which enables the temperature corresponding to the pressure and volume at an assigned crank angle to be measured, and thus all the data required for calculating the weight of air passing through the orifice per second are accurately known.

Prof. S. P. Thompson next read a paper on the laws of electromechanics; the author stated that his object was to put into concrete form the chief laws governing the performance of various electromagnetic mechanisms, and a number of formulæ was deduced.

Mr. F. Bacon then read his paper on heat insulation, in which he described his researches into the heat-insulating efficiency of a number of materials; the heat which was transmitted was produced electrically, and electrical methods were employed to measure the temperatures. In the discussion it was pointed out that in lagging steam-pipes there was with each material a definite thickness which it was uneconomical to increase, as the increase of external surface increased the radiation at a greater rate than the increased thickness diminished it.

The last paper of the day was by Prof. E. Wilson and Mr. W. H. Wilson on a new method of producing high-tension electrical discharges. In this method energy is taken from an alternating or continuous current source, and is stored in a magnetic field by inductance; it is then allowed to surge into a condenser, which together with the inductance forms a low-frequency oscillatory circuit. When the energy has accumulated in the condenser, the condenser is mechanically bridged across the primary winding of an induction coil, with which it forms a high-frequency oscillatory circuit. The energy is then transmitted by the secondary winding of the induction coil to the work circuit, and may be either oscillatory or unidirectional. The apparatus is suitable for radio-telegraphy or any work employing high-tension electricity.

The concluding meeting of the section was held on Wednesday, September 7, when the first paper was one by Mr. R. W. Weekes on self-raising rollers for maps and plans, descriptive of an ingenious arrangement for mounting plans, maps, and diagrams.

The next paper was entitled "Machine for Testing Rubber by Means of its Mechanical Hysteresis," by Prof. Schwartz. The author had designed a machine in which a specimen of rubber of standard dimensions was loaded at a given rate to a given percentage of the maximum load. The load was then gradually removed, and a complete stress-strain diagram automatically taken; as rubber possesses very considerable mechanical hysteresis, the stress diagram was of a loop form; from this the chief physical characteristics of the sample could be readily deduced.

Prof. Fessenden then gave his paper on the utilisation of solar radiation, wind power, and other intermittent natural sources of energy. The author estimated that the total first cost of the solar plant per horse-power would be about 20*l.*, and the annual charge about 30*s.* per horse-power; he stated that a plant of 3000 horse-power was at present in course of erection. In the discussion Sir William White expressed the view that in all these schemes for the working of intermittent sources of energy the cost of works of construction generally proved prohibitive.

The last paper was by Mr. Cook on an experimental investigation of the strength of thick cylinders. The author described his investigations into the strength of cast-iron and mild steel thick cylinders when subjected to gradually increasing internal pressure up to the bursting point. Mr. Cook had found in the case of the mild steel cylinder that the tensile stress at the yield point, as calculated by Lamé's equation, agreed closely with the value of the tensile stress at the yield point in an ordinary tension test of the steel.

The proceedings closed with votes of thanks to the president and secretaries of the section.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—The first congregation for the presentation of degrees in the University of Bristol was held on October 20 before a crowded assembly. Owing to failing health, the Chancellor, Mr. H. O. Wills, was not present, and his place was filled by the Vice-Chancellor, Sir Isambard Owen. The degree list was a long one, as besides the ordinary graduating students there were fifty-two old students of University College and the Merchant Venturers' Technical College, who, having taken degrees in other universities, were admitted to *ad eundem* degrees in the University. In a few special cases, also, degrees of Bachelor were awarded to associates of these institutions. Only one honorary degree was conferred, and that, the Doctorate of Science, on Prof. Conwy Lloyd Morgan, F.R.S., lately Vice-Chancellor of the University and sometime principal of University College, Bristol. He was introduced by Prof. F. R. Barrell, dean of the science faculty, who in the course of his address said:—"Expert in knowledge of the fossil past, expert in knowledge of the living present, he stands renowned in varied fields of thought; keenly has he observed, acutely has he analysed the workings of the mind in man and bird and beast; at his behest the artless infant and the unfeathered chick alike disclose the secrets of their nascent reason; psychology, zoology, geology, all acknowledge in him a master. A teacher of teachers, he has o'erstepped the boundaries of this isle; in southern Africa he has dwelt and taught; not once or twice alone has he been called across Atlantic seas to inform the wisdom of the West. With fertile pen and with lucid speech he has made clear the subtle mazes of philosophy; his written word is read where'er the English language penetrates, and done into the German tongue it guides the Teuton in the study of nature."

CAMBRIDGE.—Mr. A. E. Shipley, F.R.S., fellow and tutor of Christ's College, has been elected master of the college in succession to the late Dr. John Peile.

Dr. Tempest Anderson will deliver a lecture in the Sedgwick Museum on "Matavanu, a New Volcano in Savaii, German Samoa," illustrated with lantern photographs, on Saturday, November 5, at 5 p.m.

The Henry Sidgwick memorial lecture, to be given by Sir George Darwin, K.C.B., F.R.S., on "William and Caroline Herschel," will take place in the hall of Newnham College at 5 p.m. on Saturday, December 3, instead of November 12, as previously announced.

IT is stated in *Science* that the Tuskegee Institute will receive about 80,000*l.* from the estate of Mrs. Dotger, and the Hampden Institute will receive about 50,000*l.* from the estate of Miss Alice Byington. By the death of Mrs. Loomis, the estate of the late Colonel John Mason Loomis, amounting to more than 200,000*l.*, will, it is said, go to the establishment of a technical school at Windsor, Conn.

The College of the City of New York has acquired, says *Science*, the complete private library of the late Prof. Simon Newcomb, consisting of about 4000 volumes and 7000 pamphlets dealing with astronomy, mathematics, and physics. Both pamphlets and books are being catalogued, and are now accessible to research students, in accordance with the expressed desire of Prof. and Mrs. Newcomb.

On October 22 Mr. T. Fenwick Harrison laid the foundation-stone of new engineering laboratories for the University of Liverpool. The cost of the building will be met by a gift of 35,000*l.* received from Mr. Fenwick Harrison, Mr. J. W. Hughes, and Mr. Heath Harrison. Prof. Watkinson thanked Mr. Harrison for laying the foundation-stone, and in the course of his remarks said it is intended to make special provision for teaching and research work in connection with all branches of engineering, internal-combustion engines, steam turbine engines, refrigeration, and fuel testing, and in this respect the laboratories will be second to none in the kingdom. The donors intend that the subject of heat engines, and particularly of internal-combustion engines, shall be developed on a much more important scale than has been hitherto attempted. As shipowners who use three hundred thousand tons of coal a year they see the advantages to be derived from the successful application of the internal-combustion engine, so far as ships are concerned, for it means the reduction of coal consumption to one-half, and possibly to one-third, of that now required for steam engines. It is humiliating, said Prof. Watkinson, that the names associated with the invention of internal-combustion engines are almost without exception German, and nearly all the internal-combustion engines being built to-day in this country are being built under licence from Germany. Greater scientific knowledge is required than in the design of steam engines, and it is reasonable to conclude that the greater success of the Germans is due to their better training in scientific principles. Last year Prof. Watkinson visited all the principal schools of engineering in the United States and in Canada, and in nearly every one he found that their gigantic laboratories were being greatly extended. Both the Germans and the Americans realise far more than we do in this country the value of a university training, and they also realise that in this age, when machinery plays such a large part in almost every industry, that this training is the best for those who are to control and direct most of the great industries. That is well illustrated, said Prof. Watkinson, by the fact that there are about 17,000 students taking a four years' course in the American schools of engineering, which is about eight times the number of students taking the normal three years' course in this country.

The introductory address at the London School of Tropical Medicine was this year delivered by Dr. Henry A. Miers, F.R.S., principal of the University of London. The subject of the address was scientific observation, and Dr. Miers directed attention to an aspect of scientific research and of training in scientific investigation which, he said, seemed in danger of escaping notice. Under present conditions scientific research is seldom pursued save by those whose object is clear and whose minds are concentrated upon a special line of investigation in which they are alive and alert to the exclusion of any distracting side-issues. Each new discovery is pursued with ever-increasing rapidity and with a system which is fruitful in results; the searchlight of investigation is turned with mechanical precision upon every new problem, and it would appear unlikely that anything of importance should be overlooked. But teachers and investigators do not sufficiently bear in mind two possible dangers that beset them under modern conditions of work. It is inherent in our senses and our intelligence, first, that those whose attention is too minutely fixed upon one thing will fail to perceive other things which are equally discernible and equally important; and, secondly, that those who look or listen too intently for a thing may actually see or hear that which they desire, even though it be not there. Later in his address Dr. Miers gave it as his opinion that, taken as a whole, scientific men are not better general observers than other people, though some among them undoubtedly are. It has been too often assumed that scientific training has a special value as developing the general powers of observation, and that because students have been exercised in special observations they have become practised observers of things in general, whereas the reverse may be nearer the truth, and in many instances certainly is so. Some practice in all-round observation should be incorporated in the training of the specialist if we are to have our students quick to observe details that do not form part of their conscious exercises; neither should they be led to suppose that, because they have been practised in observing one thing, they are therefore good observers of everything else. To him who has eyes to see, the most trivial detail may be the germ of an important discovery. Our laboratory training gives the student his eyes, but does not always teach him to use them widely or wisely.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, October 10.—M. Émile Picard in the chair.—The president announced the death of M. Treub, correspondant in the section of botany, and of Ernst von Leyden, correspondant in the section of medicine and surgery.—Henri **Douvillé**: The formation of the loam of the plateaux. This loam, consisting of a very intimate mixture of clay and fine sand, is well developed in the neighbourhood of Paris and in the north of France. Two hypotheses have been put forward to explain its formation, deposition from water and transport by wind. The former hypothesis is shown to be in better accord with the observed facts; to explain the height above the sea at which these deposits are found, the floods carrying the deposits are supposed to have been caused by the sudden melting of snows, the lower portion of the valley being blocked by glacier.—Serge **Bernstein**: A generalisation of the theorems of Liouville and Picard.—F. **Robin**: The law of resistance to crushing of cylindrical bodies as a function of their dimensions. The general law of resistance to crushing as a function of the dimensions of the test-pieces is expressed geometrically by a hyperbolic paraboloid.—H. **Pelabon**: Batteries with antimony and antimony selenides. An element formed of antimony and antimony selenide, with an acid solution of antimony trichloride as the electrolyte, shows varying electromotive force under the action of light. If sulphur or tellurium is substituted for the selenium the phenomena described are not produced. The effect is strongest when the element is exposed to the yellow and red rays.—G. **Charpy** and S. **Bonnerot**: The reduction of oxide of iron by solid carbon. Ferric oxide and graphite, intimately mixed, were heated in a vacuum at temperatures up to 950° C., and the reaction studied by measuring the amount of gas evolved per hour. The speed of reaction diminished as the pressure maintained in the apparatus was reduced, and became practically zero when the pressure in the tube was of the order of 0·001 mm. of mercury. Hence it is concluded that solid carbon does not reduce oxide of iron at 950° C.—P. **Mahler** and J. **Denet**: The presence of a small quantity of carbon monoxide in the air of coal mines. The amounts found varied between 0 and 40 volumes per million, with an average of 19. The maximum amount of carbon monoxide corresponded with the minimum of methane, and the maximum methane was found in the sample containing no carbon monoxide.—Paul **Vuillemin**: A natural preventative to the oak-tree disease. The disease of the oak, caused by an Oidium, is kept in check by a Cicinnobolus, a parasite preventing the multiplication of the Oidium by conidia, and its preservation by the mycelium.—E. L. **Trouessart**: The mammalian fauna of Europe.—Ch. **Gravier**: The coral reefs of the Gulf of Aden and their madrepores.—Paul **Marchal**: Contributions to the biological study of Chermes.—Edouard **Chatton**: The existence of Dinoflagellæ, cœlomic parasites. Syndinium in the pelagic copepods.—A. **Fernbach** and E. **Vulquin**: The microbicidal power of macerations of yeast and cereals. The poison elaborated by yeast is not identical with that obtained from cereals.—A. **Briquet**: Geology of the Gallo-Belgic region.

October 17.—M. Émile Picard in the chair.—P. **Helbronner**: The complementary geodesic triangulations of the upper regions of the French Alps (eighth expedition). The work done included fixing the position of eighty-seven stations, twenty of which were above 3000 metres altitude.—A. **Jacquerod** and M. **Turpaïan**: The application of the principle of Archimides to the exact determination of gaseous densities. A bulb of about 200 c.c. in volume is suspended inside a tube of slightly larger dimensions by means of a platinum wire to the arm of a balance, a suitable counterpoise being suspended from the other arm. The suspended bulb is surrounded by the gas the density of which is being measured, the exact temperature being maintained by an external water bath. The instrument was calibrated by hydrogen and oxygen, the densities of which are exactly known. The accuracy obtainable is of the order of 1 in 10,000.—G. A. **Hemsalech**: The relative duration of the lines of the spectrum emitted by magnesium in the electric spark. The results tabulated confirm the view put forward in a previous paper, that the observation of the relative durations of the lines of the spectrum may, in certain cases, furnish useful indications in the analyses of bodies containing unknown impurities.—A. **Lafay**: The influence of a local heating on the value of the pressures supported by a body placed in a regular stream of air.—Léo **Vignon**: The influence of chemical affinity in certain adsorption phenomena.—Jean de Rufz **de Lavison**: The elective *rôle* of the root in the absorption of salts. The stem absorbs indifferently, and in the same proportion, salts which are presented to it in solution, whilst, on the contrary, the plant furnished with roots exercises a marked selective action on certain salts.—Victor **Henri**, A. **Helbronner**, and Max **de Recklinghausen**: New researches on the sterilisation of large quantities of water by the ultra-violet rays. A description of an improvement of the form of apparatus given in an earlier paper. Three-fourths of the rays emitted by the tube are now utilised. An experiment was carried on for six weeks continuously, during which 25 cubic metres of water per hour were passed through the apparatus, with an expenditure of 26 watt-hours per cubic metre of water, the exit water being sterile.—Jules **Amar**: A singularity in the working of the human machine.—A. **Knaoen**: Should materials be impermeable or porous?—L. **Landouzy**, H. **Gougerot**, and H. **Salin**: Experimental bacillary serious arthritis.—Charles **Nicolle**, A. **Conor**, and E. **Conseil**: Some properties of the exanthematic virus.—Eugène Daday **de Dées**: A new phyllopod collected by the Antarctic expedition of the *Pourquoi Pas?*—Edouard **Danois**: The spermaceti organ of *Kogia breviceps*.—A. **Pécsi**: The lines of fracture of the earth's crust.—Louis **Besson**: Observations of the upper bitangent arc of the halo of 46°.

GÖTTINGEN.

Royal **Society of Sciences**.—The *Nachrichten* (physico-mathematical section), part iv. for 1910, contains the following memoirs communicated to the society:—

May 28.—L. **Geiger**: Determination of earthquake foci from the times of arrival.—D. **Hilbert**: Outlines of a general theory of linear integral equations (vi.).

July 23.—O. **Mügge**: Deformations in the crystals of potassium chlorate ($KClO_3$), according to investigations by Paul Fischer.—E. **Hecke**: Non-regular prime numbers and Fermat's theorem.

DIARY OF SOCIETIES.

WEDNESDAY, NOVEMBER 2.

ENTOMOLOGICAL SOCIETY, at 8.—Experiments in 1909 and 1910 upon the Colour-relation between Lepidopterous Larvæ and Pupæ and their surroundings: Elizabeth Briggs.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Lactose in the presence of the commonly occurring Sugars: Julian L. Baker and H. F. E. Hulton.—The Colorimetric Estimation of Hydrogen Cyanide: A. Chaston Chapman.—The Polarimetric Estimation of Milk Sugar: H. Droop Richmond.—A New Method of Estimating Phosphoric Acid: G. F. Wesley Martin.

THURSDAY, NOVEMBER 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Origin of the Hydrochloric Acid in the Gastric Tubules: Miss M. P. Fitzgerald.—(1) Trypanosome Diseases of Domestic Animals in Uganda. II. *Trypanosoma Brucei*. (Plimmer and Bradford); (2) Trypanosome Diseases of Domestic Animals in Uganda. III. *Trypanosoma vivax* (Ziemann): Colonel Sir D. Bruce, C.B., F.R.S., and others.—Further Results of the Experimental Treatment of Trypanosomiasis; being a Progress Report to a Committee of the Royal Society: H. G. Plimmer, F.R.S., Capt. W. B. Fry, and Lieut H. S. Ranken.—On the Peculiar Morphology of a Trypanosome from a case of Sleeping Sickness and the possibility of its being a new Species: Dr. J. W. Stephens and Dr. H. B. Fantham.—Note upon the Examination of the Tissues of the Central Nervous System, with Negative Results, of a case of Human Trypanosomiasis, which apparently had been cured for years by Atoxyl Injections: Dr. F. W. Mott, F.R.S.—On a remarkable Pharetronid Sponge from Christmas Island: R. Kirkpatrick.

LINNEAN SOCIETY, at 8.—Biscayan Plankton, Part XIII. The Siphonophora: H. B. Bigelow.—Plankton Fishing in Hebridean Seas: Prof. W. A. Herdman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Dr. G. H. Rodman.

CONTENTS.

	PAGE
Ancient Plants. By D. H. S.	523
British Rainfall	523
Indian Crustacea. By W. T. C.	524
Naturalists' Notes from the old Spanish Main	525
Graphical Chemistry	525
Amateur Astronomy. By W. E. Rolston	526
Our Book Shelf	526
Letters to the Editor:—	
The Biological Laboratories at Woods Hole.—Francis B. Sumner	527
The Cocos-Keeling Atoll.—Dr. F. Wood-Jones; The Reviewer	528
Early Burial Customs in Egypt.—Prof. G. Elliot Smith, F.R.S.	529
Effect of Heat on Soils.—C. Harold Wright	530
The Colours and Spectrum of Water.—T. W. Backhouse	530
Luminous Paint.—R. G. Durrant	530
Velocity of Negative Ions in Hydrogen at Atmospheric Pressure.—A. M. Tyndall	530
An Irish Pteridosperm.—Prof. T. Johnson	531
Fermat's Theorem.—Dr. H. C. Pocklington, F.R.S.	531
The Uganda-Congo Boundary.—Edward Heawood; The Writer of the Article	531
An Agaric with Sterile Gills.—W. B. Grove	531
Art the Comrade of Science. (*Illustrated.*) By E. B. P.	532
Ethnography at the British Museum. (*Illustrated.*) By H. S. H.	536
Sight Tests in the Mercantile Marine	537
Structure and Function. (*Illustrated.*)	538
Recent Investigations on Pellagra	538
Dr. Melchior Treub	539
Dr. Sidney Ringer. By C.	540
Notes	540
Our Astronomical Column:—	
A Brilliant Meteor on October 23	544
Simultaneous Photographic Observations of a Remarkable Meteor	544
Two Remarkable Prominences	544
The Relations between Solar and Terrestrial Phenomena	545
Search-ephemerides for Westphal's Comet, 1852 IV.	545
The International Cancer Conference at Paris	545
Reports of Meteorological Observatories	546
Trees and Timber	546
Selections from American Zoological Work. By R. L.	547
Distribution of Weeds	547
The Lancashire Sea-fisheries Laboratory	548
Zoology at the British Association. By Dr. J. H. Ashworth	548
Geography at the British Association	551
Engineering at the British Association	553
University and Educational Intelligence	554
Societies and Academies	555
Diary of Societies	556

505.42

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

No. 2139, Vol. 84] THURSDAY, OCTOBER 27, 1910 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

DERBYSHIRE EDUCATION COMMITTEE.

CHESTERFIELD GIRLS HIGH SCHOOL.

The Governors invite applications for the post of HEADMISTRESS the above School. Candidates must be Graduates of a University or ve an equivalent qualification. Commencing salary, £250.
Applications, to be made in writing (on foolscap paper) and accompanied copies of three recent testimonials, should be addressed to the underned on or before November 21, 1910.

EVAN W. SMALL, Director of Education.
County Education Office, Derby.

NIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE.

LEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.

he Council of the College invites applications for the post of REGIS-AR. The salary will be £400 per annum.
urther particulars may be obtained from the undersigned, by whom lications, with not more than four testimonials, must be received on or ore Wednesday, November 2, 1910.

D. J. A. BROWN, Acting-Registrar.
niversity College, Cardiff, October, 1910.

O SCIENCE AND MATHEMATICAL MASTERS.

January (1911) Vacancies.

raduates in Science and other well-qualified masters seeking posts in blic and other Schools should apply at once, giving full details as to lifications, &c., and enclosing copies of testimonials, to:—

MESSRS. GRIFFITHS, SMITH, POWELL & SMITH,
Tutorial Agents (Estd. 1833),
34 Bedford Street, Strand, London.
Immediate notice of all the best vacancies will be sent.

CITY AND GUILDS OF LONDON INSTITUTE.

pplications are invited for the post of DEMONSTRATOR OF AP-IED MECHANICS AND MATHEMATICS at the City and Guilds chnical College, Finsbury. He will be required to take charge of the boratory of Applied Mechanics. Candidates must have had a college ining and practical engineering experience. Salary, £100 per annum. pies of the Programme of the College and particulars of the conditions ached to the appointment may be obtained on application to the REGIS-AR, City and Guilds Technical College, Leonard Street, Finsbury, ndon, E.C.

BIRMINGHAM MUNICIPAL TECHNICAL SCHOOL.

plications are invited for the post of SENIOR LECTURER in THEMATICS. Commencing salary, £200. Appointment to date (if sible) from January 1, 1911. Applications by November 25, 1910. For particulars apply to

GEO. MELLOR, Secretary.
Offices of the School, Suffolk Street, October 19, 1910.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.

CARTOGRAPHERS in the Hydrographic Department of the miralty (17–25), November 10.
he date specified is the latest at which applications can be received. ey must be made on forms to be obtained, with particulars, from the CRETARY, Civil Service Comm ssion, Burlington Gardens, London, W.

UNIVERSITY OF MANCHESTER.

Applications are invited for the post of SENIOR DEMONSTRATOR ND ASSISTANT LECTURER IN ZOOLOGY, now vacant in conuence of the appointment of Dr. W. D. Henderson to the Lectureship Zoology in the University of Bristol. Details as to the emoluments of post and further particulars may be obtained on application to the GISTRAR. Applications must be sent in before Monday, October 31.

ITISH BIRDS' EGGS.—For Sale, with cabinet, over two thousand Eggs, in sets. They represent nearly all the birds breeding in British Islands. All in perfect order and condition. To be had a bargain. Particulars on application to "AVIS," c/o Mr. O'Neil, Post Office, Handsworth, Birmingham.

OR SALE.—Analytical Balance of superior make by Becker—sensible $\frac{1}{10}$ milligramme; never been used; bought recently, will take 8 Guineas. A genuine bargain.—OWEN, 3 Adelaide Road, Shepherd's Bush.

BROWNING'S SPECTROSCOPES.

THE MINIATURE SPECTROSCOPE.

These Instruments will show many of the Fraunhofer lines, the bright lines of the metals and gases, and the absorption bands in coloured gases, crystals or liquids, and may be used for showing many of the leading experiments in Spectrum Analysis. They are made with combinations of **three prisms** at prices from **20s.** to **35s.**, or with **five prisms**, giving much greater dispersion, and therefore showing the lines and bands more distinctly, at prices from **25s. 6d.** to **70s.**

RAINBAND SPECTROSCOPE (Grace's).

This instrument is specially adapted for predicting coming rain. It is a very powerful, portable, and efficient spectroscope, and is applicable to every purpose for which a Direct Vision Spectroscope can be used.

PRICES: **£3 8 6, £4 0 0,** AND **£5 15 0**

"HOW TO WORK WITH THE SPECTROSCOPE"

By JOHN BROWNING, F.R.A.S., &c. Fourth Edition, entirely rewritten and revised. Price **9d.**, or with Coloured Chart of 14 Spectra, **1s. 6d.** Post Free.

Price Lists of Spectroscopes, Telescopes, &c., Post Free.

JOHN BROWNING, Man'f'g Optician, **146 STRAND, LONDON**
ESTAB. 1765. TEL. NO.: 7804 CENTRAL.

H.M. DOCKYARD SCHOOLS.

WANTED, a JUNIOR ASSISTANT MASTER. Candidates must possess a University degree or some equivalent qualification, and should have had experience in laboratory work.
The scale of salary is £150, rising to £200 by annual increments of £10, with a pension and prospects of promotion. Duties will commence on January 1, 1911.
Applications should be addressed to the SECRETARY OF THE ADMIRALTY (C. E.), Whitehall, London, S.W.

UNIVERSITY OF MANCHESTER.

A Course of about Twenty Lectures on "FOSSIL REPTILIA" will be given by Mr. D. M. S. WATSON, M.Sc., on Mondays, Wednesdays, and Fridays, at 5 p.m. First Lecture, November 7 next. Fee, £1 1s.

FOR SALE.—Contents of the private Chemical Laboratory of a gentleman going abroad. Comprising large collection of Metallic and Organic Compounds, large stock of Glass and Iron Chemical Apparatus, Combustion Furnace, Töpler Mercury Pump, Gas Analysis Apparatus, Glass Taps, 7-inch Harvey & Peak's Induction Coil, X-Ray Tubes and Screens, Gas Cylinders, Reagent Bottles, Rare Minerals, &c., &c. Can be seen by appointment. Apply "C., Box 6," c/o NATURE.

OLD PLATINUM, GOLD

Scrap, &c., valued or purchased.

SPINK & SON, Ltd.,

17 & 18 PICCADILLY, W., and at 6 KING STREET, ST. JAMES', LONDON, S.W.
ESTD. 1772.
Gems for experimental work at moderate prices.

PLATINUM. Extraordinary prices given for platinum scrap Cash or offer by return post. 40 ozs. wanted this week.—R. OLPHERT, Jeweller, 19 Elm Grove Parade, Barnes, S.W. Bankers: London, City and Midland (Barnes branch). 500 ozs. wanted.

TYPEWRITING OF HIGHEST QUALITY.

General MSS., 10*d.* per 1000 words. Carbon copies, 3*d.* per 1000 words. Accuracy Guaranteed.
NORA DICKINSON, 1 Sackville Gardens, Ilford, Essex.